KIPS
ENTRY TESTS
SERIES

PRACTICE BOOK
KIPS SATs
Self Assessment Tests

PHYSICS

FUNG

- 2435 Practice MCQs
- Questions from Past Papers
- Answer Keys with Explanatory N
- Chapter-wise Practice Exercises
- Chapter-wise Self Assessment T
- Pre-Assessment Test (Diagnostic T
- Post Assessment Test

Scanned by CamScanner

BOOK-I

Scanned by CamScanner

Chapter 1 MEASUREMENTS

PRACTICE EXERCISE

(1) **A nanosecond is:**
(a) 10^9 s
(b) 10^{-10} s
(c) 10^{-1}s
(d) 10^{-9} s

(2) **The dimension of energy density is same as that of**
(a) Pressure
(b) Force
(c) (velocity)^2
(d) Acceleration

(3) **The quantities L/R and RC (where L, C and R stand for inductance, capacitance and resistance respectively) have the same dimensions as those of**
(a) Velocity
(b) Acceleration
(c) Time
(d) Force

(4) **Which pair of quantities has dimensions different from the other three pairs?**
(a) Impulse and linear momentum
(b) Plank's constant and angular momentum
(c) Moment of inertia and moment of force
(d) Young's modulus and pressure

(5) **In scientific notation numbers are expressed in**
(a) Power of ten
(b) Powers of two
(c) Reciprocal
(d) Decimal

(6) **1024 can be written in scientific notation as**
(a) 1.024×10^3
(b) 2^{10}
(c) 0.000976
(d) 1/0.00097

(7) **The dimensions of plank's constant are the same as those of**
(a) Energy
(b) Power
(c) Angular frequency
(d) Angular momentum

(8) **The density of a cube is measured by measuring its mass and the length of its side. If the maximum errors in the measurement of mass and length are 3% and 2%, respectively the maximum error in the measurement of density is**
(a) 1%
(b) 5%
(c) 7%
(d) 9%

(9) **The uncertainty in a measurement may occur due to**
(a) Limitation of an instrument
(b) Natural variation of the object to be measured
(c) Inadequate technique
(d) All given in a, b and c

(10) **Which of the following quantities has not been expressed in the proper units?**
(a) Young's modulus =Nm^{-2}
(b) Surface Tension=Nm^{-1}
(c) Pressure=N m^{-2}
(d) Energy = Kg ms^{-1}

(11) **One nanometer is equal to**
(a) 10^9 mm
(b) 10^{-6} cm
(c) 10^{-7} cm
(d) 10^{-9} cm

(12) **A digit zero in a measurement**
(a) May or may not be significant
(b) Always significant
(c) Always insignificant
(d) Significant only if left to a significant figure

Scanned by CamScanner

(13) **Number of significant figures in 0.0173 are**
(a) Three (b) Four
(c) Five (d) Two

(14) **Smaller the least count of the instrument more is the measurement**
(a) Accurate (b) Precise
(c) Accurate and precise (d) None of these

(15) **The number of significant figures in 15.0 is/are**
(a) 2 (b) 6
(c) 1 (d) 3

(16) **The equation of plane progressive wave is given by. $y = A\sin(\omega t - kx)$ the dimensions of ω/k are that of**
(a) Frequency (b) Velocity
(c) Wavelength (d) Inverse of velocity

(17) **Dimensional analysis is helpful for**
(a) Deriving a possible formula
(b) Checking the homogeneity of a physical equation
(c) Verification of laws
(d) Only a and b are correct

(18) **Which equation is not dimensionally correct?**
(a) $E=mc^2$ (b) $v_f=v_i+at$
(c) $S=vt^2$ (d) $S=\frac{1}{2}at^2$

(19) **SI unit of coefficient of viscosity is**
(a) $kg.m.s^{-1}$ (b) $kg\ m^{-1}.s^{-1}$
(c) kg.m.s (d) $kg^{-1}.m^{-1}.s^{-1}$

(20) **Three students measured length of a needle with meter rod and recorded as: (i) 0.2145m (ii) 0.21m (iii) 0.214m. Which one is correct record?**
(a) Only (i) (b) Only (ii)
(c) Only (iii) (d) Both (i) and (ii)

(21) **A force F is applied on a square plate of side L. If the percentage error in the determination of L is 2% and that in F is 4%, maximum error in pressure is**
(a) 2% (b) 4%
(c) 6% (d) 8%

(22) **The energy of a photon of light of frequency f is given by hf, where h is the Planck constant. What are the base units of h?**
(a) $kg\ m\ s^{-1}$ (b) $kg\ m^2\ s^{-1}$
(c) $kg\ m^2\ s^{-2}$ (d) $kg\ m^2\ s^{-3}$

(23) **Steradian is the SI unit of**
(a) Plane angle (b) Solid angle
(c) Both plane angle and solid angle (d) Neither plane angle nor solid angle

(24) **Which pair has same dimension**
(a) Work, torque (b) Work, energy
(c) Energy, torque (d) All are correct

(25) **Total uncertainty, in result obtained from the subtraction of two measurement, is equal to**
(a) Sum of their absolute uncertainties (b) Difference of their absolute uncertainties
(c) Product of their absolute uncertainties (d) Division of their absolute uncertainties

(26) **Which one is the highest power multiple?**
(a) giga (b) peta
(c) mega (d) deca

(27) **One femto stands for**
(a) 10^{-15} (b) 10^{-12}
(c) 10^{-9} (d) 10^{-6}

(28) **Percentage uncertainty in radius r is 2%. The percentage uncertainty in volume of sphere is**
(a) 4% (b) 6%
(c) 8% (d) 9%

(29) **The unit of force is _____ and its symbol is _____. Which is the correct pair?**
(a) Newton, n (b) Newton, N
(c) Newton, n (d) newton, N

(30) **Which quantity has different units from the other three?**
(A) Weight (b) The Young modulus × area
(c) Rate of change of momentum (d) Density × volume × velocity

(31) **Which one is the derived quantity in SI units?**
(a) Electric current (b) Electric charge
(c) Mass (d) Amount of substance

(32) **Which one is the correct representation of the unit of pressure?**
(a) $newton^2/meter^2$ (b) $newton/meter^2$
(c) $newton/meter^{-2}$ (d) $Newton/meter^2$

(33) **In an experiment to determine the acceleration of free fall g, the period of oscillation T and length ℓ of a simple pendulum were measured. The uncertainty in the measurement of ℓ was estimated to be 4% and that of T, 1%. The value of g was determined using the formula $g=\frac{4\pi^2\ell}{T^2}$. What is the uncertainty in the calculated value for g?**
(a) 2% (b) 6%
(c) 5% (d) 8%

(34) **Which experimental technique reduces the systematic error of the quantity being investigated?**
(a) Adjusting an ammeter to remove its zero error before measuring a current
(b) Timing a large number of oscillations to find a period
(c) Measuring the diameter of a wire repeatedly and calculating the average
(d) All of these

(35) **In multiplication and division of measurement**
(a) Percentage uncertainties are added (b) Absolute uncertainties are added
(c) Percentage uncertainties are divided (d) Absolute uncertainties are divided

(36) **The number of significant figures in 5.400 are**
(a) Three (b) Five
(c) Two (d) Four

(37) **Which of the following could be measured in the same units as force?**
(a) Momentum × distance (b) Energy × distance
(c) Energy/time (d) Energy/distance

(38) **The number of significant figures in the length of a bar 9800mm measured by meter rod are**
(a) Four (b) Three
(c) Two (d) None of these

Scanned by CamScanner

(39) **A radio aerial of length L, when the current is I, emits a signal of wavelength λ and power P. These quantities are related by**

$$P = kI^2\left(\frac{L}{\lambda}\right)^2$$

Where k is a constant. What unit, if any, should be used for the constant k?

(a) Volt (b) Watt
(c) Ohm (d) No unit

(40) **Dimension of resistance**

(a) $[M^1L^2T^{-3}A^{-2}]$ (b) $[M^1L^{-2}T^3A^{-2}]$
(c) $[M^{-1}L^2T^{-3}A^{-2}]$ (d) $[MT^{-2}]$

(41) **The equation of state of a real gas can be expressed as** $\left(P+\frac{a}{V^2}\right)(V-b)=cT$ **where P is pressure, V the volume, T the absolute temperature and a, b and c are constants. What are dimensions of a?**

(a) $\left[M^0L^3T^{-2}\right]$ (b) $[ML^5T^{-2}]$
(c) $[M^0L^3T^0]$ (d) $[ML^{-2}T^5]$

(42) **The error in measurement may occur due to**

(a) Inexperience of a person (b) The faulty apparatus
(c) Inappropriate method (d) Due to all reasons in a, b and c

(43) **Total No. of base units in international system of unit.**

(a) 7 (b) 3
(c) 5 (d) 10

(44) **Random errors can be reduced by**

(a) Taking zero correction
(b) Comparing the instrument with another more accurate one
(c) Taking mean of several measurement
(d) All methods explained in a, b and c

(45) **Time period *T* of a simple pendulum may depend on m, the mass of the bob, *l*, the length of the string and g, the acceleration due to gravity, i.e.** $T \propto m^a l^b g^c$ **What are the values of a, b and c?**

(a) $0,\frac{1}{2},-\frac{1}{2}$ (b) $0,-\frac{1}{2},\frac{1}{2}$
(c) $\frac{1}{2},0,-\frac{1}{2}$ (d) $-\frac{1}{2},0,\frac{1}{2}$

(46) **The velocity of a particle is given by:**

$$v = at^2 + bt + c$$

If v is measured in ms^{-1} and t is measured in s, the unit of:

(a) a is ms^{-1} (b) b is ms^{-1}
(c) c is ms^{-1} (d) a and b are same but that of c is different

(47) **The least count of a stop watch is 0.1 sec. The time of 20 oscillations of the pendulum is found to be 20 sec. The percentage error in the time period is:**

(a) 0.25 % (b) 0.5 %
(c) 0.75% (d) 1.0%

(48) **Physics is an experimental science and the scientific method emphasizes on:**

(a) Accurate measurements (b) Approximate measurements
(c) Uncertain measurements (d) % age measurements

(49) **What is the answer of** $\frac{\text{milli}\times\text{kilo}}{\text{deca}}$

(a) 10^2 (b) 10^{-3}
(c) 10^{-1} (d) 10^7

(50) **The radius of a ball is** (5.2 ± 0.2) **cm. The percentage error in the volume of the ball is:**

(a) 11% (b) 4%
(c) 7% (d) 9%

ANSWER KEY

1	d	11	c	21	d	31	b	41	b
2	a	12	a	22	b	32	b	42	d
3	c	13	a	23	b	33	b	43	a
4	c	14	b	24	d	34	a	44	c
5	a	15	d	25	a	35	a	45	a
6	a	16	b	26	b	36	d	46	c
7	d	17	d	27	a	37	d	47	b
8	d	18	c	28	b	38	a	48	a
9	d	19	b	29	d	39	c	49	c
10	d	20	c	30	d	40	a	50	a

EXPLANATORY NOTES

(1) Nano is prefix which is equal to 10^{-9}.

(2) $\text{Energy density} = \frac{Energy}{Volume} = \frac{J}{m^3} = \frac{Nm}{m^3} = Nm^{-2}$

$\text{Pressure} = P = \frac{F}{A} = Nm^{-2}$

(3)

(i) RC = t ⇒ sec

(ii) $\frac{L}{R} = \frac{Henry}{ohm} = \frac{VsA^{-1}}{VA^{-1}} \Rightarrow$ sec

(4) Moment of Inertia = I = mr^2 = kgm^2

Moment of force = torque = $\vec{\tau} = \vec{r} \times \vec{F} = Nm = kgms^{-2}m = kgm^2s^{-2}$

(5) Basic rule

(6) $1024 = 1.024\times10^3$

(7) $L = mv_nr_n = \frac{nh}{2\pi}$

Scanned by CamScanner

(8) $\rho = \frac{m}{V} = \frac{m}{l^3}$

% percentage error in ρ = percentage error in mass + 3 × percentage error in length

$= 3\% + 3 \times 2\% = 9\%$

(9) Causes of uncertainty.

(10) Energy = J = Nm = $(kgms^{-2})m$

$= kgm^2s^{-2}$

(11) $1nm = 10^{-9}m$

$= 10^{-7} \times 10^{-2}m = 10^{-7}cm$

(12) Basic rule of significant figures.

(13) Zeroes on left side of non-zero digit are not significant.

(14) Least count means more precise measurement

(15) Zeroes on right side of non-zero digit are always significant.

(16)

$[\omega t] = [kx]$

$\left[\frac{\omega}{k}\right] = \left[\frac{x}{t}\right]$ = velocity

(17) Use of dimensional analysis.

(18)

$S = vt^2$

L.H.S=S=m=[L]

$R.H.S = vt^2 = (ms^{-1})(s^2) = ms = [LT]$

(19)

$F = 6\pi\eta rv$

$\eta = \frac{F}{rv} \Rightarrow \frac{kgms^{-2}}{m \times ms^{-1}} \Rightarrow kgm^{-1}s^{-1}$

(20) Least count of metre rod is 1mm.

(21) $P = \frac{F}{A} = \frac{F}{\ell^2}$

Percentage error in P = percentage error in F + 2 × percentage error in ℓ

$= 4\% + 2 \times 2\% = 8\%$

(22) $E = hf$

$h = \frac{E}{f} = \frac{kgm^2s^{-2}}{s^{-1}} = kgm^2s^{-1}$

(23) Unit of solid angle.

(24) Dimension of work, energy and torque is same i.e. $[ML^2T^{-2}]$.

(25) Absolute uncertainties are always added.

(27) Femto is prefix.

(28) $V = \frac{4}{3}\pi r^3$

Percentage error in v = 3 × percentage error in r

$= 3 \times 2\%$

$= 6\%$

(29) Convention to write unit.

(30)

$= \rho \times volume \times velocity$

$= kgm^{-3} \times m^3 \times ms^{-1} = kgms^{-1}$

(31) Q = I x t

(32) $P = \frac{F}{A} = \frac{N}{m^2}$

(33) $g = \frac{4\pi^2\ell}{T^2}$

Percentage error in g = percentage error in ℓ + 2 × percentage error in T

$= 4\% + 2 \times 1\%$

$= 6\%$

(34) A Zero error is a systematic error.

(35)

(36) Zeroes on right side of reading after decimal are always significant.

(37) $W = Fd$

$F = \frac{W}{d}$

(38) Least count of meter rod is 1mm.

(39) $K = \frac{P\lambda^2}{I^2L^2} = \frac{Js^{-1} \times m^2}{A^2 \times m^2} = \frac{Watt}{A^2} = ohm \quad (\because P = I^2R)$

(40)

$R = \frac{V}{I} = \frac{JC^{-1}}{A} = \frac{J}{A \times C} = \frac{J}{A \times A \times s}$

$= \frac{Kgm^2s^{-3}}{A^2} = [ML^2T^{-3}A^{-2}]$

Scanned by CamScanner

(41)

$$\frac{a}{V^2} = P \rightarrow a = PV^2$$

$$= Kgm^{-1}s^{-2}\left(m^3\right)^2$$

$$= ML^5T^{-2}$$

(42) All are the reasons of error.

(43) Seven base quantities has seven base units.

(44) Random error can only remove by taking mean.

(45)

$$T = 2\pi\sqrt{\frac{\ell}{g}}$$

$$T \propto m^0 \ell^{\frac{1}{2}} g^{-\frac{1}{2}}$$

(46) $v = at^2 + bt + c$

As 'v' is in ms^{-1}, all other quantities which are being added must have same units, so 'c' is in ms^{-1}

(47) $\frac{0.1}{20} \times 100 = 0.5\%$

(48)

(49) $= \frac{10^{-3} \times 10^3}{10^1} = 10^{-1}$

(50) Percentage error in radius $= \frac{0.2}{5.2} \times 100 = 3.8\%$

Percentage error in volume $= \frac{4}{3}\pi r^3 = 3.8\% \times 3 \approx 11\%$

Chapter 1 MEASUREMENTS

SELF ASSESSMENT TEST

(1) The dimensions of modulus of rigidity?
(a) $[M^{-1}L^3T^{-2}]$ (b) $[M^{-2}L^2T^{-2}]$
(c) $[ML^{-1}T^{-2}]$ (d) $[M^{-1}L^2T^2]$

(2) The ratio of the tension and surface tension has dimensions of
(a) $[M^0L^0T^0]$ (b) $[L]$
(c) $[L^{-1}]$ (d) $[ML^2T^{-1}]$

(3) $(5.0\times10^4)\times(3.0\times10^6)=$
(a) 1.5×10^9 (b) 1.5×10^{11}
(c) 1.5×10^{10} (d) 1.5×10^{21}

(4) The dimensions of the coefficient of thermal conductivity are
(a) $\left[MLT^{-3}K^{-1}\right]$ (b) $[MLT^{-2}K^{-1}]$
(c) $[MLT^{-1}K^{-1}]$ (d) $[MLT^{-2}K^{-2}]$

(5) A body travels uniformly a distance of (13.8 ±0.2) m in a time (4.0 ± 0.3) s. The velocity of the body within error limits is
(a) $(3.45 \pm 0.3)\ ms^{-1}$ (b) $(3.45 \pm 0.4)\ ms^{-1}$
(c) $(3.45 \pm 0.2)\ ms^{-1}$ (d) $(3.45 \pm 0.5)\ ms^{-1}$

(6) The unit of percentage error is
(a) percentage error is unit less
(b) different from that of physical quantity
(c) errors have got their own units which are different from that of physical quantity measured
(d) same as that of physical quantity

(7) The mean time period of second's pendulum is 2.00s and mean absolute error in the time period is 0.05s. To express maximum estimate of error, the time period should be written as
(a) (2.00 ± 0.01) s (b) (2.00 ± 0.05) s
(c) (2.00 ± 0.10) s (d) $(2.00 + 0.025)$ s

(8) The radius of sphere is $(5.3 \pm 0.1)cm$. The percentage error in the volume is
(a) $3 + \frac{0.1}{5.3} \times 100$ (b) $\frac{0.1}{3.53} \times 100$
(c) $\frac{0.1}{5.3} \times 100$ (d) $3 \times \frac{0.1}{5.3} \times 100$

(9) A thin copper wire of length l meter increases in length by 2% when heated through 10°C. What is the percentage increase in area when a square copper sheet of length l meter is heated through 10°C?
(a) 2% (b) 16%
(c) 8% (d) 4%

(10) The length of a cylinder is measured with a meter rod having least count 0.1 cm. Its diameter is measured with Vernier calipers having least count 0.01 cm. Given that length is 5.0 cm. and radius is 2.0 cm. The percentage error in the calculated value of the volume will be
(a) 2% (b) 1%
(c) 3% (d) 4%

Scanned by CamScanner

(11) **In any measurement the significant figures are**
(a) all accurately known and all doubtful digits
(b) only accurately known digits
(c) only doubtful digits
(d) all accurately known digits and the first doubtful digit

(12) **Which of the following have Nm^{-2} as the unit?**
(a) strain (b) length
(c) stress (d) luminous intensity

(13) **The error which occurs due to some definite rule is called**
(a) systematic error (b) random error
(c) personal error (d) uncertain error

(14) **The velocity of a particle is given by**

$$v = a + \frac{b}{t} + ct^2$$

The unit of b will be
(a) ms (b) m
(c) ms^{-1} (d) ms^{-2}

(15) **The number of significant figures in 140.0 is/are**
(a) 2 (b) 6
(c) 3 (d) 4

(16) **The dimensions of permittivity (ε_0) of vacuum are**
(a) $[M^{-1}L^{-3}T^4A^2]$ (b) $[ML^{-3}T^2A^2]$
(c) $[M^{-1}L^3T^4A^2]$ (d) $[ML^3T^2A^2]$

(17) **The least count of the screw gauge is 0.001 cm. What is the permissible error in the diameter of the rod measured with it?**
(a) 1cm (b) 0.01cm
(c) 0.1cm (d) 0.001cm

(18) **Which equation is not dimensionally correct?**
(a) P = F/A (b) $v = f\lambda$
(c) $S = vt^{-2}$ (d) $S = \frac{1}{2} gt^2$

(19) **Resistance of a given wire is $R = \frac{V}{I}$. If the percentage error in measurement of the current and the voltage difference are 3% each, then error in the value of resistance**
(a) 1% (b) 1%
(c) 3% (d) 6%

(20) **The unit of relative permeability is**
(a) Henry/volt (b) Henry
(c) unitless (d) Farad/m

(21) **One light year is equal to**
(a) 9.5×10^{15}m (b) 9.5×10^{15}sec
(c) 9.5×10^{15}Km (d) 9.5×10^{15}cm

(22) **Which one of the following is not a unit of time?**
(a) a year (b) light year
(c) lunar month (d) month

(23) **radian is the SI unit of**
(a) solid angle (b) plane angle
(c) both plane angle and solid angle (d) neither plane angle nor solid angle

(24) **The SI unit of Couple arm**
(a) kilo meter (b) centi meter
(c) mili meter (d) meter

(25) **Which of the following could be measured in the same units as reciprocal of unit of force?**
(a) $\sqrt{\frac{GM}{R}}$ (b) $\frac{\text{energy}}{\text{distance}} = \text{Force}$
(c) $\frac{\text{distance}}{\text{energy}} = \frac{1}{\text{Force}}$ (d) Energy × distance

(26) **What is ratio of Mega to kilo?**
(a) giga (b) kilo
(c) milli (d) deca

(27) **The ratio of unit of RC to the frequency is**
(a) sec^2 (b) unitless
(c) sec (d) sec^{-1}

(28) **The ratio of dimensions of light year to the time period is same as that of**
(a) specific gravity (b) velocity
(c) density (d) acceleration

(29) **What is the ratio $\frac{1\mu m}{1Gm}$?**
(a) 10^{-3} (b) 10^{-15}m
(c) 10^{-9} m (d) 10^{-15}

(30) **Decimal sub-multiples and multiples of unit are indicated using a prefix to the unit. For example the prefix milli (c) represents 10^{-3}. Which of the following gives the sub-multiples or multiples represented by pico (p) and giga(G)?**

	pico (p)	Giga (G)
A)	10^{-9}	10^{9}
B)	10^{-9}	10^{12}
C)	10^{-12}	10^{9}
D)	10^{-12}	10^{12}

(31) **In the beginning the man's attempt resulted in the birth of single discipline of science called**
(a) natural psychology (b) natural philosophy
(c) natural history (d) natural physics

(32) **The dimensions of a physical quantity are given by $[M^AL^BT^C]$ then the physical quantity will be**
(a) force if A = 0, B = –1, C = –1 (b) pressure if A = 1, B = –1, C = –2
(c) velocity if A = 1, B = 0, C = –1 (d) acceleration if A = –1, B = 1, C = –2

(33) **The length of a pencil is 10.2 cm. Out of the 2.34 cm is cut out. The remaining length of the pencil according to the idea of significant figure is:**
(a) 7.86 cm (b) 7 cm
(c) 7.8 cm (d) 7.9 cm

(34) **For $E \propto m^a c^b$, what should be the value of a and b that we get the correct units of E.**
(a) a = 1, b = 2 (b) a = 2, b = -1
(c) a = -1, b = 2 (d) a = 1, b = -2

(35) **When repeated measurements of quantity give different values under the same conditions, then the error is:**
(a) random error (b) systematic error
(c) personal error (d) absolute error

(36) **The number of significant figures in 500.400 are**
(a) thee (b) five
(c) two (d) six

Scanned by CamScanner

(37) **Which of the following could be measured in the same dimension as angular velocity?**
(a) density (b) time period
(c) energy/time (d) decay constant

(38) **The number of significant figures π**
(a) infinite (b) three
(c) Two (d) none of these

(39) **The least count of the stop watch is 1/5 second. The time of the 20 oscillation of a pendulum is measured to be 25 s. what is the maximum percentage error in this measurement?**
(a) 8% (b) 1%
(c) 0.8 % (d) 16 %

(40) **Which of the following is not a correct representation method for prefixes?**
(a) 1mm (b) 10 km
(c) 1000μm (d) both "a" and "b"

(41) **The dimension of change in momentum is same as that of**
(a) impulse (b) force
(c) $(\text{velocity})^2$ (d) acceleration

(42) **The quantities L/R (where L, and R stand for inductance and resistance respectively) have the same dimensions as those of**
(a) velocity (b) acceleration
(c) time (d) force

(43) **For $K.E \propto \frac{m^a}{v^b}$ what is value of a and b to get the correct unit of Kinetic Energy**
(a) a = 1, b = -2 (b) a = 1, b = 2
(c) a = 2, b = -2 (d) a = 1, b = -1

(44) **The unit of moment of Inertia is**
(a) kgm^2 (b) $kg^{-1}m^2$
(c) kgm^{-2} (d) $kg^{-2}m^{-1}$

(45) **The unit of $\sqrt{\frac{g}{l}}$ is similar to the**
(a) decay constant (b) angular frequency
(c) time period (d) both a and b

(46) **An experiment measured quantities a, and b and then x is calculated from $x = ab^2$. If the percentage errors in a, b, are $\pm 1\%$, and $\pm 3\%$ respectively, the percentage error in x can be:**
(a) $\pm 13\%$ (b) $\pm 7\%$
(c) $\pm 4\%$ (d) $\pm 1\%$

(47) **From the following which relation shows the correct unit of velocity:**
(a) $\sqrt{\frac{GM}{R}}$ (b) $\sqrt{\frac{2GM}{R}}$
(c) $\sqrt{2gR}$ (d) all of these

(48) **The percentage errors in the measurement of mass and speed are 2% and 3% respectively. How much will be the maximum error in the estimate of momentum obtained by measuring mass and speed?**
(a) 6% (b) 8%
(c) 5% (d) 4%

(49) **Which one is a base quantity:**
(a) kilogram (b) conventional current
(c) kelvin (d) charge

(50) **Siemens is the unit of**
(a) resistance (b) resistivity
(c) conductivity (d) conductance

(51) **The dimensions $[ML^{-1}T^{-2}]$ may corresponds to**
(a) work (b) energy density
(c) pressure (d) both b and c

(52) **Choose correct statement?**
(a) a dimensionally correct equation may be correct
(b) a dimensionally correct equation may be incorrect
(c) a dimensionally incorrect equation may be incorrect
(d) all of these

(53) **The velocity of particle depends upon time according to the relation $v = \propto t + \frac{\beta}{t} + \gamma$. The dimensions of $\propto, \beta, \gamma$ will be_____**
(a) $[LT^{-2}],[L],[LT^{-1}]$ (b) $[L],[LT^{-1}],[LT^{-2}]$
(c) $[LT^{-1}],[L],[LT^{-2}]$ (d) $[LT^{-1}],[L],[T^{-1}L]$

(54) **Given $x = \frac{a^n b^m}{P^r}$. The percentage error in measurement of a,b and P is 1%, 0.5% and 0.75 % respectively. If n = 2 , m = 2 and r = 4 then percent error in x?**
(a) 0 (b) 6%
(c) 5.25% (d) 0.75%

(55) **Curie is the unit of**
(a) decay constant (b) activity
(c) half life (d) average life

(56) **The S.I unit of absolute temperature is**
(a) Fahrenheit (b) Contigrade
(c) Kelvin (d) Celsius

(57) **The unit of $\sqrt{g\lambda}$ is_____**
(a) ms^{-2} (b) ms^{-1}
(c) ms^{-3} (d) $kj\ ms^{-1}$

(58) **The decimal equivalent of $\frac{1}{20}$ up to three significant figures?**
(a) 0.050 (b) 0.0500
(c) 5.0×10^{-2} (d) 0.005

(59) **The resistance $R = \frac{V}{I}$ where $V = 100 \pm 5V$ and $I = 10 \pm 0.2A$. What is the total error in R**
(a) 5% (b) 7%
(c) 5.2% (d) $\frac{5}{2}\%$

Scanned by CamScanner

(60) Total fractional uncertainty in the period $T = 2\pi\sqrt{\frac{\ell}{g}}$ will be equal to

(a) sum of percentage U.C
(b) Difference of percentage uncertainties
(c) product of percentage uncertainties in *l* and g
(d) none of these

ANSWER KEY

1	c	11	d	21	a	31	b	41	a	51	d
2	b	12	c	22	b	32	b	42	c	52	d
3	b	13	a	23	b	33	d	43	a	53	a
4	a	14	b	24	d	34	a	44	a	54	b
5	a	15	d	25	c	35	a	45	d	55	b
6	a	16	a	26	b	36	d	46	b	56	c
7	b	17	d	27	a	37	d	47	d	57	b
8	d	18	c	28	b	38	a	48	c	58	b
9	d	19	d	29	d	39	c	49	b	59	b
10	c	20	c	30	c	40	c	50	d	60	a

EXPLANATORY NOTES

(1) Elastic Modulus = Modulus of rigidity $= \frac{\text{stress}}{\text{strain}} = Kgm^{-1}s^{-2} = ML^{-1}T^{-2}$

(2) $\frac{\text{Tension}}{\text{Surface Tension}} = \frac{N}{N/m} = m = [L]$

(3) $= 5.0\times3.0\times10^{10} \Rightarrow 15\times10^{10} = 1.5\times10^{11}$
Because result must be in two significant figure.

(4) $\frac{Q}{t} = \frac{KA\Delta T}{L} \rightarrow K = MLT^{-3}K^{-1}$

(5) Here, $S = (13.8\pm0.2)m$ and $t = (4.0\pm0.3)s$ Expressing it in percentage error, we have,

$S = 13.8 \pm \frac{0.2}{13.8}\times100$ and $t = 4.0 \pm \frac{0.3}{4}\times100$ $\quad\therefore v = \frac{S}{t}$

$= \frac{13.8\pm1.4}{4\pm7.5} = (3.45\pm0.3)ms^{-1}$

(6) Percentage error $= \frac{\Delta A}{A}\times100$
So Percentage error is unitless

(7) Mean time period T = 2.00 sec & Mean absolute error $\Delta T = 0.05$sec
To express maximum estimate of error, the time period should be written as (2.00 ± 0.05)sec

(8) $\because V = \frac{4}{3}\pi r^3$

% error in volume = 3 × error in radius $= \frac{3\times0.1}{5.3}\times100$

(9) Since percentage increase in length = 2%
Hence, percentage increase in area of square sheet = 2 × 2 = 4%

(10) Volume of cylinder $V = \pi r^2\ell$
Percentage error in volume

$\frac{\Delta V}{V}\times100 = \frac{2\Delta r}{r}\times100 + \frac{\Delta\ell}{\ell}\times100 = 2\left(\frac{0.01}{2.0}\times100 + \frac{0.1}{5.0}\times100\right)$

$= (1+2) = 3$

(11) Definition of significant figures

(12) Stress has unit as Nm^{-2}.

(13) Definition

(14) v = b/t
b = v t = ms^{-1} x s = m

(15) In decimal fraction, zero's to the right of significant figures are significant

(16) $\varepsilon_o = \frac{C^2}{Nm^2} \rightarrow [M^{-1}L^{-3}T^4A^2]$

(17) Maximum permissible error is actually the least count of the device

Scanned by CamScanner

(18) $S = vt^{-2}$

$[L] = [LT^{-1}][T^{-2}]$

$[L] \neq [LT^{-3}]$

(19) Percentage uncertainty in R = percentage uncertainty in V + percentage uncertainty in I

$= 3\% + 3\% = 6\%$

(20) $\varepsilon_r = \frac{C_{med}}{C_{vac}} = unitless$

(21) $S = v \times t = 3 \times 10^8 \times 365 \times 24 \times 60 \times 60$

$= 9.5 \times 10^{15} m$

(22) Light year is a distance traveled by the light in one year.

(23) Plane angle has unit of radian

(24) Couple arm is the perpendicular distance between the line of action of two forces, so its SI unit is meter.

(25) $Force = \frac{energy}{distance}$

$or \frac{1}{Force} = \frac{distance}{energy}.$

(26) $\frac{Mega}{kilo} = \frac{10^6}{10^3} = 10^3 = kilo$

(27) $\frac{RC}{f} = \frac{s}{s^{-1}} = s^2$

(28) $\frac{Light\ year}{time\ period} = \frac{m}{s} \Rightarrow unit\ of\ velocity$

(29) $\frac{1\mu m}{1Gm} = \frac{10^{-6}}{10^9} = 10^{-15}$

(30) Pico = 10^{-12} and Giga = 10^9.

(31) General definition

(32) $P = \frac{F}{A} = \frac{kgms^{-2}}{m^2} = kgm^{-1}s^{-2} = [ML^{-1}T^{-2}]$

(33) In adding or subtracting numbers, the number of decimal places retained in the answer should equal to the smallest number of decimal places in any of the quantities being added or subtracted.

(34) As $E = mc^2$ so a should be equal to 1 and b should be equal to 2

(35) Definition of random error.

(36) In decimal fraction, zero's to the right of significant figures are significant.

(37) $\omega = \frac{\theta}{t} rads^{-1} = [T^{-1}]$

$\lambda = \frac{0.693}{T_{1/2}} = s^{-1} = [T^{-1}]$

(38) The number of significant figures in π are infinite.

(39) $t = 25 \pm \frac{1}{5} s = 25 \pm 0.2s$

percentage uncertainty in time $= \frac{0.2}{25} \times 100 = 0.8\%$

(40) It should be written in scientific notation.

$1000\ \mu m = 10^3 \times 10^{-6}\ m = 1mm$

(41) $\Delta p = F \times t = Im\ pulse$

(42) (i) L/R = t = sec

(43) K.E = ½ mv^2 so this formula will only be form if a=1 and b= -2

(44) Moment of Inertia = I = mr^2 = kgm^2

(45) $\theta = \omega t \Rightarrow \omega = \frac{\theta}{t} = s^{-1}$

$f = \frac{1}{2\pi}\sqrt{\frac{g}{l}} = s^{-1}$ which is also the unit of decay constant as . $\lambda = \frac{0.693}{T_{1/2}} = s^{-1}$

(46) $1\% + (3\% \times 2) = \pm 7\%$

(47) As $V_{esc} = \sqrt{2gR} = \sqrt{\frac{2GM}{R}}$ which is called escape velocity

And $v_0 = \sqrt{\frac{GM}{R}}$ which is called orbital velocity

So all are the relations of velocities hence their units are same

(48) P = mv

% error in m = 2% and in v = 3%

So % error in momentum = 2% +3% = 5%

(49) Option (a) and (b) are units not physical quantities

Option (d) is derived quantity as Q = I x t

So current is a base quantity whether its electric or conventional.

(50) G = 1/R

Conductance is reciprocal of resistance so its unit is per ohm or siemens.

(51) $P = \frac{F}{A} = kgm^{-1}s^{-2} = [ML^{-1}T^{-2}]$; $E.d = \frac{E}{V} = \frac{kgm^2s^{-2}}{m^3} = [ML^{-1}T^{-2}]$

(52) Dimension gives only qualitative analysis, all statements are possible.

(53) $v' = at + \frac{s}{t} + v$; $\alpha = accleration$; $\beta = distance$; $\gamma = velocity$

(54) T.U=2(1)+2(0.5)+4(0.75)

T.U=(6%)

(55) $1Ci = 3.7 \times 10^{10} Bq$ (unit of radioactivity)

(56) S.I unit of temperature is kelvin.

(57) $v = \sqrt{g\lambda} = \sqrt{m^2s^{-2}} = ms^{-1}$

(58) $\frac{1}{20} = 0.05$ *upto* 3 significant figures 0.0500

(59) $T.U = \frac{5}{100} \times 100 + \frac{0.2}{10} \times 100 = (5+2) = 7\%$

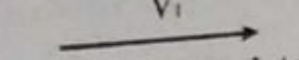
(60) In case of division, percentage U.C are added.

Scanned by CamScanner

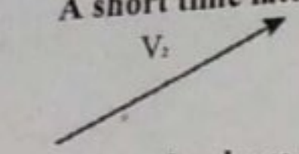
Chapter 2 VECTORS & EQUILIBRIUM

PRACTICE EXERCISE

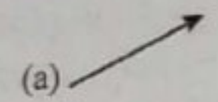
(1) At time $t = t_1$, an object's velocity is given by the vector v_1 shown below.

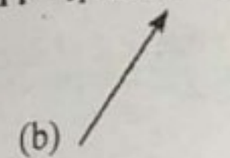


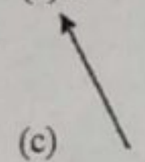
A short time later, at $t = t_2$, the object's velocity is the vector v_2.

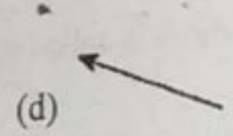


If v_1 and v_2 have the same magnitude, which one of the following vectors best illustrates the object's average acceleration between $t = t_1$ and $t = t_2$?

(a) 

(b) 

(c) 

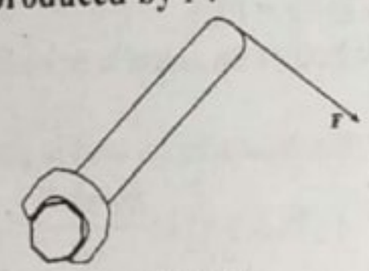
(d) 

(2) The direction of a vector in space is specified by

(a) One angle (b) Two angle

(c) Three angle (d) No angle

(3) In an effort to tighten a bolt, a force F is applied as shown in the figure above. If the distance from the end of the wrench to the center of the bolt is 20 cm and F = 20 N, what is the magnitude of the torque produced by F?



(a) 0 Nm (b) 2 Nm

(c) 1 Nm (d) 4 Nm

(4) Which of the following statement is correct about force and velocity

(a) Force and velocity both are scalars (b) Force and velocity both are vectors

(c) Force is scalar and velocity is vector (d) Force is vector and velocity is scalar

(5) A vector S of magnitude 6 and another vector T have a sum of magnitude 12. The vector T:

(a) May have a magnitude of 20

(b) Must have a magnitude of at least 6 but no more than 18

(c) Must be perpendicular to $\vec{S}$

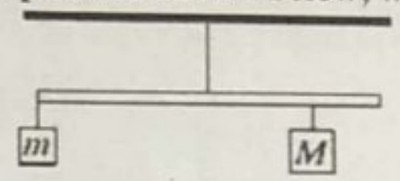
(d) Must be perpendicular to the vector T

(6) A null vector has

(a) Zero magnitude and a specific direction (b) A finite magnitude and no specific direction

(c) A finite magnitude and a specific direction (d) Zero magnitude and no specific direction

(7) A uniform meter stick of mass 1 kg is hanging from a thread attached at the stick's midpoint. One block of mass $m = 3$ kg hangs from the left end of the stick, and another block, of unknown mass M, hangs below the 80 cm mark on the meter stick. If the stick remains at rest in the horizontal position shown below, what is M?



(a) 4kg (b) 6kg

(c) 5kg (d) 8kg

(8) Maximum number of components of a vector may be

(a) One (b) Two

(c) Three (d) Infinite

(9) The magnitude of the resultant of two vectors of magnitudes 3 units and 4 units is 5 units. What is the angle between two vectors?

(a) $\frac{\pi}{4}$ (b) $\frac{\pi}{2}$

(c) $\frac{3\pi}{4}$ (d) π

(10) Given $\vec{P} = \vec{A} + \vec{B}$ and $\vec{Q} = \vec{A} - \vec{B}$. If the magnitudes of vectors $\vec{P}$ and $\vec{Q}$ are equal, what is the angle between the two vectors $\vec{A}$ and $\vec{B}$?

(a) Zero (b) $\frac{\pi}{4}$

(c) $\frac{\pi}{2}$ (d) π

(11) If $|\vec{A} + \vec{B}|^2 = A^2 + B^2$, then

(a) $\vec{A}$ and $\vec{B}$ must be parallel and in the same direction

(b) The angle between $\vec{A}$ and $\vec{B}$ must be 90°

(c) $\vec{A}$ and $\vec{B}$ must be parallel and in opposite directions

(d) none

(12) If $|\vec{A} - \vec{B}| = |A + B|$ and neither $\vec{A}$ nor $\vec{B}$ vanish, then

(a) $\vec{A}$ and $\vec{B}$ are parallel and in the same direction

(b) The angle between $\vec{A}$ and $\vec{B}$ is 60◦

(c) $\vec{A}$ and $\vec{B}$ are parallel and in opposite directions

(d) $\vec{A}$ is perpendicular to $\vec{B}$

(13) The magnitudes of four pairs of displacement vectors are given which pairs of displacement vectors cannot be added to give a resultant vector of magnitude 4cm?

(a) 2 cm, 3cm (b) 1 cm, 3cm

(c) 1cm, 5cm (d) 1cm, 7cm

(14) Given $\vec{A} \cdot \vec{B} = 0$ and $\vec{A} \times \vec{C} = \vec{0}$ what is the angle between $\vec{B}$ and $\vec{C}$, if $\vec{A}$, $\vec{B}$ and $\vec{C}$ are non-zero vector?

(a) 45° (b) 90°

(c) 135° (d) 180°

Scanned by CamScanner

(15) Let $\vec{V} = (2.00m)\hat{i} + (6.00m)\hat{j} - (3.00m)\hat{k}$. The magnitude of $\vec{V}$ is
(a) 5.00m (b) 5.57m
(c) 7.00m (d) 7.42m

(16) Vectors $\vec{A}$ and $\vec{B}$ each have magnitude L. When drawn with their tails at the same point, the angle between them is 30°. The value of $\vec{A} \cdot \vec{B}$ is:
(a) $2L^2$ (b) $\frac{\sqrt{3}L^2}{2}$
(c) L^2 (d) Zero

(17) Vector $\vec{C}$ is the sum of two vectors $\vec{A}$ and $\vec{B}$ and vector $\vec{D}$ is the cross product of vectors $\vec{A}$ and $\vec{B}$. What is the angle between vectors $\vec{C}$ and $\vec{D}$?
(a) Zero (b) 60°
(c) 90° (d) 180°

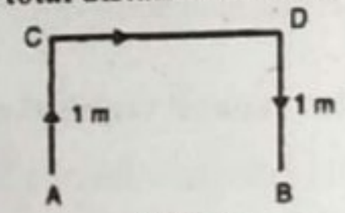
(18) The value of $\hat{i} \bullet (\hat{j} \times \hat{k})$
(a) 0 (b) 3
(c) +1 (d) -1

(19) Resultant of which of the following may be equal to zero?
(a) 10 N, 10 N, 35 N (b) 10 N, 10N, 25 N
(c)10N, 10N, 10N (d) None of these

(20) If $\vec{L} = \vec{r} \times \vec{P}$ then $\vec{r} \cdot \vec{L}$ is
(a) rL cosθ (b) zero
(c) rL (d) rL sinθ

(21) Which one is a unit vector?
(a) $\sqrt{3}\hat{i} + \sqrt{3}\hat{j} + \sqrt{3}\hat{k}$ (b) $\frac{1}{\sqrt{3}}\hat{i} + \frac{1}{\sqrt{3}}\hat{j} + \frac{1}{\sqrt{3}}\hat{k}$
(c) $\frac{\sqrt{3}}{3}\hat{i} + \frac{\sqrt{3}}{3}\hat{j} + \frac{\sqrt{3}}{3}\hat{k}$ (d) Both b and c are correct

(22) A man walks from A to C, C to D and D to B (as shown in figure). The magnitude of displacement of man is 10 m. The total distance travelled by the man is:



(a) 10m (b) 12m
(c) 7m (d) 2m

(23) If $\hat{i}$ and $\hat{j}$ are unit vectors along X-axis and y- axis respectively, the magnitude of vector $\hat{i} + \hat{j}$ will be
(a) 1 (b) $\sqrt{2}$
(c) $\sqrt{3}$ (d) 2

(24) An airplane flies 400m due north and then flies 300m south and then flies 1200m upwards. The net displacement is
(a) 1500m (b) 1200m
(c) 900m (d) 700m

(25) A child takes 8 steps towards east and 6 steps towards north. If each step is equal to 1 cm, then the magnitude of displacement is:
(a) 14m (b) 0.1m
(c) 12m (d) 0.01m

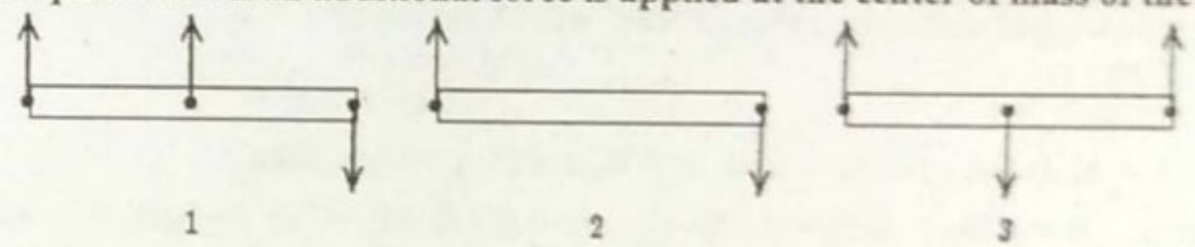
(26) For a body to be in equilibrium under the combined action of several forces:
(a) All the forces must be applied at the same point
(b) All of the forces form pairs of equal and opposite forces
(c) Any two of these forces must be balanced by a third force
(d) The sum of the components of all the forces in any direction must equal zero

(27) Torque acting on a body determines
(a) Acceleration (b) Linear acceleration
(c) Angular acceleration (d) Direction of motion of the body

(28) The dimension of torque
(a) $[MLT^{-1}]$ (b) $[ML^2T^{-1}]$
(c) $[ML^2T^{-2}]$ (d) $[ML^2T]$

(29) If $\hat{i}$, $\hat{j}$ and $\hat{k}$ are unit vectors along x, y and z –axes respectively, the angle θ between the vector $\hat{i} + \hat{j} + \hat{k}$ and vector $\hat{i}$ is given by
(a) $\theta = \cos^{-1}\left(\frac{1}{\sqrt{3}}\right)$ (b) $\theta = \sin^{-1}\left(\frac{2}{\sqrt{3}}\right)$
(c) $\theta = \cos^{-1}\left(\frac{\sqrt{3}}{2}\right)$ (d) $\theta = \sin^{-1}\left(\frac{\sqrt{3}}{2}\right)$

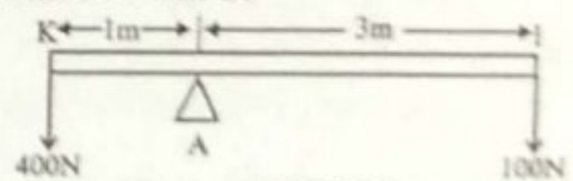
(30) Three identical uniform rods are each acted upon by two or more forces, all perpendicular to the rods and all equal in magnitude. Which of the rods could be in static equilibrium if an additional force is applied at the center of mass of the rod?



(a) Only 2 (b) Only 1
(c) Only 3 (d) Only 1 and 2

(31) Given $A = 2\hat{i} + 3\hat{j}$ and $B = \hat{i} + \hat{j}$. The magnitude of component of vector A along vector B is
(a) $\frac{1}{\sqrt{2}}$ (b) $\frac{3}{\sqrt{2}}$
(c) $\frac{5}{\sqrt{2}}$ (d) $\frac{7}{\sqrt{2}}$

(32) A uniform rod loaded as shown in the fig. below is pivoted at the point A so that it is in equilibrium. The weight of the rod will be



(a) 700N (b) 300N
(c) 500N (d) 100N

Scanned by CamScanner

(33) **A central force is that which**
(a) Can produce torque
(b) Can't produce torque
(c) Some time can produce torque some time can't
(d) Has no relation with torque

(34) **A particle is moving on a circular path with a constant speed v. The magnitude of the change in its velocity after it has described an angle of 60° is**
(a) v (b) $\sqrt{2}v$
(c) $\sqrt{3}v$ (d) $\frac{\sqrt{3}}{2}v$

(35) **A particle moves from position $\vec{r_1} = 3\hat{i}+2\hat{j}-6\hat{k}$ to position $\vec{r_2} = 14\hat{i}+13\hat{j}+9\hat{k}$ under the action of a force $\vec{F} = (4\hat{i}+\hat{j}+3\hat{k})$. The work done by the force is**
(a) 50 units (b) 75 units
(c) 100 units (d) 200 units

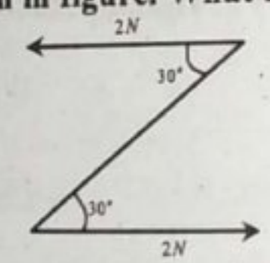
(36) **The unit vector in the direction of vector $\vec{A} = 2\hat{i}-2\hat{j}+\hat{k}$ is**
(a) $\frac{2\hat{i}-2\hat{j}+\hat{k}}{2}$ (b) $\frac{2\hat{i}-2\hat{j}+\hat{k}}{9}$
(c) $\frac{2\hat{i}-2\hat{j}+\hat{k}}{3}$ (d) $\frac{2\hat{i}-2\hat{j}+\hat{k}}{5}$

(37) **A man moves on a cycle with a velocity of 4km/h. the rain appears to fall upon him with a velocity of 3km/h vertically. The actual velocity of the rain is**
(a) 7km/h (b) 5 km/h
(c) 10 km/h (d) 15 km/h

(38) **In which quadrant only, value of 'tan' will be positive?**
(a) First (b) Second
(c) Third (d) Both 1st and 3rd

(39) **If $\vec{A} = A_x\,\hat{i} + A_y\,\hat{j} + A_z\,\hat{k}$ and $\vec{B} = B_x\,\hat{i} + B_y\,\hat{j} + B_z\,\hat{k}$ then**
(a) $\vec{A}\cdot\vec{B} = A_xB_x + A_yB_y + A_zB_z$ (b) $\vec{A}\cdot\vec{B} = A_xB_y + A_yB_z + A_zB_y$
(c) $\vec{A}\cdot\vec{B} = A_yB_z + A_zB_y + A_zB_x$ (d) $\vec{A}\cdot\vec{B} = A_xB_z + A_yB_y + A_zB_x$

(40) **A ruler of the length 0.2m is pivoted at its center. Equal and opposite forces of magnitude 2N are applied as shown in figure. What is torque**



(a) 2Nm (b) 1Nm
(c) 0.5Nm (d) 0.2Nm

(41) **$\text{Cos}\theta\,\hat{i} + \text{Sin}\theta\,\hat{j}$ is a**
(a) Vector
(b) Position vector
(c) Vector in the direction at angle θ with x-axis
(d) Unit vector in the direction at angle θ with x-axis

(42) **The resultant of two forces of equal magnitudes is also equal to the magnitude of the forces. The angle between the two forces is**
(a) 30° (b) 60°
(c) 90° (d) 120°

(43) **$\vec{A} = 3\hat{i}+4\hat{i}+2\hat{k}, \vec{B} = 6\hat{i}-\hat{j}+3\hat{k}$. Find a vector parallel to $\vec{A}$ whose magnitude is equal to that of $\vec{B}$.**
(a) $\sqrt{\frac{46}{29}}\left(3\hat{i}+4\hat{j}+2\hat{k}\right)$ (b) $\sqrt{\frac{46}{29}}\left(6\hat{i}-\hat{j}+3\hat{k}\right)$
(c) $\sqrt{\frac{46}{29}}\left(3\hat{i}-4\hat{j}-2\hat{k}\right)$ (d) None of these

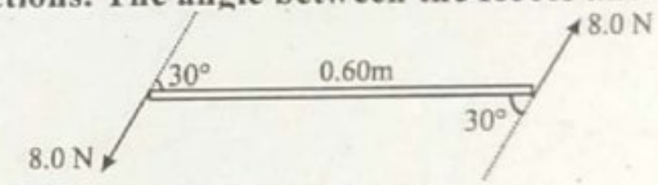
(44) **Two vectors are $\vec{A} = 3\hat{i}+2\hat{j}-\hat{k}$ and $B = -3\hat{i}-2\hat{j}+\hat{k}$ then**
(a) $\vec{B}$ is anti parallel to $\vec{A}$ (b) $\vec{B}$ is inclined at 60° with $\vec{A}$
(c) $\vec{B}$ has negative magnitude (d) B is perpendicular to $\vec{A}$

(45) **The magnitude of dot product and magnitude of cross product are same when angle between two vectors is**
(a) 30° (b) 45°
(c) 90° (d) not possible

(46) **If the position vector $\vec{r}$ and Force $\vec{F}$ lies in x–z plane. Then direction of torque is**
(a) Along y-axis (b) Along x-axis
(c) Along z-axis (d) Along x-y plane

(47) **A boy weighing 500N is sitting on a see-saw at a point 2m away from the pivot. What should be the force acting on the other side of the pivot at a point 4m away to balance:**
(a) 3000N (b) 250N
(c) 1000N (d) 750N

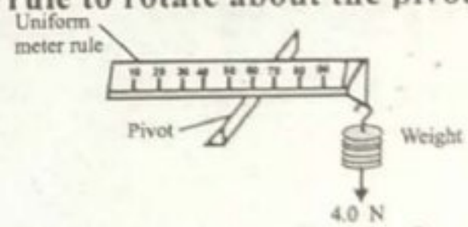
(48) **Two 8.0 N forces act at each end of a beam of length 0.60 m. The forces are parallel and act in opposite directions. The angle between the forces and the beam is 60°.**



What is the torque of the couple exerted on the beam?
(a) 2.4 Nm (b) 4.8 Nm
(c) 4.2 Nm (d) 9.6 Nm

(49) **If a nut and bolt are difficult to turn, it may be easier to turn the nut by using a longer spanner. This is because the longer spanner gives:**
(a) A larger moment of force (b) A smaller moment of force
(c) Less friction (d) More friction

(50) **A uniform meter of weight 2N is pivoted at the 60 cm mark. A 4N weight is suspended from one end, causing the rule to rotate about the pivot?**



At the instance when the rule is horizontal, what is the value of the resultant turning moment about the pivot?
(a) Zero (b) –1.4 Nm
(c) 1.6 Nm (d) 1.8 Nm

Scanned by CamScanner

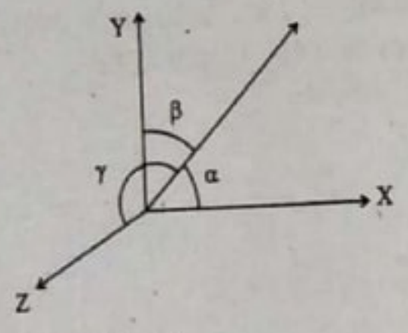
ANSWER KEY

1	c	11	b	21	d	31	c	41	d
2	c	12	d	22	b	32	d	42	d
3	d	13	d	23	b	33	b	43	a
4	b	14	b	24	b	34	a	44	a
5	b	15	c	25	b	35	c	45	b
6	d	16	b	26	d	36	c	46	a
7	c	17	c	27	c	37	b	47	b
8	d	18	c	28	c	38	d	48	a
9	b	19	c	29	a	39	a	49	a
10	c	20	b	30	c	40	d	50	b

EXPLANATORY NOTES

(1) $a=\frac{v_f-v_i}{t}$ (Vector subtraction by using head to tail rule)

(2)



(3) $\tau = rF\sin\theta$

$=(0.2)(20)\sin 90°$

$=4Nm$

(4) Both required magnitude and direction for their complete explanation.

(5) $R_{max}=T+S(\theta=0°)\longrightarrow If\ T=6\Rightarrow Sum=12$

$R_{min}=T-S(\theta=180°)\longrightarrow If\ T=6\Rightarrow Sum=0$

(6) Basic definition.

(7)

$T_1=T_2$

$r_1F\sin\theta_1=r_2F_2\sin\theta_2$

$mgr_1\sin\theta_1=Mgr_2\sin\theta_2$

$(3)(g)(0.5)\sin 90°=M(g)(0.3)\sin 90°$

$M=\frac{3\times0.5}{0.3}=\frac{15}{3}=5kg$

(8) Maximum number of component of a vector = infinite

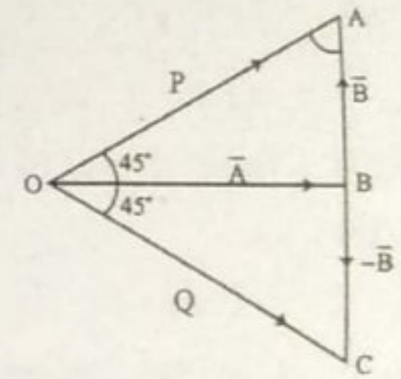
(9) $R=\sqrt{A^2+B^2+2AB\cos\theta}$

(10)

$P=\sqrt{A^2+B^2+2AB\cos\theta}$, $Q=\sqrt{A^2+B^2-2AB\cos\theta}$

$\theta=90°$, $\theta=90°$

$P=\sqrt{A^2+B^2}$.....(i) , $Q=\sqrt{A^2+B^2}$.....(ii)



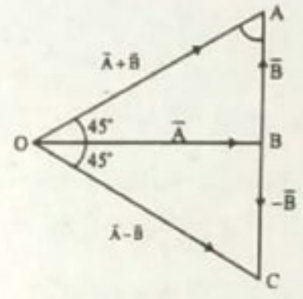
Conclusion from eq. (i) and (ii)

$|\vec{P}|=|\vec{Q}|$ when θ is 90° between $\vec{A}$ & $\vec{B}$

(11) $|\vec{R}|=\sqrt{A^2+B^2+2AB\cos\theta}$

$=A^2+B^2\ \ (\theta=90°)$

(12)

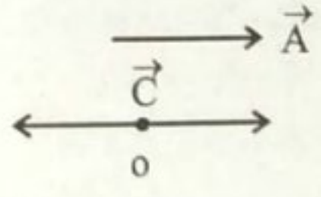


(13) $R_{min}=7-1=6$ cm

$R_{max}=7+1=8$ cm

$|\vec{R}|$ can't be greater than 8cm and can't be less than 6cm.

(14)



$\vec{A}$ is parallel or anti-parallel to $\vec{C}$, then $\vec{B}\perp\vec{C}$.

Scanned by CamScanner

(15) $|\vec{v}| = \sqrt{v_x^2 + v_y^2 + v_z^2}$

(16)

$$\vec{A}.\vec{B} = AB\cos\theta$$
$$= (L)(L)\cos 30°$$
$$= L^2 \times \frac{\sqrt{3}}{2} = \frac{\sqrt{3}L^2}{2}$$

(17) $\vec{C}$ is in same plane of $\vec{A}$ & $\vec{B}$ and $\vec{D}$ is perpendicular to plane.

(18)

$$\hat{i}.(\hat{j} \times \hat{k})$$
$$= \hat{i}.\hat{i} = 1$$

(19) Three forces of equal magnitude having sum zero in the form of triangle.

(20)

$$\vec{L} = \vec{r} \times \vec{P}$$

If $\theta = 90°$ between $\vec{r}$ & $\vec{L}$

$$\vec{r}.\vec{L} = rL\cos(90) = 0$$

(21) $|\vec{A}| = \sqrt{Ax^2 + Ay^2 + Az^2} = 1$

(22)

$$S = AC + CD + DB$$
$$1 + 10 + 1 = 12m$$

(23) $|\vec{A}| = \sqrt{Ax^2 + Ay^2}$

(24)

$$\vec{d} = 400\hat{j} - 300\hat{j} + 1200\hat{k}$$
$$\vec{d} = 100\hat{j} + 1200\hat{k}$$
$$\vec{d} = \sqrt{(100)^2 + (1200)^2}$$

(25)

$$|\vec{d}| = \sqrt{8^2 + 6^2}$$
$$= \sqrt{100} = 10cm$$

(26) Using first condition of equilibrium.

(27) $\tau = I\alpha$

(28)

$$\tau = rF$$
$$= (m)(kgms^{-2})$$
$$kgm^2s^{-2} = [ML^2T^{-2}]$$

(29) $\cos\theta = \frac{A_xB_x + A_yB_y + A_zB_z}{AB}$

(30) $\Sigma F = 0$

(31)

$$\vec{A}.\vec{B} = AB\cos\theta$$
$$A\cos\theta = \frac{\vec{A}.\vec{B}}{|\vec{B}|} = \frac{2+3}{\sqrt{2}} = \frac{5}{\sqrt{2}}$$

(32)

$$W_1r_1 = r_2W_{rod} + r_3W_3$$
$$(400)(1) = (1)(W_{rod}) + (3)(100)$$
$$W_{rod} = 100N$$

(33) It passes through axis of rotation.

(34) $|\vec{R}| = \sqrt{A^2 + B^2 - 2AB\cos\theta} = \sqrt{v^2 + v^2 - 2v^2 \times \frac{1}{2}} = v$

(35) $W = \vec{F}.\vec{d}$

$$= (4\hat{i} + \hat{j} + 3\hat{k}).(11\hat{i} + 11\hat{j} + 15\hat{k}) = 44 + 11 + 45 = 100$$

(36) $\hat{A} = \frac{\vec{A}}{|\vec{A}|}$

(37) $v_{actual} = \sqrt{v_1^2 + v_2^2}$

$$= \sqrt{4^2 + 3^2} = 5kmh^{-1}$$

(38) In 1st and 3rd quadrant.

(39) $\vec{A}.\vec{B} = A_xB_x + A_yB_y + A_zB_z$

(40) Couple = (force) (couple arm)

$$= Fl\sin\theta$$
$$= (2)(0.2)\sin 30°$$
$$= 0.2Nm$$

(41) Magnitude $= \sqrt{\cos^2\theta + \sin^2\theta} = \sqrt{1} = 1$

(42)

$$R^2 = A^2 + B^2 + 2AB\cos\theta$$
$$(\text{if } R = A = B)$$
$$R^2 = R^2 + R^2 + 2R\cos\theta$$
$$\frac{-R^2}{2R^2} = \cos\theta \rightarrow \theta = \cos^{-1}\left(-\frac{1}{2}\right) = 120°$$

Scanned by CamScanner

(43)
$$\vec{x} = \hat{A}|B| = \frac{(3\hat{i}+4\hat{j}+2\hat{k})\sqrt{36+1+9}}{\sqrt{9+16+4}}$$
$$= \sqrt{\frac{46}{29}}(3\hat{i}+4\hat{j}+2\hat{k})$$

(44) Here
$$\vec{A} = 3\hat{i}+2\hat{j}-\hat{k}$$
$$= -(-3\hat{i}-2\hat{j}+\hat{k})$$
$$\vec{A} = -\vec{B}$$

(45) Values of $\cos 45°$ is equal to $\sin 45°$ i.e $\frac{1}{\sqrt{2}}$

(46) Using right hand Rule rotate '$\vec{r}$' towards '$\vec{F}$' in $x-z$ plane then thumb will point along y-direction.

(47)
$$2\times 500 = 4\times F$$
$$F = \frac{1000}{4}$$
$$F = 250N$$

(48)
$$\tau = rF\sin\theta$$
$$\tau = 0.60\times 8\times\frac{1}{2}$$
$$\tau = 2.4Nm$$

(49) $\vec{\tau} = \vec{r}\times\vec{F}$
$\vec{\tau} \propto \vec{r}$
$\vec{\tau} = \vec{F}$
So larger $\vec{r}$ gives larger $\vec{F}$

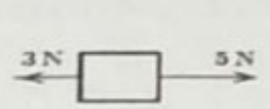
(50)
$$\tau_{net} = (10)(2)-40(4)$$
$$= -\frac{140}{100}Nm = -1.4Nm$$
$$\tau_{net} = \tau_1+\tau_2$$
$$= \frac{10}{100}\times 2+\left(-\frac{40}{100}\times 4\right)$$
$$= 0.2-1.6$$
$$\tau_{net} = -1.4Nm$$

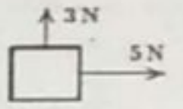
Negative sign indicates that τ_{net} is in clockwise direction.

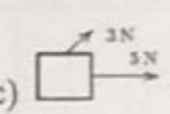
2 Chapter VECTORS AND EQUILIBRIUM

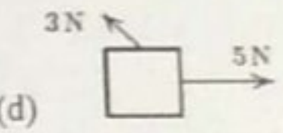
SELF ASSESSMENT TEST

(1) Two forces of magnitude F have a resultant of the same magnitude F. The angle between the two forces is
(a) 45^0 (b) 30^0
(c) 120^0 (d) 60^0

(2) Two forces, one with a magnitude of 3 N and the other with a magnitude of 5 N, are applied to an object. For which orientations of the forces shown in the diagrams is the magnitude of the acceleration of the object the least?
(a) 

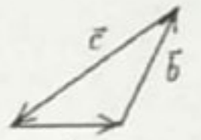
(b) 

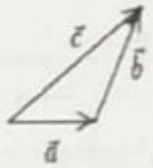
(c) 

(d) 

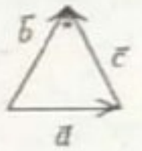
(3) An object is subjected to a force in the north-east direction. To balance this force, a second force should be applied in the direction
(a) west (b) south-West
(c) north-east (d) east

(4) The resultant force of 5 N and 10 N cannot be
(a) 5 N (b) 4 N
(c) 12N (d) 8N

(5) The vectors $\vec{a},\vec{b}$ and $\vec{c}$ are related by $\vec{c} = \vec{b}-\vec{a}$. Which diagram below illustrates this relationship?
(a) 

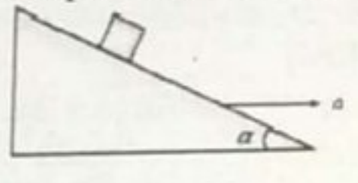
(b) 

(c) 

(d) 

(6) Which of the following sets of concurrent forces may be in equilibrium?
(a) F_1=3N,F_2=5N,F_3=9N (b) F_1=3N,F_2=5N,F_3=1N
(c) F_1=3N,F_2=5N,F_3=15N (d) F_1=3N,F_2=5N,F_3=6N

(7) Maximum number of rectangular components of a vector in space.
(a) one (b) two
(c) three (d) infinite

(8) A block is kept on a frictionless inclined surface with angle of inclination 'α'. The incline is given an acceleration 'a' to keep the block stationary. Then a is equal to


(a) g/tanα (b) g
(c) g cosecα (d) g tanα

(9) What is torque acting on a pendulum of length "*l*" at an angle "θ"
(a) zero (b) mg*l*
(c) mg*l*cosθ (d) mg*l*sinθ

Scanned by CamScanner

(10) Let F be the force acting on particle having position vector r and τ be the torque of this force about the region. Then

(a) $\vec{r}\bullet\vec{\tau}=0$ and $\vec{F}\bullet\vec{\tau}\neq 0$ (b) $\vec{r}\bullet\vec{\tau}=0$ and $\vec{F}\bullet\vec{\tau}=0$

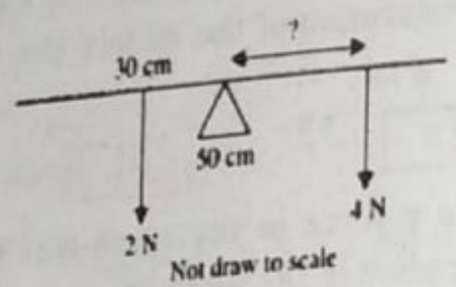
(c) $\vec{r}\bullet\vec{\tau}\neq 0$ and $\vec{F}\bullet\vec{\tau}=0$ (d) $\vec{r}\bullet\vec{\tau}\neq 0$ and $\vec{F}\bullet\vec{\tau}\neq 0$

(11) If $A\times B = B\times A$, then the angle between A and B is

(a) 45^0 (b) 90^o

(c) 270^0 (d) 0^0

(12) A uniform beam of 1m is supported at the 50cm mark. Given that a weight of 2N hangs at the 30cm mark, how far away from the pivot must another weight of 4N be hung to balance the beam



(a) 10cm (b) 20cm

(c) 15cm (d) 30cm

(13) When the net torque acting on a system is zero, which of the following will be constant?

(a) angular momentum (b) force

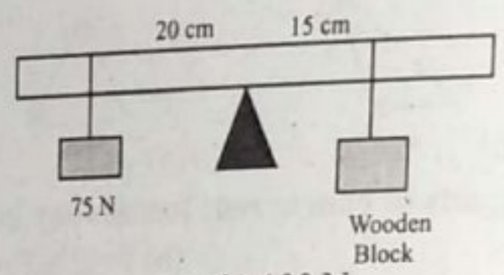
(c) velocity (d) linear momentum

(14) The rate of change in angular momentum is called

(a) angular momentum (b) linear momentum

(c) torque (d) Force

(15) The diagram shows a uniform meter rod balance at its mid-point. What can be the weight of wooden block?



(a) 50N (b) 100 N

(c) 65N (d) 150N

(16) Vectors $\vec{A}$ and $\vec{B}$ each have magnitude L. When drawn with their tails at the same point, the angle between them is 30°. The value of $\vec{A}.\vec{B}$ is:

(a) $2L^2$ (b) $\frac{\sqrt{3}L^2}{2}$

(c) L^2 (d) Zero

(17) Which one is not a correct relation?

(a) $\vec{A}\times\vec{B}=\vec{A}\times\vec{B}$ (b) $\left|\vec{A}\times\vec{B}\right|=-\left|\vec{B}\times\vec{A}\right|$

(c) $\vec{A}\times\vec{B}=AB\sin\theta\hat{n}$ (d) $\vec{B}\times\vec{A}=AB\sin\theta\left(-\hat{n}\right)$

(18) What happens if a vector is multiplied by a number 2?

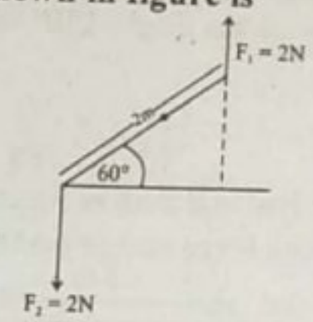
(a) the magnitude of the vector is doubled but its direction remains the same

(b) the magnitude of the vector remains the same but its direction is reversed

(c) the magnitude of the vector is doubled and its direction is reversed

(d) neither the magnitude nor the direction of the vector undergo any change

(19) The torque due to couple as shown in figure is



(a) 0.866 Nm (b) 1 Nm

(c) 2 Nm (d) 0.5 Nm

(20) A force of 15 N is along Y-axis where as the resultant is acting at 30°. What will be the horizontal components of force?

(a) 20 N (b) 26 N

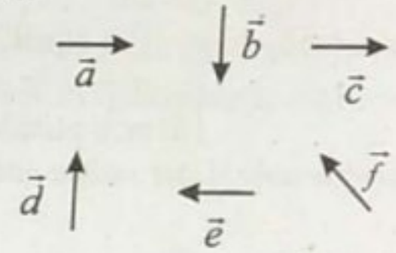
(c) 30 N (d) 21 N

(21) Sum of all torques acting on a body is zero, this condition represents equilibrium's

(a) fourth condition (b) third condition

(c) first condition (d) second condition

(22) Six vectors a through f have the magitudes and directions indicated in the figure. Which of the following statement is true?



(a) $\vec{b}+\vec{e}=\vec{f}$ (b) $\vec{d}+\vec{e}=\vec{f}$

(c) $\vec{b}+\vec{c}=\vec{f}$ (d) $\vec{d}+\vec{c}=\vec{f}$

(23) The magnitude of cross product of two vectors is equal to the dot product between them. The angle between the two vectors is

(a) 30° (b) 45°

(c) 60° (d) 180°

(24) If $\left|\vec{A}\times\vec{B}\right|=\sqrt{3}\vec{A}\bullet\vec{B}$ then the value of $\left|\vec{A}+\vec{B}\right|$ is

(a) $(A^2+B^2+\frac{AB}{\sqrt{3}})^{1/2}$ (b) $(A^2+B^2+AB)^{1/2}$

(c) $(A^2+B^2+\sqrt{3}AB)^{1/2}$ (d) A+B

(25) The vector sum of two forces is perpendicular to their vector differences. In that case, the forces:

(a) are equal to each other

(b) are equal to each other in magnitude

(c) are not equal to each other in magnitude

(d) cannot be predicted

(26) If $\left|\vec{A}.\vec{B}\right| = \sqrt{3}.\left|\left(\vec{A}\times\vec{B}\right)\right|$ then angle between $\vec{A}$ and $\vec{B}$

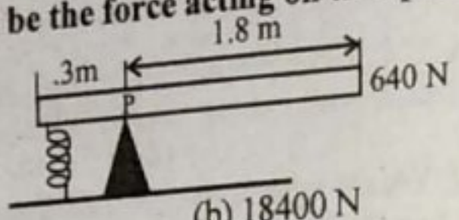
(a) 45° (b) 30°

(c) 90° (d) 60°

Scanned by CamScanner

(27) **A person swims in a river aiming to reach exactly opposite point on the bank of a river. His speed of swimming is 0.5 m/s at an angle 120° with the direction of flow of water. The speed of water in stream is:**
(a) 0.43 m/s (b) 1.0 m/s
(c) 0.25 m/s (d) 0.5 m/s

(28) **The distance between spring and pivot is 0.3 as in figure. A man of weight 640 N is standing on the diving board. What will be the force acting on the spring top to balance him?**



(a) 1840 N (b) 18400 N
(c) 3840 N (d) 5840 N

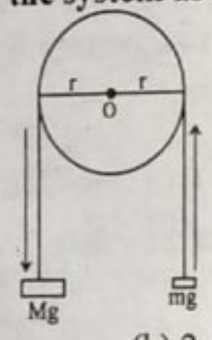
(29) **A body will be in complete equilibrium when it is satisfying**
(a) 1st condition of equilibrium (b) 2nd condition of equilibrium
(c) both 1st and 2nd condition of equilibrium (d) impossible

(30) **A person moves 30 m north, then 20 m east and finally $30\sqrt{2}$ south-west. What is his displacement from the original position?**
(a) 10m (b) 6m
(c) 1m (d) 2m

(31) **Three coplanar forces acting on a body keep it in equilibrium. They should therefore be**
(a) concurrent (b) non concurrent
(c) parallel (d) non parallel

(32) **body will be in rotational equilibrium only if the vector sum of all the external Torque's acting in a body is equal to:**
(a) double (b) zero
(c) maximum (d) unity

(33) **The resultant torque produced in the system as shown in the fig.**



(a) Mgr + mgr (b) 2gr (M + m)
(c) Mgr – mgr (d) (M – m) 2gr

(34) **It is easier to turn a steering wheel with both hands than with a single hand because**
(a) accelerating force increases on the wheel (b) two forces act on the wheel
(c) two hands provide firm grip (d) couple acts on the wheel

(35) **A force of 10N is acting along y-axis. Its component along x-axis is**
(a) zero (b) 10N
(c) 100N (d) 5N

(36) **When a steady torque is acting on a body, the body:**
(a) gets linear acceleration
(b) continues in its state of rest or uniform motion along a straight line
(c) gets angular acceleration
(d) rotated at a constant speed

(37) **Give the example of couple is**
(a) moving coil of generator (b) both a and c
(c) moving coil galvanometer (d) none of these

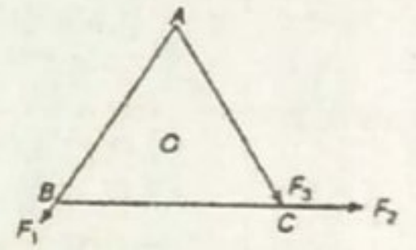
(38) **A tight nut is to be opened by a wrench of length 30 cm. Find the maximum torque caused by applying 20N force on the wrench**
(a) 6 Nm (b) 4 Nm
(c) 10 Nm (d) 8 Nm

(39) **Torque depends only on**
(a) direction of force, magnitude of the force and point of application of the force relative to the origin
(b) direction of force
(c) magnitude of the force
(d) point of application of force relative to the origin

(40) **The cross product of two vectors is zero when**
(a) they are parallel vectors (b) they are anti parallel vectors
(c) they are perpendicular vector (d) both a and b are correct

(41) **The speed of a boat is 5 km/h in still water. It crosses a river of width 1.0 km along the shortest possible path in 15 min. The velocity of the river water is: (in km/h)**
(a) 5 (b) 1
(c) 3 (d) 4

(42) **O is the center of an equilateral triangle ABC. F_1,F_2 and F_3 are three forces along AB, BC and AC as shown in figure. What should be the magnitude of F_3 so that total torque about O is zero?**



(a) $(F_1 + F_2)/2$ (b) $F_1 - F_2$
(c) F_1+F_2 (d) $2(F_1+F_2)$

(43) **The magnitudes of sum and difference of two vectors arc same then the angle between them is**
(a) 90^0 (b) 45^0
(c) 180^0 (d) 0^0

(44) **A force passing through the centre of gravity of a bod**
(a) results only in rotational motion
(b) results only in translational motion
(c) results in both translational & rotational motion
(d) holds the body in equilibrium

(45) **The body is said to be in rotational equilibrium only if the sum of all the _____ acting on the body about any arbitrary axis is zero:**
(a) external torques (b) external forces
(c) second condition (d) none of these

(46) **When first condition of equilibrium is satisfied, the body has**
(a) no linear acceleration (b) no angular acceleration
(c) rotational equilibrium (d) none of these

Scanned by CamScanner

(47) **What is not true of two forces that give rise to a couple?**
(a) they act in opposite directions (b) they both act on the same body
(c) they both act at the same point (d) they both have the same magnitude

(48) **If force applied makes an angle 'θ' with its position vector r relative to point O, then the torque will be**
(a) $\tau = rF\cos\theta$ (b) $\tau = rF\sin\theta$
(c) $\tau = rF$ (d) $\tau = 0$

(49) **If the direction of force acting on a body capable of rotating about a point is reversed then**
(a) magnitude of torque changes and direction remains same
(c) magnitude of torque changes and direction is reversed
(b) magnitude and direction both changes
(d) magnitude of torque remains same and direction is reversed

(50) **Which of the following sets of displacements have equal resultants when performed in the order given?**
I: 6 m east, 9 m north, 12 m west
II: 6 m north, 9 m west, 12 m east
III: 6 m east, 12 m west, 9 m north
IV: 9 m north, 6 m east, 12 m west
(a) I and IV (b) I and II
(c) I, III and IV (d) I, II and IV

(51) **The product of two vectors $\vec{A}$ and $\vec{B}$ may be**
(a) $= AB$ (b) $\leq AB$
(c) zero (d) all of these

(52) **The rectangular components of force 5 dyne are**
(a) 2.5 dyne and 5 dyne (b) 3 and 4 dyne
(c) 1 and 2 dyne (d) 2 and 3 dyne

(53) **If $\vec{P}$ and $\vec{Q}$ are two forces then such that resultant $R^2 = P^2 + Q^2$ then angle between $\vec{P}$ and $\vec{Q}$ will be_____**
(a) 0° (b) 90°
(c) 180° (d) 30°

(54) **Given $\vec{F} = \left(4\hat{i} - 10\hat{j}\right)$ and $\vec{r} = \left(-5\hat{i} - 3\hat{j}\right)$, compute torque**
(a) $-62\hat{j}$ *units* (b) $62\hat{k}$ *units*
(c) $48\hat{i}$ *units* (d) $48\hat{i}$ *units*

(55) **Torque is counter part of _____ for rotational motion**
(a) force (b) product
(c) power (d) inertia

(56) **Work done by torque will be equal to**
(a) Fd (c) $I\propto$
(b) $r\theta$ (d) $\tau\theta$

(57) **If the angle between the vectors $\vec{A}$ and $\vec{B}$ is θ, the value of the product $\left(\vec{B}\times\vec{A}\right).\vec{A}$ is equal to**
(a) $BA^2\sin\theta$ (b) $BA^2\cos\theta\sin\theta$
(c) $BA^2\cos\theta$ (d) zero

(58) **Two vectors $\vec{A}$ and $\vec{B}$ have magnitude 3 each. $\vec{A}\times\vec{B} = -5\hat{k} + 2\hat{i}$. Find the angle between $\vec{A}$ and $\vec{B}$**
(a) $\cos^{-1}\frac{\sqrt{29}}{9}$ (b) $\tan^{-1}\left(\frac{-5}{2}\right)$
(c) $\sin^{-1}\left(\frac{2}{3}\right)$ (d) $\sin^{-1}\left(\frac{\sqrt{29}}{9}\right)$

(59) **If $\vec{A}.\vec{B} = \vec{B}.\vec{C}$ then**
(a) $\vec{A} = \vec{C}$ always (b) $\vec{A} \neq \vec{C}$ always
(c) $\vec{A}$ may not be equal to $\vec{C}$ (d) none of these

(60) **If a vector $2\hat{i} + 3\hat{j} + 8\hat{k}$ is perpendicular to a vector $4\hat{j} - 4\hat{i} + \alpha\hat{k}$ then the value of α is**
(a) $\frac{1}{2}$ (b) $-\frac{1}{2}$
(c) 1 (d) -1

ANSWER KEY

1	c	11	d	21	d	31	a	41	c	51	d
2	a	12	a	22	b	32	b	42	c	52	b
3	b	13	a	23	b	33	c	43	a	53	b
4	b	14	c	24	b	34	d	44	b	54	b
5	d	15	b	25	b	35	a	45	a	55	a
6	d	16	b	26	b	36	c	46	a	56	d
7	c	17	b	27	c	37	b	47	c	57	d
8	d	18	a	28	c	38	a	48	b	58	d
9	d	19	c	29	c	39	a	49	d	59	c
10	b	20	b	30	b	40	d	50	c	60	b

Scanned by CamScanner

EXPLANATORY NOTES

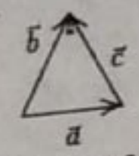
(1) $F=\sqrt{(F)^2+(F)^2+2F.F\cos\theta}=120°$

(2) When $\Sigma F=ma$, $a\propto F$ and $a_{min}\propto F_{min}$ As F_{min} where forces are opposite.

(3) Direction of second force should be at 180°.

(4) $F_{max}=5+10=15$ N and $F_{min}=10-5=5N$
Range of resultant $5\le F\le 15$

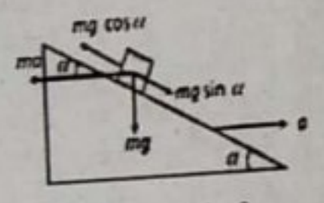
(5) By RHR $\vec{a}+\vec{c}=\vec{b}\Rightarrow\vec{c}=\vec{b}-\vec{a}$



(6) Range of resultant of F_1 and F_2 varies between (3+5) = 8 N and (5–3) = 2N.
It means for some value of angle (θ), resultant 6 can be obtained. So, the resultant of 3N, 5 N and 6 N may be zero and the forces may be in equilibrium.

(7) Maximum Rectangular components in plane = two
Maximum Rectangular components in space = three
Maximum components of a vector may be infinite

(8) Let the mass of a block is m. It will remain stationary if forces acting on it are in equilibrium.
i.e. $ma\cos\alpha=mg\sin\alpha\Rightarrow a=g\tan\alpha$ Here ma = Pseudo force on block, mg = weight



(9) $\tau=r\times F=rF\sin\theta$ $(\because r=\ell$ and $F=w=mg)$ $=\ell\, mg\sin\theta$

(10) The torque, $\tau=r\times F$ As, τ is perpendicular to both r and F, so $r.\tau$ as well as F. τ has to be zero

(11) Given, $(A\times B)=(B\times A)\Rightarrow(A\times B)-(B\times A)=0$ or $(A\times B)+(A\times B)=0$
$[\because (B\times A)=-(A\times B)]\Rightarrow 2(A\times B)=0\Rightarrow 2AB\sin\theta=0\Rightarrow\sin\theta=0$
$(\because |A|=A\neq 0, |B|=B\neq 0)\ \therefore\theta=0$ or π

(12) Apply the principle of moments $\Sigma\tau=0$
Sum of clockwise torque = sum of anti-clock wise torque
2 x 20 = L x 4
L = 10cm

(13) $\tau=\frac{\Delta L}{\Delta t}=0\Rightarrow\Delta L=0\Rightarrow L=$ constant

(14) By definition $\tau=\frac{\Delta L}{\Delta t}$

(15) $\Sigma\tau=0\Rightarrow$ Sum of clockwise torque = sum of anti-clock wise torque
75 x 20 = w x 15 $\Rightarrow$ w = 100N

(16) $\vec{A}.\vec{B}=AB\cos\theta$
$\vec{A}.\vec{B}=(L)(L)\cos 30°$
$\vec{A}.\vec{B}=L^2\left(\frac{\sqrt{3}}{2}\right)$

(17) $|\vec{A}\times\vec{B}|=|\vec{B}\times\vec{A}|$ or $\vec{A}\times\vec{B}=-\vec{B}\times\vec{A}$
$|\vec{A}\times\vec{B}|=-|\vec{B}\times\vec{A}|$ is not correct

(18) 2 is positive, so magnitude become double but direction remain same

(19) Torque due to couple = $F\times\ell\cos 60°=2\times 2\times\frac{1}{2}=2Nm$

(20) $\tan 30°=\frac{F_y}{F_x}$
$F_x=\frac{F_y}{\tan 30°}=\frac{15}{1/\sqrt{3}}=15\sqrt{3}=26N$

(21) Definition of 2nd condition of equilibrium

(22) If two non-zero vectors are represented by the two adjacent sides of a parallelogram, then the resultant is given by the diagonal of the parallelogram passing through the point of intersection of the two-vectors $\therefore\ \vec{d}+\vec{e}=\vec{f}$

(23) $|\vec{A}\times\vec{B}|=\vec{A}.\vec{B}$
$AB\sin\theta=AB\cos\theta$
$\frac{\sin\theta}{\cos\theta}=1$
$\theta=45°$

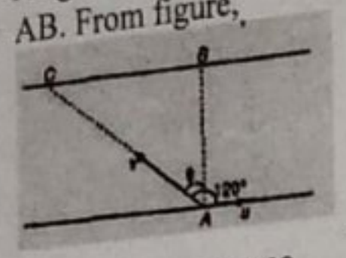
(24) Given $|\vec{A}\times\vec{B}|=\sqrt{3}\vec{A}.\vec{B}\Rightarrow AB\sin\theta=\sqrt{3}AB\cos\theta\Rightarrow\tan\theta=\sqrt{3}\Rightarrow\theta=60°$
The addition of vector $\vec{A}$ and $\vec{B}$ can be given by the law of parallelogram.
$\therefore|\vec{A}+\vec{B}|=\sqrt{A^2+B^2+2AB\cos 60°}=\sqrt{A^2+B^2+2AB\times\frac{1}{2}}=(A^2+B^2+AB)^{1/2}$

(25) The two vectors must be perpendicular if their dot product must be zero. Let $\vec{A}$ and $\vec{B}$ are two forces. The sum of the two forces.
$\vec{F}_1=\vec{A}+\vec{B}...(i)$ The difference of the two forces.
$\vec{F}_2=\vec{A}-\vec{B}...(ii)$ Since, sum of the two forces is perpendicular to their differences as given so, $\vec{F}_1.\vec{F}_2=0$ or $(\vec{A}+\vec{B}).(\vec{A}-\vec{B})=0$ or $A^2-\vec{A}.\vec{B}+\vec{B}.\vec{A}-B^2=0$ or $A^2=B^2$ or $|\vec{A}|=|\vec{B}|$. Thus, the forces are equal to each other in magnitude.
$AB\cos\theta=\sqrt{3}AB\sin\theta$

(26) $\frac{1}{\sqrt{3}}=\tan\theta$
$\theta=30°$

Scanned by CamScanner

(27) Let u be the speed of stream and v the speed of person starts from A and wants to reach at point B directed opposite to A.
As given, v makes an angle of 120° with direction of flow u, the resultant of v and u is along AB. From figure,,



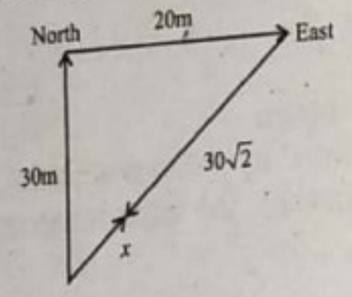
$u = v\sin\theta = v\sin 30°$ $\quad \therefore u = \frac{v}{2} = \frac{0.5}{2}(v = 0.5m/s) = 0.25m/s$

(28) $F \times 0.3 = 640 \times 1.8 \Rightarrow F = \frac{640 \times 18}{3} = 3840N$

(29) Both conditions require for complete equilibrium

(30) $\sqrt{B^2 + P^2} = H$

$\sqrt{20^2 + 30^2} = (30\sqrt{2} - x)$



Hence:

$42 - 36 = x$

$6m = x$

(31) Concurrent forces produces zero resultant, when they are added to form a triangle.

(32) Statement of second condition of equlibrium

(33) $\tau_{ACW} - \tau_{CW} = \tau_{Net} \Rightarrow Mgr - mgr = \tau_{Net}$

(34) Couple increase rotational effect

(35) If force is along x-axis then y-component is zero and vice versa

(36) Whenever torque is produced then the quantity which must produce is angular acceleration.

(37) General information

(38) $\tau = rF = \left(\frac{30}{100}\right)(20) = 6Nm$

(39) $\tau = rF\sin\theta \Rightarrow \tau \propto r, \tau \propto F \ \& \ \tau \propto \theta (angle\ between\ r\ and\ F)$

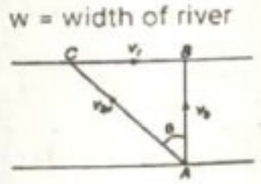
(40)

$|\vec{A} \times \vec{B}| = AB\sin\theta = 0$

$\sin\theta = 0$, when $\theta = 0 or 180°$

(41)

Let v_r = velocity of river $\quad v_{br}$ =velocity of boat in still water and $\quad$ w = width of river



Time taken to cross the river = 15 min $\quad = \frac{15}{60}h = \frac{1}{4}h$

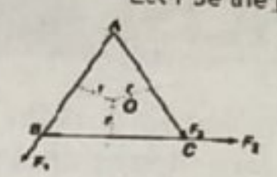
Shortest path is taken when v_b is along AB. In this case $\quad v_{br}^2 = v_r^2 + v_b^2$ $\quad$ Now,

$t = \frac{w}{v_b} = \frac{w}{\sqrt{v_{br}^2 - v_r^2}} \therefore \frac{1}{4} = \frac{1}{\sqrt{5^2 - v_r^2}} \Rightarrow 5^2 - v_r^2 = 16 \Rightarrow v_r^2 = 25 - 16 = 9$

$\therefore v_r = \sqrt{9} = 3\,km/h$ $\quad$ Note: If $v_r \geq v_{br}$, the boatman can never reach at point B.

(42)

Let r be the perpendicular distance of F_1, F_2 and F_3 from O as shown in figure



The torque of force F_3 about O is clockwise, while torque due to F_1 and F_2 are ant clockwise.

For total torque to be zero about O, we must have

$F_1 r + F_2 r - F_3 r = 0 \quad \Rightarrow F_3 = F_1 + F_2$

(43)

Given $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}| \Rightarrow |\vec{A} + \vec{B}|^2 = |\vec{A} - \vec{B}|^2 \Rightarrow (\vec{A} + \vec{B}).(\vec{A} + \vec{B}) = (\vec{A} - \vec{B}).(\vec{A} - \vec{B})$

$\Rightarrow \vec{A}.\vec{A} + \vec{A}.\vec{B} + \vec{B}.\vec{A} + \vec{B}.\vec{B} = \vec{A}.\vec{A} - \vec{A}.\vec{B} - \vec{B}.\vec{A} + \vec{B}.\vec{B}$ As $\vec{A}.\vec{B} = \vec{B}.\vec{A}$

$\Rightarrow A^2 + 2\vec{A}.\vec{B} + B^2 = A^2 - 2\vec{A}.\vec{B} - B^2 \Rightarrow 4\vec{A}.\vec{B} = 0$

$\Rightarrow \vec{A}.\vec{B} = 0$ Hence $\vec{A}$ and $\vec{B}$ are mutaully perpendicular.

(44) If force is applied at center of gravity then the there will be no rotation will produce, so there will be only linear motion.

(45) Statement of second condition of equilibrium

(46) $F = ma \Rightarrow F = 0 \Rightarrow a = 0$

(47) In couple forces acts on two different points.

(48) $\tau = rF\sin\theta$

(49) $\vec{\tau} = \vec{r} \times \vec{F}$ If $\vec{F}$ is reverse $\vec{\tau}' = \vec{r} \times (-\vec{F}) = -\vec{r} \times \vec{F}$

$\vec{\tau}$ is reversed but magnitude remain same.

(50) We know addition of vectors is commutative. Resultant is same even if the order of the vectors is different.

(51) $\vec{A}.\vec{B} = AB\cos\theta$ *and* $|\vec{A} \times \vec{B}| = AB\sin\theta$; product depends upon angle "θ".

(52) $F = \sqrt{9+16} = \sqrt{25} = 5$; if A = 3 dyne and B = 4 dyne.

(53) $R = \sqrt{P^2 + Q^2 + 2PQ\cos\theta} \quad \because \theta = 90° \ ; R^2 = P^2 + Q^2$

(54) $\vec{\tau} = \vec{r} \times \vec{F} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ -5 & -3 & 0 \\ 4 & -10 & 0 \end{vmatrix} = \hat{k}(50 - 12)62\hat{k}$

(55) $\tau = I\alpha$; F = ma

(56) $W = \tau(\theta)$

(57) $(\vec{B} \times \vec{A}) \perp \vec{A} \quad \theta = 90°$

(58) $\sin\theta = \frac{|\vec{A} \times \vec{B}|}{|\vec{A}||\vec{B}|} = \frac{\sqrt{25+4}}{9} = \frac{\sqrt{29}}{9}$

(59) Dot product obeys commutative law.

(60) $(2\hat{i} + 3\hat{j} + 8\hat{k}).(4\hat{j} - 4\hat{i} + \alpha\hat{k}) = 0$

$-8 + 12 + 8\alpha = 0$

$\left(\alpha = -\frac{1}{2}\right)$

Scanned by CamScanner

Chapter 3 MOTION AND FORCE

PRACTICE EXERCISE

(1) **A particle moves along the x axis from x_i to x_f, which of the following values of the initial and final coordinates, which results in the displacement with the largest magnitude?**
(a) $x_i = 4m, x_f = -2m$ (b) $x_i = -4m, x_f = 4m$
(c) $x_i = 4m, x_f = 6m$ (d) $x_i = -4m, x_f = -8m$

(2) **A stone is dropped from the top of a cliff of height 30m. At the same instant another stone is projected vertically upwards from the ground with a speed of 30 m/s. The two stones will cross each other after a time**
(a) 1s (b) 2s
(c) 3s (d) 4s

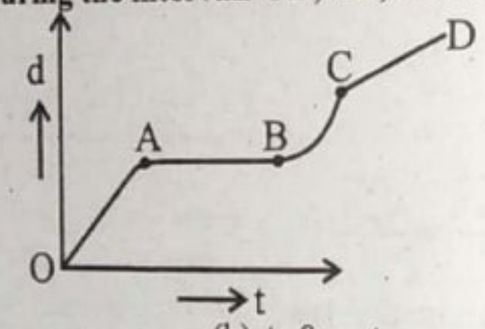
(3) **Which of the following must always be true?**
I. If an object's acceleration is constant, then it must move in a straight line.
II. If an object's acceleration is zero, then its speed must remain constant.
III. If an object's speed remains constant, then its acceleration must be zero.
(a) I and II only (b) I and III only
(c) II only (d). III only

(4) **A stone is thrown horizontally with an initial speed of 30 m/s from a bridge. Find the stone's total speed when it enters the water 4 seconds later. (Ignore air resistance.)**
(a) 30 m/s (b) 40 m/s
(c) 50 m/s (d) 60 m/s

(5) **A baseball is thrown vertically into the air. The acceleration of the ball at its highest point is**
(a) 2g, down (b) g, up
(c) Zero (d) g, down

(6) **A feather, initially at rest, is released in a vacuum 12 m above the surface of the earth. Which of the following statements is correct?**
(a) The maximum velocity of the feather is 9.8 m/s
(b) The acceleration of the feather remains constant during the fall
(c) The acceleration of the feather increases during the fall
(d) The acceleration of the feather decreases until terminal velocity is reached

(7) **The displacement time graph for a particle moving in a straight line is shown below. The accelerations of the particle during the intervals OA, AB, BC and CD are**

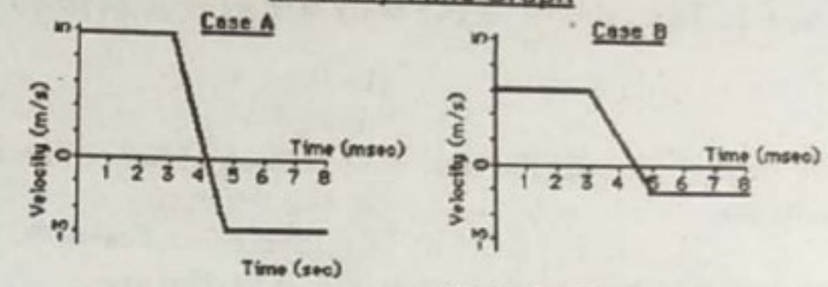


(a) 0 , 0, +, 0 (b) +, 0, -, +
(c) -, 0, -, - (d) –, 0, +, 0

(8) **A baseball is hit straight up and is caught by the catcher 2.0 s later. The maximum height of the ball during this interval is:**
(a) 4.9m (b) 19.6m
(c) 9.8m (d) 12.6m

(9) **In the diagram given below in which case the acceleration is maximum**

Velocity-Time Graph



(a) Case B (b) In both cases same
(c) Case A (d) None of these

(10) **Newton's laws do not hold good for particles, which**
(a) Are at rest
(b) Are moving slowly
(c) Move with high velocity
(d) Move with velocity comparable to velocity of light

(11) **A person standing on a horizontal floor feels two forces: the downward pull of gravity and the upward supporting force from the floor. These two forces**
(a) Have equal magnitudes and form an action/reaction pair
(b) Have equal magnitudes but do not form an action/reaction pair
(c) Have unequal magnitudes and form an action/reaction pair
(d) Have unequal magnitudes and do not form an action/reaction pair

(12) **A frictionless inclined plane of length 20 m has a maximum vertical height of 5 m. If an object of mass 2 kg is placed on the plane, which of the following best approximates the net force it feels?**
(a) 5 N (b) 10 N
(c) 15 N (d) 20 N

(13) **Imran travels 2m with speed v_1 and then 2m with speed v_2 his average speed is**
(a) $\frac{v_1 + v_2}{2}$ (b) $\frac{v_1 v_2}{2}$
(c) $\frac{v_1 v_2}{v_1 + v_2}$ (d) $\frac{2v_1 v_2}{v_1 + v_2}$

(14) **A 20 N block is being pushed across a horizontal table by an 18 N force. If the coefficient of kinetic friction between the block and the table is 0.4, find the acceleration of the block.**
(a) 0.5 m/s^2 (b) 1 m/s^2
(c) 5 m/s^2 (d) 7.5 m/s^2

(15) **Why does an object falling in the earth's gravitational field reach a steady velocity?**
(a) Air resistance increases with increase in velocity
(b) The earth's gravitational field decreases as the object falls
(c) The mass of the object remains constant
(d) The weight of the object increases as it falls

(16) **Assuming a frictionless, massless pulley, determine the acceleration of the blocks once they are released from rest.**
(a) $\frac{m}{M+m}g$ (b) $\frac{M}{M+m}g$
(c) $\frac{M}{m}g$ (d) $\frac{M-m}{M+m}g$

Scanned by CamScanner

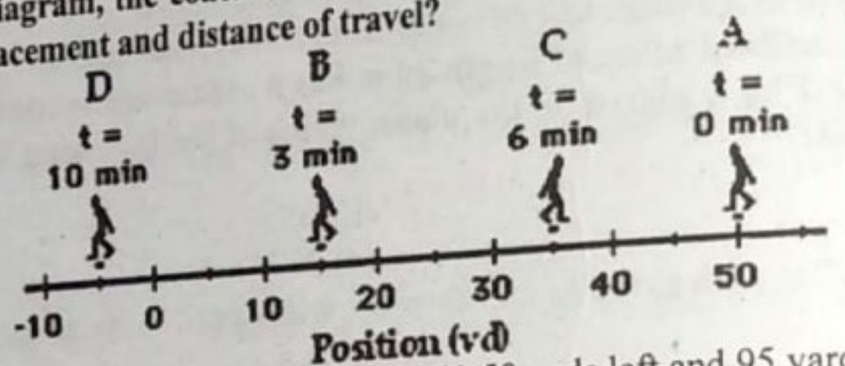
(17) The displacement X (in meters) of a body varies with time t (in seconds) as $X = -\frac{2}{3}t^2 + 16t + 2$. The velocity of the body will be zero at time
(a) 8s (b) 10s
(c) 12s (d) 14s

(18) Motorcycle safety helmet extends the time of collision and hence decreasing the
(a) Chance of collision (b) Force acting
(c) Velocity (d) Impulse – Remains same

(19) The collision between two bodies may be elastic if bodies are
(a) Solid and soft (b) Soft and elastic
(c) Solid and hard (d) Hard and elastic

(20) Two balls of masses m_1, and m_2 are thrown vertically upwards with the same speed u. If air resistance is neglected, they will pass through their point of projection in the downward direction with a speed.
(a) $\frac{m_1 u}{m_2}$ (b) $\frac{m_2 u}{m_1}$
(c) $\frac{(m_1 + m_2)\, u}{(m_1 - m_2)}$ (d) u

(21) In the given diagram, the coach moves from position A to B to C to D. What is the coach's resulting displacement and distance of travel?



(a) 55yards left and 90 yards (b) 50yards left and 95 yards
(c) 55yards left and 95 yards (d) 45yards left and 95 yards

(22) A body is falling freely under gravity. How much distance it falls during an interval of time between 1st and 2nd seconds of its motion, taking g=10?
(a) 10 m (b) 15 m
(c) 20 m (d) 25 m

(23) A body goes from A to B with a velocity of 40 kmh^{-1} and returns from B to A with a velocity of 60 kmh^{-1}. What is the average velocity of the body during the whole journey?
(a) 50 kmh^{-1} (b) 45 kmh^{-1}
(c) 55 kmh^{-1} (d) Zero

(24) When collision between the bodies in a system is inelastic in nature then for the system
(a) Momentum changes but K.E remain conserve
(b) K.E changes but momentum remain conserve
(c) Both momentum and K.E changes
(d) Both momentum and K.E remain conserve

(25) A ball is projected horizontally with a velocity of 5ms^{-1} from the top of a building 19.6 m high. How long will the ball take to hit the ground?
(a) $\sqrt{2}$s (b) 2s
(c) $\sqrt{3}$ s (d) 3s

(26) If an iron ball and wooden ball of the same radius are released from the height 'h' in vacuum, then time taken by both of them to reach the ground will be
(a) Unequal (b) Equal
(c) Zero (d) None of these

(27) Taking off rocket can be explained by
(a) 1st law of motion (b) 2nd law of motion
(c) Law of conservation of momentum (d) Law of conservation of energy

(28) Which of the following is not an example of projectile motion?
(a) A gas filled balloon (b) Bullet fired from gun
(c) A football kicked (d) A base ball shot

(29) A body is projected with kinetic energy K at an angle of 60° with the horizontal. Its kinetic energy at the highest point of its trajectory will be
(a) 2K (b) K
(c) $\frac{K}{2}$ (d) $\frac{K}{4}$

(30) Four projectiles are projected with the same speed at angles 20°, 35°, 60° and 75° with the horizontal. The range will be the longest for the projectile whose angle is
(a) 20° (b) 35°
(c) 60° (d) 75°

(31) When two bodies move toward each other with constant speeds the distance between them decreases at the rate of 6m/sec. If they move in the same direction the distance between them increases at the rate of 4m/sec. Then their speeds are
(a) 5m/s, 1m/s (b) 3m/s, 3m/s
(c) 6m/s, 1m/s (d) 4m/s, 2m/s

(32) A projectile throws at an angle of 30° with the horizontal has a range R_1, and attains a maximum height h_1. Another projectile thrown, with the same velocity at an angle 30° with the vertical has a range R_2 and attains a maximum height h_2. The relation between R_1 and R_2 is
(a) $R_1 = \frac{R_2}{2}$ (b) $R_1 = R_2$
(c) $R_1 = 2R_2$ (d) $R1 = 4\, R_2$

(33) Two masses, each equal to m, are attached to one another by a mass less string passing over a smooth pulley. The tension in the string is
(a) mg (b) 2mg
(c) $\frac{mg}{2}$ (d) Zero

(34) Flight of a rocket in the space is an example of
(a) Second law of motion (b) Third law of motion
(c) First law of motion (d) Law of gravitation

(35) A balloon has 2g of air. If a small hole is pierced into it, the air comes out with a speed of 2 m/s. If the balloon shrink completely in 5s, the average thrust experienced by the balloon is
(a) 8×10^{-1} N (b) 8×10^{-2}N
(c) 8×10^{-3} N (d) 8×10^{-4} N

Scanned by CamScanner

(36) **Rocket engine lifts rocket from the earth's surface, because hot gas with high velocity**
(a) React against the rocket and push it up (b) Push against the air
(c) Push against the earth (d) Heat up the air which lifts the rocket

(37) **The force experienced by a wall on which water strikes normally at a speed of $10ms^{-1}$ and at a discharge of $0.0001m^3s^{-1}$ is.**
(a) 1N (b) 10N
(c) 100N (d) none

(38) **Time rate of change of momentum is equal to**
(a) Force (b) Impulse
(c) Velocity (d) Both (a) and (c)

(39) **The ratio of distance to displacement along a semi circle of radius r is**
(a) 2π (b) $\pi/2$
(c) π (d) None of these

(40) **Why Ballistic missiles fail in some circumstances of precision.**
(a) Due to their shape (b) Due to air resistance
(c) Due to angle of projection (d) All of these

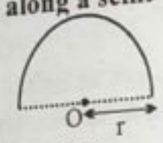
(41) **The graph of range of projectile (on y-axis) as plotted against velocity, of projectile (x-axis) will be**



(42) **A body, projected with a certain kinetic energy, has a horizontal range R. The kinetic energy will be minimum at a position of the projectile when its horizontal range is**
(a) R (b) 3R/4
(c) R/2 (d) R/4

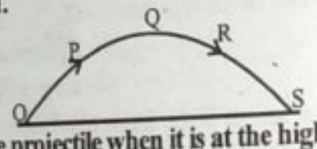
(43) **A boy can throw a stone upto maximum height of 10 m. The maximum horizontal distance that the boy can throw is**
(a) 0 m (b) $10\sqrt{2}$ m
(c) 20 m (d) $20\sqrt{2}$ m

(44) **The ratio of distance to displacement along a semi-circle of radius r is**



(a) 2π (b) π
(c) $\pi/2$ (d) $\pi/4$

(45) **A projectile is launched at point O and follows the path OPQRS, as shown. Air resistance may be neglected.**

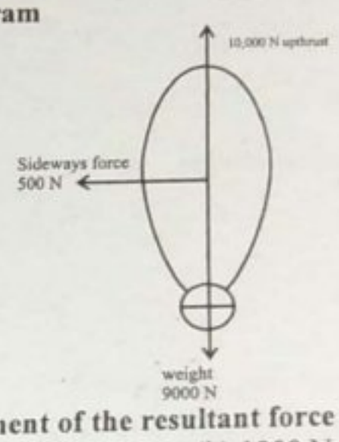


Which statement is true for the projectile when it is at the highest point Q of its path?
(a) The horizontal component of the projectile's acceleration is zero.
(b) The horizontal component of the projectile's velocity is zero.
(c) The kinetic energy of the projectile is zero.
(d) The momentum of the projectile is zero.

(46) **When a force of 4N acts on a mass of 2kg for a time of 2sec, what is the rate of change of momentum?**
(a) $2kgms^{-2}$ (b) $4kgms^{-2}$
(c) $8kgms^{-2}$ (d) $16kgms^{-2}$

(47) **The ratio of the distances covered by an object allowed to fall freely in 1^{st}, 2^{nd} and 3^{rd} seconds.**
(a) 1 : 3 : 5 (b) 1 : 4 : 9
(c) 1 : 25 : 45 (d) 1 : 20 : 45

(48) **A balloon is acted upon by three force, weight, up thrust and sideway force due to the wind, as shown in the diagram**



What is the vertical component of the resultant force on the balloon?
(a) 500 N (b) 1000 N
(c) 10000 N (d) 10500 N

(49) **The instantaneous acceleration is the limit of average acceleration as $\Delta t \to 0$ is given by**
(a) $\vec{a}_{ins} = \lim_{\Delta t \to 0} \frac{\Delta \vec{d}}{\Delta t}$ (b) $\vec{a}_{ins} = \lim_{\Delta t \to 0} \frac{\Delta t}{\Delta \vec{v}}$
(c) $\vec{a}_{ins} = \lim_{\Delta t \to 0} \frac{\Delta \vec{v}}{\Delta t}$ (d) $\vec{a}_{ins} = \lim_{\Delta t \to 0} \frac{\Delta \vec{a}}{\Delta t}$

(50) **When force of 1N is applied on a body of mass 100g then the acceleration would be**
(a) $5ms^{-2}$ (b) $0.5ms^{-2}$
(c) $10ms^{-2}$ (d) $0.1ms^{-2}$

ANSWER KEY

1	b	11	b	21	c	31	a	41	d
2	a	12	a	22	b	32	b	42	c
3	c	13	d	23	d	33	a	43	a
4	c	14	c	24	b	34	b	44	c
5	d	15	a	25	b	35	d	45	a
6	b	16	d	26	b	36	a	46	b
7	a	17	c	27	c	37	a	47	a
8	a	18	b	28	a	38	a	48	b
9	c	19	c	29	d	39	b	49	c
10	d	20	d	30	b	40	b	50	c

Scanned by CamScanner

(1) $\left|\vec{d}\right| = \vec{r}_2 - \vec{r}_1$

(2) $S_1 = \frac{1}{2}gt^2$

$S_2 = v_i t - \frac{1}{2}gt^2$

$S_1 + S_2 = v_i t$

$30 = (30)t$

$t = 1\text{sec}$

(3) According to statement of 2nd law of motion.

(4)

$v = \sqrt{v_{ix}^2 + g^2t^2}$

$= \sqrt{30^2 + 10^2 \times 4^2} = 50$

(5) At highest point a = g, and its direction is downward.

(6) A freely falling body has constant acceleration (a = g)

(7) Slope of d-t graph is velocity.

(8) $H = \frac{gT^2}{8}$

(9) Case A

$a = \frac{-3-5}{8} = \frac{-8}{8} = -1ms^{-2}$

Case B

$a = \frac{-1-3}{8} = \frac{-4}{8} = -0.5ms^{-2}$

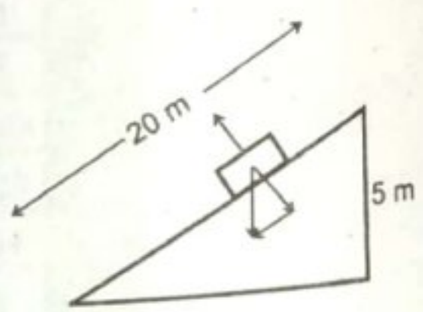
(10) Newton's law hold good for massive bodies having small velocity.

(11) Two forces are on same object.

(12)

$\sin\theta = \frac{5}{20} = \frac{1}{4}$

$F_{net} = mg\sin\theta = (2)(10)\left(\frac{1}{4}\right) = 5\text{N}$



ce in both intervals in same then

$v_{av} = \frac{2v_1v_2}{v_1 + v_2}$

(14)

$F_{net} = F_{app} - F_{friction}$

$ma = F_{app} - \mu f_N$

$(2)(a) = (18) - (0.4)(20)$

$a = 5ms^{-2}$

(15) Force due to air friction becomes equal to weight of object.

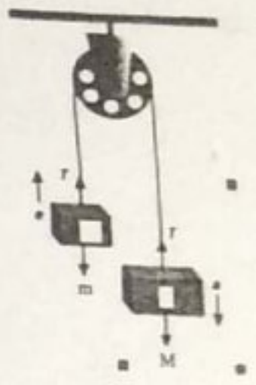
(16)

$Mg - T = Ma$

$T - mg = ma$

$(M-m)g = (M+m)a$

$a = \left(\frac{M-m}{M+m}\right)g$



(17)

$v = \frac{dx}{dt} = \frac{-2}{3}t^2 + 16t + 2$

$= \frac{d}{dt}\left(\frac{-2t^2}{3t} + 16t + 2\right)$

$v = \frac{-4}{3}t + 16$

$0 = \frac{-4}{3}t + 16$

$\frac{-4t}{3} = -16$

$t = \frac{48}{4} = 12\text{sec}$

(18) $\downarrow \vec{F} \times t \uparrow = \Delta\vec{P}$

(19) Book statement

(20) In the absence of air friction. Speed will remain same

(21) $S = AB + BC + CD$

$d = AB - BC + CD$

(22) Distance in nth sec for freely falling body $S_n = 5(2n-1)$

Scanned by CamScanner

(23) Displacement is zero.

(24) In an inelastic collision, kinetic energy is not conserved.

(25) $Y = \frac{1}{2}gt^2$

(26) They have same acceleration due to gravity.

(27) Working principle of rocket.

(28) Action and reaction are equal but opposite.

(29) $[K.E]_{inst.} = K.E_i \cos^2\theta$

(30) Angle which is closer to 45°

(31)

$v_1 + v_2 = 6ms^{-1}$

$v_1 - v_2 = 4ms^{-1}$

(32)

$\theta_1 = 30°$

$\theta_2 = 90° - 30° = 60°$

$\theta_1 + \theta_2 = 30° + 60° = 90°$

Then, $R_1 = R_2$

(33) Tension is always equal to weight.

(35) $F = \frac{mv}{t}$

(37) $F = \frac{mv}{t} = \frac{\rho \times V \times v}{t} = 10^3 \times 1 \times 10^{-4} \times 10 = 1N$

(38) $\vec{F} = \frac{\Delta\vec{P}}{\Delta t}$

(39) $\frac{S}{d} = \frac{\pi r}{2r} = \frac{\pi}{2}$

(40) Air resistance effect both direction (horizontal and vertical)

(41) $R = \frac{v_i^2 \sin 2\theta}{g} \rightarrow R \propto v_i^2$ (Parabola along y-axis)

(42) K.E will minimum at maximum height and at that point $R' = \frac{R}{2}$

(43)

$$H = \frac{v_i^2 (\sin 90)^2}{2g} \rightarrow v_i^2 = 200 m^2 s^{-2}$$

$$R_{max} = \frac{v_i^2 \sin 2(45)}{g} = \frac{200}{10} = 20m$$

(44) $\frac{d}{d} = \frac{\pi f}{2f} = \frac{\pi}{2}$

(45) As $v_x = \text{constant}, a_x = 0$ and $F_x = 0$

(46) Rate of change of momentum is equal to applied force

So

$$F = \frac{\Delta p}{\Delta t}$$

(47)

$$S_{nth} = v_i + \frac{a}{2}(2n-1)$$

$$S_1 = 5(2(1)-1) = 5m$$

$$S_2 = 5[2(2)-1] = 15m$$

$$S_3 = 5[2(3)-1] = 25m$$

$$S_1 : S_2 : S_3 = 5 : 15 : 25$$

$$= 1 : 3 : 5$$

(48) Net force along y-axis = 10000-9000= 1000 N

(49) $\vec{a}_{in} = \lim_{\Delta t \to 0} \frac{\Delta \vec{v}}{\Delta t}$

(50) $a = \frac{F}{m} = \frac{1}{6.1} = 10 ms^2$

Scanned by CamScanner

Chapter 3 MOTION AND FORCE

SELF ASSESSMENT TEST

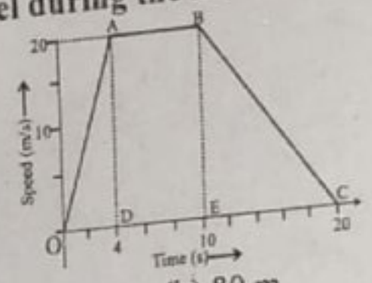
(1) **A bullet is fired horizontally from a rifle at a distant target. Ignoring the effect of air resistance, what is the horizontal and vertical acceleration of the bullet?**

Horizontal	Vertical
(a) 9.8 ms^{-2}	9.8 ms^{-2}
(b) 9.8 ms^{-2}	0 ms^{-2}
(c) 0	9.8 ms^{-2}
(d) 0	0

(2) **A car travels 40 kilometers at an average speed of 80km/h and then travels 40 kilometers at an average speed of 40km/h. The average speed of the car for this 80-km trip is**
(a) 40km/h (b) 45km/h
(c) 48km/h (d) 53km/h

(3) **A man in a car moving with velocity of 36km/hr. His speed with respect to the car is**
(a) 10m/s (b) 36m/s
(c) zero (d) infinite

(4) **The given figure represents the speed-time graph of a body moving in a straight line. How much distance does it travel during the last 10 seconds?**



(a) 40 m (b) 80 m
(c) 100 m (d) 220 m

(5) **A car travelling at a speed of 30 km/hour is brought to a halt in 8 m by applying brakes. If the same car is travelling at 60 km/hour, it can be brought to a halt with the same braking force in**
(a) 8 m (b) 16 m
(c) 24 m (d) 32 m

(6) **A ball is thrown at the angle of 45° with the horizontal: Then**
(a) the path of the ball is parabola and horizontal range in maximum
(b) the path of the ball is a parabola and horizontal range is minimum
(c) the path of ball is straight line and horizontal range is maximum
(d) the path of the ball is semi-circle having maximum diameter

(7) **An object dropped from the window of a tall building hits the ground in 12.0 s. If its acceleration is 9.80 m/s^2, the height of the window above the ground is**
(a) 706 m (b) 353 m
(c) 118 m (d) 29.4m

(8) **In which case does the potential energy decreasess**
(a) on the rising of an air bubble in water (b) on moving a body against gravitational force
(c) on compressing a spring (d) on stretching a spring

(9) **If the increase in the kinetic energy of a body is 22%, then the increase in the momentum will be**
(a) 22% (b) 44%
(c) 300% (d) 10%

(10) **A light and a heavy body have equal momenta. Which one has greater K.E**
(a) the heavy body (b) the K.E. are equal
(c) the light body (d) none of these

(11) **Two particles of masses m and 4m have linear momenta in the ratio of 2 : 1. What is the ratio of their kinetic energies?**
(a) $\sqrt{2}$ (b) 2
(c) 4 (d) 16

(12) **A rocket works on the principle of conservation of**
(a) mass (b) kinetic energy
(c) linear momentum (d) angular momentum

(13) **An aeroplane is flying at a constant horizontal velocity of 600 km/hr at an elevation of 6 km towards a point directly above the target on the earth's surface. At an appropriate time, the pilot releases a ball so that it strikes the target at the earth. The ball will appear to be falling**
(a) on a parabolic path as seen by pilot in the plane
(b) vertically along a straight path as seen by an observer on the ground near the target
(c) on a zig-zag path as seen by pilot in the plane
(d) on a parabolic path as seen by an observer on the ground near the target

(14) **A ball is dropped from a height of 10 m. It is embedded 1 m in sand and stops. In this process**
(a) only momentum is conserved
(b) only kinetic energy is conserved
(c) both momentum and kinetic energy are conserved
(d) neither momentum nor kinetic energy is conserved

(15) **An aeroplane flying 490 m above ground level at 100 m/s, releases a block. How far on ground will it strike**
(a) 1 km (b) 2 km
(c) 0.1 km (d) 0.01 km

(16) **When a body moves in a straight line then its displacement coincides with**
(a) distance (b) force
(c) acceleration (d) both (a) and (b).

(17) **When two bodies stick together after collision, the collision is said to be**
(a) perfectly elastic (b) partially elastic
(c) completely inelastic (d) none of these

(18) **A particle (a) is dropped from a height and another particle (b) is thrown in horizontal direction with speed of 5 m/sec from the same height. The correct statement is**
(a) particle (a) will reach at ground first with respect to particle (b)
(b) particle (b) will reach at ground first with respect to particle (a)
(c) both particles will reach at ground simultaneously
(d) both particles will reach at ground with same speed

(19) **The maximum range of a gun on horizontal terrain is 16 km. If $g=10m/s^2$. What must be the muzzle velocity of the shell?**
(a) 100 m/s (b) 200 m/s
(c) 400 m/s (d) 50 m/s

(20) **At maximum height on the trajectory which of projectile becomes zero**
(a) acceleration (b) velocity
(c) vertical velocity (d) horizontal velocity

Scanned by CamScanner

(21) A particle of mass having velocity 'v' makes head on elastic collision with another particle of the same mass and initially at rest. The velocity of the first particle after the collision is
(a) v (b) −v
(c) $\frac{v}{2}$ (d) 0

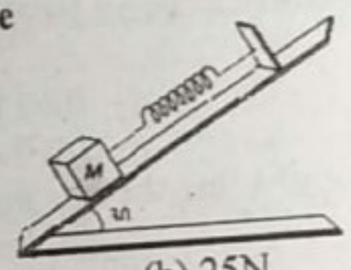
(22) A man is standing at a spring platform. Reading of spring balance is 60 N. If man jumps outside platform, then reading of spring balance
(a) increases (b) first increases then decreases to zero
(c) decreases (d) remain same

(23) A particle of mass m moving with velocity v strikes a stationary particle of mass 2m and sticks to it. The speed of the system will be?
(a) $\frac{v}{2}$ (b) 2v
(c) $\frac{v}{3}$ (d) 3v

(24) A book is lying on the table. What is the angle between the action of the book on the table and the reaction of the table on the book
(a) 90∘ (b) 180∘
(c) 60∘ (d) 45°

(25) Which shows the correct relation between time of flight T and maximum height H?
(a) $H=\frac{gT^2}{8}$ (b) $H=\frac{8T^2}{g}$
(c) $H=\frac{8g}{T^2}$ (d) $H=\frac{8}{gT^2}$

(26) A body of mass 5kg is suspended by a spring balance on an inclined plane as shown in figure. The spring balance measure



(a) 26N (b) 25N
(c) 500N (d) 10N

(27) Newton's third law concerns the forces of interaction between two bodies. Which of the following statements relating to the third law is not correct?
(a) the two forces must be of the same type
(b) the two forces must act on different bodies
(c) the two forces are always opposite in direction
(d) the two forces are equal and opposite so the bodies are in equilibrium

(28) A wagon weighing 1000 kg is moving with a velocity 50km/h on smooth horizontal rails. A mass of 250 kg is dropped into it. The velocity with which it moves now is
(a) 40 km/hour (b) 50 km/hour
(c) 20 km/hour (d) 2.5 km/hour

(29) What is the angle of projection for which the range and maximum height become equal?
(a) $\tan^{-1}\frac{1}{4}$ (b) $\tan^{-1}4$
(c) $\cos^{-1}\frac{1}{4}$ (d) $\sin^{-1}\frac{1}{4}$

(30) If a force of 250 N act on body, the momentum acquired is 125 kg-m/s. What is the period for which force acts on the body.
(a) 0.5 sec (b) 0.1 sec.
(c) 0.2 sec (d) 0.4 sec

(31) If a bullet of mass 5 gm moving with velocity 100 m /sec, penetrates the wooden block upto 6 cm. Then the average force imposed by the bullet on the block is
(a) 417 N (b) 830 N
(c) zero (d) 8300 N

(32) Distance covered by a freely falling body in 2 seconds will be
(a) 4.9m (b) 19.6m
(c) 39.2m (d) 44.1m

(33) The distance covered by a body with uniform acceleration in time 't' starting from rest is
(a) $at^2/2$ (b) Vt
(c) $a^2t/2$ (d) both a and b

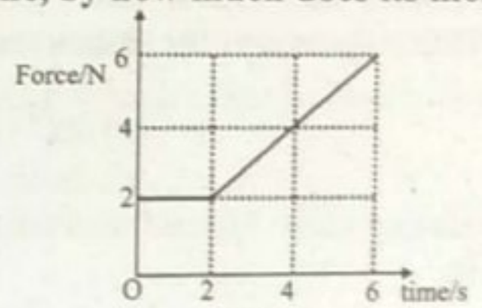
(34) A body, initially at rest, explodes into two masses M_1 and M_2 that move apart with speeds v_1 and v_2 respectively. What is the ratio $\frac{v_1}{v_2}$?
(a) $\frac{M_1}{M_2}$ (b) $\frac{M_2}{M_1}$
(c) $\left(\frac{M_1}{M_2}\right)^{\frac{1}{2}}$ (d) $\left(\frac{M_2}{M_1}\right)^{\frac{1}{2}}$

(35) The trajectory (or path) of a projectile flying against strong air currents is
(a) straight line (b) parabola
(c) hyperbola (d) not a parabola

(36) An object with a mass 10 kg moves at a constant velocity of 10 m/sec. A constant force then acts for 4 second on the object and gives it a speed of 2 m/sec in opposite direction. The acceleration produced in it, is
(a) $-3m/sec^2$ (b) $0.3m/sec^2$
(c) $-0.3m/sec^2$ (d) $3m/sec^2$

(37) A force vector applied on a mass is represented as $\vec{F}=6\hat{i}-8\hat{j}+10\hat{k}$ and accelerates with 1 m/s^2. What will be the mass of the body .
(a) $10\sqrt{2}$ kg (b) 10kg
(c) $2\sqrt{10}$ kg (d) 20kg

(38) The graph shows how the force acting on a body varies with time. Assuming that the body is moving in a straight line, by how much does its momentum change?

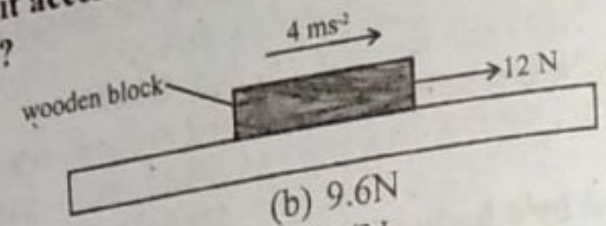


(a) $40 kgms^{-1}$ (b) $20 kgms^{-1}$
(c) $36 kgms^{-1}$ (d) $16 kgms^{-1}$

Scanned by CamScanner

(39) The range of the projectile at 30° is R_{30} and at 60° is R_{60} then
(a) $R_{30} = R_{60}$ (b) $R_{30} = 2R_{60}$
(c) $2R_{30} = R_{60}$ (d) $R_{30} = R_{60}$ if initial velocities are same

(40) A wooden block of mass 0.60kg is on a rough horizontal surface. A force of 12 N is applied to the block and it accelerates at 4.0ms^{-2}. What is the magnitude of the frictional force acting on the block?

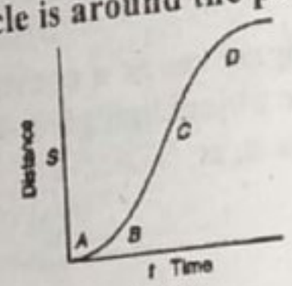


(a) 2.4N (b) 9.6N
(c) 14N (d) 16N

(41) A body of mass 2 kg is moving with a velocity 8 m/s on a smooth surface. If it is to be brought to rest in 4 seconds, then the force to be applied is
(a) 4N (b) 8N
(c) 2N (d) 1N

(42) A boy sitting on the topmost berth in the compartment of a train which is just going to stop on a railway station, drops an apple aiming at the open hand of his brother sitting vertically below his hands at a distance of about 2 meter. The apple will fall
(a) precisely on the hand of his brother
(b) slightly away from the hand of his brother in the direction of motion of the train
(c) slightly away from the hand of his brother in the direction opposite to the direction of motion of the train
(d) none of these

(43) A particle shows distance-time curve as given in this figure. The maximum instantaneous velocity of the particle is around the point



(a) A (b) B
(c) D (d) none

(44) Two bodies, A (of mass 1 kg) and B (of mass 3 kg) are dropped from heights of 16 m and 25 m, respectively. The ratio of the time taken by them to reach the ground is.
(a) 5/4 (b) 5/12
(c) 12/5 (d) 4/5

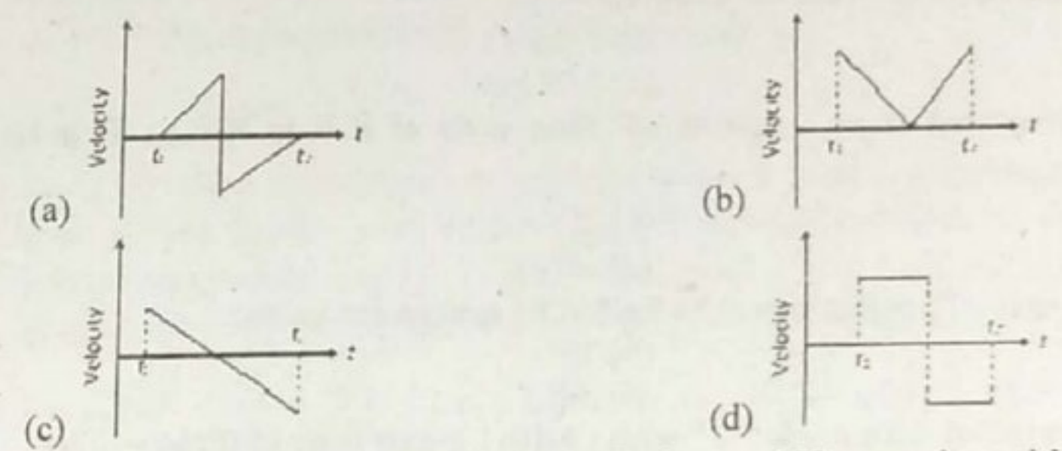
(45) A block of mass 1 kg is placed on a truck which accelerates with acceleration 5ms^{-2}. The coefficient of static friction between the block and truck is 0.6. The frictional force acting on the block is
(a) 5N (b) 6N
(c) 5.88N (d) 4.6N

(46) A particle has initial velocity (2i + 3j) and acceleration (0.3 i + 0.2 j). The magnitude of velocity after 10 s will be
(a) 5 unit (b) $5\sqrt{2}$
(c) 9 units (d) $9\sqrt{2}$

(47) A boy standing at the top of a tower of 20 m height drops a stone. Assuming g=10ms^{-2}, the velocity with which it hits the ground is
(a) 20m/s (b) 10m/s
(c) 40m/s (d) 5 m/s

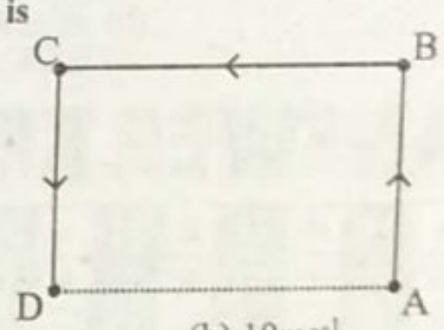
(48) Three identical blocks of masses m=2kg are drawn by a force F=10.2N with an acceleration of 0.6ms^{-2} on a frictionless surface, then what is the tension (in N) in the string between the blocks B and C?
(a) 9.2 (b) 7.8
(c) 9.8 (d) 4

(49) A batsman hits a sixer and the ball touches the ground outside the cricket ground. Which of the following graph describes the variation of the cricket ball's vertical velocity v with time between the time t_1 as it hits the bat and time t_2 when it touches the ground?



(50) A player takes 0.1 s in catching a ball of mass 150 g moving with velocity of 20 m/s. The force imparted by the ball on the hands of the player is:
(a) 0.3 N (b) 300N
(c) 3 N (d) 30 N

(51) A particle moves along the sides AB, BC and CD of a square of side 25m with a velocity of 15ms^{-1}. Its average velocity is



(a) 15ms^{-1} (b) 10ms^{-1}
(c) 7.5ms^{-1} (d) 5ms^{-1}

(52) Large numbers of bullets are fired in all directions with the same speed v. What is the maximum area on the ground on which these bullets will spread?
(a) $\frac{\pi v^2}{g}$ (b) $\frac{\pi v^3}{g^3}$
(c) $\frac{\pi v^4}{g^2}$ (d) $\frac{\pi v}{g}$

Scanned by CamScanner

(53) In doubling the mass and acceleration of the mass, the force acting on the mass with respect to the previous value
(a) decreases to half (b) remain uncharged
(c) increases two times (d) increase four times

(54) A ball of mass 150g starts moving with an acceleration of $20ms^{-2}$. When ball hit by a force, which acts on it for 0.1sec. The impulsive force is_____
(a) 0.5 Ns (b) 0.1 Ns
(c) 0.3 Ns (d) 1.2 Ns

(55) An aeroplane flying 490m above ground level at $100ms^{-1}$ releases a block. How far on ground will it strike
(a) 0.1 Km (b) 1 Km
(c) 2 Km (d) none

(56) The range of projectile when launched at an angle 15° with the horizontal is 1.5m. Its range, when launched at 45° with the same speed is:
(a) 3.0 m (b) 1.5m
(c) 6.0 km (d) 0.75 km

(57) A projectile is projected at an angle of 45° then ratio of K.E to $K.E_{max}$ at maximum height?
(a) 1:2 (b) 2:1
(c) $1:\sqrt{2}$ (d) $\sqrt{2}:1$

(58) At which angle range of projectile will be half of its maximum value?
(a) 15° (b) 30°
(c) 60° (d) 90°

(59) A projectile is projected with angle "θ" with positive y-axis time of flight will be
(a) $t=\frac{2vi\sin\theta}{g}$ (b) $t=\frac{2vi}{g}$
(c) $t=\frac{2vi\cos\theta}{g}$ (d) $t=\frac{2vi\sin 2\theta}{g}$

(60) Area under velocity-time graph is numerically equal to _____
(a) acceleration (b) velocity
(c) distance covered (d) force

ANSWER KEY

1	c	11	d	21	d	31	a	41	a	51	d
2	d	12	c	22	b	32	b	42	b	52	c
3	c	13	d	23	c	33	a	43	c	53	d
4	c	14	a	24	b	34	b	44	d	54	c
5	d	15	a	25	a	35	d	45	b	55	b
6	a	16	a	26	b	36	a	46	b	56	a
7	a	17	c	27	d	37	a	47	a	57	a
8	a	18	c	28	a	38	b	48	b	58	a
9	d	19	c	29	b	39	d	49	c	59	c
10	c	20	c	30	a	40	b	50	d	60	c

EXPLANATORY NOTES

(1) Bullet will be in state of projectile motion, so, $a_x=0$, $a_y=g=9.8ms^{-2}$

(2) For same distance, the relation for average speed is
$$v_{av}=\frac{2(80)(40)}{80+40}=53kmh^{-1}$$

(3) Because man is at rest w.r.t. car

(4) Area of v-t graph is equal to distance covered by object.
$$S=\frac{1}{2}(20-10)(20-0)=100\,m$$

(5) $S\propto v^2$ i.e. if speed becomes double then stopping distance will become four times i.e. $8\times4=32m$

(6) At 45° range is maximum and path will be parabolic

(7) $S=\frac{1}{2}gt^2=706m$

(8) In compression or extension of a spring work is done against restoring force. In moving a body against gravity work is done against gravitational force of attraction. It means in all three cases potential energy of the system increases. But when the bubble rises in the direction of up thrust force then system works so the potential energy of the system decreases.

(9) $P=\sqrt{2mE}\Rightarrow\frac{P_2}{P_1}=\sqrt{\frac{E_2}{E_1}}$ (If m is constant) $\Rightarrow\sqrt{\frac{1.22E}{E}}=\sqrt{1.22}=1.1$
$P_2=1.1P_1\Rightarrow P_2=P_1+0.1P_1\Rightarrow P_2=P_1+10\%P_1$
So, the momentum will be increase by 10%

(10) $E=\frac{P^2}{2m}$ if P = constant then $E\propto\frac{1}{m}$

(11) $K.E=\frac{P^2}{2m}\rightarrow\frac{K_1}{K_2}=\frac{(P_1/P_2)^2}{(m_1/m_2)}=\frac{(2/1)^2}{m/4m}=16:1$

(12) Basic principle upon which rocket work is law of conservation of linear momentum and Newton's 3rd Law

(13) The pilot will see the ball falling in straight line because the reference frame is moving with the same horizontal velocity but the observer at rest will see the ball falling in parabolic path.

(14) During inelastic collision only momentum is conserved

(15) $S=u\times\sqrt{\frac{2h}{g}}=100\times\sqrt{\frac{2\times490}{9.8}}=1000\,m=1\,km$

(16) In a straight line motion, magnitude of displacement is equal to distance

(17) When bodies stick its all K.E lost, so collision is perfectly inelastic. $K.E_i\neq K.E_f$ because, $K.E_f=0$

Scanned by CamScanner

(18) For both cases $t = \sqrt{\frac{2h}{g}}$ =constant. Because vertical downward component of velocity will be zero for both the particles.

(19) $R_{max} = \frac{u^2}{g} = 16 \times 10^3 \Rightarrow u = 400\ m/s$

(20) At maximum height $v_y = 0$, v_x = constant

(21) If masses are same their velocities will alter, so velocity of 1st ball after collision = velocity of 2nd ball before collision = 0

(22) For jumping he presses the spring platform, so the reading of spring balance increases first and finally it becomes zero.

(23) $mv + 0 = (m + 2m)v'$

$v' = \frac{mv}{3m} = \frac{v}{3}$

(24) Since action and reaction acts in opposite direction on same line, hence angle between them is 180°

(25) $H = \frac{v_i^2 \sin^2\theta}{2g}$ .....(1)

$T = \frac{2v_i \sin\theta}{g} \Rightarrow T^2 = \frac{4v_i^2 (\sin\theta)^2}{g^2}$ .....(2)

By dividing both equations

$H = \frac{gT^2}{8}$

(26) Since downward force along the inclined plane = mgsinθ=5×10×sin30°= 25N

(27) Two forces must not cancel each other

(28) According to principle of conservation of linear momentum

1000 ×50=1250 ×v

v=40km/hr

(29) As, $R\tan\theta = 4H \rightarrow$ if $R = H$ then $H\tan\theta = 4H \rightarrow \theta = \tan^{-1}(4)$

(30)

Change in momentum = Impulse

$\Delta p = F \times \Delta t \Rightarrow \Delta t = \frac{\Delta p}{F} = \frac{125}{250} = 0.5$ sec

(31)

$u = 100\ m/s,\ v = 0,\ s = 0.06\ m$ Retardation $= a = \frac{u^2}{2s} = \frac{(100)^2}{2 \times 0.06} = \frac{1 \times 10^6}{12}$

$\therefore$ Force $= ma = \frac{5 \times 10^{-3} \times 1 \times 10^6}{12} = \frac{5000}{12} = 417\ N$

(32) $S = \frac{1}{2}gt^2 = 19.6m$

(33) $S = v_i t + \frac{1}{2}at^2$ $v_i = 0$

So, $S = \frac{1}{2}at^2$

(34) $M_1v_1 - M_2v_2 = 0$

$M_1v_1 = M_2v_2$

$\frac{v_1}{v_2} = \frac{M_2}{M_1}$

(35) For short ranges, and flat earth approximation, the trajectory is parabolic but the drag less ballistic trajectory for spherical earth should actually be elliptical.

(36)

$\vec{a} = \frac{\vec{v_2} - \vec{v_1}}{t} = \frac{(-2) - (+10)}{4} = \frac{-12}{4} = -3\ m/s^2$

(37)

$m = \frac{F}{a} = \frac{\sqrt{6^2 + 8^2 + 10^2}}{1} = \sqrt{200} = 10\sqrt{2}\ kg$

(38) P = Area of F-t graph

$P = (2\times2) + \frac{1}{2}(4)(4) + (4\times2)$

$= 4 + 8 = 20$Ns

(39) For complementary angles ranges are same

$R_{30} = R_{60}$ if initial velocities are same

(40) $F_{net} = ma = 0.6 \times 4 = 2.4$ N

Friction $= 12 - 2.4 = 9.6$ N

(41)

$F = ma = \frac{m(u - v)}{t} = \frac{2 \times (8 - 0)}{4} = 4N$

(42) Horizontal velocity of apple will remain same but due to retardation of train, velocity of train and hence velocity of boy w.r.t. ground decreases, so apple falls away from the hand of boy in the direction of motion of the train.

(43)

Particle has maximum instantaneous velocity at that point at which its slope is maximum. Therefore,

$v_{max} = \frac{dx}{dt}$ = maximum slope From figure it is obvious that at point C, slope is maximum, hence at this point velocity is maximum.

(44)

Key Idea: As bodies are dropped from a certain height, their initial velocities are zero i.e., u = 0

For free fall from a height u = 0 (initial velocity). From second equation of motion

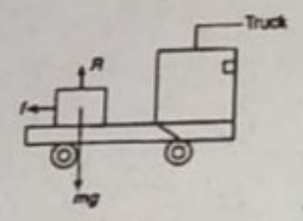
$h = ut + \frac{1}{2}gt^2\ or\ h = 0 + \frac{1}{2}gt^2 \therefore \frac{h_1}{h_2} = \left(\frac{t_1}{t_2}\right)^2\ Given, h_1 = 16\ m,\ h_2 = 25\ m$

$\therefore \frac{t_1}{t_2} = \sqrt{\frac{h_1}{h_2}} = \sqrt{\frac{16}{25}} = \frac{4}{5}$ Note: Time taken by the object in falling does not depend on mass of object

Scanned by CamScanner

(45)

The frictional force acting on the block



$f = \mu R$

but from figure, R = mg $\therefore f = \mu mg$ Here,

$\mu = 0.6,\ m = 1\ kg,\ g = 10 m/s^2$ $\therefore f = 0.6 \times 1 \times 10 = 6N$ Note: Due to

acceleration of truck, the block experiences a forward force $F = ma$ Since $f > F$, so

block is not displaced from its previous position.

(46)

From the equation of motion, we knows $\mathbf{v} = \mathbf{u} = \mathbf{at}$ Given, $\mathbf{v} = (2\mathbf{i} + 3\mathbf{j})$ and $\mathbf{a} = (0.3\mathbf{i} + 0.2\mathbf{j})$

$\mathbf{v} = (2\mathbf{i} + 3\mathbf{j}) + (0.3\mathbf{i} + 0.2\mathbf{j}) \times 10$ $\mathbf{v} = 5\mathbf{i} + 5\mathbf{j}$ $(\because v = u + at)$

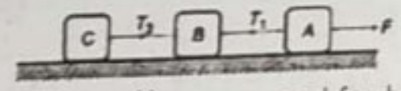
$v = 5\sqrt{2}$units

(47)

Given, $g = 10\, ms^{-2}$ and h = 20 m We have $v = \sqrt{2gh}\ v = \sqrt{2 \times 10 \times 20} = \sqrt{400} = 20\, ms^{-1}$

(48)

The system of masses is shown below.



From the figure.

For block A, $F - T_1 = ma$ ... (i) and for block B, $T_1 - T_2 =$ ma ... (ii)

Eq. (i) gives $102 - T_1 = 2 \times 0.6 \Rightarrow T_1 = 102 - 12 = 9N$

Again from Eq. (ii), we get $9 - T_2 = 2 \times 0.6 \Rightarrow$

$T_2 = 9 - 1.2 = 7.8N$

(49) At time t1 the velocity of ball will be maximum and it goes on decreasing with respect to time. At the highest point of path its velocity becomes zero, then it increases but direction is reversed. This explanation match with graph.

(50)

Key Idea: The force imparted (or impulse) by the ball to the hands of the player is equal to the rate of change of linear momentum. Force imparted = Rate of change of momentum

$$or F = \frac{\Delta p}{\Delta t}\ or F = \frac{p_1 - p_2}{\Delta t}\ or F = \frac{m(v_1 - v_2)}{\Delta t}$$

Here, m = 150 g = 0.150 kg,

v1 = 20 m/s, v2 = 0 $\Delta t = 0.1\ s$ $\therefore F = \dfrac{0.150 \times (20 - 0)}{0.1} = 30\ N$

(51) $t = \dfrac{75}{15} = 5\sec$, $V_{avr} = \dfrac{25}{5} = 5ms^{-1}$

(52) $R_{max} = \dfrac{v^2}{g}$ $maximum\ area = \pi (R_{max})^2$

$$= \pi \left(\frac{V^2}{g}\right)^2 = \frac{\pi v^4}{g^2}$$

(53) F = ma

(54) I = F × t = ma × t

(55) $S = Vx \times \sqrt{\dfrac{2h}{g}} = 100 \times \sqrt{\dfrac{2 \times 490}{9.8}} = 1000m = 1km$

(56) $K.E = K.E_{max} \cos^2 \theta$

(57) $R = R_{max} \sin 2\theta$

(58) $\theta' = 90 - \theta$, $T = \dfrac{2v_i \sin\theta}{g} = \dfrac{2v_i \sin(90-\theta)}{g} = \dfrac{2v_i \cos\theta}{g}$

$R = \dfrac{v_i^2 \sin 2\theta}{g}$

$R \propto \sin 2\theta$

$\dfrac{R_2}{R_1} = \dfrac{\sin 2\theta_2}{\sin 2\theta_i}$

$\dfrac{R_2}{1.5} = \dfrac{\sin(2\times 45°)}{\sin(2\times 15°)}$

(59) $\dfrac{R_2}{1.5} = \dfrac{1}{1/2} \Rightarrow R_2 = 1.5 \times 2 = 3\text{m}$

(60) S = vt

Scanned by CamScanner

Chapter 4 WORK AND ENERGY

PRACTICE EXERCISE

(1) A car of mass m has an engine which can deliver power P, what is the minimum time in which the car can be accelerated from rest to speed
(a) Mv/P (b) P/Mv
(c) $Mv^2/2P$ (d) P/Mv^2

(2) Under the influence of a force, an object of mass 4 kg accelerates from 3 m/s to 6 m/s in 8 s. How much work was done on the object during this time?
(a) 27 J (b) 54 J
(c) 72 J (d) 96 J

(3) A 500gm ball is thrown vertically upward with K.E of 58.8J the K.E is reduced to half at a height of ___m above point of projections
(a) 2m (b) 3m
(c) 5m (d) 6m

(4) Which of the following types of force does no work on the particle when it acts on it?
(a) Frictional force (b) Gravitational force
(c) Elastic force (d) Centripetal force

(5) If a body of mass of 2 kg is raised vertically through 2m, then the work done will be
(a) 38.2 J (b) 392.1 J
(c) 39.2J (d) 3.92J

(6) An elevator weighing $3.5 \times 10^{+6}$ N is raised to a height of 1000 m in the absence of friction, the work done is
(a) 3.5×10^3 J (b) 3.5×10^4 J
(c) 3.5×10^6 J (d) 3.5×10^9 J

(7) The average power and instantaneous power become equal if work is done at
(a) Any rate (b) Variable rate
(c) Uniform rate (d) High rate

(8) The relation between horse power and watt is
(a) 1 hp = 546 watts (b) 1 hp = 746 watts
(c) 1 hp = 1000 watts (d) 1 hp = 946 watts

(9) Proton, electron, neutron and α particles have same momentum. Which of them have highest K.E?
(a) Proton (b) Electron
(c) Neutron (d) α-particle

(10) The power output of a lamp is 6W. How much energy does the lamp give out in 2 minutes?
(a) 3 J (b) 120J
(c) 720J (d) 430J

(11) Work done by variable force is determine by dividing
(a) Force into small interval
(b) Displacement into small interval
(c) Both force and displacement into small intervals
(d) Force into small and displacement into large intervals

(12) A box of mass *m* slides down a frictionless inclined plane of length *L* and vertical height *h*. What is the change in its gravitational potential energy?
(a) $-mgL$ (b) $-mgh$
(c) $-mgL/h$ (d) $-mgh/L$

(13) The escape velocity of a body in gravitational field of earth is independent of
(a) Its mass (b) The angle at which it is thrown
(c) Both its mass and the angle at which it is thrown (d) Gravitational field of earth

(14) The tides raise the water in the sea roughly in a day
(a) Once (b) Twice
(c) Four time (d) Eight time

(15) The source of geothermal energy is
(a) Decay of radioactive element in the earth (b) Compression of material in the earth
(c) Residual heat of the earth (d) All in a, b and c

(16) The highest value of escape velocity in solar system is for planet
(a) Earth (b) Neptune
(c) Jupiter (d) Moon

(17) Work done by the force of friction is
(a) Always positive (b) Always negative
(c) Positive only for small frictional force (d) Positive only for large frictional force

(18) A body of mass 2 kg is projected vertically upwards with a velocity of 2 m/s. The kinetic energy of the body just before striking the ground is
(a) 2 (b) 4
(c) 6 (d) 8

(19) If velocity is doubled, then
(a) Momentum increases to 4 times and K.E increases to 2 times
(b) Momentum and K.E. remain same
(c) Momentum increases to 2 times and K.E increases constant
(d) Momentum increases to 2 times and K.E increases to 4 times

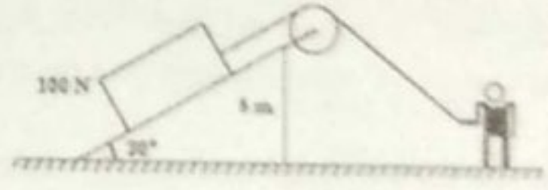
(20) While a person lifts a book of mass 2 kg from the floor to a tabletop, 1.5 m above the floor, how much work does the gravitational force do on the book?
(a) -30J (b) 0J
(c) -10J (d) -15J

(21) One mega watt hour is equal to
(a) 3.6×10^6 J (b) 3.6×10^{12} J
(c) 3.6×10^8 J (d) 3.6×10^9 J

(22) A boy holds a 40N weight at arm's length for 10s. His arm is 1.5m above the ground. The work done by the force of the boy on the weight while he is holding it is:
(a) 0 (b) 90J
(c) 60J (d) 40J

(23) A block of mass 3 kg slides down a frictionless inclined plane of length 6 m and height 4 m. If the block is released from rest at the top of the incline, what is its speed at the bottom?
(a) 5 m/s (b) 8 m/s
(c) 6 m/s (d) 9 m/s

(24) A man pulls a 100 N crate up on a frictionless plane, as shown. Assuming that the crate moves at constant speed, the work done by the man at highest point is



(a) −500J (b) 500J
(c) −250J (d) 0

(25) The relation between the escape velocity v_{esc} and orbital speed v_o is given by
(a) $v_{esc} = 1/2 v_o$ (b) $v_{esc} = \sqrt{2}\, v_o$
(c) $v_{esc} = v_o$ (d) $v_{esc} = 2v_o$

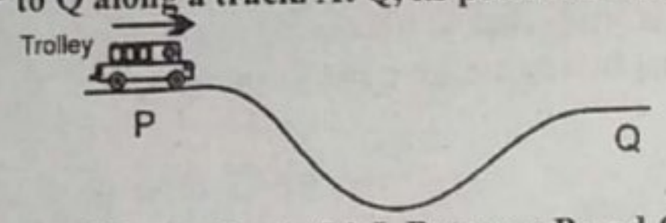
Scanned by CamScanner

(26) The escape velocity form the earth surface is about
(a) 4.2 km s^{-1} (b) 7.5 km s^{-1}
(c) 9.5 km s^{-1} (d) 11km s^{-1}

(27) A boat moving at constant speed v through still water experiences a total frictional drag F. What is the power developed by the boat?
(a) $\frac{1}{2}Fv$ (b) $\frac{1}{2}Fv^2$
(c) Fv^2 (d) Fv

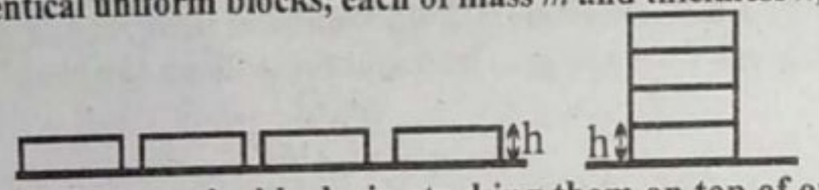
(28) When two protons are brought close, their
(a) Kinetic energy increases (b) P.E. increases
(c) P.E. decreases (d) P.E. doe not change

(29) A trolley runs from P to Q along a track. At Q, its potential energy is 50 kJ less than at P.



At P, the kinetic energy of the trolley is 5 kJ. Between P and Q the work that the trolley does against friction is 10 kJ. What is the kinetic energy of the trolley at Q?
(a) 35 kJ (b) 55 kJ
(c) 45 kJ (d) 65 kJ

(30) Initially, four identical uniform blocks, each of mass m and thickness h, are spread on a table.



How much work is done on the blocks in stacking them on top of one another?
(a) $2mgh$ (b) $4mgh$
(c) 6mgh (d) 8mgh

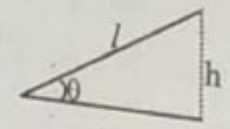
(31) A horizontal force F pulls a 20 kg box at a constant speed along a horizontal floor. If the coefficient of friction between the box and the floor is 0.25, how much work is done by the force F in moving the box through a distance of 2m?
(a) 49 J (b) 98 J
(c) 147 J (d) 196 J

(32) Temperature of hot igneous rocks is about
(a) 20, 000°C or more (b) 2000°C or more
(c) 200°C or more (d) 20°C or more

(33) A ball is thrown vertically upwards. Neglecting air resistance, which statement is correct?
(a) The kinetic energy of the ball is greatest at the greatest height attained
(b) The potential energy of the ball increase uniformly with time during the ascent.
(c) By the principle of conservation of momentum, the momentum of the ball is constant throughout its motion
(d) By the principle of conservation of energy, the total energy of the ball is constant throughout its motion

34) Propulsion force of a rocket is
(a) Non-conservative force
(b) Conservative force
(c) Conservative and rocket has reached high altitude
(d) None of these

(35) The work done in moving a body of mass m upon inclined plane of angle θ height h and length l is:



(a) mgh (b) $mg\sqrt{(h^2+l^2)}$
(c) $mgh\sin\theta$ (d) $mgh\cos\theta$

(36) Geothermal energy is a _____ source of energy.
(a) Non-renewable (b) Stable
(c) Renewable (d) None of the above

(37) As a rock of mass 4 kg drops from the edge of a 40-meter-high cliff, it experiences air resistance, whose average strength during the descent is 20 N. At what speed will the rock hit the ground?
(a) 8 m/s (b) 10 m/s
(c) 12 m/s (d) 20 m/s

(38) A force of 200 N is required to keep an object sliding at a constant speed of 2 m/s across a rough floor. How much power is being expended to maintain this motion?
(a) 50 W (b) 100 W
(c) 200 W (d) 400 W

(39) Which of the following bodies has the largest kinetic energy?
(a) Mass 3M and speed v (b) Mass 3M and speed 2v
(c) Mass 2M and speed 3v (d) Mass M and speed 4v

(40) A body travels displacement of 10 m by force of 5N If work done is 25 J then angle between $\vec{F}$ and $\vec{d}$ is
(a) 0° (b) 45°
(c) 30° (d) 60°

(41) A particle of mass 10 g is kept on the surface of a uniform sphere of mass 100kg and radius 10cm. find the work to be done against the gravitational force between them to take the particle far away from them.
(a) $13.34\times10^{-10}J$ (b) $3.33\times10^{-10}J$
(c) $6.67\times10^{-11}J$ (d) $6.67\times10^{-10}J$

(42) A man of mass 65 kg is holding a bucket of mass 15 kg. He walks 50 m on a level road at a constant speed of 3 ms^{-1} and then climbs up a hill of height 20 m. What is the work done by the man in lifting the bucket? Take $g = 10ms^{-2}$.
(a) 2.05 kJ (b) 3.0 kJ
(c) 12 kJ (d) 16 kJ

(43) An electric motor can lift a weight of 2000 N through a height of 10 m in 20 s. What is the power of the motor?
(a) 10 W (b) 1000 W
(c) 1500 W (d) 2000 W

(44) A bicycle, motor cycle, car and a truck have same momentum. Which of them have highest K.E?
(a) Truck (b) Motor cycle
(c) Car (d) Bicycle

Scanned by CamScanner

(45) A body is subjected to a constant force F in newton given by $F = \hat{i}+2\hat{j}+3\hat{k}$ where $\hat{i}, \hat{j}$ and $\hat{k}$ are unit vectors along x, y and z axes respectively. What is the work done by this force in moving the body through the distance of 4 m along the z-axis and then 3 m along the y-axis?

(a) 6 J (b) 12 J (c) 18 J (d) 24 J

(46) If 10 kg mass is dropped from a certain height, hits the ground with speed 10 ms^{-1}. The height will be

(a) 100 m (b) 50 m (c) 10 m (d) 5 m

(47) A body is dropped from 1000m height, if its potential energy is 8×10^8 J. What will be its velocity on reaching the ground

(a) 1410 ms^{-1} (b) 1.41 ms^{-1} (c) 141 ms^{-1} (d) 9800 ms^{-1}

(48) A 500N force is applied on an object and it moves with velocity 10ms^{-1}. If value of power is 2500 watt. Then what will be the angle between force and displacement

(a) 0° (b) 90° (c) 60° (d) 23°

(49) A body is falling from a height h. After it has fallen a height h/2 , it will possess

(a) only potential energy (b) half potential and half kinetic energy (c) only kinetic energy (d) more kinetic and less potential energy

(50) What will be the ratio of kinetic energies of alpha particle and proton if their linear momentum will be same

(a) 18 : 1 (b) 4 : 1 (c) 1 : 4 (d) 10^4 : 1

ANSWER KEY

1	c	11	b	21	d	31	b	41	d
2	b	12	b	22	a	32	c	42	b
3	d	13	c	23	d	33	d	43	b
4	d	14	b	24	b	34	a	44	d
5	c	15	d	25	b	35	a	45	c
6	d	16	c	26	d	36	c	46	d
7	c	17	b	27	d	37	d	47	c
8	b	18	b	28	b	38	d	48	c
9	b	19	d	29	c	39	c	49	b
10	c	20	a	30	c	40	d	50	c

EXPLANATORY NOTES

(1)

$$P = \frac{W}{t}$$

$$P = \frac{mv^2}{2t}$$

$$t = \frac{mv^2}{2P}$$

(2)

$$W = \frac{1}{2}m\left(v_f^2 - v_i^2\right)$$

$$= \frac{1}{2} \times 4(36-9)$$

$$= 54\,J$$

(3) Gain in P.E = Loss in K.E.

$$mgh = \frac{K.E}{2}$$

$$h = \frac{K.E}{2mg}$$

$$h = \frac{58.8}{2 \times 0.5 \times 9.8}$$

$$= \frac{58.8}{9.8}$$

$$h = 6\,m$$

(4) Centripetal force does not work. Because centripetal force is perpendicular to displacement

(5) $W = mgh$

$$= 2 \times 9.8 \times 2 = 39.2J$$

(6) $W = mgh$

$$= 3.5 \times 10^6 \times 10^3$$

$$= 3.5 \times 10^9\,J$$

(7) At uniform rate average and instantaneous values are equal.

(8) 1 hp = 746 watt

(9) $K.E = \frac{P^2}{2m} \Rightarrow K.E \propto \frac{1}{m}$ $(P = \text{const.})$

Since mass of electron is least, so it has hi_nest K.E.

Scanned by CamScanner

(10) $P = \frac{W}{t} \Rightarrow W = Pt = 6W \times 120\,sec = 720\,J$

(11) Work done by variable force is determined by dividing displacement into small intervals.

(12)

Change in P.E = Final value − initial value

$= 0 - mgh = -mgh$

(13) Escape velocity of body in gravitation field is independent of mass of body and its angle of projection.

(14) Book information.

(15) Book information.

(16) Book information.

(17) Frictional force and displacement are always opposite, to give –ve work.

(18) Initial and final K.E of projectile are same.

$K.E = \frac{1}{2}mv^2$

$= \frac{1}{2} \times 2 \times 4 = 4J$

(19) $P = mv$, $K.E = \frac{1}{2}mv^2$

$P \propto v$, $K.E \propto v^2$

If velocity is doubled, momentum will also double and K.E becomes four times.

(20) Work done on body against gravitation is always negative.

$W = -mgh = -(2 \times 10 \times 1.5) = -30J$

(21)

$1MW\ h = 1 \times 10^6\,W \times 3600\,sec$

$= 3.6 \times 10^9\,J$

(22) In case of just holding weight without displacement, work is zero.

(23) loss of P.E = Gain in K.E

$mgh = \frac{1}{2}mv^2$

$\sqrt{2gh} = v$

$\sqrt{2 \times 10 \times 4} = v$

$9 = \sqrt{80} = v$

(24) $W = mgh = 100 \times 5 = 500\,J$

(25)

$v_{esc} = \sqrt{2gR}$, $v_o = \sqrt{gR}$

$v_{esc} = \sqrt{2}v_o$

(26) $v_{sec} = \sqrt{2gR} = 11 kms^{-1}$

(27) $P = Fv$

(28) When two protons come close to each other P.E increases.

(29) $K.E_p + P.E_p$ – work against friction = $K.E_Q + P.E_Q$

$5 + x - 10 = K.E_Q + x - 50$

$K.E_Q = 5 - 10 + 50 = 45KJ$

(30)

$W_{total} = W_1 + W_2 + W_3 + W_4$

$= mgh_1 + mgh_2 + mgh_3 + mgh_4$

$= 0 + mgh + 2mgh + 3mgh$

$= 6mgh$

(31)

$W = \mu mgS = F_k S$

$= 0.25 \times 20 \times 9.8 \times 2$

$= 98\,J$

(32)

(33) Law of conservation of mechanical energy.

(34) For non-conservative force law of conservation of mechanical energy is not valid.

(35) $W = \Delta P.E$

$W = mgh - 0 = mgh$

(36)

(37) loss of P.E – work against friction = Gain in K.E

$mgh - fh = \frac{1}{2}mv^2$

$1600 - 800 = 2v^2$

$20 ms^{-1} = v$

(38) $P = Fv = 200 \times 2 = 400\,W$

Scanned by CamScanner

(39) $K.E = \frac{1}{2}mv^2$

$K.E' = \frac{1}{2}(2m)(3v)^2 = 18\left(\frac{1}{2}mv^2\right) = 18K.E$

(40) $W = Fd\cos\theta$

$25 = (5)(10)\cos\theta$

$\cos^{-1}(1/2) = \theta$

$60° = \theta$

(41) $W = \Delta U = \frac{GMm}{r} = \frac{6.67\times10^{-11}\times100\times10^{-2}}{10^{-1}} = 6.67\times10^{-10}J$

(42) $W = mgh = 15\times10\times20$

$W = 3000J = 3kJ$

(43) $P = \frac{mgh}{t} = \frac{W\times h}{t}$

$P = \frac{2000\times10}{20} = 1000\,W$

(44) $K.E = \frac{P^2}{2m}$

$K.E \propto \frac{1}{m}\,(P = \text{constant})$

(45) $W = F_xd_x + F_yd_y + F_zd_z$

$= (0)(1) + (2)(3) + (3)(4)$

$W = 18J$

(46) $v_f = v_i + at$

$v_i = 0$

$v_f = at$

$t = \frac{v_f}{g} = \frac{10}{10} = 1s$

$y = \frac{1}{2}gt^2 \Rightarrow \frac{1}{2}\times10\times(1)^2$

(47) $v = \sqrt{2gh}$

$v = \sqrt{2\times10\times1000}$

$v = \sqrt{20000}$

$v = 141\,m/s$

(48) $P = \vec{F}.\vec{v}$

$P = Fv\cos\theta$

$\theta = \cos^{-1}\left(\frac{P}{Fv}\right)$

$= \cos^{-1}\left(\frac{2500}{500\times10}\right)$

$= \cos^{-1}\left(\frac{1}{2}\right)$

$\theta = 60°$

(49) Using inter conversion of kinetic energy and potential energy. At $\frac{h}{2}$, body has half kinetic energy and half potential energy.

(50) Mass of α – paricle $= 6.644\times10^{-27}$ kg

mass of proton $= 1.672\times10^{-27}$ kg

$p_\alpha = p_p$

$K.E = \frac{p^2}{2m}$, $K.E \propto \frac{1}{m}$

$\frac{K.E_\alpha}{K.E_p} = \frac{m_p}{m_\alpha} = \frac{1.672\times10^{-27}}{4(1.672\times10^{-27})}$

$\frac{K.E_\alpha}{K.E_p} = \frac{1}{4}$

Scanned by CamScanner

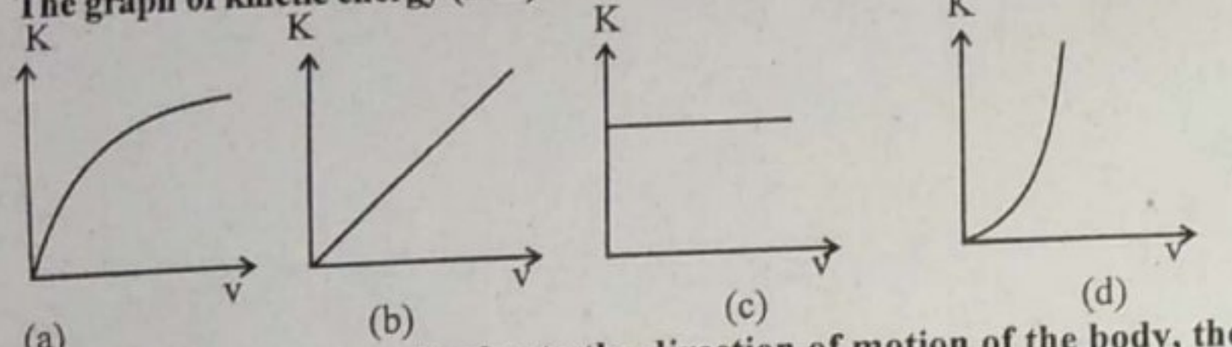
4 Chapter WORK AND ENERGY

SELF ASSESSMENT TEST

(1) **Work done will be maximum if the angle between the force $\vec{F}$ and displacement $\vec{d}$ is**

(a) 45° (b) 90°
(c) 180° (d) 0°

(2) **The graph of kinetic energy (K.E) of the body versus velocity (v) is represented by as**

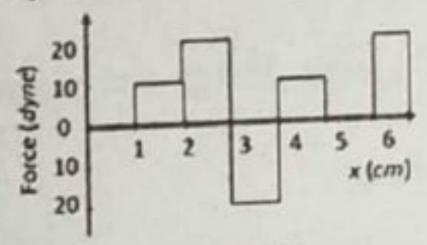


(a) (b) (c) (d)

(3) **When a force is perpendicular to the direction of motion of the body, then work done on the body is**

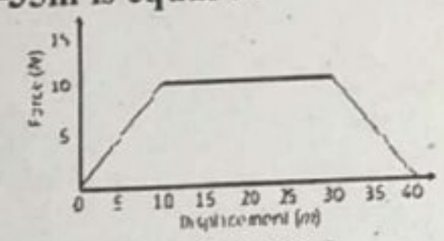
(a) zero (b) negative
(c) infinity (d) maximum

(4) **The relationship between force and position is shown in the figure given (in one dimensional case). The work done by the force in displacing a body from x = 1 cm to x = 5 cm is**



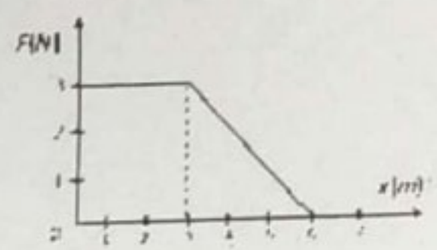
(a) 60 ergs (b) 700 ergs
(c) 70 ergs (d) 20 ergs

(5) **Adjacent figure shows the force-displacement graph of a moving body, the work done in displacing body from x=0 to x=35m is equal to**



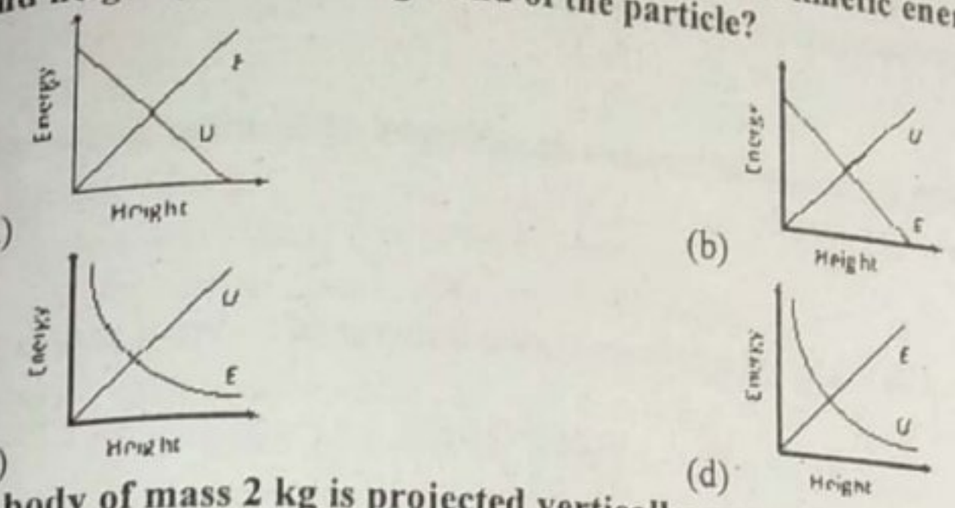
(a) 25 J (b) 200 J
(c) 287.5 J (d) 50 J

(6) **A force F acting on an object varies with distance x as shown here. The force is in newton and x in metre. The work done by the force in moving the object from x=0 to x=6m is**



(a) 4.5 J (b) 9.0 J
(c) 18.0 J (d) 13.5 J

(7) **Which of the following graph is correct between kinetic energy (E), potential energy (U) and height (h) from the ground of the particle?**



(a) (b) (c) (d)

(8) **A body of mass 2 kg is projected vertically upwards with a velocity of $2msec^{-1}$. The K.E. of the body just before striking the ground is**

(a) 2J (b) 4J
(c) 1J (d) 8J

(9) **If the water falls from a dam into a turbine wheel 19.6 m below, then the velocity of water at the turbine is ($g=9.8m/s^2$)**

(a) 9.8 m/s (b) 19.6 m/s
(c) 39.2 m/s (d) 98.0 m/s

(10) **A particle of mass m at rest is acted upon by a force F for a time t. its K.E after an interval t is**

(a) $\frac{F^2t^2}{m}$ (b) $\frac{F^2t^2}{3m}$
(c) $\frac{F^2t^2}{2m}$ (d) $\frac{Ft}{2m}$

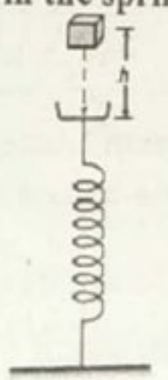
(11) **A body moving with velocity v has momentum and kinetic energy numerically equal. What is the value of v**

(a) 4m/s (b) 2m/s
(c) $\sqrt{2}$ m/s (d) 0.2 m/s

(12) **Work done on the body equals**

(a) Change in its K.E always
(b) Change in its P.E always
(c) Change in its K.E or change in its P.E
(d) Neither change in K.E nor change in its P.E

(13) **A block of mass m initially at rest is dropped from a height h on to a spring of force constant k. the maximum compression in the spring is x then**



(a) $mgh=1/2kx^2$ (b) $mg(h+x)=1/2k(x+h)$
(c) $mg(h+x)=1/2kx^2$ (d) $mgh=1/2k(x+h)^2$

Scanned by CamScanner

(14) An electric motor exerts a force of 40 N on a cable and pulls it by a distance of 30 m in one minute. The power supplied by the motor (in Watts) is
(a) 200 (b) 20
(c) 10 (d) 2

(15) A weight lifter lifts 300 kg from the ground to a height of 2 meter in 3 second. The average power generated by him is
(a) 5880 watt (b) 4410 watt
(c) 2205 watt (d) 1960 Watt

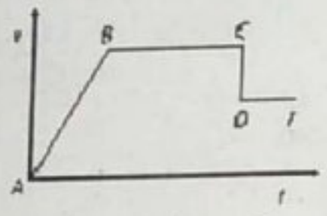
(16) Power of a water pump is 2 kW. If $g=10m/sec^2$, the amount of water it can raise in one minute to a height of 10 m is
(a) 2000 litre (b) 1000 litre
(c) 1200 litre (d) 100 litre

(17) A car of mass 1000 kg accelerates uniformly from rest to a velocity of 54 km/hour in 5s. The average power of the engine during this period in watts is
(a) 2000 W (b) 22500 W
(c) 5000 W (d) 2250 W

(18) Gravitational P.E of a body can be found by
(a) $\frac{Gm}{r}$ (b) mgh
(c) $-\frac{Gm}{r}$ (d) both "b" and "c"

(19) From an automatic gun a man fires 360 bullet per minute with a speed of 360 km/hour. If each weighs 20 g, the power of the gun is
(a) 75W (b) 600W
(c) 300W (d) 600W

(20) The adjoining diagram shows the velocity versus time plot for a particle. The work done by the force on the particle is positive from



(a) B to C (b) D to E
(c) A to B (d) C to D

(21) To travel at a constant speed, a car engine provides 24 kW of useful power. The driving force on the car is 600 N. At what speed does it travel?
(a) $25ms^{-1}$ (b) $4.0ms^{-1}$
(c) $25ms^{-1}$ (d) $40ms^{-1}$

(22) A boy holds a 400 N weight at arm's length for 10s. His arm is 1.5m above the ground. The work done by the force of the boy on the weight while he is holding it is:
(a) 0 (b) 900J
(c) 600J (d) 400J

(23) Work has the same dimension as that of
(a) torque (b) angular momentum
(c) linear momentum (d) power

(24) A man does a given amount of work in 10 sec. Another man does the same amount of work in 20 sec. The ratio of the output power of first man to the second man is
(a) 2/1 (b) 1/2
(c) 1 (d) 4/1

(25) Two springs have their force constant as k_1 and k_2 ($k_1>k_2$). When they are stretched by the same force
(a) more work is done in case of first spring
(b) more work is done in case of second spring
(c) equal work is done in case of both the springs
(d) no work is done in case of both the springs

(26) A body of mass 0.1 kg moving with a velocity of 10 m/s hits a spring (fixed at the other end) of force constant 1000 N/m and comes to rest after compressing the spring. The compression of the spring is
(a) 0.2m (b) 0.1m
(c) 0.5m (d) 0.01m

(27) If the unit of force and length each be increased by four times, then the unit of energy is increased by
(a) 2 times (b) 8 times
(c) 4 times (d) 16 times

(28) You lift a heavy book from the floor of the room and keep it in the book-shelf having a height 2 m. In this process you take 5 seconds. The work done by you will depend upon
(a) mass of the book and time taken
(b) weight of the book and height of the book-shelf
(c) height of the book-shelf and time taken
(d) mass of the book, height of the book-shelf and time taken

(29) A man of weight 500 newtons walks up to the top of a building of height of 20 m above the street level. The increase in the potential energy of man is
(a) 5×9.8 J (b) 500×20 J
(c) 500×9.8 J (d) $\frac{500\times20}{9.8}J$

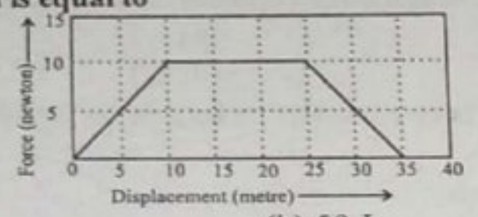
(30) Kinetic energy of a body moving with speed of 10 ms^{-1} is 30 J. If its speed becomes 30 ms^{-1} then its K.E becomes
(a) 10 J (b) 90 J
(c) 270 J (d) 180 J

(31) Escape velocity depends upon the radius of Earth. Which one shows its proper dependence
(a) $v \propto R$ (b) $v \propto R^{-\frac{1}{2}}$
(c) $v \propto R^{\frac{1}{2}}$ (d) $v \propto R^{-1}$

(32) An engine pulls a car of mass 1500 kg on a level road at a constant speed of 5 ms^{-1}. If the frictional force is 500 N, what power does the engine generate?
(a) 5.0 kW (b) 2.5 kW
(c) 10 kW (d) 12.5 kW

Scanned by CamScanner

(33) The figure shows force-displacement graph of a moving body; the work done in displacing a body from x= 0 to x = 35 m is equal to

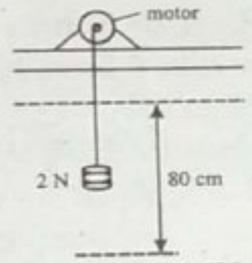


(a) 25 J (b) 50 J
(c) 200 J (d) 250 J

(34) A force of 5 N acts on a 15 kg body initially at rest. The work done by the force during the first second of motion of the body is
(a) 5/6 J (b) 6 J
(c) 75 J (d) 5 J

(35) A car is driven along a level road. The total energy input from the petrol is 60kJ and the car wastes 45kJ of energy, what is the efficiency of car
(a) 25% (b) 15%
(c) 45% (d) 75%

(36) A small electric motor is used to raise a weight of 2.0 N through a vertical height of 80 cm in 4.0 s. The efficiency of the motor is 20%. What is the electrical power supplied to the motor?



(a) 0.080 W (b) 2.0 W
(c) 0.80 W (d) 200 W

(37) The source of tidal energy is
(a) sun (b) earth
(c) both (a) and (b) (d) moon

(38) _____ cell converts solar energy into electrical energy
(a) rotatory (b) photovoltaic
(c) galvanic (d) none of these

(39) A 50kg man with 20kg load on his head climbs up 20 steps of 0.25m height each. The work done in climbing is?
(a) 100 J (b) 350 J
(c) 3430 J (d) 5 J

(40) The amount of work required to stop a moving object is equal to:
(a) the velocity of the object
(b) the mass of the object times its velocity
(c) the kinetic energy of the object
(d) the mass of the object times its acceleration

(41) If force and displacement of particle in direction of force are doubled. Work would be
(a) double (b) 1/4 times
(c) half (d) 4 times

(42) A uniform chain of length 2m is kept on a table such that a length of 60cm hangs freely from the edge of the table. The total mass of the chain is 4kg. What is the work done in pulling the entire chain on the table
(a) 7.2 J (b) 120 J
(c) 3.6 J (d) 1200 J

(43) A particle is acted upon by a force of constant magnitude which is always perpendicular to the velocity of the particle, the motion of the particle takes place in a plane. It follows that
(a) its velocity is constant (b) its acceleration is constant
(c) its kinetic energy is constant (d) it moves in a straight line

(44) A ball of mass m moves with speed v and strikes a wall having infinite mass and it returns with same speed then the work done by the ball on the wall is.
(a) zero (b) v/m J
(c) mv J (d) m/v J

(45) It is easier to draw up a wooden block along an inclined plane than to haul it vertically, principally because
(a) the friction is reduced (b) the mass becomes smaller
(c) only a part of the weight has to be overcome (d) mg becomes smaller

(46) A man starts walking from a point on the surface of earth (assumed smooth) and reaches diagonally opposite point. What is the work done by him?
(a) Negative (b) zero
(c) positive (d) none

(47) The kinetic energy acquired by a body of mass m is travelling some distance s, starting from rest under the actions of a constant force, is directly proportional to
(a) m^0 (b) m
(c) m^2 (d) $m^{1/2}$

(48) A body of mass 5 kg is placed at the origin, and can move only on the x-axis. A force of 10 N is acting on it in a direction making an angle of 60° with the x-axis and displaces it along the x-axis by 4 metres. The work done by the force is
(a) 2.5 J (b) 20 J
(c) 7.5 J (d) 40 J

(49) A person walks 2m with an acceleration of $5ms^{-2}$, holding an object of mass 2kg. The work done on the object is
(a) 20 J (b) 10 J
(c) 5 J (d) 0 J

(50) The work done on an object does not depend upon the
(a) displacement (b) angle between force and displacement
(c) force applied (d) initial velocity of the object

(51) Which of the following is correct order?
(a) 1kwh > 1erg > 1J (b) 1J > 1erg > 1kwh
(c) 1kwh > 1J > 1erg (d) 1kwh = 1J = 1erg

(52) A bomb of mass 30 kg at rest explodes into two pieces of masses 18 kg and 12 kg. The velocity of 18 kg mass is $6ms^{-1}$. The K.E of other mass is?
(a) 324 J (b) 486 J
(c) 256 J (d) 524 K

(53) You lift a suit case from the floor and keep it on a table. The work done by you on the suitcase does not depend upon
(a) the path taken by the suitcase (b) the time taken by you in doing work
(c) weight of the suitcase (d) A and B

Scanned by CamScanner

(54) **A bullet losses 19% of its K.E when passes through an obstacle. The percentage change in its speed is:**

(a) reduced by 10% (b) reduced by 19%

(c) reduced by 9.5% (d) reduced by 11%

(55) **A body is falling freely under the action of gravity in vacuum. Which of the following quantity remain constant during fall?**

(a) K.E (b) P.E

(c) total mechanical energy (d) total linear momentum

(56) **Two springs have force constants, k_1 and k_2 ($k_1 > k_2$) the work done, when both are stretched by the same amount of length will be**

(a) equal (b) greater for k_1

(c) greater for k_2 (d) given data is incomplete

(57) **A particle moves with velocity $6\hat{i}-4\hat{j}+3\hat{k}\ ms^{-1}$ under the influence of constant force $\vec{F}=20\hat{i}+15\hat{j}-5k\ N$. The instantaneous power applied to particle is**

(a) 45 Js^{-1} (b) 35 Js^{-1}

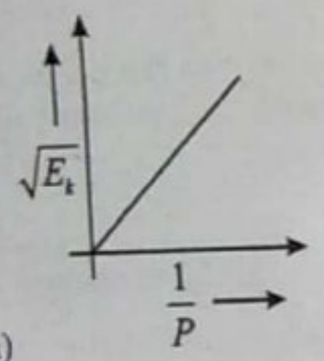
(c) 25 Js^{-1} (d) 195 Js^{-1}

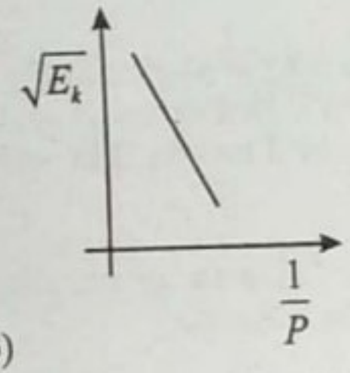
(58) **What is the average power output of a laser that can deliver 0.20J of energy m 10ns?**

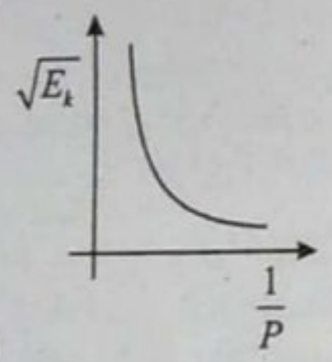
(a) 2nW (b) 20mW

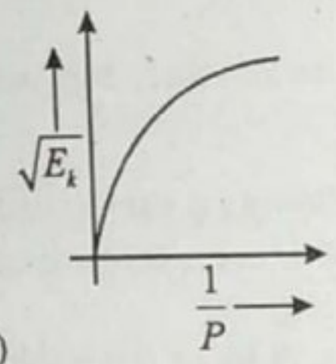
(c) 200kW (d) 20MW

(59) **The graph between $\sqrt{E_k}$ and $\frac{1}{P}$ is_____**

(a) 

(b) 

(c) 

(d) 

(60) **Uniform constant retarding force is applied to stop a truck. If its speed is doubled then the distance travelled by it will be_____**

(a) four times (b) doubled

(c) half (d) same

ANSWER KEY

1	d	11	b	21	d	31	b	41	d	51	c
2	d	12	c	22	a	32	b	42	c	52	b
3	a	13	c	23	a	33	d	43	c	53	d
4	d	14	b	24	a	34	a	44	a	54	a
5	c	15	d	25	b	35	a	45	c	55	c
6	d	16	c	26	b	36	b	46	b	56	b
7	b	17	b	27	d	37	d	47	a	57	a
8	b	18	b	28	b	38	b	48	b	58	d
9	b	19	d	29	b	39	c	49	d	59	c
10	c	20	c	30	c	40	c	50	d	60	a

EXPLANATORY NOTES

(1) $W = Fd\cos\theta$

$\theta = 0^\circ$

$W_{max} = Fd$

(2) $K.E = \frac{1}{2}mv^2$

$K.E \propto v^2$ (m = constant)

(3) $W = Fd\cos\theta$

$\theta = 90^\circ$

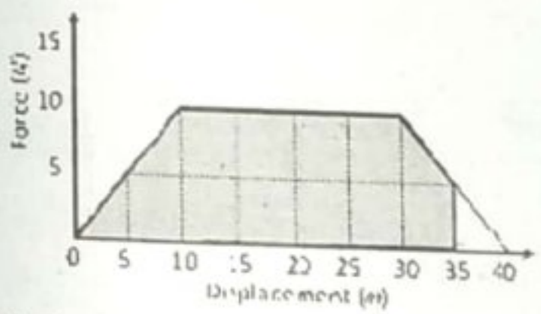
$W = 0$

(4)

Work done = area between the graph and position axis

$W = 10 \times 1 + 20 \times 1 - 20 \times 1 + 10 \times 1 = 20\ erg$

(5)



Work done = (Shaded area under the graph between x = 0 to x = 35 m) =287.5J

(6) Work done = Area enclosed by F – x graph $= \frac{1}{2}\times(3+6)\times 3 = 13.5J$

(7) Potential energy increases and kinetic energy decreases when the height of the particle increases it is clear from the graph.

Scanned by CamScanner

(8) If particle is projected vertically upward with velocity of 2m/s then it returns with the same velocity. So its kinetic energy $= \frac{1}{2}mv^2 = \frac{1}{2} \times 2 \times (2)^2 = 4\,J$

(9) Potential energy of water = kinetic energy at turbine $mgh = \frac{1}{2}mv^2$

$v = \sqrt{2gh} = \sqrt{2 \times 9.8 \times 19.6} = 19.6\,m/s$

(10) Kinetic energy $E = \frac{P^2}{2m} = \frac{(Ft)^2}{2m} = \frac{F^2t^2}{2m}$ [As P = F t]

(11) $P = E \Rightarrow mv = \frac{1}{2}mv^2 \Rightarrow v = 2ms^{-1}$

(12) Work done on a body equal to change in its energy.

(13) Change in gravitational potential energy = Elastic potential energy stored in compressed spring $\Rightarrow mg(h+x) = \frac{1}{2}kx^2$

(14) $P = Fv = F \times \frac{s}{t} = 40 \times \frac{30}{60} = 20W$

(15) $P = \frac{\text{Workdone}}{\text{Time}} = \frac{mgh}{t} = \frac{300 \times 9.8 \times 2}{3} = 1960\,W$

(16) $P = \frac{mgh}{t} \Rightarrow m = \frac{P \times t}{gh} = \frac{2 \times 10^3 \times 60}{10 \times 10} = 1200kg$ As volume $= \frac{\text{mass}}{\text{density}}$

$v = \frac{1200kg}{10^3 kg/m^3} = 1.2m^3$ Volume = 1.2 m^3 = 1.2 × 10^3 litre

(17) Power $= \frac{\text{Work done}}{\text{time}} = \frac{\text{Increase in K.E.}}{\text{time}}$ $P = \frac{\frac{1}{2}mv^2}{t} = \frac{\frac{1}{2} \times 10^3 \times (15)^2}{5} = 22500\,W$

(18) P.E = mgh

(19) Power of gun $= \frac{\text{Total K.E. of fired bullet}}{\text{time}}$

$= \frac{n \times \frac{1}{2}mv^2}{t} = \frac{360}{60} \times \frac{1}{2} \times 2 \times 10^{-2} \times (100)^2 = 600\,W$

(20) From the graph it is clear that force is acting on the particle in the region AB and due to this force kinetic energy (velocity) of the particle increases. So the work done by the force is positive.

(21) $P = Fv$

$v = \frac{P}{F} = \frac{24000}{60}$

$v = 40ms^{-1}$

(22) $W = Fd\cos\theta$

$W = F(0)\cos\theta = 0$

(23) Unit of work = J = Nm = kgm^2s^{-2}

$[W] = [ML^2T^{-2}]$

$[\tau] = Nm = [ML^2T^{-2}]$

(24) Power $= \frac{W}{t}$. If W is constant then $P \propto \frac{1}{t}$ i.e. $\frac{P_1}{P_2} = \frac{t_2}{t_1} = \frac{20}{10} = \frac{2}{1}$

(25) $W = \frac{F^2}{2k}$ If both springs are stretched by same force then $W \propto \frac{1}{k}$ As $k_1 > k_2$ therefore $W_1 < W_2$ i.e. more work is done in case of second spring.

(26) $\frac{1}{2}mv^2 = \frac{1}{2}kx^2; x = v\sqrt{\frac{m}{k}} = 10\sqrt{\frac{0.1}{1000}} = 0.1\,m$

(27) Work = Force × Displacement (length) If unit of force and length be increased by four times then the unit of energy will increase by 16 times

(28) Work done = Force × displacement = Weight of the book × Height of the book shelf.

(29) $P.E = (mg)h = 500 \times 20\,J$

(30) $K.E = \frac{1}{2}mv^2$

$K.E \propto v^2$ (m=constant)

if $v' = 3v$, then $K.E' = 9K.E$

$K.E' = 9K.E$

$= 9(30)$

$K.E = 270\,J$

(31) $v_{esc} = \sqrt{\frac{2GM}{R}} \Rightarrow v_{esc} \propto R^{\frac{-1}{2}}$

Scanned by CamScanner

(32) $P = Fv = 500 \times 5 = 2500 = 2.5\,kW$

(33) $W = \frac{1}{2}(10)(10) + (15)(10) + \frac{1}{2}(10)(10)$

$= 50 + 150 + 50 = 250\,J$

(34) $W = Fs = F \times \frac{1}{2}at^2 \left[\text{ from } s = ut + \frac{1}{2}at^2\right] \Rightarrow W = F\left[\frac{1}{2}\left(\frac{F}{m}\right)t^2\right]$

$= \frac{F^2t^2}{2m} = \frac{25 \times (1)^2}{2 \times 15} = \frac{25}{30} = \frac{5}{6}\,J$

(35) Input power = 60 KJ, wasted energy = 45 KJ, output power= 15 KJ

$\%\eta = \frac{\text{output power}}{\text{input power}} \times 100 = \frac{15}{60} \times 100 = 25\%$

(36) $P_{out} = \frac{W \times h}{t} = \frac{2 \times 0.8}{4} = 0.4\,\text{Watt}$

$\eta = \frac{P_{out}}{P_{in}}$

$\frac{20}{100} = \frac{0.4}{P_{in}} \Rightarrow P_{in} = 2\,\text{Watt}$

(37) Moon is source of tidal energy.

(38) Photovoltaic cell converts solar energy into electrical energy.

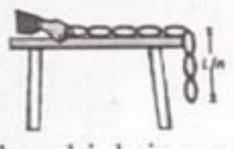
(39) Total mass = (50 + 20) = 70 kg Total height = 20 × 0.25 = 5m \ Work done = mgh = 70 × 9.8 × 5 = 3430 J

(40) $W = \Delta K.E$

(41) Work = Force × Displacement If force and displacement both are doubled then work would be four times.

(42) Fraction of length of the chain hanging from the table $= \frac{1}{n} = \frac{60cm}{200cm} = \frac{3}{10} \Rightarrow n = \frac{10}{3}$

Work done in pulling the chain on the table $W = \frac{mgL}{2n^2} = \frac{4 \times 10 \times 2}{2 \times (10/3)^2} = 3.6J$



(43) When a force of constant magnitude which is perpendicular to the velocity of particle acts on a particle, work done is zero and hence change in kinetic energy is zero.

(44) The ball rebounds with the same speed. So change in it's Kinetic energy will be zero i.e. work done by the ball on the wall is zero.

(45) Opposing force in vertical pulling = mg But opposing force on an inclined plane is mg sinθ, which is less than mg.

(46) As surface is smooth so work done against friction is zero. Also the displacement and force of gravity are perpendicular so work done against gravity is zero.

(47) K.E. acquired by the body = work done on the body $K.E. = \frac{1}{2}mv^2 = Fs$ i.e. it does not depend upon the mass although velocity depends upon the mass $v^2 \propto \frac{1}{m}$ [If F and s are constant]

(48) $W = FS\cos\theta = 10 \times 4 \times \cos 60^\circ = 20\,\text{Joule}$

(49) $W = Fd\cos\theta$

Since angle between $\vec{F}$ & $\vec{d}$ is 90^0 so $W = 0$

(50) $W \propto F$

$W \propto d$

$W \propto \theta$

It does not depends upon initial velocity.

(51) 1kwh > 1cal > 1J > 1erg > 1ev

(52) $m_1v_1 = m_2v_2 \qquad v_2 = \frac{18 \times 6}{12} = 9ms^{-1}$

$K.E = \frac{1}{2} \times 12(19)^2 = 486J$

(53) Gravitational force is conservative work done is independent of path and time.

(54) $K.E = \frac{1}{2}mv^2 \rightarrow v = \sqrt{\frac{2K}{m}}$

$v' = \sqrt{\frac{2k'}{m}} = \sqrt{\frac{2 \times 0.81k}{m}} = 0.9v$ change in speed =1-0.9=0.1=10%

(55) $T.E = P.E + K.E$

(56) $w = \frac{1}{2}kx^2$

(57) $P = \vec{F}.\vec{v}$

$= \left(20\hat{i} + 15j - 5\hat{k}\right).\left(6\hat{i} - 4\hat{j} + 3\hat{k}\right)$

$= 120 - 60 - 15$

$P = 45\ Js^{-1}$

(58) $p = \frac{w}{t}$

(59) $\sqrt{E_k} \propto P$

(60) $F.d = \frac{1}{2}mv^2$

$d \propto v^2$

$\frac{d_1}{d_2} = \frac{v_1^2}{v_2^2}$

Scanned by CamScanner

Chapter 5 CIRCULAR MOTION

PRACTICE EXERCISE

(1) **The rotational K.E of hoop is**
(a) Equal to its translational K.E (b) Half than its translational K.E
(c) Double than its translational K.E (d) Four times than its translational K.E

(2) **The racing cars of masses m_1, and m_2 are moving in circles of radii r_1 and r_2 respectively. Their speeds are such that each makes a complete circle in the same length of time. The ratio of the angular speed of the first car to that of the second car is**
(a) $m_1 : m_2$ (b) $r_1 : r_2$
(c) 1:1 (d) $m_1 r_1 : m_2 r_2$

(3) **The angular velocity of the minute hand of a clock is**
(a) $\frac{2\pi}{60} rads^{-1}$ (b) $\frac{\pi}{24} rads^{-1}$
(c) $\frac{2\pi}{3600} rads^{-1}$ (d) $\frac{\pi}{3600} rads^{-1}$

(4) **If a wheel turns with constant angular speed then:**
(a) Each point on its rim moves with constant velocity
(b) Each point on its rim moves with constant acceleration
(c) The angle through which the wheel turns in each second decreases as time goes on
(d) The wheel turns through equal angles in equal times

(5) **A boy suddenly comes and sit on the circular rotating table. What will remain conserved**
(a) Angular momentum (b) Linear velocity
(c) Kinetic energy (d) None of these

(6) **A wheel rotates about an axis passing through the center and perpendicular to the plane with slowly increasing angular speed. Then it has**
(a) Radial velocity and radial acceleration
(b) Tangential velocity and radial acceleration
(c) Tangential velocity and tangential acceleration
(d) Tangential velocity but acceleration having both components

(7) **Ten seconds after an electric fan is turned on, the fan rotates at 300rev/min. Its average angular acceleration is**
(a) 30 rad/s^2 (b) 3.14rad/s^2
(c) 30 rev/s^2 (d) 500 rev/s^2

(8) **At the surface of the earth, an object of mass m has weight W. If this object is transported to an altitude that's twice the radius of the earth, then, at the new location,**
(a) Its mass is $\frac{m}{2}$ and its weight is $\frac{W}{2}$ (b) Its mass is $\frac{m}{2}$ and its weight is $\frac{W}{4}$
(c) Its mass is m and its weight is $\frac{W}{9}$ (d) Its mass is m and its weight is $\frac{W}{4}$

(9) **When a mass is rotated in a plane about a fixed point, its angular momentum is directed along**
(a) The radius (b) The tangent to the orbit
(c) A line at an angle of 45° to the plane of rotation (d) The axis of rotation

(10) **When a body moves in a circle, the angle between its linear velocity and angular velocity is always**
(a) 180° (b) 0°
(c) 90° (d) 45°

(11) **An arc of length equal to the circumference of circle subtends an angle**
(a) π radian (b) 2π radian
(c) $\pi/2$ radian (d) 4π radian

(12) **A mass slides down on an inclined plane and reach the bottom with velocity v. if the same mass were in term of a ring which rolls down this plane, its linear speed at the bottom would be**
(a) v (b) $\frac{v}{\sqrt{2}}$
(c) $\sqrt{2}v$ (d) 2v

(13) **When a body is whirled in a horizontal circle by means of a string the centripetal force is supplied by**
(a) Mass of a body (b) Velocity of body
(c) Tension in the string (d) Centripetal acceleration

(14) **What remains constant when the earth revolve around the sun**
(a) Linear momentum (b) Linear K.E
(c) Angular K.E (d) Angular momentum

(15) **A satellite is currently orbiting Earth in a circular orbit of radius R; its kinetic energy is K_1. If the satellite is moved and enters a new circular orbit of radius $2R$, what will be its kinetic energy?**
(a) $\frac{K_1}{4}$ (b) $\frac{K_1}{2}$
(c) K_1 (d) $2K_1$

(16) **A stone is whirled in a vertical circle at the end of a string. When the stone is at the highest position the tension in the string is**
(a) Maximum (b) Zero
(c) Equal to the weight of the stone (d) Less than the weight of the stone

(17) **The angular speed of hour's hand of mechanical watch is -------- radian per hours**
(a) $\pi/6$ (b) $\pi/4$
(c) $\pi/12$ (d) $\pi/8$

(18) **$\tau = I\alpha$ for an object rotating about a fixed axis, where τ is the net torque acting on it, I is its rotational inertia, and α is its angular acceleration. This expression:**
(a) Follows directly from Newton's second law
(b) Is the definition of angular acceleration
(c) Is the definition of rotational inertia
(d) Is the definition of torque

(19) **If a car moves with a uniform speed of 2 ms^{-1} in a circle of radius 0.4m. Its angular speed is**
(a) 4 rad. s^{-1} (b) 5 rad. s^{-1}
(c) 1.6 rad. s^{-1} (d) 2.8 ms^{-1}

(20) **The mean distance from Saturn to the sun is 9 times greater than the mean distance from Earth to the sun. How long is a Saturn year?**
(a) 18 Earth years (b) 27 Earth years
(c) 81 Earth years (d) 243 Earth years

(21) **A body moving along the circumference of a circle, completes two revolutions. If the radius of the circular path is R, total angular displacement covered is**
(a) π R (b) 2πR
(c) Zero (d) 4π

Scanned by CamScanner

(22) A 60 kg man stands on a spring scale in a lift. At some instant he finds that the scale reading has changed from 60 kg to 50 kg for a while and then comes back to the original mark. What should he conclude?

(a) The lift was in constant motion upwards
(b) The lift was in constant motion downward
(c) The lift while in motion downwards suddenly stopped
(d) The lift while in motion upwards suddenly stopped

(23) Time taken by geostationary satellite to complete one rotation around earth is

(a) 1 year (b) 1 day
(c) 1 hour (d) 84 min

(24) What will be duration of day and night if earth shrinks to half the present radius

(a) 24 hrs (b) 6 hrs
(c) 12 hrs (d) 3 hrs

(25) If a wheel of radius r turns through an angle of 30°, then the distance through which any point on its rim moves is

(a) $\frac{\pi}{3}r$ (b) $\frac{\pi}{6}r$
(c) $\frac{\pi}{30}r$ (d) $\frac{\pi}{180}r$

(26) In angular motion, Newton's second law of motion is

(a) F=ma (b) $F=\Delta p/\Delta t$
(c) $\tau = I\alpha$ (d) All of above

(27) Angular speed of second's hand of a watch in $rads^{-1}$ is

(a) π (b) $\frac{\pi}{2}$
(c) $\frac{\pi}{30}$ (d) $\frac{\pi}{180}$

(28) The angle subtended by an arc equal to radius is

(a) 1 rad (b) One degree
(c) 1 Revolution (d) All

(29) What is outward force acting on a mass of 10kg when rotating at one end of an inelastic string 10m long at speed of 1m/s?

(a) 1N (b) 10N
(c) 2N (d) 100N

(30) If we whirl a stone at the end of a string in the vertical circle, it is likely to break when the stone is

(a) At the highest point (b) At the lowest point
(c) At any point during motion (d) At the point where gravity is not acting .

(31) Global positioning system consists of how many satellites?

(a) 24 Natural satellites (b) 24 artificial satellites
(c) 3 synchronous satellites (d) Both "b" and "c"

(32) A man of weight W is standing on an elevator which is ascending with an acceleration a. The apparent weight of the man is

(a) mg (b) ma – mg
(c) mg + ma (d) mg – ma

(33) A body moving in a circular path of radius r has tangential acceleration a_t, and centripetal acceleration a_c. If the body is moving at constant speed v, what are the magnitudes of a_t and a_c?

	Tangential acceleration, a_t	Centripetal acceleration, a_c
(a)	rv^2	0
(b)	v^2/r	0
(c)	0	v^2/r
(d)	0	v^2r

(34) An object of mass of 2 kg rotates at constant speed in a horizontal circle of radius 5 m. The time for one complete revolution is 3 s. What is the magnitude of the resultant force acting on the object?

(a) $\frac{4\pi^2}{9}N$ (b) $\frac{40\pi^2}{9}N$
(c) $\frac{100\pi^2}{9}N$ (d) $\frac{400\pi^2}{9}N$

(35) A moon of Jupiter has a nearly circular orbit of radius R and an orbit period of T. Which of the following expressions gives the mass of Jupiter?

(a) $\frac{2\pi R}{T}$ (b) $\frac{2\pi^2 R}{T}$
(c) $\frac{2\pi R^3}{(GT^2)}$ (d) $\frac{4\pi^2 R^3}{GT^2}$

(36) A body of mass 10kg is rotating in a circular path of radius 'r' with constant speed. The work done in one complete revolution is

(a) 10.3 $rads^{-1}$ (b) Zero
(c) 100 $rads^{-1}$ (d) 0.5 $rads^{-1}$

(37) A monkey sits on the pan of a spring scale kept in an elevator. The reading of the spring scale will be maximum when the elevator

(a) Is stationary (b) Accelerates downwards
(c) Cable brakes and it falls freely towards the earth (d) Accelerates upwards

(38) Which of the following is the correct vector form of centripetal force

(a) $m\omega\vec{r}$ (b) $m\omega^2\vec{r}$
(c) $-\frac{m\omega^2}{r}\hat{r}$ (d) $-m\omega^2\vec{r}$

(39) A particle is moved in a circle with a constant angular velocity. Its angular momentum is L. If the radius of the circle is halved keeping the angular velocity same, the angular momentum of the particle will become

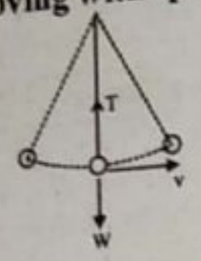
(a) L/4 (b) L/2
(c) L (d) 2L

(40) In the solar eclipse of 1919 A.D., bending of starlight was measured to be

(a) 1.745 degree (b) 1.745 minute
(c) 1.745 seconds (d) 1.745 radian

Scanned by CamScanner

(41) An oscillating pendulum bob of mass m and weight w is supported by a string of length r. What is the relationship between w and the tension T in the string at the instant when the string is vertical and the bob is moving with speed v?



(a) $T = W$ (b) $T - W = \frac{v^2}{r}$

(c) $T - W = m\frac{v^2}{r}$ (d) $W - T = m\frac{v^2}{r}$

(42) The angular momentum of a rotating body changes from A_0 to $4A_0$ in 4 seconds. The torque acting on the body is

(a) $\frac{3}{4}A_0$ (b) $4A_0$

(c) $3A_0$ (d) $\frac{3}{2}A_0$

(43) A cable is wrapped several times around a uniform solid cylinder that can rotate about its axis. The cylinder has diameter 12cm and mass 50kg. The cable is pulled with a force 9N. Assuming cable unwinds without stretching or slipping, find its acceleration

(a) $0.3ms^{-2}$ (b) $0.32\ ms^{-2}$

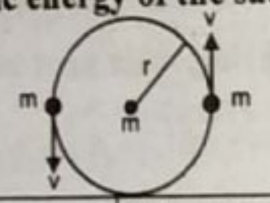
(c) $0.36ms^{-2}$ (d) $0.4ms^{-2}$

(44) The period of a circular motion is given by

(a) T = r v (b) T = ω w

(c) T = 2π ω (d) T = 2π/ω

(45) A satellite moves at constant speed in a circular orbit about the Earth. Which statement about the momentum and kinetic energy of the satellite is correct?



	Momentum	Kinetic energy
(a)	Constant	Changing
(b)	Constant	Constant
(c)	Changing	Changing
(d)	Changing	Constant

(46) A ball of steel rolls down an incline of inclination 6. Find the ratio of rotational *K.E* to linear *K.E*.

(a) $\frac{2}{7}$ (b) $\frac{2}{3}$ (c) $\frac{2}{5}$ (d) $\frac{5}{7}$

(47) Two rotating bodies have same angular momentum but their moments of inertia are I_1 and I_2 respectively $(I_1 > I_2)$. Which body will have higher kinetic energy of rotation?

(a) First (b) Second

(c) Both will have same kinetic energy (d) Not possible to predict

(48) Two particle of equal masses are revolving in circular paths of radius r_1 and r_2, respectively with the same speed. The ratio of their centripetal force is

(a) $\left(\frac{r_2}{r_1}\right)$ (b) $\sqrt{\left(\frac{r_2}{r_1}\right)}$

(c) $\left(\frac{r_2}{r_1}\right)^2$ (d) $\left(\frac{r_1}{r_2}\right)^2$

(49) A satellite moving round the earth constitutes

(a) An inertial frame of reference (b) Non inertial frame

(c) Neither inertial nor non inertial (d) Both inertial and non-inertial

(50) The average angular velocity is defined by the relation

(a) $\omega_{av} = \frac{\Delta t}{\Delta\theta}$ (b) $\omega_{av} = \frac{\Delta\theta^2}{\Delta t}$

(c) $\omega_{av} = \frac{\Delta\theta}{\Delta t}$ (d) $\omega_{av} = \Delta\theta \times \Delta t$

ANSWER KEY

1	a	11	b	21	d	31	b	41	a
2	c	12	b	22	c	32	c	42	a
3	c	13	c	23	b	33	c	43	c
4	d	14	d	24	b	34	b	44	d
5	a	15	b	25	b	35	d	45	d
6	d	16	c	26	c	36	b	46	c
7	b	17	a	27	c	37	d	47	b
8	c	18	a	28	a	38	d	48	a
9	d	19	b	29	a	39	a	49	a
10	c	20	b	30	b	40	c	50	c

Scanned by CamScanner

EXPLANATORY NOTES

(1) Rotational K.E of hoop is equal to its translational K.E.

(2) $\omega = \frac{2\pi}{t}$

(3) $\omega = \frac{\theta}{t} = \frac{2\pi}{3600}\ \text{rads}^{-1}$

(4)

(5)

(6) Body rotating with increasing angular speed will have both tangential and radial acceleration.

(7) $\alpha = \frac{\omega}{t} = \frac{300\times 2\pi}{60\times 10} = (3.14)\ \text{rads}^{-2}$

(8) When object is transported form surface of earth to altitude two times the radius of earth weight decreases, mass remains same. "W=mg" , $"W' = \frac{GmM}{r^2} = \frac{GmM}{(3R)^2} = \left(\frac{GMm}{9R}\right)"$

$$\boxed{W' = \frac{W}{9}}$$

(9) Direction of angular momentum is along axis of rotation.

(10) In circular motion, linear and angular velocities are perpendicular.

(11)

(12) For mass m:

$v = \sqrt{2gh}$.....(i)

$mgh = \frac{1}{2}mv'^2 + \frac{1}{2}I\omega^2$

$mgh = \frac{1}{2}mv'^2 + \frac{1}{2}mv'^2$

$mgh = mv'^2 \Rightarrow v' = \sqrt{gh}$

For ring, $(K.E)_{rot} = \frac{1}{2}mv^2$

Hence, $v' = \frac{v}{\sqrt{2}}$

(13)

(14)

(15)

$$v' = \sqrt{\frac{GM}{2r}} = \frac{v}{\sqrt{2}}$$

As $K.E' = \frac{1}{2}mv'^2 \Rightarrow K.E' = \frac{K.E}{2}$

(16) Object moving in vertical circle at the end of string have tension at highest point equal to its weight i.e. minimum.

$T = \frac{mv^2}{r} + mg\cos\theta$

$T = \frac{mv^2}{r} + mg \quad \theta = 0° \rightarrow$ at lowest point

$T = \frac{mv^2}{r} - mg \quad \theta = 180° \rightarrow$ at highest point

(17) $\omega = \frac{\theta}{t} = \frac{2\pi}{12} = \frac{\pi}{6}\ \frac{\text{rad}}{\text{hour}}$

(18) $\tau = I\alpha$ is analogous of $F = ma$, i.e. follows Newton's second law.

(19) $\omega = \frac{v}{r} = \frac{2}{0.4} = 5\ \text{rads}^{-1}$

(20) $R_s = 9R_E$

By Kepler's law

$R^3 \propto T^2$

$\frac{R_s^3}{R_E^3} = \frac{T_s^2}{T_E^2}$

$\frac{(9R_E^3)}{R_E^3} = \frac{T_s^2}{1\,\text{earth year}}$

$27 = \sqrt{(3^3)^2} = T_s$

(21)

$\theta = \frac{S}{r}$

$\theta = \frac{2(2\pi R)}{R} = 4\pi\,\text{rad}$

Scanned by CamScanner

(22) Initially the lift is moving upward with constant velocity, then it is retarded and finally it is at rest; so initial weight = final weight = 60 kg. During upward retardation or downward acceleration, the weight decreases (Also as we know T = m(g–a))

(23) Time taken by geostationary satellite to complete one rotation around earth is 1 day.

(24) $L_1 = L_2$

$I\omega_1 = I\omega_2$

$$\cancel{MR^2}\frac{\cancel{2\pi}}{T_1} = \frac{\cancel{MR^2}}{4}\frac{\cancel{2\pi}}{T_2}$$

$$T_2 = T/4 = \frac{24}{4}$$

$T_1 = 6$ hours

(25)

$$\theta = 30° = \frac{\pi}{6}\text{rad}$$

$$S = r\theta \Rightarrow S = r \times \frac{\pi}{6}$$

(27) $\omega = \frac{\theta}{t} = \frac{2\pi}{60} = \frac{\pi}{30}\text{rad s}^{-1}$

(28) Angle subtend by arc length at center of circle equals to radius is, one radian.

(29) $F_C = \frac{mv^2}{r} = \frac{10\times(1)^2}{10} = 1N$

(30) In a vertical circle, tension will be maximum at lowest point.

(32) Apparent weight of man in elevator ascending with "a" is $mg + ma$.

(33) For body moving in circle with constant speed has $a_T = 0$. Because $a_T = r\alpha$

(34)

$$F_C = mr\omega^2 = mr\left(\frac{\theta}{t}\right)^2$$

$$= 2\times5\times\frac{4\pi^2}{9} = \frac{40\pi^2}{9}N$$

(35) $F_g = F_c$

$$\frac{GMm}{R^2} = m\omega^2 R$$

$$\frac{GM}{R^2} = \frac{4\pi^2}{T^2}R$$

$$M = \frac{4\pi^2R^3}{GT^2}$$

(36) Body moving in circle has always zero work.

(37) Apparent weight is maximum only when elevator is accelerating upwards. $T = m(g + a)$

(38) Vector form of centripetal force $\vec{F_C} = -m\omega^2\vec{r}$.

(39) $L = I\omega = mr^2\omega$

if $r' = \frac{r}{2}$

$$L' = \frac{mr^2}{4}\omega = \frac{L}{4}$$

(40)

(41) At mean position

$T = W + F_c$

$$T - W = \frac{mv^2}{r^2}$$

(42) $\tau = \frac{\Delta L}{\Delta t} = \frac{4A_0 - A_0}{4} = \frac{3A_0}{4}$

(43) $\tau = I\alpha = Fr$ **or** $\alpha = \frac{Fr}{1}$

$$= \frac{2\times9}{50\times(.06)} = 6\text{rad } s^{-2}$$

$$a_t = r\alpha = 0.06\times6 = 0.36ms^{-2}$$

(44)

$\theta = \omega t$

$$\omega = \frac{2\pi}{T}$$

$$T = \frac{2\pi}{\omega}$$

Scanned by CamScanner

(45)

$$\vec{P} = m\vec{v}$$

$$K.E = \frac{1}{2}mv^2$$

Speed is constant so K.E does not change while velocity is changing so it will change $\vec{P}$.

(46)

$$\frac{\frac{1}{2}I\omega^2}{\frac{1}{2}mv^2} = \frac{2}{5}\frac{MR^2\omega^2}{Mv^2} = \frac{2}{5}$$

(47) $K.E = \frac{1}{2}LI^2$

$$I_1\omega_1 = I_2\omega_2 \left(L = \text{constant}\right)$$

(48)

$$\frac{F_1}{F_2} = \frac{\frac{mv^2}{r_1}}{\frac{mv^2}{r_2}} = \frac{r_2}{r_1}$$

(49) Because satellites move with uniform velocity.

(50) By definition angular velocity = time rate of change in angular displacement.

5 Chapter CIRCULAR MOTION

SELF ASSESSMENT TEST

(1) A fireman wants to slide down a rope. The breaking load for the rope is 3/4th of the weight of the man. With what minimum acceleration should the fireman slide down? Acceleration due to gravity is g.

(a) zero
(b) $\frac{g}{4}$
(c) $\frac{3g}{4}$
(d) $\frac{g}{2}$

(2) A hoop and disc have same mass and radius. Their rotational K.E are related by an equation

(a) $K.E_{hoop} = K.E_{disc}$
(b) $K.E_{hoop} = 2K.E_{disc}$
(c) $K.E_{hoop} = 1/2K.E_{disc}$
(d) $K.E_{hoop} = 4K.E_{disc}$

(3) The angular velocity of the minute hand of a clock is

(a) $\frac{2\pi}{60} rads^{-1}$
(b) $\frac{\pi}{24} rads^{-1}$
(c) $\frac{2\pi}{3600} rads^{-1}$
(d) $\frac{\pi}{3600} rads^{-1}$

(4) The period of a satellite in a circular orbit of radius R is T, the period of another satellite in a circular orbit of radius 4R is

(a) 4T
(b) T/8
(c) 8T
(d) T/4

(5) If the earth is at one-fourth of its present distance from the sun, the duration of the year will be

(a) one-eighth the present year
(b) one-sixth the present year
(c) one-fourth the present year
(d) half the present year

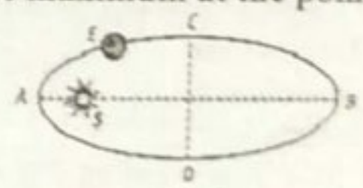
(6) According to Einstein, the gravity interaction is possible between

(a) material objects only
(b) material objects and electromagnetic radiation only
(c) electromagnetic radiations
(d) none of the above

(7) The rotation period of an earth satellite close to the surface of the earth is 83 minutes. The time period of another earth satellite in an orbit at a distance equal to three times radius of earth from its surface will be

(a) 83 minutes
(b) 664 minutes
(c) 249 minutes
(d) 830 minutes

(8) The earth E moves in an elliptical orbit with the sun S at one of the foci as shown in figure. Its speed of motion will be maximum at the point



(a) E
(b) B
(c) C
(d) A

(9) The direction of linear velocity of body moving in a circle is

(a) along the axis of rotation
(b) along the tangent
(c) directed towards the center
(d) directed away form the center

Scanned by CamScanner

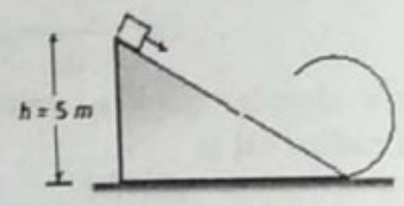
(10) A body revolved around the sun 27 times faster then the earth what is the ratio of their radii
(a) 1/27 (b) 1/4
(c) 1/9 (d) 1/3

(11) A stone of mass 250 g is tied to the end of a string of length 1.0 m. It is whirled in a horizontal circle with a frequency of 30 rev./min. What is the tension in the string?
(a) $\frac{\pi^2}{4}$N (b) $\frac{\pi^2}{2}$N
(c) π^2N (d) $2\pi^2$N

(12) The relation between linear and angular acceleration is
(a) $\vec{\alpha}=\vec{a}\times\vec{r}$ (b) $\vec{a}=\vec{r}\times\vec{\alpha}$
(c) $\vec{a}=\vec{\alpha}\times\vec{r}$ (d) $\vec{r}=\vec{\alpha}\times\vec{a}$

(13) For a particle in a non-uniform accelerated circular motion
(a) velocity is radial and acceleration is transverse only
(b) velocity is transverse and acceleration is radial only
(c) velocity is transverse and acceleration has both radial and transverse components
(d) velocity is radial and acceleration has both radial and transverse components

(14) As per given figure to complete the circular loop what should be the radius if initial height is 5 m



(a) 4 meter (b) 5 meter
(c) 2.5 meter (d) 2 meter

(15) The torque of 100Nm acting on a wheel at rest, rotates it through 200 radians in 10s. The angular acceleration of wheel in rads^{-2} is
(a) 4 (b) 2
(c) 6 (d) 8

(16) A body crosses the topmost point of a vertical circle with critical speed. Its centripetal acceleration, when the string is horizontal will be
(a) 4g (b) 3g
(c) g (d) 6g

(17) A particle moves in a circular path with decreasing speed. Choose the correct statement
(a) the direction of angular momentum remains constant
(b) particle moves in a spiral path with decreasing radius
(c) acceleration $(\vec{a})$ is towards the center
(d) angular momentum remains constant

(18) For a particle in circular motion the centripetal acceleration is
(a) may be more or less than its tangential acceleration
(b) more than its tangential acceleration
(c) equal to its tangential acceleration a
(d) less than its tangential acceleration

(19) A heavy mass is attached to a thin wire and is whirled in a vertical circle. The wire is most likely to break
(a) when the mass is at the highest point of the circle
(b) when the mass is at the lowest point of the circle
(c) when the wire is horizontal
(d) at an angle of $\cos^{-1}(1/3)$ from the upward vertical

(20) A body can have constant velocity when it follows a
(a) elliptical path (b) circular path
(c) parabolic path (d) rectilinear path

(21) A body moving along the circumference of a circle, completes two revolutions. If the radius of the circular path is R, total angular displacement covered is
(a) π R (b) 2πR
(c) zero (d) 4π

(22) A hoop rolls with constant velocity and without sliding along level ground. Its rotational kinetic energy is:
(a) half its translational kinetic energy
(b) twice its translational kinetic energy
(c) four times its translational kinetic energy
(d) the same as its translational kinetic energy

(23) The angular velocity of the second hand in a mechanical watch is
(a) $\frac{\pi}{60}$ rad s^{-1} (b) $\frac{\pi}{30}$ rad s^{-1}
(c) $\frac{\pi}{120}$ rad s^{-1} (d) π rad s^{-1}

(24) A cyclist turns around a curve at 15 miles/hour. If he turns at double the speed, the tendency to overturn is
(a) quadrupled (b) halved
(c) unchanged (d) doubled

(25) A body is moving in a circular path with a constant speed. It has
(a) a constant acceleration (b) an acceleration of constant magnitude
(c) a constant velocity (d) an acceleration which varies with time

(26) A man of mass 90 kg is standing in an elevator whose cable broke suddenly. If the elevator falls freely, the force exerted by the floor on the man is:
(a) 90 N (b) 900 N
(c) 0 N (d) any negative value

(27) A man weight 1000 N is in a stationary lift. What will be it's weight if the lift starts moving up with an acceleration 10 m/s^2
(a) 2000 N (b) 3000 N
(c) 1500 N (d) 1000 N

(28) A body is revolving with a constant speed along a circle. If its direction of motion is reversed but the speed remains the same, then which of the following statement is true
(a) the centripetal force will not suffer any change in magnitude
(b) the centripetal force will have its direction reversed
(c) the centripetal force will not suffer any change in direction
(d) the centripetal force would be doubled

(29) Two bodies of mass 10 kg and 5 kg moving in concentric orbits of radii R and r such that their periods are the same. Then the ratio between their centripetal acceleration is
(a) R/r (b) r/R
(c) R^2/r^2 (d) r^2/R^2

(30) The ratio of angular speeds of minute hand and hour hand of a watch is
(a) 6 : 1 (b) 12 : 1
(c) 1 : 12 (d) 1 : 6

Scanned by CamScanner

(31) The period of a satellite in a circular orbit of radius R is T. The period is given by

(a) $T = \frac{2\pi R}{v}$ (b) $T = \frac{2\pi R^2}{v}$

(c) $T = \frac{3\pi R}{v}$ (d) $T = \frac{4\pi R}{v}$

(32) The angular speed of a fly wheel making 120 revolutions/minute is

(a) 2π rad/s (b) $4\pi^2$rad/s

(c) 4π rad/s (d) π rad/s

(33) A lift is moving up with an acceleration equal to $\frac{g}{5}$. The apparent weight of a 60 kg man standing in the lift is:

(a) 480 N (b) 720 N

(c) 600 N (d) 120 N

(34) If such a star has a radius of 20 km, the acceleration of an object on the equator of the star will be

(a) 20×10^8m/sec^2 (b) 8×10^5m/sec^2

(c) 120×10^5m/sec^2 (d) 4×10^8m/sec^2

(35) A particle of mass m is executing uniform circular motion on a path of radius r. If p is the magnitude of its linear momentum. The radial force acting on the particle is

(a) mp^2/r (b) p^2/rm

(c) rm/p (d) pmr

(36) A string breaks if its tension exceeds 10 newtons. A stone of mass 250 gm tied to this string of length 10 cm is rotated in a horizontal circle. The maximum angular velocity of rotation can be

(a) 20 rad/s (b) 40 rad/s

(c) 100 rad/s (d) 200 rad/s

(37) A 500 kg car takes a round turn of radius 50 m with a velocity of 36 km/hr. The centripetal force is

(a) 250 N (b) 750 N

(c) 1200 N (d) 1000 N

(38) Two satellite A and B orbiting around the earth in circular orbits of the same radius. The mass of A is 16 times that of B. The ratio of the period of revolution of B to that of A is

(a) 1 : 16 (b) 1 : 4

(c) 1 : 2 (d) 1 : 1

(39) If θ_E is the angle of bending of light predicted by Einstein's theory of gravity and θ_N that by Newton's, then

(a) $\theta_E = \theta_N$ (b) $\theta_E = \frac{1}{2}\theta_N$

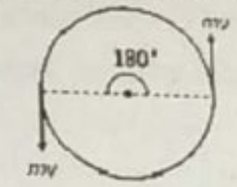
(c) $\theta_E = 2\theta_N$ (d) No relation exists between θ_E and θ_N

(40) Two cars of masses m_1 and m_2 are moving in circle of radius r_1 and r_2. Their speeds are such that period of rotation same. The ratio of their centripetal force is

(a) $m_1:m_2$ (b) $r_1:r_2$

(c) 1:1 (d) $m_1 r_1 : m_2 r_2$

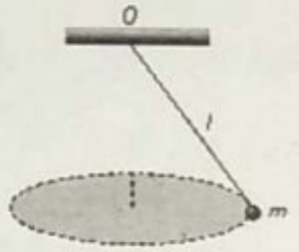
(41) If a particle covers half the circle of radius R with constant speed then

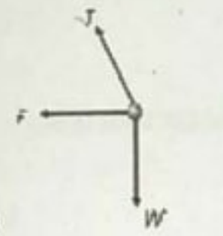


(a) momentum change is mvr (b) change in K.E. is 1/2 mv^2

(c) change in K.E. is mv^2 (d) change in K.E. is zero

(42) A point mass m is suspended from a light thread of length *l*, fixed at O, is whirled in a horizontal circle at constant speed as shown. From your point of view, stationary with respect to the mass, the forces on the mass are

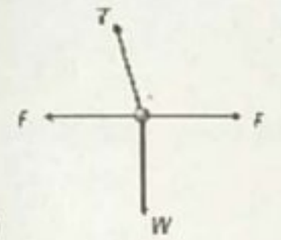




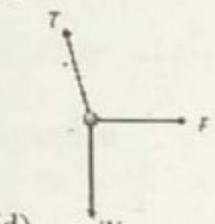
(a)



(b)



(c)



(d)

(43) A stone ties to the end of a string 1m long is whirled in a horizontal circle with a constant speed. If the stone makes 22 revolution in 44 seconds, what is the magnitude and direction of acceleration of the stone

(a) $\pi^2/4$ ms^{-2} and direction along the radius towards the centre

(b) π^2 ms^{-2} and direction along the radius away from the centre

(c) π^2 ms^{-2} and direction along the radius towards the centre

(d) π^2 ms^{-2} and direction along the tangent to the circle

(44) A lift is moving down with acceleration a. A man in the lift drops a ball inside the lift. The acceleration of the ball as observed by the man in the lift

(a) 0 (b) g + a

(c) g (d) g – a

(45) A spring balance is attached to the ceiling of a lift. A man hangs his bag on the spring and the spring reads 49 N, when the lift is stationary. If the lift moves downward with an acceleration of 5m/s^2, the reading of the spring balance will be

(a) 24 N (b) 74 N

(c) 15 N (d) 49 N

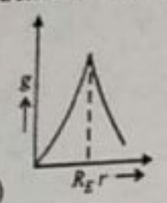
Scanned by CamScanner

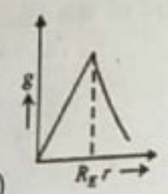
(46) A thin circular ring of mass m and radius R is rotating about its axis of with constant angular velocity ω. Two objects of each mass Mare attached gently to the opposite ends of the ring. The ring now rotates with an angular velocity ω' is equal to

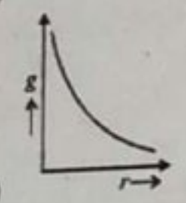
(a) $\frac{\omega(m+2M)}{m}$ (b) $\frac{\omega(m-2M)}{m-2M}$

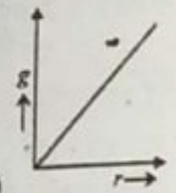
(c) $\frac{\omega m}{m+M}$ (d) $\frac{\omega m}{m+2M}$

(47) Which graph correctly presents the variation of acceleration due to gravity with the distance from the centre of the earth (radius of the earth is R_E)

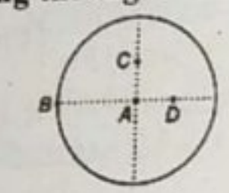
(a) 

(b) 

(c) 

(d) 

(48) The moment of inertia of a uniform circular disc is maximum about an axis perpendicular to the disc and passing through



(a) B (b) D

(c) C (d) A

(49) As we move to pole from equator of earth the our weight

(a) increases (b) remain same

(c) decreases (d) becomes zero

(50) The density of newly discovered planet is twice that of earth. The acceleration due to gravity at the surface of the planet is equal to that at the surface of the earth. If the radius of the earth is R, the radius of the planet would be

(a) 2R (b) 0.25 R

(c) 4R (d) 0.5 R

(51) A body is moving along a circular path with variable speed. It has

(a) a radial acceleration (b) a tangential acceleration

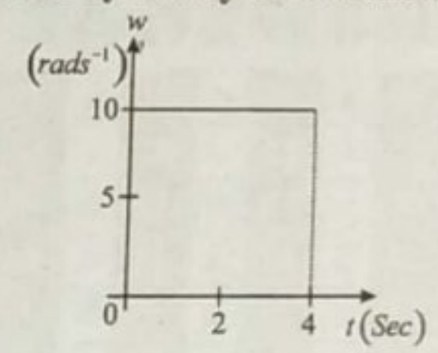
(c) zero acceleration (d) both tangential and radial acceleration

(52) A bucket containing water is tied to one end of a rope of length 2.5m and rotated about the other end in a vertical circle. What should be the minimum velocity of the bucket at the highest point, so that the water in the bucket will not spill

(a) 2.5 ms^{-1} (b) 4ms^{-1}

(c) 5ms^{-1} (d) 7ms^{-1}

(53) The angular displacement covered by a body in the following graph is



(a) 40 rev (b) 20 rev

(c) 30 rad (d) 40 rad

(54) A wheel rotates with a constant angular velocity of 600 rpm. What is the angle through which the wheel rotates in one second?

(a) 5π radian (b) 20π radian

(c) 15π radian (d) 10π radian

(55) Angle between centripetal acceleration and radius vector is

(a) 90° (b) 180°

(c) 0° (d) 45°

(56) If a cycle wheel of radius 0.4m completes one revolution in one second, then acceleration of the cycle is

(a) $0.4\pi ms^{-2}$ (b) $0.8\pi ms^{-2}$

(c) $0.4\pi^2 ms^{-2}$ (d) $1.6\pi^2 \frac{m}{s^{-2}}$

(57) The angular speed of a flywheel making 180 rpm is

(a) $2\pi\ rads^{-1}$ (b) $4\pi\ rads^{-1}$

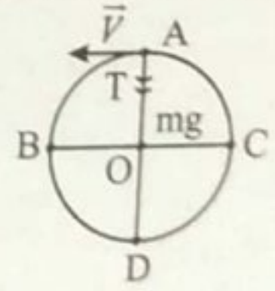
(c) $6\pi\ rads^{-1}$ (d) $3\pi^2\ rads^{-1}$

(58) The angle described in 2sec by an object rotating at a rate of 600 rpm is

(a) $20\pi\ rad$ (b) $40\pi\ rad$

(c) $5\pi\ rad$ (d) zero

(59) A ball tied to the end of a string, is swing in a vertical circle of radius 'r' under the action of gravity as shown in fig. What will be tension in string at 'A'?



(a) minimum (b) equal to weight

(c) equal to centripetal force (d) none

(60) In case of planets the necessary acceleration is provided by

(a) gravitational force (b) coulomb force

(c) normal force (d) tangential force

Scanned by CamScanner

ANSWER KEY

1	b	11	a	21	d	31	a	41	d	51	d
2	b	12	c	22	c	32	c	42	c	52	c
3	c	13	c	23	b	33	b	43	c	53	d
4	c	14	d	24	a	34	b	44	a	54	b
5	a	15	a	25	b	35	b	45	a	55	b
6	b	16	b	26	c	36	a	46	d	56	d
7	b	17	a	27	a	37	d	47	b	57	b
8	d	18	a	28	a	38	d	48	a	58	b
9	b	19	b	29	a	39	c	49	a	59	a
10	c	20	d	30	b	40	d	50	d	60	a

EXPLANATORY NOTES

(1) $T = mg - ma$

$$T = W\left(1 - \frac{a}{g}\right)$$

$$\frac{3}{4} = 1 - \frac{a}{g}$$

$$a = \frac{g}{4}$$

(2) $K.E_{Hoop} = \frac{1}{2}mv^2$

$$K.E_{Disc} = \frac{1}{4}mv^2$$

$$K.E_{Disc} = \frac{1}{2}\left(\frac{1}{2}mv^2\right)$$

$$2K.E_{Disc} = K.E_{Hoop}$$

(3) $\theta = \omega t$

$$\omega = \frac{\theta}{t} = \frac{2\pi}{3600} = \text{rads}^{-1}$$

(4)

$$\frac{T_1}{T_2} = \left(\frac{R_1}{R_2}\right)^{3/2} = \left(\frac{R}{4R}\right)^{3/2} \Rightarrow T_2 = 8T_1$$

(5)

$$\text{Since } T^2 \propto r^3 \therefore \left(\frac{T'}{T}\right)^2 = \left(\frac{1}{4}\right)^3 \Rightarrow T' = \frac{1}{8}T$$

(6) According to Einstein, materials and E.M radiation can interact.

(7)

For first satellite $r_1 = R$ and $T_1 = 83\ minute$ For second satellite $r_2 = 4R$

$$T_2 = T_1\left(\frac{r_2}{r_1}\right)^{3/2} = T_1(4)^{3/2} = 8T_1 = 8 \times 83 = 664 \text{ minutes}$$

(8) Speed of the earth will be maximum when its distance from the sun is minimum because mvr=constant

(9) Direction of 'v' is always along tangent and 'ω' is along axis of rotation.

(10)

$$\omega_{body} = 27\omega_{earth} \qquad T^2 \propto r^3 \Rightarrow \omega^2 \propto \frac{1}{r^3} \Rightarrow \omega \propto \frac{1}{r^{3/2}}\ r \propto \frac{1}{\omega^{2/3}}$$

$$\frac{r_{body}}{r_{earth}} = \left(\frac{\omega_{earth}}{\omega_{body}}\right)^{2/3} = \left(\frac{1}{27}\right)^{2/3} = \frac{1}{9}$$

(11) $F_c = mr\omega^2$

$$F_c = \frac{\pi^2}{4}N$$

(12) $\vec{a} = \vec{\alpha} \times \vec{r}$

(13) In non-uniform circular motion particle possess both centripetal as well as tangential acceleration.

(14)

$$h = \frac{5}{2}r \Rightarrow r = \frac{2}{5} \times h = \frac{2}{5} \times 5 = 2\,metre$$

(15) $\theta = \frac{1}{2}\alpha t^2$

$$\alpha = \frac{2\theta}{t^2} = \frac{2\times 200}{(10^2)} = \frac{400}{100} = 4$$

(16)

$$v = \sqrt{3gr} \text{ and } a = \frac{v^2}{r} = \frac{3gr}{r} = 3g$$

(17) Angular momentum is a axial vector. It is directed always in a fix direction (perpendicular to the plane of rotation either outward or inward), if the sense of rotation remain same.

(18) There is no relation between centripetal and tangential acceleration. Centripetal acceleration is must for circular motion but tangential acceleration may be zero.

(19) When the mass is the lowest point of the vertical circle, the tension is maximum

(20) In rectilinear motion, body moves with constant velocity.

(21)

one revolution = 2π radiation

two revolution = 4π radiation

$S = r\theta$

$$\theta = \frac{s}{r} = \frac{2\pi r}{r} \times 2$$

$\theta = 4\pi$

Scanned by CamScanner

(22) $K.E_{rot} = \frac{1}{2} I\omega^2$

$I = mr^2$

$K.E_{rot} = \frac{1}{2} mr^2\omega^2$

$= \frac{1}{2} mv^2 = K.E_{trans}$

(23) $\omega = \frac{\theta}{t} = \frac{2\pi}{60} = \frac{\pi}{30} \text{ rads}^{-1}$

(24)

$F = \frac{mv^2}{r} \Rightarrow F \propto v^2$. If v becomes double then F (tendency to overturn) will become four times.

(25) Centripetal acceleration = v^2/r = constant. Direction keeps changing.

(26) $T = mg - mg$

$T = 0$

(27) $T = w + ma$

$T = 1000 + (100)10$

$T = 1000(20)$

$T = 2000\,N$

(28) $\vec{F}_c = m\omega^2(-\vec{r})$ the magnitude of the centripetal force remains constant but its direction is continuously changing.

(29)

$$\frac{a_R}{a_r} = \frac{\omega_R^2 \times R}{\omega_r^2 \times r} = \frac{T_r^2}{T_R^2} \times \frac{R}{r} = \frac{R}{r} \quad [\text{As} T_r = T_R]$$

(30)

$$\omega_{min} = \frac{2\pi}{60} \frac{Rad}{min} \text{ and } \omega_{hr} = \frac{2\pi}{12 \times 60} \frac{Rad}{min} \qquad \frac{\omega_{min}}{\omega_{hr}} = \frac{2\pi/60}{2\pi/12 \times 60}$$

(31) $S = vt$

$2\pi R = v \times T$

$$\boxed{\frac{2\pi R}{v} = T}$$

(32)

$$120\,rev/\min = 120 \times \frac{2\pi}{60} rad/\sec = 4\pi\, rad/\sec$$

(33) $T = ma + mg$

$T = m\left(\frac{g}{5} + g\right)$

$= 60\left(\frac{g + 5g}{5}\right)$

$T = 720N$

(34)

$$a = \omega^2 r = 4\pi^2 n^2 r = 4\pi^2 \times 1^2 \times 20 \times 10^3 \quad = 8 \times 10^5\ m/\sec^2$$

(35)

$$\text{Radial force} = \frac{mv^2}{r} = \frac{m}{r}\left(\frac{p}{m}\right)^2 = \frac{p^2}{mr} \text{ [As p = mv]}$$

(36)

$$T = m\omega^2 r \quad 10 = 0.25 \times \omega^2 \times 0.1 \quad \omega = 20\, rad/s$$

(37)

$$v = 36\frac{km}{h} = 10\frac{m}{s} \quad F = \frac{mv^2}{r} = \frac{500 \times 100}{50} = 1000N$$

(38) $T = \frac{2\pi R}{v} \Rightarrow T \propto R$ (mass independent)

(39) Einstein and Newton's theory prediction is related by $\theta_E = 2\theta_N$

(40) $F = \frac{mv^2}{r}$

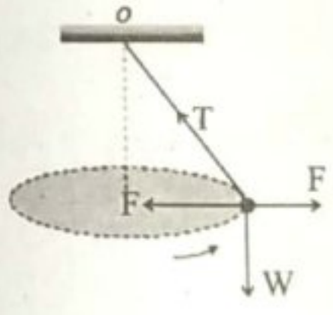
$\frac{F_1}{F_2} = \frac{m_1}{m_2} \times \frac{r_2}{r_1} (v = \text{constant})$

$F_1 : F_2 = m_1 r_1 : m_2 r_2$

(41)

As momentum is vector quantity \ change in momentum $\Delta P = 2mv\sin(\theta/2) = 2mv\sin(90) = 2mv$ But kinetic energy remains always constant so change in kinetic energy is zero.

(42)



(43)

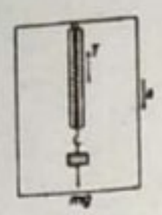
$$a = \frac{v^2}{r} = \omega^2 r = 4\pi^2 n^2 r = 4\pi^2 \left(\frac{22}{44}\right)^2 \times 1 = \pi^2\, m/s^2$$ and its direction is always along the radius and towards the centre.

(44) Both belong to the same frame of reference. So, acceleration is zero.

Scanned by CamScanner

(45)

In stationary position, spring balance reading



= mg = 49

$m = \frac{49}{9.8} = 5\,kg$ When lift moves downward

mg - T = ma

Reading of

balance

T = mg - ma

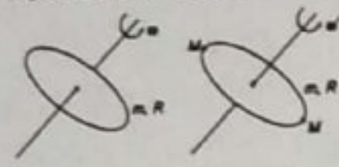
= 5 (9.8 - 5)

$= 5 \times 4.8$

= 24.0 N

(46)

As external torque is acting about the axis, angular momentum of system remains conserved.



$\therefore I_1\omega = I_2\omega' \Rightarrow mR^2\omega = (mR^2 + 2MR^2)\omega' \Rightarrow \omega' = \left(\frac{m}{m+2M}\right)\omega$

(47)

Acceleration due to gravity, $g \propto r (if\ r < R_E)$ and $g \propto \frac{1}{r^2} (if\ r > R_E)$

(48) Moment of inertia of circular disc $=1/2mR^2$

Thus, as the distance between the centre and the point increases, moment of inertia increases.

(49) According to relation $g' = g - R\omega^2 \cos^2\theta$, the value of g is maximum at poles so our weight will increase there.

(50)

Acceleration due to gravity is the acceleration in vertically downward direction acting on every object on earth. Its value is given by Newton's second law which is $g = \frac{F}{m}$ The acceleration due to gravity on an object of mass m $g = \frac{F}{m}$ but from Newton's law of gravitation $F = \frac{GMm}{R^2}$ where M is the mass of the earth and R the radius of earth. $g = \frac{GMm/R^2}{m} = \frac{GM}{R^2}$ Given: $\rho_{planet} = 2\rho_{earth}$

Also, $g_{planet} = g_{earth}$ $\frac{GM_p}{R_p^2} = \frac{GM_g}{R_e^2}$ or $\frac{G \times \frac{4}{3}\pi R_p^3 \rho_p}{R_p^2} = \frac{G \times \frac{4}{3}\pi R_e^3 \rho_e}{R_e^2}$ or $R_p\rho_p = R_e\rho_e$ or

$R_p \times 2\rho_e = R_e\rho_e$ or $R_p = \frac{R_e}{2} = \frac{R}{2}$

(51) Due to variable speed it has both tangential and centripetal acceleration.

(52) $v = \sqrt{gr}$

(53) $\theta = w \times t = 10 \times 4 = 40 rad$

(54) $\theta = \omega t\ ;\ \omega = 600 \times \frac{\pi}{30} = 20\pi$

(55)

(56) $a = \frac{v^2}{r} \therefore v = r\omega$

(57) $\omega = \frac{\theta}{t} = \frac{180 \times 2\pi}{60} = 6\pi\ rads^{-1}$

(58) $\theta = \omega t = \frac{600 \times 2\pi}{60} \times 2 = 40\pi\ rad$

(59) (T = minimum) $T = \frac{mv^2}{r} - mg\cos\theta \therefore \theta = 0°$

(60) Planets are under the action of gravity so necessary centripetal acceleration is provided by gravitational force.

Scanned by CamScanner

Chapter 6 FLUID DYNAMICS

PRACTICE EXERCISE

(1) A small spherical ball falls through a viscous medium of negligible density with terminal velocity v. If another ball of twice the radius of the first one but having the same mass falls through the same medium, its terminal velocity will be

(a) 2v (b) $\frac{v}{\sqrt{2}}$

(c) $\frac{v}{2}$ (d) $\frac{v}{4}$

(2) The density of a block of wood that float in water with 10% of its volume outside water is (density of water is $10^3 kgm^{-3}$)

(a) $10 kgm^{-3}$ (b) $90 kgm^{-3}$

(c) $900 kgm^{-3}$ (d) none of these

(3) Up thrust of water acting on a wooden cube of sides 10cm immersed completely in water is

(a) 5N (b) 10N

(c) 15 N (d) 10^{-1} N

(4) When body moves with terminal velocity the acceleration in the body become

(a) Zero (b) Maximum

(c) Variable (d) Infinite

(5) Terminal velocity is given by equation

(a) $v_t = gr^2\rho/\eta$ (b) $v_t = 2gr^2\rho/9\eta$

(c) $v_t = gr^2\rho/9\eta$ (d) $v_t = 9gr^2\rho/2\eta$

(6) We have three beakers A, B and C containing glycerin, water and kerosene respectively. They are stirred vigorously and placed on a table. The liquid which comes to rest at the earliest is

(a) Glycerin (b) Kerosene

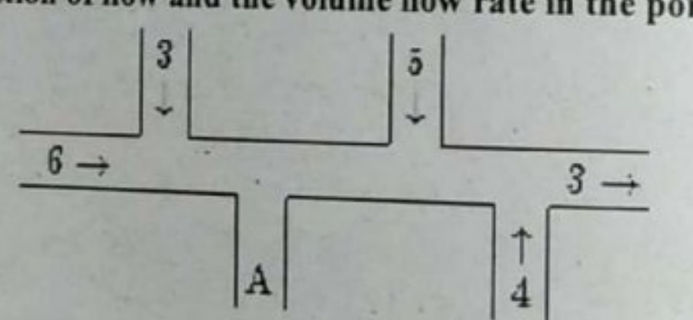
(c) Water (d) All of them at the same time

(7) Up thrust of body is equal to the

(a) Weight of liquid (b) Mass of liquid

(c) Weight of liquid displaced (d) Density of liquid

(8) The diagram shows a pipe of uniform cross section in which water is flowing. The directions of flow and the volume flow rates (in cm^3s^{-1}) are shown for various portions of the pipe. The direction of flow and the volume flow rate in the portion marked A are:



(a) ↓ and $3cm^3/s$ (b) ↑ and $7cm^3/s$

(c) ↑ and $11cm^3/s$ (d) ↓ and $15cm^3/s$

(9) The velocity of flow of a liquid through an orifice at the bottom of a tank depends on the

(a) density of liquid (b) height of liquid above the orifice

(c) acceleration due to gravity (d) both "b" and "c"

(10) An ideal fluid flows through horizontal tube of variable diameter. The pressure is lowest where the

(a) Velocity is highest (b) Diameter is smallest

(c) Diameter is largest (d) Both a and b

(11) Two solid spheres of same metal but of mass M and 8M fall simultaneously on a viscous liquid and their terminal velocity are v and 'nv' then value of 'n' is

(a) 16 (b) 8

(c) 4 (d) 2

(12) Equation of continuity is obtained by applying law of conservation of

(a) Mass (b) Energy

(c) Momentum (d) All

(13) Bernoulli's equation is applicable to

(a) Flow of liquids (b) Viscosity

(c) Surface tension (d) All of these

(14) Speed of efflux can be determined by applying

(a) Bernoulli's theorem (b) Torricelli's theorem

(c) Venture relation (d) Stoke's law

(15) A constriction in a pipe reduces its diameter from 4.0cm to 2 .0cm. Where the pipe is narrow the water speed is 8.0m/s. Where it is wide the water speed is:

(a) 16m/s (b) 32m/s

(c) 4.0m/s (d) 2.0m/s

(16) If a stream of air is blown under one of the pans of a physical balance in equilibrium, then pan may

(a) Go up (b) Not effected

(c) Go down (d) None of these

(17) A man standing near a fast-moving train may fall

(a) Over the train (b) Away from the train

(c) Towards the train (d) On himself

(18) For which position, maximum blood pressure in the body have the smallest value?

(a) Standing straight (b) Sitting on chair

(c) Sitting on ground (d) Lying horizontally

(19) Two fog droplets have radii 2:3, their terminal velocities are

(a) 4:6 (b) 4:9

(c) 2:9 (d) 4:3

(20) Bernoulli's equation is obtained by applying law of conservation of

(a) Mass (b) Energy

(c) Momentum (d) Fluid

(21) Venturi meter is used to measure

(a) Fluid pressure (b) Fluid density

(c) Fluid speed (d) Fluid energy

(22) A large water tank, open at the top, has a small hole in the bottom. When the water level is 30m above the bottom of the tank, the speed of the water leaking from the hole is

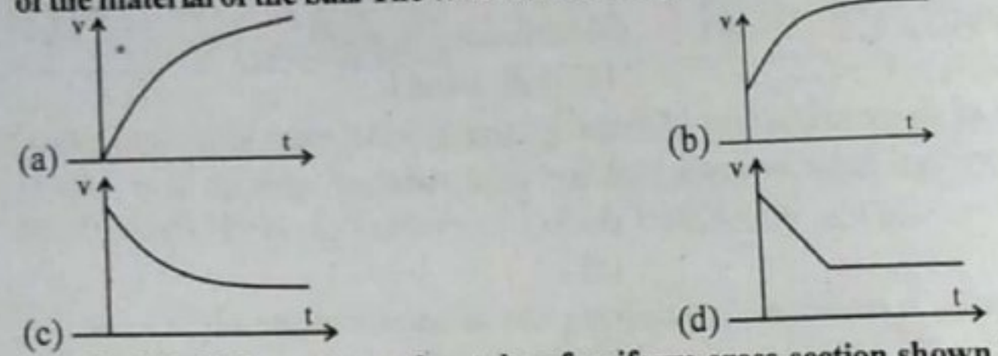
(a) 24.24 m/s (b) 27.27 m/s

(c) 44.44 m/s

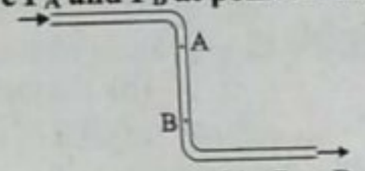
(d) Cannot be calculated without knowing areas of hole and tank

Scanned by CamScanner

(23) **A small spherical ball is dropped from some height into a viscous liquid of density smaller than that of the material of the ball. The variation of the speed of the ball inside the liquid is described by**



(24) **An ideal fluid flows through a tube of uniform cross-section shown in the figure. The liquid has velocities v_A and v_B and pressure P_A and P_B at point A and B respectively. The**



(a) $v_A = v_B$ (b) $P_A = P_B$
(c) $v_B < v_A$ (d) Both a and b

(25) **Systolic pressure is called**
(a) Lower blood pressure (b) Higher blood pressure
(c) Normal blood pressure (d) Abnormal blood pressure

(26) **Instrument used to measure blood pressure is called**
(a) Venturimeter (b) Blood pressure
(c) Sphygmomanometer (d) Sonometer

(27) **A chimney works best if air exposed to the chimney is**
(a) Stationary (b) Moving
(c) Moving slowly (d) Moving fast

(28) **Which one is venturi relation?**
(a) $P_1 - P_2 = \frac{1}{2}\rho v_2^2$ (b) $P_1 - P_2 = \frac{1}{2}\rho v_1^2$
(c) $P + \frac{1}{2}\rho v^2 = \text{constant}$ (d) Both "a" and "b"

(29) **The effect of the decrease in pressure with the increase of the speed of fluid in a horizontal pipe is known as**
(a) Bernoulli`s effect (b) Torricelli`s effect
(c) Venturi effect (d) Stoke's effect

(30) **Density of metal spoon when its weight in air is 0.48 N and in water is 0.42 N is**
(a) 1000 kg m^{-3} (b) 5000 kg m^{-3}
(c) 2000 kg m^{-3} (d) 8000 kg m^{-3}

(31) **Laminar flow usually occurs at speeds which are**
(a) low (b) high
(c) very high (d) some time high and some time low

(32) **For _____ flow the path of the fluid particles cannot be tracked.**
(a) Laminar (b) Streamline
(c) Turbulent (d) Both (a) and (b)

(33) **Sphygmomanometers measure blood pressure.**
(a) Statically (b) Dynamically
(c) Sometime static and sometime dynamic (d) None of these

(34) **Carburetor of a car is an application of**
(a) Venturi meter (b) Bernoulli's equation
(c) Equation of continuity (d) Torricelli's theorem

(35) **The blood flow is _____ flow at systolic pressure**
(a) Laminar (b) Turbulent
(c) Mixed (d) None

(36) **A person blows across the top of one arm of a U-tube partially filled with water. The water in that arm:**
(a) Drops slightly
(b) Rises slightly
(c) Rises if the blowing is soft but drops if it is hard
(d) Remains at the same height

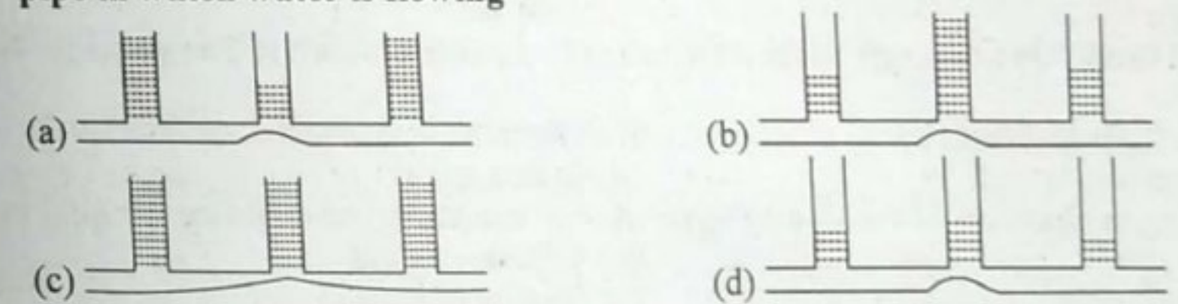
(37) **Bernoulli's equation is applicable for**
(a) Laminar flow (b) Turbulent flow
(c) Static fluids (d) All kinds of flow

(38) **A small sphere is dropped into a medium of infinite extent. As the sphere falls, then which of the following is correct?**

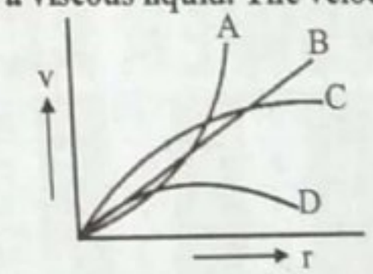
	Net Force	Weight	Drag Force
(a)	Increases	Remain same	Increases
(b)	Decreases	Increases	Decreases
(c)	Decreases	Remain same	Increases
(d)	Remain same	Remain same	Increases

(39) **The speed of the fluid is maximum in the venture-meter at**
(a) Does not change (b) Increases
(c) Varies accordingly (d) Decreases

(40) **Which figure shows correct representation of water level in capillaries attached with pipe in which water is flowing**



(41) **A small solid ball is released in a viscous liquid. The velocity of ball is given by:**

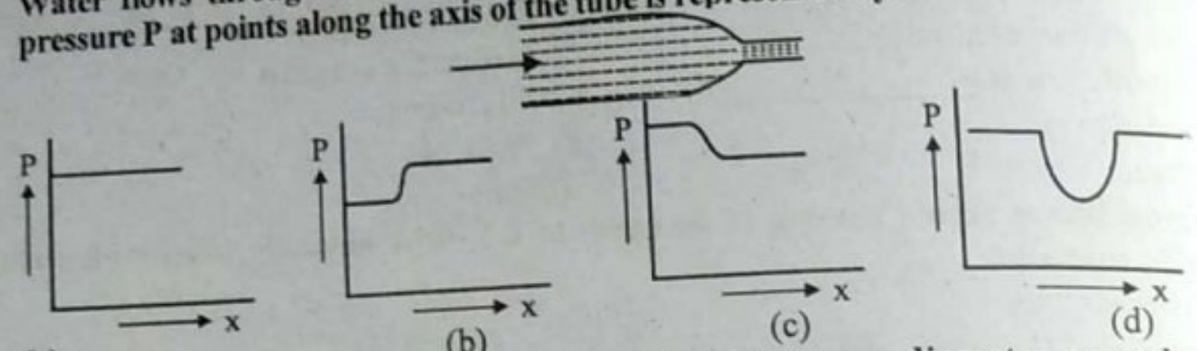


(a) Curve A (b) Curve B
(c) Curve C (d) Curve D

(42) **A piece of wood is taken deep inside a long column of water and released. It will move up**
(a) with a constant upward acceleration. (b) with a decreasing upward acceleration
(c) with a deceleration. (d) with a uniform velocity

Scanned by CamScanner

(43) **Water flows through a frictionless duct with a cross-section varying as shown in fig. The pressure P at points along the axis of the tube is represented by:**



(a) (b) (c) (d)

(44) **A solid iron ball and a solid aluminum ball of the same diameter are released together on a deep lake. Which ball will reach the bottom first?**
(a) Aluminium ball
(b) Iron ball
(c) Both balls will reach the bottom at the same time
(d) The aluminium ball will never reach the bottom and will remain suspended in the lake

(45) **The dimensions of velocity gradient are**
(a) T^{-1} (b) T (c) T_2 (d) T^0

(46) **Eight spherical rain drops of the same mass and radius are falling down with a terminal speed of 6 cms^{-1}. If they coalesce to form one big drop, what will be its terminal speed? Neglect the buoyancy due to air.**
(a) 1.5 cms^{-1} (b) 6 cms^{-1}
(c) 24 cms^{-1} (d) 32 cms^{-1}

(47) **When body moves with terminal velocity the acceleration in the body become**
(a) Zero (b) Maximum
(c) Variable (d) Infinite

(48) **The relative velocity of two consecutive layers is 8 cm/s. If the perpendicular distance between the layers is 0.1 cm, then the velocity gradient will be**
(a) 8 sec^{-1} (b) 80 sec^{-1}
(c) 0.8 sec^{-1} (d) 0.08 sec^{-1}

(49) **An ideal fluid flows through horizontal tube of variable diameter. The pressure is lowest where the**
(a) Velocity is highest (b) Diameter is smallest
(c) Diameter is largest (d) Both a and b

(50) **According to equation of continuity $A_1v_1 = A_2v_2$ = constant, the constant is equal to**
(a) Flow rate (b) Volume of fluid
(c) Mass of fluid (d) Density of fluid

ANSWER KEY

1	c	11	c	21	c	31	a	41	c
2	c	12	a	22	a	32	c	42	b
3	b	13	a	23	c	33	b	43	c
4	a	14	b	24	d	34	b	44	a
5	b	15	d	25	b	35	b	45	a
6	a	16	c	26	c	36	b	46	c
7	c	17	c	27	d	37	a	47	a
8	d	18	d	28	a	38	c	48	b
9	d	19	b	29	a	39	c	49	d
10	d	20	b	30	d	40	a	50	a

EXPLANATORY NOTES

(1)

$$v_t = \frac{mg}{6\pi\eta r}$$

$$v_t \propto \frac{1}{r}$$

$$\frac{v_{t_1}}{v_{t_2}} = \frac{2r}{r}$$

$$\frac{v_{t_1}}{2} = v_{t_2}$$

(2)

90% of volume of wood causes to float the wooden block.

$$\Rightarrow 90\% \text{ of } 1000 = \frac{90}{100} \times 1000 = 900\,\text{kgm}^{-3}$$

(3)

$$F = mg = \rho Vg$$
$$= 1000 \times (10\text{cm})^3 \times 10$$
$$= 1000 \times 10^3 \times (10^{-2})^3 \times 10$$
$$= 10^6 \times 10^{-6} \times 10 = 10\text{N}$$

(4) Acceleration is zero because net force is zero in case of terminal velocity.

(5) $$v_t = \frac{2\rho g r^2}{9\eta}$$

(6) Glycerin has more viscosity.

(7) Up thrust of body is equal to weight of liquid displaced. $F = \rho gv$

(8) Volume rate flow in = Volume flow rate out

(9) Velocity of flow of a liquid through an orifice at the bottom of a tank depends on the g and height of liquid above orifice.

$$v = \sqrt{2gh}$$

(10) Pressure of fluid is lowest, where the diameter is smaller and speed is high.

Scanned by CamScanner

(11) Mass = volume x density

$$\Rightarrow M = \frac{4}{3}\pi r^3 \times \rho$$

As the density remains constant

$M \propto r^3$

$r \propto m^{1/3}$

$$\frac{r_1}{r_2} = \frac{(m_1)^{1/3}}{(m_2)^{1/3}} = \frac{(M)^{1/3}}{(8M)^{1/3}} = \frac{1}{2}$$

$r_2 = 2r$

$$v_t = \frac{2\rho g r^2}{9\eta}$$

$$\frac{v_2}{v_1} = \frac{r_2^2}{r_1^2}$$

$$\frac{nv}{v} = \frac{(2r_1)^2}{r_1^2}$$

$\boxed{n = 4}$

(12) $\Delta m_1 = \Delta m_2$ (law of conservation of mass)

(13) General equation of fluid dynamics.

(14) Speed of efflux can be determined by applying Torricelli's theorem.

(15) $A_1 v_1 = A_2 v_2$

$$\frac{\pi}{4} d_1^2 v_1 = \frac{\pi}{4} d_2^2 v_2$$

$$d_1^2 v_1 = \frac{d_1^2}{4} \times 8$$

$v_1 = 2ms^{-1}$

(16) Pressure decreases under one of the pans, so due to pressure difference pan moves downward.

(17) Due to pressure difference a person may fall towards train.

(18) Maximum blood pressure has smallest value in body while lying horizontal.

(19) For density same

$v_t \propto r^2$

(20) Bernoulli's equation is accordance with law of conservation of energy.

(21) Use of venturi meter

(22) $v = \sqrt{2g(h_1 - h_2)} = \sqrt{2 \times 10 \times 30} = 24.5 ms^{-1}$

(23) $v_{initial} > v_t$ (v_t is constant)

(24) Speed and pressure will be same for same cross-sectional area of pipe.

(25) 120 torr (Systolic), 80 torr diastolic

(26) Basic definition.

(27) v decreases and P increases.

(28) $P_1 - P_2 = \frac{1}{2}\rho v_2^2$

(29) One of application of Bernoulli's equation.

(30) Relative density = $\frac{\text{weight in air}}{\text{loss of weight in water}} = \frac{\rho'}{\rho} = \frac{0.48}{0.06} \Rightarrow \rho' = 8000 kgm^{-3}$

(31) At low speed (laminar flow), at high speed (turbulent flow)

(32) (Irregular flow)

(33) Sphygmomanometer measures dynamic pressure of blood.

(34) Carburetor is an application of Bernoulli's equation.

(35) At systolic pressure, blood flow is turbulent.

(36) Speed is high pressure is low above U-tube partially filled with water.

(37) Bernoulli's equation is derived for laminar flow.

(38)

$\uparrow F_d = 6\pi\eta r v \uparrow$

$\downarrow F_{net} = W(\text{constant}) - F_d \uparrow$

(39) Speed of fluid varies accordingly.

(40) Where diameter of pipe is narrow, pressure will be low and water level decreases.

(41) Velocity goes on increasing till it reach maximum value which is terminal velocity.

(42) Acceleration decreases before attaining terminal velocity.

(43) Pressure $\propto$ Area

(44) $v_t \propto m$

(45) Velocity gradient = $\frac{\Delta v}{\Delta x}$

(46)

$v_t = n^{\frac{2}{3}} v$

$v_t = (8)^{\frac{2}{3}} 6$

$= (2)^{\frac{2}{3}} 6$

$= 24 cms^{-1}$

Scanned by CamScanner

(47) Since terminal velocity is a maximum constant velocity, so acceleration will be zero.

(48) Velocity gradient $= \frac{\Delta v}{\Delta x}$

(49) $A \propto \frac{1}{v} \propto P \propto r \propto d$

(50)

$$A_1 v_1 = A_2 v_2$$

$$Av = \frac{V}{t}$$

$$\frac{V}{t} = \text{constant} = \text{flow rate}$$

6 Chapter FLUID DYNAMICS

SELF ASSESSMENT TEST

(1) Which of the given has the least coefficient of viscosity

(a) milk (b) water

(c) tarcoal (d) engine oil

(2) The rain drop falling from the sky reach the ground with

(a) constant acceleration (b) terminal velocity

(c) constant pressure (d) variable acceleration

(3) Human blood pressure is measured in

(a) pascal (b) Nm^{-2}

(c) mm Hg (d) cm Hg

(4) A 3m tall cylinder, full of water, has four identical small holes at height 2.1m, 2.2m, 2.3, and 2.4m, the speed of efflux is minimum from

(a) 2.4 m high hole (b) 2.3 m high hole

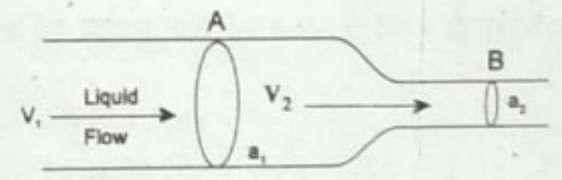
(c) 2.2 m high hole (d) 2.1 m high hole

(5) Terminal velocity is given by equation

(a) $V_t = gr^2\rho/\eta$ (b) $V_t = 2gr^2\rho/9\eta$

(c) $V_t = gr^2\rho/9\eta$ (d) $V_t = 9gr^2\rho/2\eta$

(6) A liquid flows through a tube of non-uniform area of cross section the ratio of velocities of liquid at A to B is



(a) $\sqrt{\frac{a_1}{a_2}}$ (b) $\sqrt{\frac{a_2}{a_1}}$

(c) $\frac{a_1}{a_2}$ (d) $\frac{a_2}{a_1}$

(7) The flow of ideal fluid is

(a) turbulent (b) streamline

(c) along straight path (d) all of these

(8) Which of the following is true?

(a) on increase in temperature viscosity of gases decrease

(b) on increase in temperature viscosity of liquid increase

(c) there is no effect on viscosity of lubricate of car engine due to temperature

(d) viscosity does not depend on temperature

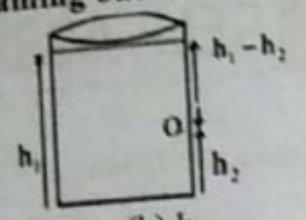
(9) When fluid is incompressible then

(a) velocity of the fluid is constant (b) flow of the fluid is along straight line

(c) density of the fluid is constant (d) volume of the fluid is constant

Scanned by CamScanner

(10) **The speed of efflux of a liquid streaming out of an orifice 'O' in a tank depends on**



(a) can't be predicted (b) h_2
(c) h_1 (d) $h_1 - h_2$

(11) **The velocity of liquid below which its flow is laminar is called**
(a) critical velocity (b) escape velocity
(c) relative velocity (d) terminal velocity

(12) **The pressure will be high where the speed of fluid is**
(a) low (b) zero
(c) high (d) constant

(13) **The characteristic of an ideal fluid is**
(a) stream line flow (b) ρ = constant
(c) non viscous (d) all

(14) **Speed of efflux can be determined by applying**
(a) Bernoulli's theorem (b) Torricelli's theorem
(c) Venturi relation (d) Stoke's law

(15) **A constriction in a pipe reduces its diameter from 4.0cm to 2 .0cm. Where the pipe is narrow the water speed is 8.0m/s. Where it is wide the water speed is:**
(a) 16m/s (b) 32m/s
(c) 4.0m/s (d) 2m/s

(16) **If a stream of air is blown under one of the pans of a physical balance in equilibrium, then pan may**
(a) go up (b) not effected
(c) go down (d) none of these

(17) **A man standing near a fast moving train may fall**
(a) over the train (b) away from the train
(c) towards the train (d) on himself

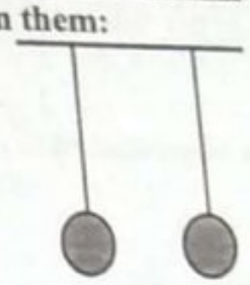
(18) **For which position, maximum blood pressure in the body have the smallest value?**
(a) standing straight (b) sitting on chair
(c) sitting on ground (d) lying horizontally

(19) **Two fog droplets have radii 2:3, their terminal velocities are**
(a) 4:6 (b) 4:9
(c) 2:9 (d) 4:3

(20) **Water is flowing through a tube of radius r with a speed v. If this tube is joined to another tube of radius r/2, what is the speed of water in the second tube?**
(a) $\frac{v}{4}$ (b) $\frac{v}{2}$
(c) $2v$ (d) $4v$

(21) **Venturi meter is used to measure**
(a) fluid pressure (b) fluid density
(c) fluid speed (d) fluid energy

Question 22 and 23 are based on the following data: Two light balls are suspend as shown in figure. When a stream of air passes between them:



(22) **The pressure between them?**
(a) Increases (b) Decreases
(c) Remains same (d) Data is insufficient

(23) **The distance between them?**
(a) Increases
(b) Decreases
(c) Remains same
(d) May increase or decrease depending upon speed of air

(24) **Stoke's law is applicable if body has_____ shape**
(a) rough (b) square
(c) spherical (d) all of these

(25) **The maximum drag force on a sphere falling with zero acceleration is 9.8N. Its real weight is**
(a) zero (b) 9.8 N
(c) 4.9N (d) 19.6N

(26) **Instrument used to detect blood pressure is called**
(a) venturimeter (b) blood pressure
(c) stethoscope (d) sphygmomanometer

(27) **A rain drop of radius "r" fall in air with a terminal speed v_1. What is the terminal speed of a rain drop of radius r/3**
(a) 6r (b) 9r
(c) r/6 (d) r/9

(28) **Which one is venturi relation?**
(a) $P_1 - P_2 = \frac{1}{2}\rho v_2^2$ (b) $A_1v_1 = A_2v_2$
(c) $P + \frac{1}{2}\rho v^2 = \text{constant}$ (d) Both "a" and "b"

(29) **The effect of the decrease in pressure with the increase of the speed of fluid in a horizontal pipe is known as**
(a) Bernoulli's effect (b) Torricelli's effect
(c) Venturi effect (d) Stoke's effect

(30) **Two spheres of equal masses but radii R and 2R are allowed to fall in a liquid. The ratio of their terminal velocities is**
(a) 1 : 4 (b) 1 : 2
(c) 1 : 32 (d) 2 : 1

(31) **Laminar flow usually occurs at speeds which are**
(a) low (b) high
(c) very high (d) some time high and sometime low

Scanned by CamScanner

(32) **Two solid spheres of same metal but of mass M and 8M fall simultaneously on a viscous liquid and their terminal velocity are v and 'nv' then value of 'n' is**
(a) 16 (b) 8
(c) 4 (d) 2

(33) **Sphygmomanometers measure blood pressure**
(a) statically
(b) dynamically
(c) some time static and some time dynamic
(d) none of these

(34) **Carburetor of a car is an application of**
(a) Venturi meter (b) Bernoulli's equation
(c) Equation of continuity (d) Torricelli's theorem

(35) **The blood flow is _____ flow at systolic pressure**
(a) laminar (b) turbulent
(c) mixed (d) none

(36) **A person blows across the top of one arm of a U-tube partially filled with water. The water in that arm:**
(a) drops slightly
(b) rises slightly
(c) rises if the blowing is soft but drops if it is hard
(d) remains at the same height

(37) **Bernoulli's equation is applicable for**
(a) laminar flow (b) turbulent flow
(c) static fluids (d) all kinds of flow

(38) **The density of human blood is nearly equal to**
(a) water (b) honey
(c) mercury (d) oil (kerosene)

(39) **The speed of the fluid is maximum in the venture-meter at**
(a) convergent duct (b) divergent duct
(c) at end points (d) at any point

(40) **Which of the term in Bernoulli's equation** $P+\frac{1}{2}\rho v^2+\rho gh=\text{constant}$ **represents pressure?**
(a) P (b) ρgh
(c) $\frac{1}{2}\rho v^2$ (d) All

(41) **The coefficient of viscosity of a liquid does not depend upon**
(a) the density of liquid (b) temperature of liquid
(c) pressure of liquid (d) nature of liquid

(42) **When the velocity of a liquid is greater than its critical velocity then the flow of liquid will be**
(a) streamline
(b) turbulent
(c) sometimes streamline and sometimes turbulent
(d) none of the above

(43) **There is a small hole of diameter 2mm in the wall of a water tank at a depth of 10m below water surface the velocity of efflux of water from the hole will be**
(a) 0.14 ms^{-1} (b) 1.4 ms^{-1}
(c) 0.014 ms^{-1} (d) 14 ms^{-1}

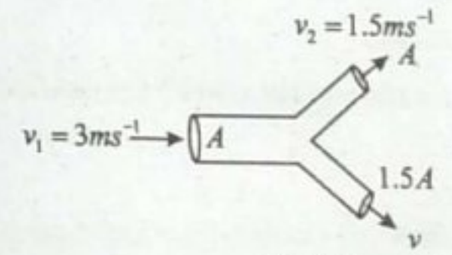
(44) **Water is flowing with a velocity of 3ms^{-1} in a pipe of diameter 4 cm. This water enters another tube of diameter 2cm. The velocity of water in this tube is**
(a) 12 ms^{-1} (b) 6 ms^{-1}
(c) 1.5 ms^{-1} (d) 3 ms^{-1}

(45) **The cause of floating of clouds in atmosphere is**
(a) low viscosity (b) low temperature
(c) low pressure (d) low density

(46) **Water flowing through hose having diameter 1 cm at speed of 1 ms^{-1} if water is to emerge at 21 ms^{-1}, diameter of nozzle should be**
(a) 0.2 cm (b) 0.1 cm
(c) 0.01 cm (d) 0.02 cm

(47) **When magnitude of drag force gets equal to weight of drop, net force acting on a drop becomes**
(a) 1 (b) 0
(c) minimum (d) maximum

(48) **An incompressible liquid flows through a horizontal tube as shown in the following fig. Then velocity v of fluid?**



(a) 3 ms^{-1} (b) 1.5 ms^{-1}
(c) 1.0 ms^{-1} (d) 2.25 ms^{-1}

(49) **A good lubricant should have**
(a) high viscosity (b) low viscosity
(c) moderate viscosity (d) high density

(50) **According to the equation of continuity when water falls then its speed increases while its cross-sectional area**
(a) increases (b) decreases
(c) same (d) different

ANSWER KEY

1	b	11	a	21	c	31	a	41	c
2	b	12	a	22	b	32	c	42	b
3	c	13	d	23	b	33	b	43	d
4	a	14	b	24	c	34	b	44	a
5	b	15	d	25	b	35	b	45	d
6	d	16	c	26	c	36	b	46	a
7	b	17	c	27	d	37	a	47	b
8	c	18	d	28	a	38	a	48	c
9	c	19	b	29	a	39	a	49	a
10	d	20	d	30	d	40	d	50	b

Scanned by CamScanner

EXPLANATORY NOTES

(1) Coefficient of viscosity $\propto \frac{1}{\text{flow rate}}$

(2) $F_d = W$

$v_t = \frac{2\rho g r^2}{9\eta} = \text{constant}$

$a = 0$

(3) General information

(4) $v = \sqrt{2g(h_1 - h_2)}$

$v \propto \sqrt{h_1 - h_2}$ where, $h_1 - h_2$ = depth

(5) $v_t = \frac{2\rho g r^2}{9\eta}$

(6) $A_1v_1 = A_2v_2$

(7) Ideal fluid is incompressible, having streamline flow and have zero viscosity.

(8) Viscosity of lubricants remain same

(9) Incompressible mean ρ = constant

(10) $v = \sqrt{2g(h_1 - h_2}$ where h_1-h_2 is the height above the orifice which is directly proportional to v

(11) Definition

(12) Bernoulli's application

(13) Ideal fluid is incompressible, having streamline flow and have zero viscosity.

(14) By using Torricelli's theorem, we can determine speed of efflux $v = \sqrt{2g(h_1 - h_2)}$

(15) $A_1v_1 = A_2v_2$

$v_1 = \frac{A_2v_2}{A_1} = \frac{d_2^2v_2}{d_1^2} = \frac{4\times 8}{16} = 2\text{m/s}$

(16) The stream of air, below the pan reduces the pressure and the pressure difference causes to move pan downward.

(17) $v \propto \frac{1}{P}$

(18) All organs of the body are at same level with the heart. So, heart apply the least pressure on pumping the blood.

(19) $v_t = \frac{2\rho g r^2}{9\eta} \Rightarrow v_t \propto r^2$

$\frac{v_1}{v_2} = \frac{r_1^2}{r_2} = \frac{4}{9}$

(20) $A_1v_1 = A_2v_2$

$v_2 = \frac{r_1^2 v_1}{r_2^2}$

$v_2 = 4v_1$

(21) Venturimeter measures fluid speed.

$P_1 - P_2 = \frac{1}{2}\rho v_2^2$

(22) Where the speed is high pressure will be low.

(23) Where the speed is high pressure will be low. So, the distance between the balls will decrease.

(24) Stokes law is applicable for spherical objects.

(25) $F_{drag} = W$

(26) Stethoscope is used to detect the instant for measuring blood pressure.

(27) $v_t \propto r^2$

(28) $P_1 - P_2 = \frac{1}{2}\rho v_2^2$

(29) Where speed is high and pressure will be low. This is Bernoulli's principle.

(30) $v_t = \frac{mg}{6\pi\eta r}$

$v_t \propto \frac{1}{r} \Rightarrow \frac{(v_t)_1}{(v_t)_2} = \frac{r_2}{r_1}$

(31) At low speeds flow is always laminar.

(32) $\because v_t \propto m^{2/3}$

$\frac{nv}{v} = \left(\frac{8M}{M}\right)^{2/3} = \left(2^3\right)^{2/3} = 2^2 \Rightarrow n = 4$

(33) It measures blood pressure dynamically.

(34)

(35) Blood vessels are in contracted position at systolic pressure.

(36) When person blows across the top of one arm, the pressure reduces and the pressure difference causes water to rises in that arm.

(37) If flow is laminar and then Bernoulli's equation is applicable.

(38) $\rho_{water} \approx \rho_{blood}$

(39) $A \propto \frac{1}{v} \propto P$

(40) In Bernoulli's equation $P + \frac{1}{2}\rho v^2 + \rho gh = \text{constant}$

P = Static pressure

$\frac{1}{2}\rho v^2$ = Dynamic pressure

ρgh = Depth pressure

(41) Coefficient of viscosity is independent of pressure of liquid.

(42) If velocity of fluid is less then critical velocity than flow of fluid is laminar. If velocity of fluid is greater than critical velocity than flow of fluid is turbulent.

(43) $v = \sqrt{2gh} = \sqrt{2\times 9.8\times 10} = \sqrt{196} = 14ms^{-1}$

(44) $\frac{v_1}{v_2} = \frac{d_2^2}{d_1^2} \Rightarrow v_2 = \frac{d_1^2}{d_2^2}\times v_1 = \frac{16cm}{4cm}\times 3ms^{-1} = 12ms^{-1}$

Scanned by CamScanner

Chapter-6

(45) Due to less density, it is lighter.

(46) $\frac{v_1}{v_2}=\frac{d_2^2}{d_1^2}\Rightarrow\frac{1}{25}=\frac{d_2^2}{1cm^2}$

$\sqrt{\frac{1cm^2}{25}}=d_2$

$0.2cm=d_2$

(47) $F_{net}=W-F_d$

$When \quad W=F_d$

$F_{net}=W-W=0$

(48) $A_1v_1=A_2v_2+A_3v_3$

$3A=1.5A+1.5Av$

$1.5A=1.5Av$

$\frac{1.5A}{1.5A}=v$

$1ms^{-1}=v$

(49) Property of good lubricant.

(50) $Av=$ constant

$v\propto\frac{1}{A}$

Speed of fluid and area is inversely proportional.

Chapter 7 OSCILLATIONS

PRACTICE EXERCISE

(1) A block attached to an ideal spring undergoes simple harmonic motion. The acceleration of the block has its maximum magnitude at the point where

(a) The speed is the maximum
(b) The potential energy is the minimum
(c) The speed is the minimum
(d) The restoring force is the minimum

(2) A student measures the maximum speed of a block undergoing simple harmonic oscillations of amplitude A on the end of an ideal spring. If the block is replaced by one with twice the mass but the amplitude of its oscillations remains the same, then the maximum speed of the block will

(a) Decrease by a factor of 4
(b) Decrease by a factor of 2
(c) Decrease by a factor of $\sqrt{2}$
(d) Remain the same

(3) A simple pendulum of frequency f is dropped from a certain height along with its support so that it falls freely under gravity. The frequency of oscillations of the falling pendulum will

(a) Remain equal to f
(b) Become greater than f
(c) Become less than f.
(d) Became zero

(4) A simple pendulum swings about the vertical equilibrium position with a maximum angular displacement of 5° and period T. If the same pendulum is given a maximum angular displacement of 10°, then which of the following best gives the period of the oscillations?

(a) $\frac{T}{2}$
(b) $\frac{T}{\sqrt{2}}$
(c) T
(d) $T\sqrt{2}$

(5) The acceleration of a projection on the diameter for a particle moving along a circle is

(a) ω^2x
(b) ωx^2
(c) $-\omega^2x$
(d) $-\omega x^2$

(6) A simple pendulum of frequency f has a metal bob. If the bob is charged negatively and is allowed to oscillate with a positively charged plate placed under it, the frequency will

(a) Remain equal to f
(b) Become less than f
(c) Become more than f
(d) Become zero

(7) A student is performing a lab experiment on simple harmonic motion. She has two different springs (with force constants k_1 and k_2) and two different blocks (of masses m_1 and m_2). If $k_1 = 2k_2$ and $m_1 = 2m_2$, which of the following combinations would give the student the spring–block simple harmonic oscillator with the shortest period?

(a) The spring with force constant k_1 and the block of mass m_1
(b) The spring with force constant k_1 and the block of mass m_2
(c) The spring with force constant k_2 and the block of mass m_1
(d) The spring with force constant k_2 and the block of mass m_2

(8) The length of second's pendulum on the surface of earth is 1m, its length on the surface of the moon, where g is $1/6^{th}$ value of g on the earth is

(a) Remain same
(b) 6m
(c) 1/6m
(d) 1/36m

Scanned by CamScanner

(9) If length of a pendulum becomes four times, then its time period will become
(a) Four times (b) Six times
(c) Eight time (d) Two times

(10) The force responsible for the vibratory motion of the simple pendulum is
(a) mg sinθ (b) mg cosθ
(c) mg tanθ (d) mg

(11) The tension in the string of simple pendulum is
(a) Constant (b) Maximum at the extreme position
(c) Maximum at the mean position (d) Zero at the mean position

(12) The waves produced in microwave oven have wavelength of
(a) 12 m (b) 1.2 cm
(c) 12 cm (d) 12 μm

(13) The SI unit of force constant is identical with that of
(a) Force (b) Pressure
(c) Surface tension (d) Loudness

(14) When the amplitude of a SHM become double, its energy become
(a) Double (b) Four times
(c) One half (d) None time

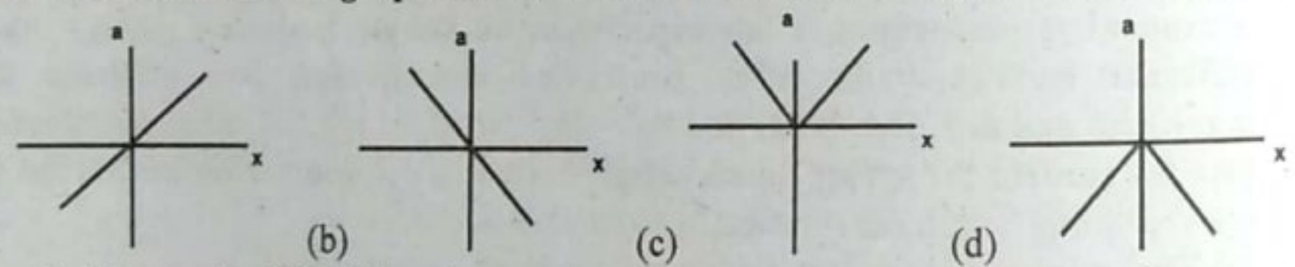
(15) A particle oscillating in simple harmonic motion is
(a) Never in equilibrium because there is always a force
(b) Never in equilibrium because it is in motion
(c) In equilibrium at the center of its path because the acceleration is zero there
(d) in equilibrium at the ends of its path because its velocity is zero there

(16) A uniform spring has a certain mass suspended from it and its period for vertical oscillations is T, The spring is now cut into two equal halves and the same mass is suspended from one of the halves. The period of vertical oscillations now is T_2. The ratio $\frac{T_1}{T_2}$ is

(a) $\frac{1}{2}$ (b) $\frac{1}{\sqrt{2}}$
(c) 2 (d) $\sqrt{2}$

(17) If a hollow bob of a simple pendulum be filled with mercury that drains out slowly, its time period
(a) Increases continuously (b) Decreases continuously
(c) Remain same (d) First increases then decreases

(18) Which one is the correct graph between acceleration 'a' and displacement 'x' for SHM?



(a) (b) (c) (d)

(19) The displacement of SHM is written as $x = x_0 \sin\omega t$. If displacement is written as $x = x_0 \cos\omega t$ then phase constant will be equal to
(a) 0° (b) 45°
(c) 90° (d) 180°

(20) For what displacement the P.E of SHM becomes 1/4 of its maximum value?
(a) $x = x_0$ (b) $x = x_0/2$
(c) $x = x_0/4$ (d) $x = x_0^2/2$

(21) K.E and P.E of a spring mass system executing SHM become equal at which displacement? (A being the amplitude)
(a) $\pm\sqrt{2}A$ (b) $\pm\frac{1}{\sqrt{2}}A$
(c) $\pm\frac{1}{2}A$ (d) $\frac{1}{\sqrt{2}}A$

(22) When a mass m is hung from the lower end of a spring of negligible mass, an extension x is produced in the spring. The mass is set into vertical oscillations. The time period of oscillation is:
(a) $T = 2\pi\frac{\sqrt{x}}{mg}$ (b) $T = 2\pi\frac{\sqrt{gx}}{m}$
(c) $T = 2\pi\sqrt{\frac{x}{g}}$ (d) $T = 2\pi\frac{\sqrt{x}}{2g}$

(23) A spring of force constant K is cut into three equal pieces. If these three pieces are connected in parallel, the force constant of the combination will be
(a) $\frac{K}{3}$ (b) $\frac{K}{9}$
(c) 3K (d) 9K

(24) Phase of SHM describes
(a) Displacement only
(b) Direction of motion only
(c) Both displacement and direction of motion
(d) Neither displacement nor direction of motion

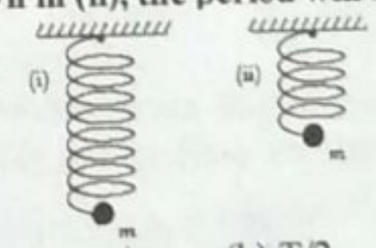
(25) Natural frequency of simple pendulum depends upon
(a) Its mass (b) Its length
(c) Square of its length (d) Square root of its length

(26) The amplitude and phase constant of an oscillator are determined by:
(a) Both the initial displacement and velocity (b) The initial velocity alone
(c) The initial displacement alone (d) The angular frequency

(27) Total distance traveled by bob of simple pendulum in one vibration is equal to
(a) A (b) 2A
(c) 4A (d) zero

(28) A simple pendulum of length L and mass m swings about the vertical equilibrium position ($\theta = 0$) with a maximum angular displacement of θ_{max}. What is the tension in the connecting rod when the pendulum's angular displacement is $\theta = \theta_{max}$?
(a) zero (b) mg sin θ_{max}
(c) mg cosθ_{max} (d) mg tan θ_{max}

(29) A simple harmonic oscillator consists of a particle of mass m and an ideal spring with spring constant k. Particle oscillates as shown in (i) with period T. If the spring is cut in half and used with the same particle, as shown in (ii), the period will be

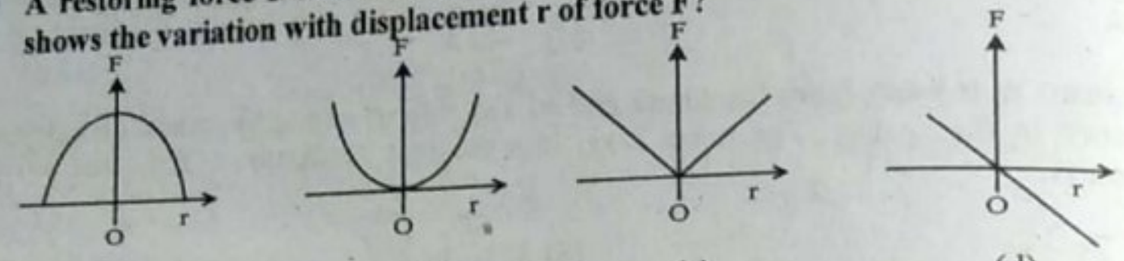


(a) T (b) T/2
(c) $\frac{T}{\sqrt{2}}$ (d) 2T

Scanned by CamScanner

(30) **Forced vibrations are known as**
(a) Simple harmonic vibration (b) Natural vibration
(c) Driven harmonic vibration (d) Free vibration

(31) **A restoring force F acts on a particle moving with simple harmonic motion. Which graph shows the variation with displacement r of force F?**



(a) (b) (c) (d)

(32) **If the length of second pendulum becomes four times, then its time period will become**
(a) Two times (b) Six time
(c) Eight times (d) Four times

(33) **A simple harmonic oscillator has a time period of 10 seconds. Which equation relates is acceleration a and displacement x?**
(a) $a=-10x$ (b) $a=-\left(\frac{2\pi}{10}\right)^2 x$
(c) $a=-(20\pi)^2 x$ (d) $a=-(20\pi)x$

(34) **A pendulum clock is set to give correct time at sea level. This clock is moved to a hill station. In order to keep correct time on the hill station, length of pendulum.**
(a) Has to be reduce
(b) Has to be increased
(c) Need no adjustment
(d) Need no adjustment but its mass has to be increased

(35) **If an oscillator starts vibrating from negative extreme, its phase constant will be**
(a) $\frac{\pi}{2}$ rad (b) π rad
(c) $\frac{3\pi}{2}$ rad (d) 0°

(36) **For a simple pendulum the restoring force is caused by**
(a) Gravity (b) Spring
(c) Hand (d) All of these

(37) **The distance covered by a body in one complete vibration is 20cm. What is the amplitude of body**
(a) 10cm (b) 5cm
(c) 15cm (d) 7.5cm

(38) **If the mass of the spring-mass oscillator become half then squared frequency will be**
(a) Quadruple (b) Half
(c) Double (d) Remain same

(39) **The time period of a simple pendulum measured inside a stationary lift is T. If the lift starts accelerating upwards with an acceleration g/3, the time period will be**
(a) $\sqrt{3}T$ (b) $\frac{\sqrt{3}}{2}T$
(c) $\frac{T}{\sqrt{3}}$ (d) $\frac{T}{\sqrt{2}}$

(40) **The energy absorbed by a body is _____ at resonance.**
(a) Maximum as well minimum (b) Minimum only
(c) Maximum only (d) Zero

(41) **The time taken for a pendulum t_1 swing from X to Y 1.5, then its frequency is**



(a) $\frac{1}{1.5}$Hz (b) $\frac{1}{3}$Hz
(c) $\frac{1}{6}$Hz (d) $\frac{1}{4}$Hz

(42) **A glider is oscillating in SHM on an air track with an amplitude A. You slow it so that its amplitude becomes half. Find the total mechanical energy in terms of previous value.**
(a) $1/2$ (b) $1/3$
(c) $1/\sqrt{5}$ (d) $1/4$

(43) **A body moves with simple harmonic motion and makes n-complete oscillations in one second. What is its angular frequency?**
(a) $n\,rad\,s^{-1}$ (b) $2\pi n\,rad\,s^{-1}$
(c) $\frac{1}{n}rad\,s^{-1}$ (d) $\frac{2\pi}{n}rad\,s^{-1}$

(44) **A particle moves according to the equation $x=a\sin^2\left(\omega t-\frac{\pi}{4}\right)$. Find the amplitude and frequency of oscillations.**
(a) a, ω (b) $\frac{a}{2}$, ω
(c) $\frac{a}{2},\frac{\omega}{2}$ (d) $\frac{a}{2}$, 2ω

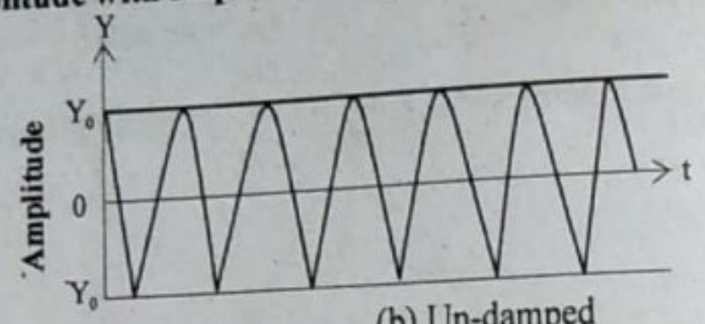
(45) **The equation of a wave is 10 sin (6.28x – 314t) where x is in centimetres and t is in seconds. The maximum velocity of the particle is**
(a) 62.8 cm s^{-1} (b) 3140 ms^{-1}
(c) 50 cm s^{-1} (d) 31.4 ms^{-1}

(46) **A spring of constant K is cut into two parts by the ratio of length 1:2. The spring constant of larger one is**
(a) $\frac{K}{2}$ (b) $\frac{K}{3}$
(c) $\frac{2K}{3}$ (d) $\frac{3K}{2}$

(47) **A mass of 0.5 kg is suspended from a spring. The spring is stretched by 0.0980m. Its spring constant will be**
(a) 1 Nm^{-1} (b) 50 Nm^{-1}
(c) 5 Nm^{-1} (d) 0.5 Nm^{-1}

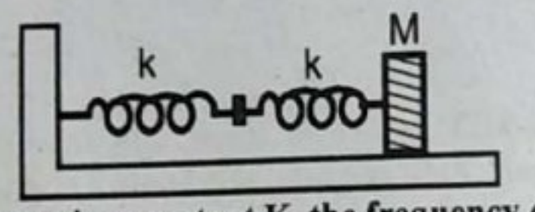
Scanned by CamScanner

(48) Variation of amplitude with respect to time for an oscillating object is shown in figure.



(a) Damped (b) Un-damped
(c) Critical (d) Heavily damped

(49) **Two springs are connected to a block of mass M placed on friction less surface as shown in the figure.**

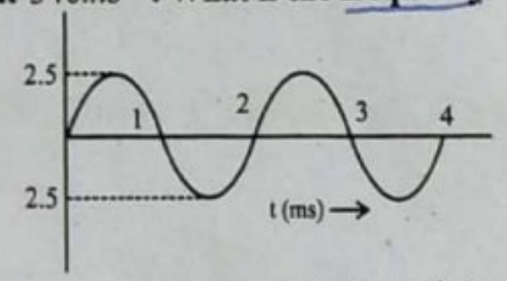


If both the spring have a spring constant K, the frequency of oscillation of block is

(a) $\frac{1}{2\pi}\sqrt{\frac{k}{M}}$ (b) $\frac{1}{2\pi}\sqrt{\frac{k}{2M}}$

(c) $\frac{1}{2\pi}\sqrt{\frac{2k}{M}}$ (d) $\frac{1}{2\pi}\sqrt{\frac{M}{k}}$

(50) **The diagram represents the variation of pressure with time at a point in air through which a sound wave is travelling at $340ms^{-1}$. What is the frequency of the wave?**



(a) 1.5*Hz* (b) 1.5×10^4 *Hz*
(c) 5.0×10^2 *Hz* (d) 3×10^3 *Hz*

ANSWER KEY

1	c	11	c	21	b	31	d	41	c
2	c	12	c	22	c	32	a	42	d
3	d	13	c	23	d	33	b	43	b
4	c	14	b	24	c	34	a	44	d
5	c	15	c	25	d	35	c	45	d
6	c	16	d	26	a	36	a	46	d
7	b	17	d	27	c	37	b	47	b
8	c	18	b	28	c	38	c	48	b
9	d	19	c	29	c	39	b	49	b
10	a	20	b	30	c	40	c	50	c

EXPLANATORY NOTES

(1) $a = \omega^2 x$

$v = \omega\sqrt{x_o^2 - x^2}$

Acceleration is maximum at extreme position where $x = x_o$

So $v = o$

(2)

$v = \sqrt{\frac{k}{m}\left(x_o^2 - x^2\right)}$

$m' = 2m$

$v' = \sqrt{\frac{k}{2m}\left(x_o^2 - x^2\right)}$

$v' = \frac{v}{\sqrt{2}}$

(3) $f = \frac{1}{2\pi}\sqrt{\frac{g-a}{\ell}}$

(4) $T = 2\pi\sqrt{\frac{\ell}{g}}$

If $\theta \le 10°$ time period is not affected by change in angular displacement.

(5) Acceleration is given by $a = -\omega^2 x$

(6) Frequency is given by.

$f = \frac{1}{2\pi}\sqrt{\frac{g+\frac{qE}{m}}{\ell}}$

$\ell = Cons\tan t$

$f \propto \sqrt{g+\frac{qE}{m}}$

f increases

(7)

$T = 2\pi\sqrt{\frac{m}{k}}$

$T \propto \sqrt{m}$

$T \propto \frac{1}{\sqrt{k}}$

So if *k* is large *T* will be short so $k_1 = 2k_2$ and $\frac{m_1}{2} = m_2$

Scanned by CamScanner

(8) $T = 2\pi\sqrt{\frac{\ell}{g}}$

T=2s which is constant. So $\sqrt{g} \propto \sqrt{\ell}$. So length will be $\frac{1}{6}$m.

(9) $T = 2\pi\sqrt{\frac{\ell}{g}}$

$\ell' = 4\ell$

$T' = 2\pi\sqrt{\frac{4\ell}{g}}$

$T' = 2T$

(10) F is broken into two components.

$T = mg\cos\theta$

$F = mg\sin\theta$

$mg\sin\theta$ provides restoring force.

(11) Tension is maximum at mean position because it is equal to weight.

(12) Waves produced have $\lambda = 12\text{cm}$, using $c = f\lambda$

$$\lambda = \frac{c}{f} = \frac{3\times10^8}{2450\times10^6} = 12\text{cm}$$

(13) $F = kx$

$k = \frac{F}{x} = \text{Nm}^{-1}$ is same as that of surface tension.

(14) $E = \frac{1}{2}kx_0^2$

$x_0' = 2x_0$

$E' = 4\left(\frac{1}{2}kx_0^2\right)$

$E' = 4E$

(15) At center of its path, no net force acts on it has, so weight = Tension

(16) $T_1 = 2\pi\sqrt{\frac{m}{k}}$ When cut into half each part has

$k' = 2k$

$T_2 = 2\pi\sqrt{\frac{m}{2k}}$

so $\frac{T_1}{T_2} = \frac{\sqrt{2}}{1}$

(17) $T = 2\pi\sqrt{\frac{\ell}{g}}$

When mercury drains out center of gravity changes and length increases so time period increases after when mercury is completely drained out length decreases and time period decreases.

(18) $a \propto -x$, So graph lies in 2nd and 4th quadrant.

(19) As $x=x_o \sin(\omega t+\varphi)$

Since $x=x_0\cos\omega t$ then $\varphi = 90°$

(20) $P.E = \frac{P.E_{max}}{4}$

$\frac{1}{2}kx^2 = \frac{1}{4}\left(\frac{1}{2}kx_o^2\right)$

$x = \frac{x_o}{2}$

(21) K.E = P.E

$\frac{1}{2}kx_0^2\left(1-\frac{x^2}{x_0^2}\right) = \frac{1}{2}kx^2$

$x_0^2 - x^2 = x^2$

$x_0^2 = 2x^2$

$x = \pm\frac{x_o}{\sqrt{2}}$

(22) $F = kx$

$F = mg$

$mg = kx$

$k = mg/x$

$T = 2\pi\sqrt{\frac{m}{k}}$

$T = 2\pi\sqrt{\frac{mx}{mg}}$

$T = 2\pi\sqrt{\frac{x}{g}}$

(23) If spring is cut into three equal parts spring constant of each part is $3k$. If they are connected in parallel then force constant becomes.

$K_{eq} = 3k + 3k + 3k$

$K_{eq} = 9k$

Scanned by CamScanner

(24) Phase describes the displacement as well as direction of motion.

(25) $T \propto \sqrt{\ell}$

(26)

$x = x_o \sin(\omega t + \varphi)$ *and* $v = \omega\sqrt{x_o^2 - x^2}$

$v = x_o\omega$

(27) Total distance in one vibration =4A as A+A+A+A in complete vibration

(28) At extreme position $T = mg\cos\theta$ so when $\theta = \theta_{max}$ T is given by $mg\cos\theta$.

(29) $T = 2\pi\sqrt{\frac{m}{k}}$

When spring is cut into half the spring constant is equal to $2k$, so $T' = \frac{T}{\sqrt{2}}$

(30) Forced vibration are known as driven harmonic vibration.

(31) $F \propto -x$

(32) $T \propto \sqrt{L}$

(33)

$a = -\omega^2 x$

$a = -\left(\frac{2\pi}{T}\right)^2 x$

$a = -\left(\frac{2\pi}{10}\right)^2 x$

(34)

$T = 2\pi\sqrt{\frac{\ell}{g}}$

T= Constant

$\sqrt{g} \propto \sqrt{\ell}$ length has to be reduced.

(35) $x = x_0\cos\omega t$ will be the displacement and phase will be $\frac{3\pi}{2}$.

(36) Restoring force is caused by gravity since $F = mg\sin\theta$

(37) $S = \frac{20}{4} = 5cm$

(38)

$f = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$

$m' = \frac{m}{2}$

$f' = \left(\frac{1}{2\pi}\sqrt{\frac{k}{m}}\right)\sqrt{2}$

$f' = \sqrt{2}f$

$f'^2 = 2f^2$

(39)

$T = 2\pi\sqrt{\frac{\ell}{g+a}}$

$a = \frac{g}{3}$

$T' = 2\pi\sqrt{\frac{\ell}{g+\frac{g}{3}}}$

$T' = 2\pi\sqrt{\frac{3\ell}{4g}}$

$T' = \frac{\sqrt{3}}{2}T$

(40) Energy absorption by a body is maximum at resonance. At resonance, frequency of vibrating body matches with the applied frequency of simple harmonic Oscillator.

(41)

$\frac{T}{4} = 1.5 \Rightarrow T = 6s$

$f = \frac{1}{T} = \frac{1}{6}Hz$

(42) initial total energy $= \frac{1}{2}m\omega^2A^2$

Final total energy $= \frac{1}{2}m\omega^2\left(\frac{A}{2}\right)^2$

Total mechanical energy becomes ¼ th.

(43)

$\omega = 2\pi f$ $\quad\because f = n$

$\omega = 2\pi n\frac{rad}{s}$

Scanned by CamScanner

(44) By comparison

$$x = x_0 \sin^2\left(\omega t - \frac{\pi}{4}\right)$$

(45) $y_{max} = \omega y_0 = 314(10)\text{cms}^{-1}$ or 31.4ms^{-1}

(46) $K \propto \frac{1}{\text{length of spring}}$

(47) As,

$F = kx$

$k = \frac{F}{x} = \frac{mg}{x} \quad \because F = w = mg$

$= \frac{0.5 \times 9.8}{0.0980} = 50 Nm^{-1}$

(48) Amplitude remains constant.

(49)

Series:- $\frac{1}{K_{eq}} = \frac{1}{K_1} + \frac{1}{K_2}$

$f = \frac{1}{2\pi}\sqrt{\frac{K}{m}}$

(50) $f = \frac{1}{T} = \frac{1}{2 \times 10^{-3}} = 500\text{Hz}$

Chapter 7 OSCILLATIONS

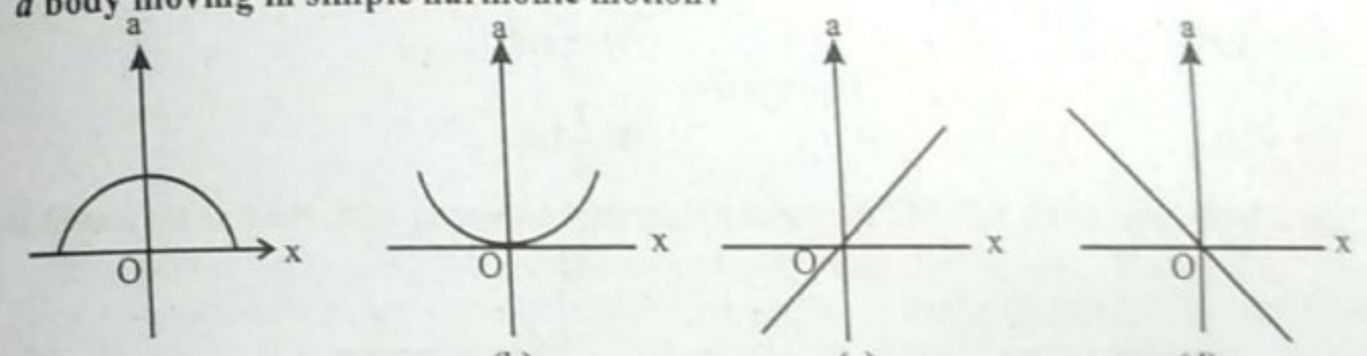
SELF ASSESSMENT TEST

(1) The length of the seconds' pendulum on the surface of Earth is 1m. Its length on the surface of Moon, where g is $\frac{1}{6}$ th the value of g on the surface of Earth, is

(a) $\frac{1}{6}$m (b) 6m

(c) $\frac{1}{36}$m (d) 36m

(2) Which graph correctly represents the variation of acceleration a with displacement x for a body moving in simple harmonic motion?



(a) (b) (c) (d)

(3) An oscillatory motion must be simple harmonic if:

(a) the motion is along the arc of a circle
(b) the potential energy is equal to the kinetic energy
(c) the acceleration varies sinusoidally with time
(d) the amplitude is small

(4) The displacement of a particle in simple harmonic motion in one time period is (where A is the amplitude)

(a) A (b) 2A
(c) 4A (d) zero

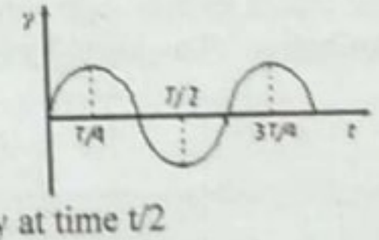
(5) The acceleration of a projection on the diameter for a particle moving along a circle is

(a) $\omega^2 x$ (b) ωx^2
(c) $-\omega^2 x$ (d) $-\omega x^2$

(6) Total energy of a body executing S.H.M, is directly proportional to

(a) square root of amplitude (b) the amplitude
(c) reciprocal of amplitude (d) square of amplitude

(7) The graph shows the variation of displacement of a particle executing S.H.M. with time. We infer from this graph that:



(a) the p.e. is equal to total energy at time t/2
(b) the acceleration is maximum at time t
(c) the velocity is maximum at time t/2
(d) the force is zero at time 3t/4

Scanned by CamScanner

(8) A simple pendulum is oscillating in an elevator having time period T, as the elevator accelerates upward with a = g/4, then the time period will be

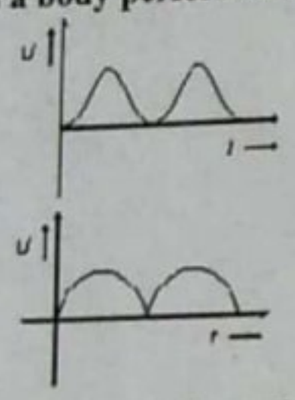
(a) T/2
(b) $\frac{\sqrt{3}}{2}$T
(c) $\frac{\sqrt{5}}{2}$T
(d) $\frac{2}{\sqrt{5}}$T

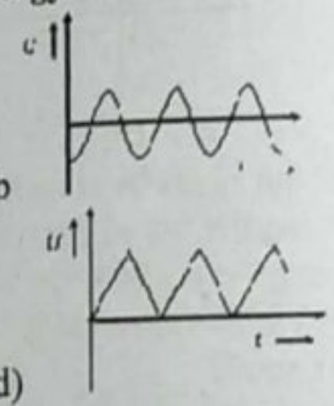
(9) The time taken for a pendulum t_1 swing from X to Y 1.5s, then its frequency is



(a) $\frac{1}{1.5}$Hz
(b) $\frac{1}{3}$Hz
(c) $\frac{1}{6}$Hz
(d) $\frac{1}{4}$Hz

(10) As a body performs S.H.M., its potential energy U. varies with time as indicated in

(a) 

(b) 

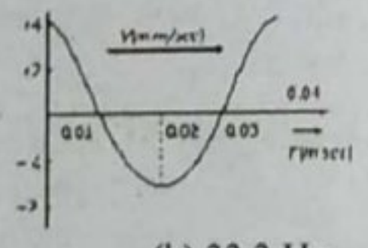
(c)

(d)

(11) The tension in the string of simple pendulum is

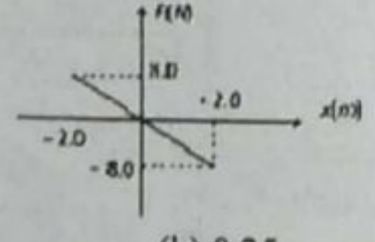
(a) constant
(b) maximum at the extreme position
(c) maximum at the mean position
(d) zero at the mean position

(12) The velocity-time diagram of a harmonic oscillator is shown in the adjoining figure. The frequency of oscillation is



(a) 50 Hz
(b) 33.3 Hz
(c) 25 Hz
(d) 25.5 Hz

(13) A body of mass 0.01 kg executes simple harmonic motion (S.H.M.) about x=0 under the influence of a force shown below : The period of the S.H.M. is

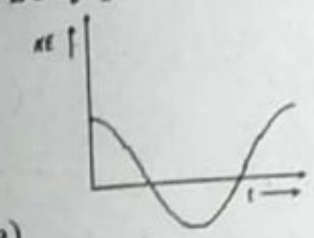


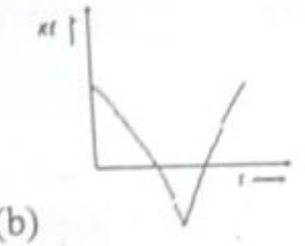
(a) 0.52 s
(b) 0.25 s
(c) 0.30 s
(d) 1.05 s

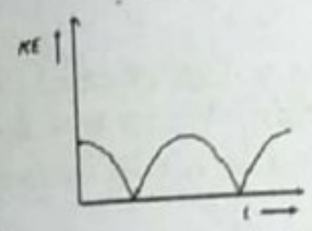
(14) It is required to double the frequency of simple harmonic oscillator. It can be done by reducing the suspended mass to

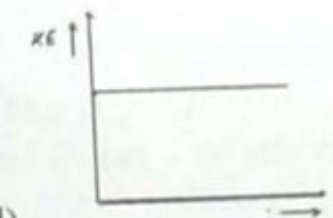
(a) $\frac{1}{2}$ of initial mass
(b) $\frac{1}{4}$ of initial mass
(c) $\frac{1}{8}$ of initial mass
(d) $\frac{1}{16}$ of initial mass

(15) A body performs S.H.M. Its kinetic energy K varies with time t as indicated by graph

(a) 

(b) 

(c) 

(d) 

(16) Which of the following is a necessary and sufficient condition for S.H.M.

(a) proportionality between acceleration and displacement from equilibrium position
(b) proportionality between restoring force and displacement from equilibrium position
(c) constant acceleration
(d) constant period

(17) A small body of mass 0.10 kg is executing S.H.M. of amplitude 1.0 m and period 0.20 sec. The maximum force acting on it is

(a) 985.96 N
(b) 76.23 N
(c) 100.2 N
(d) 98.596 N

(18) A body executing simple harmonic motion has a maximum acceleration equal to 24 meters/sec^2 and maximum velocity equal to 16 metres/sec. The amplitude of the simple harmonic motion is

(a) 3/32metres
(b) 32/3metres
(c) 1024/9metres
(d) 64/9metres

(19) Which one of the following statements is true for the speed v and the acceleration a of a particle executing simple harmonic motion

(a) value of a is zero, whatever may be the value of v
(b) when v is zero, a is zero
(c) when v is maximum, a is zero
(d) when v is maximum, a is maximum

(20) The amplitude and the periodic time of a S.H.M. are 5cm and 6sec respectively. At a distance of 2.5cm away from the mean position, the phase will be

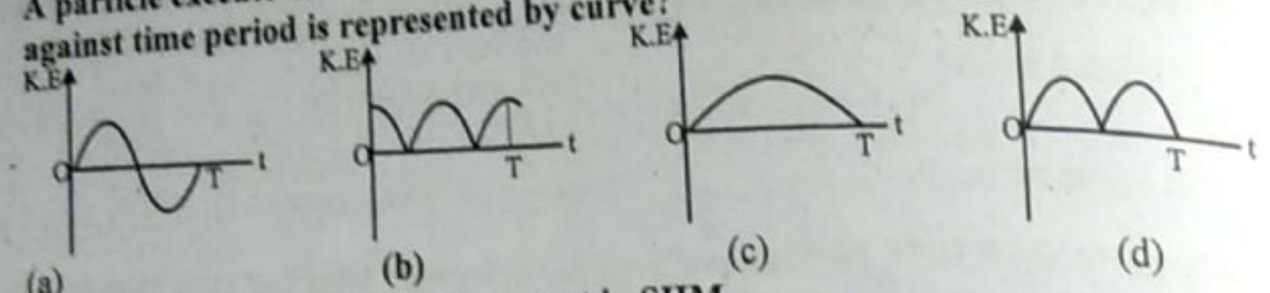
(a) $\pi/3$
(b) $\pi/6$
(c) $\pi/4$
(d) $5\pi/12$

(21) A particle executes a simple harmonic motion of time period T. Find the time taken by the particle to go directly from its mean position to half the amplitude

(a) T / 8
(b) T / 12
(c) T / 4
(d) T / 2

Scanned by CamScanner

(22) A particle execute SHM. Its initial position is mean position. The K.E of a particle against time period is represented by curve?



(a) (b) (c) (d)

(23) Which of the given equation is correct in SHM

(a) $T.E = \frac{1}{2}kx_o^2$ (b) $T.E = K.E_{max}$

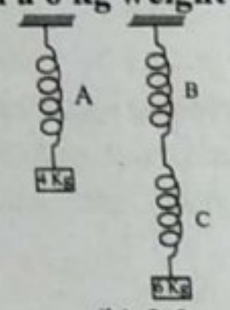
(c) $T.E = P.E_{max}$ (d) All are correct

(24) A system exhibiting S.H.M. must possess

(a) elasticity only (b) inertia only

(c) elasticity as well as inertia (d) elasticity, inertia and an external force

(25) Three identical springs A, B, C are shown in the figure below. When a 4 kg weight is hung on A, it descends by 1 cm. When a 6 kg weight is hung on C, it will descend by



(a) 1.5 cm (b) 3.0 cm

(c) 4.5 cm (d) 6.0 cm

(26) The potential energy of a particle executing S.H.M. is 2.5 J, when its displacement is half of amplitude. The total energy of the particle be

(a) 10 J (b) 18 J

(c) 20 J (d) 12 J

(27) There is a body having mass m and performing S.H.M. with amplitude a. There is a restoring force F=–Kx , where x is the displacement. The total energy of body depends upon

(a) K, x (b) K, a, x

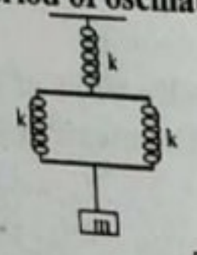
(c) K, a, v (d) K, a

(28) When K.E of SHM is maximum, its

(a) P.E is zero (b) acceleration is zero

(c) restoring force is zero (d) all P.E, acceleration & restoring force are zero

(29) A body of mass m hangs from three springs each of spring constant as shown in fig. If the mass is slightly displaced and let go, the time period of oscillations of system is:



(a) $2\pi\sqrt{\frac{m}{3k}}$ (b) $2\pi\sqrt{\frac{3m}{2k}}$

(c) $2\pi\sqrt{\frac{2m}{3k}}$ (d) $2\pi\sqrt{\frac{3k}{m}}$

(30) A body executes simple harmonic motion. The potential energy (P.E.), the kinetic energy (K.E.) and total energy (T.E.) are measured as a function of displacement x. Which of the following statements is true

(a) K.E. is maximum when x is maximum (b) T.E. is zero when x = 0

(c) K.E. is maximum when x = 0 (d) P.E. is maximum when x = 0

(31) A particle executes free simple harmonic motion of time period T. The time period with which the potential energy changes is:

(a) T/2 (b) T

(c) 2T (d) ∞

(32) The kinetic energy of a particle executing S.H.M. is 16 J when it is at its mean position. If the mass of the particle is 0.32 kg, then what is the maximum velocity of the particle

(a) 5m/s (b) 15m/s

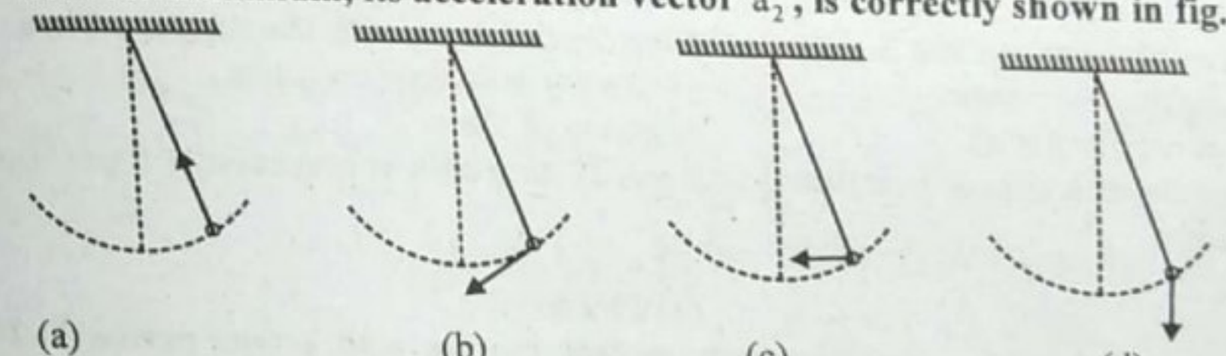
(c) 20m/s (d) 10m/s

(33) A simple harmonic oscillator has a time period of 10 seconds. Which equation relates is acceleration a and displacement x?

(a) $a = -10x$ (b) $a = -\left(\frac{2\pi}{10}\right)^2 x$

(c) $a = -(20\pi)^2 x$ (d) $a = -(20\pi)x$

(34) A simple pendulum is oscillating without damping. When the displacement of the bob is less than maximum, its acceleration vector $\vec{a}_2$, is correctly shown in fig.



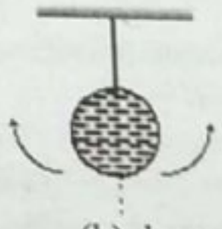
(a) (b) (c) (d)

(35) In case of a forced vibration, the resonance wave becomes very sharp when the

(a) applied periodic force is small (b) quality factor is small

(c) damping force is small (d) restoring force is small

(36) A simple pendulum is made of a body which a hollow sphere is containing mercury suspended by means of a wire. If a little mercury is drained off, the period of pendulum will



(a) increase (b) decrease

(c) remain same (d) none of these

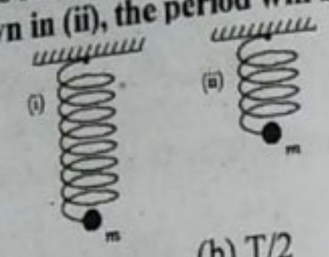
(37) A pendulum suspended from the ceiling of a train has a period T, when the train is at rest. When the train is accelerating with a uniform acceleration a, the period of oscillation will

(a) increases (b) decreases

(c) remain same (d) none of these

Scanned by CamScanner

(38) A simple harmonic oscillator consists of a particle of mass m and an ideal spring with spring constant k. Particle oscillates as shown in (i) with period T. If the spring is cut in half and used with the same particle, as shown in (ii), the period will be



(a) T (b) T/2
(c) $\frac{T}{\sqrt{2}}$ (d) 2T

(39) In case of a simple pendulum, the cause of damping is
(a) drag force of air (b) gravity
(c) tension in string (d) none of these

(40) A simple pendulum executes SHM from x = 0 with an amplitude x_o and time period T, the speed of the pendulum will be when $x = \frac{x_o}{2}$
(a) $\frac{\pi x_o\sqrt{3}}{T}$ (b) $\frac{\pi x_o\sqrt{3}}{2T}$
(c) $\frac{\pi x_o}{T}$ (d) $\frac{3\pi^2 x_o\sqrt{3}}{T}$

(41) A simple pendulum executing S.H.M. is falling freely along with the support. Then
(a) its periodic time decreases (b) its periodic time increases
(c) it does not oscillate at all (d) none of these

(42) The time period of a simple pendulum is 2 sec. If its length is increased 4 times, then its period becomes
(a) 16 sec (b) 4 sec
(c) 8 sec. (d) 12 sec

(43) A simple pendulum is executing simple harmonic motion with a time period T. If the length of the pendulum is increased by 21%, the percentage increase in the time period of the pendulum of increased length is
(a) 10% (b) 21%
(c) 30% (d) 50%

(44) If length of a pendulum becomes 4^2 times, then its time period will become
(a) four times (b) six times
(c) eight time (d) two times

(45) If the length of simple pendulum is increased by 300%, then the time period will be increased by
(a) 100% (b) 200%
(c) 300% (d) 400%

(46) A particle executes S.H.M. with a period of 6 second and amplitude of 3 cm. Its maximum speed in cm/sec is
(a) π/2 (b) π
(c) 2π (d) 3π

(47) If the displacement of a particle executing SHM is given by $y=0.30\sin(220t+0.64)$ in metre, then the frequency and maximum velocity of the particle is
(a) 35 Hz, 66 m / s (b) 45 Hz, 66 m / s
(c) 58 Hz, 113 m / s (d) 35 Hz, 132 m / s

(48) Two particles P and Q start from origin and execute Simple Harmonic Motion along X-axis with same amplitude but with periods 3 seconds and 6 seconds respectively. The ratio of the velocities of P and Q when they meet is
(a) 1 : 2 (b) 2:1
(c) 2 : 3 (d) 3 : 2

(49) A particle executing simple harmonic motion with amplitude of 0.1 m. At a certain instant when its displacement is 0.02 m, its acceleration is 0.5 m/s^2. The maximum velocity of the particle is (in m/s)
(a) 0.01 (b) 0.05
(c) 0.5 (d) 0.25

(50) A particle is performing simple harmonic motion with amplitude A and angular velocity ω. The ratio of maximum velocity to maximum acceleration is
(a) ω (b) 2 ω
(c) 1/ω (d) 2/ω

(51) Time period of vertical mass-spring system is $T = 2\pi\sqrt{\frac{x}{g}}$. What will be its time period on the surface of moon?
(a) $\frac{T}{2}$ (b) T
(c) 2T (d) $\sqrt{6}T$

(52) A machine part is undergoing SHM with a frequency of 5Hz and amplitude 1.8 cm. How long does it take the part to go from $x = 0$ *to* $x = -1.8cm$?
(a) $\frac{1}{20}$sec (b) $\frac{1}{15}$sec
(c) $\frac{1}{10}$sec (d) $\frac{1}{30}$sec

(53) The work done by a simple pendulum in one complete oscillation is
(a) equal to E_k (b) equal to U
(c) zero (d) equal to $U + E_k$

(54) Which of the following is not essential for the free oscillations of a mass attached to spring?
(a) elasticity (b) gravity
(c) inertia (d) restoring force

(55) Restoring force in SHM is
(a) conservative (b) non-conservative
(c) frictional (d) centripetal

(56) The time period of a simple pendulum as seen by an astronaut in a space ship is
(a) 84.6 mints (b) 2 sec
(c) ∞ (d) 0

(57) The displacement equation of an oscillator is $y = 5\sin(0.2\pi t + 0.5\pi)$ in S-I units the time period of oscillation is
(a) 10 sec (c) 0.2 sec
(b) 1 sec (d) 0.5 sec

Scanned by CamScanner

(58) **What is constant in S.H.M?**
(a) restoring force (b) kinetic energy
(c) P.E (d) periodic time

(59) **The potential energy of a particle executing S.H.M is 2.5J, when its displacement is half of amplitude. The total energy of the particle be.**
(a) 18J (c) 12J
(b) 10J (d) 2.5J

(60) **A body falling freely on a planet covers 8m in 2 sec. The time period of a one meter long simple pendulum on this planet will be_____**
(a) 1.57sec (c) 6.28 sec
(b) 3.14 sec (d) none

ANSWER KEY

1	a	11	c	21	b	31	a	41	c	51	b
2	d	12	c	22	b	32	d	42	b	52	a
3	c	13	c	23	d	33	b	43	a	53	c
4	d	14	b	24	c	34	c	44	a	54	b
5	c	15	c	25	b	35	c	45	a	55	a
6	d	16	b	26	a	36	a	46	b	56	c
7	a	17	d	27	d	37	b	47	a	57	a
8	d	18	b	28	d	38	c	48	b	58	d
9	c	19	c	29	b	39	a	49	c	59	b
10	a	20	b	30	c	40	a	50	c	60	b

EXPLANATORY NOTES

(1) $T = 2\pi\sqrt{\frac{\ell}{g}} \Rightarrow \ell \propto g \quad [T = \text{constant}]$

At moon,

$\frac{g}{6} \propto \frac{\ell}{6}$

Length of second pendulum at moon $= \frac{\ell}{6} = \frac{1}{6}m$

$T_m = 2\pi\sqrt{\frac{\ell/6}{g/6}} = 2\sec$

(2) $a \propto -x$

(3) $a = a_o \sin\omega t$

(4) In one time period, oscillator comes to initial position, so displacement = zero

(5) $F_r = -kx$

$ma = -kx$

$a = -\frac{k}{m}x \Rightarrow a = -\omega^2 x \qquad \because \omega^2 = \frac{k}{m}$

(6) $T.E = \frac{1}{2}kx_o^2 \Rightarrow T.E \propto x_o^2$

(7)

At time $\frac{T}{2}$; $v = 0$ ∴Total energy = Potential energy.

(8) $T = 2\pi\sqrt{\frac{\ell}{g+a}}$

$= 2\pi\sqrt{\frac{\ell}{g+g/4}} = 2\pi\sqrt{\frac{4}{5}}T = \frac{2}{\sqrt{5}}T$

(9) $\frac{T}{4} = 1.5 \Rightarrow T = 6s$

$f = \frac{1}{T} = \frac{1}{6}Hz$

(10) PE varies from zero to maximum. It is always positive sinusoidal function

(11) $T = mg\cos\theta$

At mean position

$\theta = 0°$

$T_{max} = mg$

Scanned by CamScanner

(12)

$$f = \frac{1}{T} = \frac{1}{0.04} = 25\ Hz$$

(13)

From graph, slope $K = \frac{F}{x} = \frac{8}{2} = 4$ $\qquad T = 2\pi\sqrt{\frac{m}{K}} \Rightarrow T = 2\pi\sqrt{\frac{0.01}{4}} = 0.3\ \text{sec}$

(14) $f = \frac{1}{2\pi}\sqrt{\frac{K}{m}}$

$f \propto \frac{1}{\sqrt{m}}$

(15) Kinetic energy varies with time but is never negative

(16) Characteristic of SHM

(17)

Maximum acceleration $\qquad A_{max} = a\omega^2 = \frac{a \times 4\pi^2}{T^2} = \frac{1 \times 4 \times (3.14)^2}{0.2 \times 0.2}$

$$F_{max} = m \times A_{max} = \frac{0.1 \times 4 \times (3.14)^2}{0.2 \times 0.2} = 98.596\ N$$

(18)

Maximum velocity $= a\omega = 16$ Maximum acceleration $= \omega^2 a = 24$

$$\Rightarrow a = \frac{(a\omega)^2}{\omega^2 a} = \frac{16 \times 16}{24} = \frac{32}{3} m$$

(19) $\therefore V = \sqrt{x_o^2 - x^2}$ and $a = -\omega^2 x$

When $x = x_o$

$v_{min} = 0$ and $a_{max} = -\omega^2 x_o$

(20) Equation of motion is $y = 5\sin\frac{2\pi t}{6}$. For $y = 2.5$ cm $2.5 = 5\sin\frac{2\pi t}{6} \Rightarrow \frac{2\pi t}{6} = \frac{\pi}{6} \Rightarrow$

$t = \frac{1}{2}$ sec and phase $= \frac{2\pi t}{6} = \frac{\pi}{6}$

(21) $x = x_o \sin\omega t$

$\frac{x_o}{2} = x_o \sin 2\pi\frac{t}{T} \Rightarrow t = \frac{T}{12}$

(22) At mean position K.E is maximum.

(23) $T.E = \frac{1}{2}kx_o^2$

$P.E_{max} = \frac{1}{2}kx_o^2$

$K.E_{max} = \frac{1}{2}kx_o^2$

(24) Definition

(25) $F_r = kx$

$mg = kx$

$\frac{m_A}{m_C} = \frac{kx_1}{\frac{k}{2}x_2}$

$\frac{m_A}{m_C} = 2\frac{x_1}{x_2}$

$x_2 = \frac{2x_1 m_C}{m_A}$

(26) $\frac{Potential\ energy\ (U)}{Total\ energy\ (E)} = \frac{\frac{1}{2}m\omega^2 y^2}{\frac{1}{2}m\omega^2 a^2} = \frac{y^2}{a^2}$ $So\ \frac{2.5}{E} = \frac{\left(\frac{a}{2}\right)^2}{a^2} \Rightarrow E = 10J$

(27)

Total energy $U = \frac{1}{2}Ka^2$

(28) At mean position $(x = 0)$

$F_{min.} = Kx = 0$, $P.E_{min.} = \frac{1}{2}Kx^2 = 0$, $a_{min.} = \omega^2 x = 0$

(29) $\frac{1}{k_{eq}} = \frac{1}{k} + \frac{1}{k_P}$

$\frac{1}{k_{eq}} = \frac{1}{k} + \frac{1}{2k}$

$\frac{1}{k_{eq}} = \frac{3}{2k} \Rightarrow k_{eq} = \frac{2}{3}k$

Hence,

$T = 2\pi\sqrt{\frac{3m}{2k}}$

(30) In S.H.M., at mean position i.e. at x = 0 kinetic energy will be maximum and P.E will be minimum. Total energy is always constant.

(31) $f_{P.E} = 2f_{S.H.M}$

$\frac{1}{T_{P.E}} = 2\frac{1}{T_{S.H.M}}$

$\frac{T_{S.H.M}}{2} = T_{P.E}$

(32)

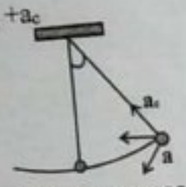
Kinetic energy at mean position, $\qquad K_{max} = \frac{1}{2}mv_{max}^2 \Rightarrow v_{max} = \sqrt{\frac{2K_{max}}{m}}$

$= \sqrt{\frac{2 \times 16}{0.32}} = \sqrt{100} = 10\ m/s.$

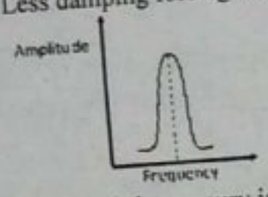
Scanned by CamScanner

(33) $a = -\omega^2 x \Rightarrow a = -\left(\frac{2\pi}{T}\right)^2 x$

(34) Two accelerations are acting on the bob.
(i) centripetal acceleration a_c
(ii) Tangential acceleration a_t $a = a_t + a_c$



(35) Less damping force gives a taller and narrower resonance peak



(36) When a little mercury is drained off, the position of c.g. of ball falls (w.r.t. fixed and) so that effective length of pendulum increases hence T increase.

(37)

Initially time period was $T = 2\pi\sqrt{\frac{l}{g}}$  When train

accelerates, the effective value of g becomes $\sqrt{(g^2 + a^2)}$ which is greater than g Hence, new time period, becomes less than the initial time period.

(38) $T = 2\pi\sqrt{\frac{m}{k}}$

When spring is cut into half the spring constant is equal to $2k$, so $T' = \frac{T}{\sqrt{2}}$

(39) Due to drag force of air, amplitude of vibrating body decreases

(40) $v = \omega\sqrt{(x_0^2 - x^2)} \Rightarrow v = \omega\sqrt{\left(x_0^2 - \frac{x_0^2}{4}\right)}$

$$v = \frac{2\pi}{T}\sqrt{\left(\frac{4x_0^2 - x_0^2}{4}\right)} \Rightarrow v = \frac{2\pi}{T}\sqrt{\left(\frac{3}{4}x_0^2\right)}$$

$$v = \frac{2\pi}{T}\frac{\sqrt{3}x_0}{2} \Rightarrow v = \frac{\pi}{T}\sqrt{3}x_0$$

(41)

$= \frac{2}{3}l$, for freely falling system effective $g = 0$ so $T = \infty$ or n = 0 It means that pendulum does not oscillate at all.

(42) $T \propto \sqrt{\ell} \Rightarrow \frac{T_1}{T_2} = \sqrt{\frac{\ell_1}{\ell_2}} \Rightarrow \frac{2}{T_2} = \sqrt{\frac{\ell}{4\ell}} \Rightarrow T_2 = 4\,\text{sec}$

(43) $\%\ell' = 100\%\ell + 21\%\ell$
$\%\ell' = 121\%\ell$
or $\ell' = 1.21\ell$

$$\frac{T'}{T} = \sqrt{\frac{\ell'}{\ell}}$$

$$\frac{T'}{T} = \sqrt{\frac{1.21\ell}{\ell}}$$

$$T' = \sqrt{1.21}T$$

(44) $T = 2\pi\sqrt{\frac{\ell}{g}}$

$\ell' = 4\ell$

$$T' = 2\pi\sqrt{\frac{4^2\ell}{g}}$$

$T' = 4T$

(45)

$$\frac{T_1}{T_2} = \sqrt{\frac{l_1}{l_2}} \Rightarrow \frac{T_1}{T_2} = \sqrt{\frac{100}{400}} \text{ (If } l_1 = 100 \text{ then } l_2 = 400) \qquad \Rightarrow T_2 = 2T_1$$

Hence % increase $= \frac{T_2 - T_1}{T_1} \times 100 = 100$

(46) $v_{max} = a\omega = a\frac{2\pi}{T} = 3 \times \frac{2\pi}{6} = \pi\, cm/s$

(47) $n = \frac{\omega}{2\pi} = \frac{220}{2\pi} = 35\, Hz \qquad v_{max} = \omega a = 220 \times 0.30\, m/s = 66\, m/s$

(48) The particles will meet at the mean position when P completes one oscillation and Q completes half an oscillation So $\frac{v_P}{v_Q} = \frac{a\omega_P}{a\omega_Q} = \frac{T_Q}{T_P} = \frac{6}{3} = \frac{2}{1}$

(49) Acceleration $A = \omega^2 y \Rightarrow \omega = \sqrt{\frac{A}{y}} = \sqrt{\frac{0.5}{0.02}} = 5$ Maximum velocity

$v_{max} = a\omega = 0.1 \times 5 = 0.5$

Scanned by CamScanner

(50)
$$\frac{v_{max}}{A_{max}} = \frac{a\omega}{a\omega^2} = \frac{1}{\omega}$$

(51) $T = 2\pi\sqrt{\frac{x/6}{g/6}} = T$

(52) $T = \frac{T}{4} = \frac{1}{5\times4} = \frac{1}{20}\text{sec}$

(53) For complete oscillation displacement zero. So $W = Fd\cos\theta$
$W = 0$

(54) $T = 2\pi\sqrt{\frac{m}{K}}$, $F_t = -Kx$

(55) Restoring force is conservative force.

(56) $T = 2\pi\sqrt{\frac{l}{g}} \quad \therefore g = 0 \Rightarrow T = 2\pi\sqrt{\frac{l}{0}} = \infty$

(57) $\omega = 0.2\pi \Rightarrow T = \frac{2\pi}{0.2\pi} = 10\text{sec}$

(58) S.H.M motion is periodic motion.

(59) $At\ x = \frac{x_o}{2}$

$P.E = \frac{1}{4}T.E$

$T.E = 4\times P.E$

$T.E = 4\times 2.5 = 10J$

(60) $S = \frac{1}{2}gt^2 \Rightarrow 8\frac{1}{2}(g)(2)^2 \Rightarrow g = 4ms^{-2}$

$T = 2\pi\sqrt{\frac{l}{g}} = 2\pi\sqrt{\frac{1}{4}} = \pi\text{ sec}$

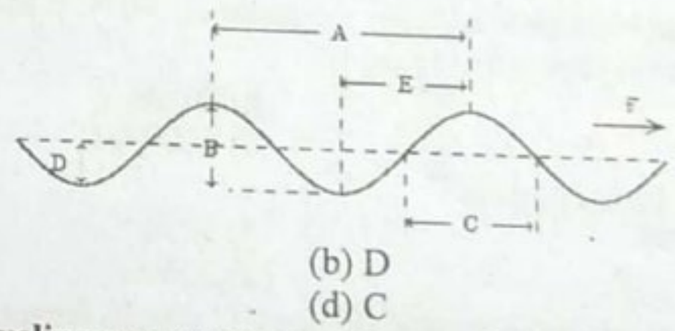
8 Chapter WAVES

PRACTICE EXERCISE

(1) **A rope of length 5 m is stretched to a tension of 80 N. If its mass is 1 kg, at what speed would a 10 Hz transverse wave travel down the string?**
(a) 2 m/s (b) 5 m/s
(c) 20 m/s (d) 50 m/s

(2) **A transverse wave on a long horizontal rope with a wavelength of 8 m travels at 2 m/s. At $t = 0$, a particular point on the rope has a vertical displacement of $+A$, where A is the amplitude of the wave. At what time will the vertical displacement of this same point on the rope be $-A$?**
(a) t = 1/8 sec (b) t = ½ sec
(c) t = 4 sec (d) t = 2sec

(3) **A sinusoidal wave is traveling toward the right as shown. Which letter correctly labels the amplitude of the wave?**



(a) A (b) D
(c) B (d) C

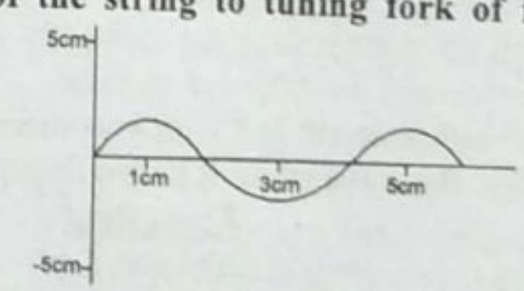
(4) **When two identical traveling waves are superimposed, the velocity of the resultant wave**
(a) Decreases (b) Increases
(c) Remains unchanged (d) Becomes zero

(5) **In vibrating cord the points where the amplitude is maximum, are called**
(a) Antinodes (b) Nodes
(c) Troughs (d) Crests

(6) **Echo is the phenomenon of**
(a) Interference of sound (b) Reflection of sound
(c) Refraction of sound (d) None of these

(7) **A string, fixed at both ends, has a length of 6 m and supports a standing wave with a total of 4 nodes. If a transverse wave can travel at 40 m/s down the rope, what is the frequency of this standing wave?**
(a) 6.7 Hz (b) 10.0 Hz
(c) 13.3 Hz (d) 20.0 Hz

(8) **Figure shows the shape of part of a long string in which transverse waves are produced by attaching one end of the string to tuning fork of frequency 250Hz. What is the velocity of the waves?**



(a) 10 ms^{-1} (b) 15 ms^{-1}
(c) 20 ms^{-1} (d) 25 ms^{-1}

Scanned by CamScanner

(9) **A stationary wave is set up in the air column of a closed pipe. At the closed end of the pipe**
(a) Always a node is formed
(b) Always an antinode is formed
(c) Neither node nor antinode is formed
(d) Sometimes a node and sometimes an antinode is formed

(10) **A source of frequency f sends waves of wavelength λ traveling with speed v in some medium. If the frequency is changed from f to 2f, then the new wavelength and new speed are (respectively):**
(a) 2λ, v (b) λ/2, v
(c) λ,2 v (d) λ, v/2

(11) **A tuning fork of frequency 340 Hz is sounded above a cylindrical tube 1 m high. Water is slowly poured into the tube. If the speed of sound is 340 ms^{-1} at what levels of water in the tube will the sound of the fork be appreciably intensified?**
(a) 25 cm, 75 cm (b) 20 cm, 80 cm
(c) 15 cm, 85 cm (d) 17 cm, 83 cm

(12) **A string stretched at both ends is under a tension of 100 N. If mass of string is 4×10^{-6}kg/cm, the velocity of transverse waves in string is:**
(a) 330 ms^{-1} (b) 50 ms^{-1}
(c) 500 ms^{-1} (d) 5000 ms^{-1}

(13) **Velocity of sound in vacuum is**
(a) 332 ms^{-1} (b) 320 ms^{-1}
(c) Zero (d) 224 ms^{-1}

(14) **Increase in velocity of sound in the air for 1°C rise in temperature is**
(a) 1.61 ms^{-1} (b) 61.0 ms^{-1}
(c) 0.61 ms^{-1} (d) 2.00ms^{-1}

(15) **Energy is not transferred by**
(a) Longitudinal wave (b) Transverse waves
(c) Stationary waves (d) Electromagnetic waves

(16) **On loading the prong of a tuning fork with wax, its frequency**
(a) Increases (b) Decreases
(c) Remains unchanged (d) May increase or decrease

(17) **The velocity of sound in air would become double than its velocity at 0°C at temperature**
(a) 313°C (b) 586°C
(c) 819°C (d) 1172°C

(18) **Fully constructive interference between two sinusoidal waves of the same frequency occurs only if they**
(a) Travel in opposite directions and are in phase
(b) Travel in the same direction and are in phase
(c) Travel in opposite directions and are 180◦ out of phase
(d) Travel in the same direction and are 180◦ out of phase

(19) **A sound wave travels through a metal rod with wavelength λ and frequency *f*. Which of the following best describes the wave when it passes into the surrounding air?**

Wavelength	Frequency
(a) Less than λ	Equal to *f*
(b) Less than λ	Less than *f*
(c) Greater than λ	Equal to *f*
(d) Greater than λ	Less than *f*

(20) **A string, clamped at its ends, vibrates in three segments. The string is 100cm long. The wavelength is:**
(a) 33.3cm (b) 150cm
(c) 66.7cm (d) 300cm

(21) **A tube closed at one end containing air, produces when excited the fundamental note of frequency 512 Hz. If the tube is open at both ends, the fundamental frequency that can be excited is (in Hz)**
(a) 1024 (b) 512
(c) 256 (d) 128

(22) **A wave in soft string reflects from a hard steel rod. Its phase difference relative to incident wave will be**
(a) 0° (b) 90°
(c) 180° (d) 76°

(23) **If the intensity of sound increases by a factor of 10^5 the increase in intensity level is**
(a) 5db (b) 10db
(c) 25db (d) 50db

(24) **An observer is 2 m from a source of sound waves. By how much will the sound level decrease if the observer moves to a distance of 20 m?**
(a) 1 dB (b) 2 dB
(c) 10 dB (d) 20 dB

(25) **An organ pipe with one end closed and the other open has length L. Its fundamental frequency is proportional to**
(a) L (b) 1/L
(c) L^2 (d) $\sqrt{L}$

(26) **To monitor blood flow through major arteries, ultrasonic waves of which frequencies are employed?**
(a) 5 to 10 Hz (b) 5 to 10 MHz
(c) 15 – 100 MHz (d) None of these

(27) **Which one is the correct relation for fundamental frequency of open and closed pipe?**
(a) $f_{open} = 2\ f_{closed}$ (b) $f_{closed} = 2f_{open}$
(c) $f_{open} = f_{closed}$ (d) $f_{open} = 1/\ f_{closed}$

(28) **In open organ pipe**
(a) Only even harmonics are present (b) Only odd harmonics are present
(c) Both even and odd harmonics are present (d) Selected harmonics are present

(29) **The minimum length of a tube, open at both ends, that resonates with a tuning fork of frequency 350Hz is: (speed of sound = 350ms^{-1})**
(a) 0.25m (b) 0.5m
(c) 1m (d) 2m

(30) **Progressive waves of frequency 300 Hz are superimposed to produce a system of stationary waves in which adjacent nodes are 1.5 m apart. What is the speed of the progressive waves?**
(a) 100 ms^{-1} (b) 900 ms^{-1}
(c) 450 ms^{-1} (d) 200 ms^{-1}

(31) **A source of sound moves towards a stationary observer with a speed one third that of sound. If the frequency of the sound from the source is 100 Hz, the apparent frequency of the sound heard by the observer is**
(a) 67 Hz (b) 100 Hz
(c) 150 Hz (d) 75 Hz

Scanned by CamScanner

(32) The source is moving towards a stationary observer then the pitch of the sound will
(a) Sometimes increases and some times decreases
(b) Remains constant
(c) Decrease
(d) Increase

(33) A bat emits a 40 kHz "chirp" with a wavelength of 8.75 mm toward a tree and receives an echo 0.4 s later. How far is the bat from the tree?
(a) 35m (b) 70m
(c) 105m (d) 140m

(34) Laplace found that the alternate compressions and rarefactions produced in sound waves follow
(a) Isothermal law (b) Adiabatic law
(c) Isochoric law (d) All of the above

(35) For destructive interference of sound waves the path difference between two interfering sounds should be
(a) $n\lambda$ (b) $\left(n+\frac{1}{2}\right)\lambda$
(c) Some time $n\lambda$ and some times $\left(n+\frac{1}{2}\right)\lambda$ (d) None of these

(36) When water waves pass from deep water into shallow water how do the frequency, wave length and speed change

Frequency	Wavelength	Speed
(a) Increases	Decreases	No change
(b) No change	Decreases	Decreases
(c) No change	Increases	Increases
(d) None of these		

(37) The beats frequency (sensible) for a human ear is
(a) 24Hz (b) 10Hz
(c) 12Hz (d) 16Hz

(38) The speed of stationary waves in a stretched string are independent of
(a) Number of loops (b) Tension in the string
(c) Point where string is plucked (d) Both (a) and (c)

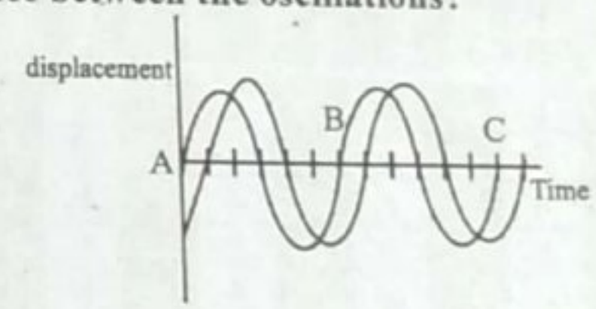
(39) The audible frequency range will be maximum for
(a) Dog (b) Dolphin
(c) Bat (d) Cat

(40) A car is traveling at 20 m/s away from a stationary observer. If the car's horn emits a frequency of 600 Hz, what frequency will the observer hear? (Use $v = 340$ m/s for the speed of sound.)
(a) (34/36)(600 Hz) (b) (34/32)(600 Hz)
(c) (36/34)(600 Hz) (d) (32/34)(600 Hz)

(41) Velocity of sound at 0°C is 330 ms^{-1}. When pressure increases by 1 atmosphere and temperature increases by 1°C, the velocity of sound
(a) increases by 0.6 ms^{-1} (b) decreases by 0.6 ms^{-1}
(c) increases by 60 ms^{-1} (d) decreases by 60 ms^{-1}

(42) Two waves of equal amplitude x_o and equal frequency travel in the same direction in a medium. The amplitude of the resultant wave is
(a) 0 (b) x_o
(c) $2x_o$ (d) between 0 and $2x_o$

(43) What is the phase difference between the oscillations?



(a) $\frac{3}{4}\pi\, rad$ (b) $\frac{\pi}{4} rad$
(c) $\frac{\pi}{3} rad$ (d) $\pi\, rad$

(44) A progressive wave of frequency 500 Hz is travelling with a velocity 360 ms^{-1}. How far are two points 60° out of phase?
(a) 0.06 m (b) 0.12 m
(c) 0.18 m (d) 0.24 m

(45) Two sinusoidal plane waves of the same frequency having intensities I_o and $4I_o$ are traveling in the same direction. The resultant intensity at a point at which waves meet with a phase difference of zero radian is
(a) I_o (b) $5I_o$
(c) $9I_o$ (d) $3I_o$

(46) If a Radar system designed in accordance with the Doppler's effect, if an airplane is moving away from a Radar, the wavelength of the reflected wave from the air plane would be:
(a) Smaller than the transmitting wave
(b) Same as that of the transmitting wave
(c) Larger than the transmitting wave
(d) Either smaller or larger than the transmitting wave

(47) The speed of sound waves having a frequency of 256 Hz, compared with the speed of sound waves having a frequency of 512 Hz is:
(a) Half as great (b) Twice as great
(c) Four times as great (d) Same

(48) When an observer moves towards source with a velocity u_o, then the modified frequency 'f_A' becomes
(a) $f_A = f(v-u_o)$ (b) $f_A = f\left(\frac{v+u_o}{v}\right)$
(c) $f_A = \left(\frac{v+u_o}{2}\right)f$ (d) $f_A = \left(\frac{v-u_o}{v}\right)f$

(49) Doppler shift in frequency does not depend upon
(a) The actual frequency of the wave (b) The velocity of the source
(c) The distance of the source from the listener (d) The velocity of the observer

(50) A 2 kHz siren and a person are both at rest with respect to earth. What frequency does the person hear, if the wind is blowing at 12 ms^{-1} from source to observer?
(a) 2 kHz (b) > 2 kHz
(c) < 24 kHz (d) > 24 kHz

Scanned by CamScanner

ANSWER KEY

1	c	11	a	21	a	31	c	41	a
2	d	12	c	22	c	32	d	42	d
3	b	13	c	23	d	33	b	43	c
4	c	14	c	24	d	34	b	44	b
5	a	15	c	25	b	35	b	45	c
6	b	16	b	26	b	36	b	46	c
7	b	17	c	27	a	37	b	47	d
8	a	18	b	28	c	38	c	48	b
9	a	19	a	29	b	39	b	49	c
10	b	20	c	30	b	40	a	50	a

EXPLANATORY NOTES

(1) $v=\sqrt{\frac{F}{m/\ell}}$

$v=\sqrt{\frac{80\times5}{1}}$

$v=20ms^{-1}$

(2) $v=f\lambda$

$f=\frac{v}{\lambda}=\frac{2}{8}=\frac{1}{4}Hz$

$T=4sec$

at $'-A'$ $t=\frac{T}{2}=\frac{4}{2}=2sec$

(3) Amplitude is the maximum displacement from mean position.

(4) When two waves are superimpose, only amplitude increases, speed is not affected because medium is same.

(5) Antinodes are the points of maximum displacement

(6) Echo is due to reflection of sound.

(7) Total nodes = 4

$l=\frac{3\lambda}{2}$

$\lambda=\frac{2\ell}{3}=\frac{2\times6}{3}$

$\lambda=4m$

$f=\frac{v}{\lambda}=\frac{40}{4}=10Hz$

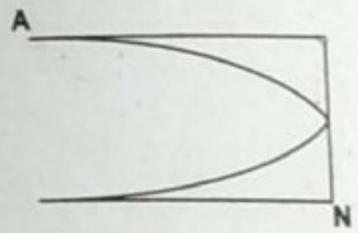
(8) $\lambda=4cm$

$\lambda=\frac{4}{100}=0.04m$

$v=f\lambda=256\times\frac{4}{100}$

$\lambda=\frac{100}{10}=10m/s$

(9) Node is always formed at the closed end.



(10) In same medium "v" remains same.

So $f\propto\frac{1}{\lambda}$

$f\rightarrow2f$

$\lambda\rightarrow\frac{\lambda}{2}$

(11) $f_n=\frac{nv}{4l}$ for closed end pipe

$n=1$

$l=\frac{v}{4f}=\frac{340}{4\times340}=\frac{1}{4}=25cm$

$n=3$

$l=\frac{3v}{4f}=3\times25=75cm$

(12) $v=\sqrt{\frac{T}{m'}}$ As $m'=4\times10^{-6}$ kg/cm $=\frac{4\times10^{-6}}{0.01}kg/m=4\times10^{-4}kg/m$

$v=\sqrt{\frac{100}{4\times10^{-4}}}=500ms^{-1}$

(13) (Because speed of sound depends on medium)

(14) $v_t=v_o+0.61t$

So 1°C rise in temperature, velocity increases to 0.61 m/s

Scanned by CamScanner

(15) Stationary waves do not transfer energy. Energy remains oscillating between nodes and antinodes.

(16) $v=\sqrt{\frac{E}{\rho}}$

$f\lambda=\sqrt{\frac{E}{m/V}}$

$f=\frac{1}{\lambda}\sqrt{\frac{EV}{m}}$

$f\propto\frac{1}{\sqrt{m}}$

(17) $\frac{v_l}{v_o}=\sqrt{\frac{T}{T_o}}$

(18) Two waves having same frequency and travelling in same direction gives interference.

(19)

$v=f\lambda$

$v\propto\lambda$

v decreases frequency remains same.

(20)

$n=3$

$3\frac{\lambda}{2}=l$ $\quad l=\frac{\lambda}{2}$

$\lambda=\frac{2l}{3}$

$\lambda=66.7cm$

(21) $f_{closed}=\frac{f_{open}}{2}$

$512\times2=f_{open}$

$f_{open}=1024\,\text{Hz}$

(22) Phase shift will be 180° when waves reflects back from denser medium.

(23) $I_L=10\log\frac{I}{I_o}$

$I_L=10\log\frac{10^5 I_o}{I_o}$

$I_L=50\,dB$

(24) Intensity $\propto\frac{1}{r^2}$, so intensity decreases by 100 times according to formula

Sound level $=10\log\frac{I_o}{I}\Rightarrow S.L=20\,dB$

(25) $f\propto\frac{1}{l}$

As $f_n\propto\frac{nv}{4l}$

(26) Frequency of range 5-10MHz are used.

(27) $f_c=\frac{nv}{4l}$

$f_c=\frac{1}{2}\left(\frac{nv}{2l}\right)$

$f_o=\frac{f_o}{2}$

$f_o=2f_c$

(28) $f_n=\frac{nv}{2l}$

$n=1,2,3,4...$

$f_1=\frac{v}{2l}$

$f_2=\frac{v}{l}$

$f_3=\frac{3v}{2l}$

(29) $f=\frac{v}{2l_{min.}}$

$l_{min}=\frac{350}{2\times350}=\frac{1}{2}=0.5\,\text{m}$

(30) $\frac{\lambda}{2}=1.5$

$\lambda=3m$

$v=f\lambda=300\times3$

$v=900\,\text{m/s}$

Scanned by CamScanner

(31) $f' = \frac{v}{v - v_s} f \Rightarrow f' = \frac{v}{v - \frac{1}{3}v} \times 100$

$f' = \frac{v}{\frac{2}{3}v} \times 100 = \frac{3}{2} \times 100 = 150\,\text{Hz}$

(32) As source is moving towards stationary observe.

$\because f' = \frac{v}{v - v_s} f \Rightarrow f' > f$ so pitch will increase.

(33) $v = f\lambda \Rightarrow v = 40 \times 10^3 \times \frac{8.75}{100} \times 10^{-3} = 350 ms^{-1}$

$S = v\frac{t}{2} \Rightarrow S = 350 \times \frac{0.2}{10} = 70m$

(34) According to Laplace, compression & rarefactions of sound waves follow adiabatic law.

(35) Path difference $= \Delta x = \left(n + \frac{1}{2}\right)\lambda = (2n+1)\frac{\lambda}{2}$

For all n – values $= n = 0,1,2,3.....$

(36) Speed of water waves increases from shallow to deep water but frequency remains same.

(37) Beat frequency should not be more than 10 Hz

(38) $v = \sqrt{\frac{T}{m}}$

Speed of stationary waves is independent of (a) number of loops and (c) point where string is plucked.

(39) Dolphin has frequency range $150Hz - 150KHz$.

(40) $f' = \frac{v}{v+20} \times 600 = \frac{340}{360} \times 600$

$f' = \frac{34}{36} \times 600$ Hz

(41) $v = v_0(1 + 0.61t)$

When temperature rise by 1°C then

$\Delta v = 0.61(1) = 0.61 ms^{-1}$

(42) use $x_0' = \sqrt{x_{01}^2 + x_{02}^2 + 2x_{01}x_{02}\cos\theta}$

$\because \theta = 0 \quad x_0' = 2x_0$

$\theta = 180° \quad x_0' = x_0 - x_0 = 0$

(43) For 1st wave at 'A' $\phi_1 = 0$

For 2nd wave at 'A' $\phi_2 = \frac{-\pi}{3}$

$\Delta\phi = 0 - \left(\frac{-\pi}{2}\right) = \frac{\pi}{3}$

(44)

$\lambda = \frac{v}{f} = \frac{360}{500} = 0.72\text{m}$

$\Delta\phi = \frac{2\pi}{\lambda}(\Delta x)$

or $\Delta x = \frac{\Delta\phi\lambda}{2\pi} = \frac{\pi/3(0.72)}{2\pi} = 0.12\text{m}$

(45)

$I = I_1 + I_2 + 2\left(\sqrt{I_1 I_2}\right)\cos\phi$

$= I_0 + 4I_0 + 2\sqrt{(I_0)(4I_0)}\cos\phi = 5I_0 + 4I_0\cos\phi$

As $\phi = 0, \text{so}\cos\phi = 1$

$\therefore I = 5I_0 + 4I_0 = 9I_0$

(46) Source is moving away from observer so apparent frequency decreases and wavelength increases.

(47)

$v = f\lambda$

$f \propto \frac{1}{\lambda} (\because v = \text{same})$

(48) $f_A = \left(\frac{v + u_0}{v}\right) f$

(49) $f_A = \left(\frac{v}{v - u_s}\right) f$

(50) There is no change in frequency because both source and observer are in rest.

Scanned by CamScanner

8 Chapter WAVES

SELF ASSESSMENT TEST

(1) A cylindrical tube, open at both ends, has fundamental frequency n. If one of the ends is closed, the fundamental frequency will become

(a) n/2 (b) n
(c) 2 n (d) 4 n

(2) The waves that requires a material medium for their propagation are called

(a) matter waves (b) electromagnetic waves
(c) carrier waves (d) mechanical waves

(3) The distance between two particles in a wave motion in the same phase is:

(a) $\frac{\lambda}{4}$ (b) $\frac{\lambda}{2}$
(c) $\frac{3\lambda}{4}$ (d) λ

(4) The observed wavelength of light coming from a distant galaxy is found to be increased by 0.5% as compared with that coming from a terrestrial source. The galaxy is

(a) stationary with respect to the earth
(b) approaching the earth with velocity of light
(c) receding from the earth with a velocity equal to 1.5×10^6m/s
(d) receding from the earth with the velocity of light

(5) An organ pipe, open at both ends and another organ pipe, closed at one end, will resonate with each other, if their lengths are in ratio of

(a) 1 : 1 (b) 1 : 4
(c) 2 : 1 (d) 1 : 2

(6) The wavelength of light observed on the earth, from a moving star is found to decrease by 0.05%. Relative to the earth the star is

(a) moving away with a velocity of 1.5×10^5m/s
(b) coming closer with a velocity of 1.5×10^5m/s
(c) moving away with a velocity of 1.5×10^4m/s
(d) coming closer with a velocity of 1.5×10^4m/s

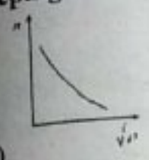
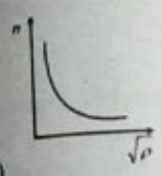
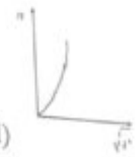
(7) The speed of a sinusoidal wave on a string depends on

(a) the length of the string (b) the tension in the string
(c) the wavelength of the wave (d) the frequency of the wave

(8) If stretching force T of a wire increases, then its frequency

(a) decreases (b) increases
(c) remains the same (d) any of above

(9) The correct graph between the frequency n and square root of density (ρ) of a wire, keeping its length, radius and tension constant, is

(a) 
(b) 
(c) 
(d) 

(10) A sound wave is passing through an air column. During the consequent compressions and rarefactions:

(a) Boyle's law is obeyed (b) Density of air remains constant
(c) Bulk modulus of air oscillates (d) Total amount of heat remains constant

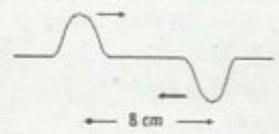
(11) According to Newton sound travel in air under the conditions of which type of process?

(a) Adiabatic (b) Isothermal
(c) Isobaric (d) Isochoric

(12) Beats are a result of

(a) Diffraction
(b) Constructive interference
(c) Destructive interference
(d) Alternate constructive and destructive interference

(13) Two pulses in a stretched string whose centres are initially 8 cm apart are moving towards each other as shown in the figure. The speed of each pulse is 2 cm/s. After 2 seconds, the total energy of the pulses will be.

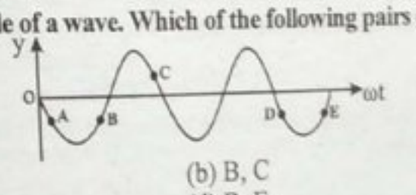


(a) zero (b) purely kinetic energy
(c) purely potential energy (d) Partly kinetic and partly potential

(14) The phase difference between the two particles situated on both the sides of a node is

(a) 0^0 (b) 90^0
(c) 180^0 (d) 360^0

(15) The diagram shows the profile of a wave. Which of the following pairs of points are in phase?



(a) A, B (b) B, C
(c) B, D (d) B, E

(16) In stationary waves, distance between a node and its nearest antinode is 20 cm. The phase difference between two particles having a separation of 60 cm will be

(a) $\pi/2$ (b) $3\pi/2$
(c) zero (d) π

Scanned by CamScanner

(17) **Stationary waves of frequency 300 Hz are formed in a medium in which the velocity of sound is 1200 metre/sec. The distance between a node and the neighboring antinode is**
(a) 2 m (b) 3 m
(c) 1 m (d) 4 m

(18) **A wave of frequency 100 Hz is sent along a string towards a fixed end. When this wave travels back after reflection, a node is formed at a distance of 10 cm from the fixed end of the string. The speed of incident (and reflected) wave are**
(a) 20 m/s (b) 5 m/s
(c) 10 m/s (d) 30 m/s

(19) **Two tuning forks A and B produce 10 beats per second when sounded together. On slightly loading fork A with a little wax, it was observed that 15 beats are heard per second. If the frequency of fork B is 480 Hz, what is the frequency of fork A before it was loaded?**
(a) 465 Hz (b) 470 Hz
(c) 490 Hz (d) 495 Hz

(20) **Two sinusoidal waves with same wavelengths and amplitudes travel in opposite directions along a string with a speed 10 ms^{-1}. If the minimum time interval between two instants when the string is flat is 0.5 s, the wavelength of the waves is**
(a) 15 m (b) 20 m
(c) 10 m (d) 30 m

(21) **The number of beats produced per second is equal to**
(a) the sum of the frequencies of two tuning forks
(b) the difference of the frequencies of two tuning forks
(c) the ratio of the frequencies of two tuning forks
(d) the frequency of either of the two tuning forks

(22) **Standing waves can be produced**
(a) on a string clamped at one end and free at the other
(b) when incident wave gets reflected from a wall
(c) on a string clamped at both the ends
(d) when two identical waves with a phase difference of p are moving in the same direction

(23) **Silence zone takes place due to**
(a) constructive interference (b) destructive interference
(c) beats (d) resonance

(24) **Doppler effect applies to**
(a) sound wave only (b) light wave only
(c) both sound and light waves (d) neither sound nor light wave

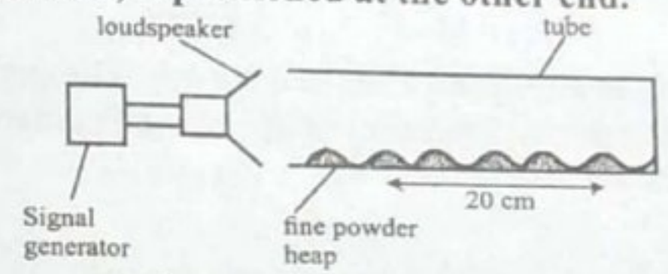
(25) **The velocity of sound in a gaseous medium is 330 ms^{-1}. If the pressure is increased 4-times without change in temperature, the velocity of sound in gas is:**
(a) 330 ms^{-1} (b) 660 ms^{-1}
(c) 165 ms^{-1} (d) 1320 ms^{-1}

(26) **A closed pipe and an open pipe have their first overtones identical in frequency. Their lengths are in the ratio**
(a) 1 : 2 (b) 3 : 4
(c) 4 : 5 (d) 2 : 3

(27) **Which one is the correct relation for fundamental frequency of open and closed pipe?**
(a) $f_{open} = 2\, f_{closed}$ (b) $f_{closed} = 2f_{open}$
(c) $f_{open} = f_{closed}$ (d) $f_{open} = 1/ f_{closed}$

(28) **The first overtone in a closed pipe has a frequency**
(a) same as the fundamental frequency of an open tube of same length
(b) twice the fundamental frequency of an open tube of same length
(c) same as that of the first overtone of an open tube of same length
(d) none of these

(29) **A long horizontal tube, containing a fine powder, is closed at one end. A loudspeaker, connected to a signal generator, is positioned at the other end.**



At a particular frequency, a stationary wave is set up inside the tube and the powder forms heaps at the nodes. The speed of what type of wave is the stationary wave and what is its frequency

	Type of wave	Frequency/kHz
(a)	longitudinal	3.3
(b)	transverse	3.3
(c)	longitudinal	6.6
(d)	transverse	6.6

(30) **An air column in a pipe, which is closed at one end, will be in resonance with a vibrating body of frequency 166 Hz, if the length of the air column is**
(a) 1.00 m (b) 0.50 m
(c) 1.50 m (d) 2.00 m

(31) **If the velocity of sound in air is 350 m/s. Then the fundamental frequency of an open organ pipe of length 50 cm, will be**
(a) 175 Hz (b) 100 Hz
(c) 350 Hz (d) 900 Hz

(32) **The fundamental note produced by a closed organ pipe is of frequency f. The fundamental note produced by an open organ pipe of same length will be of frequency**
(a) f/2 (b) f/4
(c) f (d) 2f

(33) **At what temperature, the velocity of sound will be double its value at 273 K?**
(a) 2 × 273 K (b) 4 × 273 K
(c) 8 × 273 K (d) 16 × 273 K

(34) **If the velocity of sound in air is 336 m/s. The maximum length of a closed pipe that would produce a just audible sound will be**
(a) 3.2 cm (b) 4.2 m
(c) 3.2 m (d) 4.2 cm

(35) **A cylindrical tube, open at both ends, has a fundamental frequency f_0 in air. The tube is dipped vertically into water such that half of its length is inside water. The fundamental frequency of the air column now is**
(a) $3f_0/4$ (b) f_0
(c) $f_0/2$ (d) $2f_0$

(36) **The speed of sound in hydrogen is time than that in oxygen**
(a) two times (b) three times
(c) four time (d) six time

Scanned by CamScanner

(37) The frequency of fundamental tone in an open organ pipe of length 0.48 m is 320 Hz. Speed of sound is 320 m/sec. Frequency of fundamental tone in closed organ pipe will be
(a) 153.8 Hz (b) 160.0 Hz
(c) 320.0 Hz (d) 1143.2 Hz

(38) Two open organ pipes of length 25 cm and 25.5 cm produce 10 beat/sec. The velocity of sound will be
(a) 350 m/s (b) 250 m/s
(c) 150 m/s (d) 255 m/s

(39) A passenger is sitting in a train which is moving fast. The engine of the train blows a whistle of frequency 'n'. If the apparent frequency of the sound heard by the passenger is 'n'' then
(a) $n' = n$ (b) $n' > ns$
(c) $n' < n$ (d) $n' \leq n$

(40) Which phenomena can be applied to estimate the velocity of star with respect to Earth
(a) doppler's effect (b) interference of waves
(c) beats phenomena (d) all of these

(41) An open pipe of length l vibrates in fundamental mode. The pressure variation is maximum at
(a) 1/4 from ends (b) the middle of pipe
(c) the ends of pipe (d) at 1/8 from ends of pipe middle of the pipe

(42) Fundamental frequency of pipe is 100 Hz and other two frequencies are 300 Hz and 500 Hz then
(a) pipe is open at both the ends (b) pipe is closed at both the ends
(c) one end open and another end is closed (d) none of the above

(43) If the tension of sonometer's wire increases four times then the fundamental frequency of the wire will increase by
(a) 2 times (b) 4 times
(c) 1/2 times (d) 3/2 times

(44) Four wires of identical length, diameters and of the same material are stretched on a sonometre wire. If the ratio of their tensions is 1 : 4 : 9 : 16 then the ratio of their fundamental frequencies are
(a) 16 : 9 : 4 : 1 (b) 4 : 3 : 2 : 1
(c) 1 : 4 : 2 : 16 (d) 1 : 2 : 3 : 4

(45) Length of a string tied to two rigid supports is 40 cm. Maximum length (wavelength in cm) of a stationary wave produced on it, is
(a) 20 (b) 10
(c) 80 (d) 40

(46) When source is moving towards observer with velocity u_s then the modified frequency 'f_c' will be
(a) $f_c = f\left[\frac{v-u_s}{v}\right]$ (b) $f_c = f\left[\frac{v}{v+u_s}\right]$
(c) $f_c = f\left[\frac{v}{v-u_s}\right]$ (d) $f_c = f\left[\frac{v+u_s}{v}\right]$

(47) Doppler's effect is not applicable for:
(a) microwaves (b) ultrasonic
(c) electromagnetic waves (d) standing waves

(48) An observer standing at the sea coast observes 54 waves reaching the coast per minute. If the wavelength of the waves is 10 m, find the velocity.
(a) 3 m/s (b) 9 m/s
(c) 4 m/s (d) 5 m/s

(49) A tuning fork of known frequency 256 Hz makes 5 beats/s with the vibrating string of a piano. The beat frequency decreases to 2 beats/s when the tension in the piano string is slightly increased. The frequency of the piano string before increasing the tension was
(a) (256 + 2) Hz (b) (256 - 2) Hz
(c) (256 - 5) Hz (d) (256 + 5) Hz

(50) With the increase in temperature, the frequency of the sound from an organ pipe
(a) decreases (b) remains unchanged
(c) increases (d) none of these

(51) A source of sound produces waves of $\lambda = 40$ cm in air. It is moving with a velocity one-fourth the velocity of sound towards east. The apparent wavelength noted by a man in the opposite direction is:
(a) 30 cm (b) 60 cm
(c) 50 cm (d) 75 cm

(52) When a stationary wave is formed then its frequency is_____
(a) same as that of the individual waves (b) twice that of the individual waves
(c) half of the individual waves (d) none of the above

(53) It is possible to hear beats from the two vibrating sources of frequency
(a) 100 Hz and 150 Hz (b) 20 Hz and 25 Hz
(c) 400 Hz and 500 Hz (d) 1000 Hz and 1500 Hz

(54) A tuning fork vibrated with 2 beats in 0.04 second. The frequency of the fork is
(a) 50 Hz (b) 100 Hz
(c) 80 Hz (d) none

(55) A supersonic jet produces waves in air. The wave front is _____
(a) elliptical (b) conical
(c) spherical (d) parabolic

(56) A sound source is moving towards a stationary observer with $\frac{1}{10}$ of the speed of sound. The ratio of apparent to real frequency is _____
(a) $\frac{10}{9}$ (b) $\frac{11}{10}$
(c) $\left(\frac{11}{10}\right)^2$ (d) $\left(\frac{9}{10}\right)^2$

(57) A standing wave having 3 nodes and 2 antinodes is formed between two atoms having a distance 1.21Å between them. The wavelength of the standing wave is
(a) 1.21Å (b) 2.42Å
(c) 3.63Å (d) 0.5Å

(58) An empty vessel is partially filled with water. Then the frequency of vibration of air column in the vessel
(a) remain same (b) decrease
(c) increase (d) first increase then decrease

Scanned by CamScanner

(59) At what temperature velocity of sound is double than that of at 0°C.
(a) 819k (b) 819°C
(c) 600l°C (d) 600°C

(60) There are two strings of equal length and diameter but the densities are in the ratio 1:2 they are stretched by a tension T. The ratio of their fundamental frequencies will be:
(a) $\sqrt{2}:1$ (b) 1:4
(c) 1:2 (d) 2:1

ANSWER KEY

1	a	11	b	21	b	31	c	41	b	51	c
2	d	12	d	22	c	32	d	42	c	52	a
3	d	13	b	23	b	33	b	43	a	53	b
4	c	14	c	24	c	34	b	44	d	54	a
5	c	15	d	25	a	35	b	45	c	55	b
6	b	16	b	26	b	36	c	46	c	56	a
7	b	17	c	27	a	37	b	47	d	57	a
8	b	18	a	28	d	38	d	48	b	58	c
9	a	19	a	29	a	39	a	49	c	59	b
10	d	20	c	30	b	40	a	50	c	60	a

EXPLANATORY NOTES

(1) $[f_1]_{open} = n = \frac{v}{2l}$

$[f_1]_{close} = \frac{v}{4l} = \frac{1}{2}\left[\frac{v}{2l}\right] = \frac{1}{2}(n)$

(2) Mechanical waves do not propagate without medium.

(3) If two particles have same phase then,
Path difference $= 0, \lambda, 2\lambda, 3\lambda \ldots..$

(4) $\frac{\Delta\lambda}{\lambda} = \frac{v}{c}$, Now $\Delta\lambda = \frac{0.5}{100}\lambda \Rightarrow \frac{\Delta\lambda}{\lambda} = \frac{0.5}{100}$

$\therefore v = \frac{0.5}{100} \times c = \frac{0.5}{100} \times 3 \times 10^8 = 1.5 \times 10^6 m/s$ Increase in l indicates that the star is receding.

(5) $f_1 = f_2$

$\frac{v}{2\ell_1} = \frac{v}{4\ell_2}$

$\ell_1 : \ell_2 = 2:1$

(6) $\frac{\Delta\lambda}{\lambda} = \frac{v}{c} \Rightarrow \frac{0.05}{100} = \frac{v}{3\times10^8} \Rightarrow v = 1.5\times10^5$ m/s (since wavelength is decreasing, so star coming closer)

(7) $v = \sqrt{\frac{T}{m}} \Rightarrow v \propto \sqrt{T}$

(8) $f = \frac{1}{2\ell}\sqrt{\frac{T}{m}} \Rightarrow f \propto \sqrt{T}$

(9) $n = \frac{1}{2\ell}\sqrt{\frac{T}{m}} = \frac{1}{2\ell}\sqrt{\frac{T}{\rho V}} = \frac{1}{2\ell}\sqrt{\frac{T}{\rho\pi r^2\ell}} \Rightarrow n \propto \frac{1}{\sqrt{\rho}}$ (Graph between n and ρ will be hyperbola)

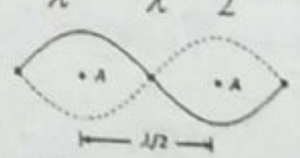
(10) Propagation of sound waves obey adiabatic process i.e. No heat enters or leave the system.

(11) According to Newton formula, sound travels in air under isothermal process $V \propto \frac{1}{P}$ (T = constant)

(12) Beats phenomenon is a special type of interference

(13) After 2 sec the pulses will overlap completely. The string becomes straight and therefore does not have any potential energy and its entire energy must be kinetic

(14) Phase difference $= \frac{2\pi x}{\lambda} = \frac{2\pi}{\lambda} \times \frac{\lambda}{2} = \pi$



(15) In phase, points are lies on different waves having same phase of vibrations.

Scanned by CamScanner

(16) Distance between node and antinode is $\frac{\lambda}{4}=20\Rightarrow\lambda=80cm$

Phase difference $=\frac{2\pi x}{\lambda}=\frac{2\pi\times60}{80}=\frac{3\pi}{2}$

(17) Distance between node and antinode $=\frac{\lambda}{4}=\frac{v/f}{4}=\frac{1200}{4\times300}=1m$

(18)

$v=f\lambda$

$\because\left(\frac{\lambda}{2}=10\right)$

$v=(100)\left(20\times10^{-2}\right)=20\,ms^{-1}$

(19) $f_A-f_B=\pm n$

$f_A=f_B\pm n$

$f_A=470$ Hz or 490 Hz

After loaded wax f_A should be decrease and now difference is equal to 15, so

$f_B-f_A=15$

$480-465=15$

So, after wax loaded f_A decreases to 465 Hz.

(20) Minimum time interval between two instants when the string is flat = $\frac{T}{2}=0.5\sec\Rightarrow T=1\sec$ Hence $\lambda=v\times T=10\times1=10\,m$.

(21) $n=f_A-f_B$

(22) Standing waves can be produced only when two similar type of waves (same frequency and speed, but amplitude may be different) travel in opposite directions

(23) In silence zone, compression meets with a rare faction. The resultant displacement becomes zero.

(24) Doppler's effect is applicable for both sound and light waves.

(25) $V=\sqrt{\frac{\gamma p}{\rho}}$

Speed of sound does not depend upon pressure. $v\propto P^o$

(26) As given, first overtones identical in frequency.

$f_{open}=f_{closed}$

$\frac{2v}{2\ell_1}=\frac{3v}{4\ell_2}$

$\frac{\ell_2}{\ell_1}=\frac{3}{4}$

(27) Fundamental frequency of closed pipe $=f_c=\frac{v}{4\ell}=\frac{1}{2}\left(\frac{v}{2\ell}\right)\Rightarrow f_c=\frac{1}{2}f_{open}\Rightarrow f_{open}=2f_{closed}$

(28) First overtone in closed pipe = Second overtone in open pipe = $3f_1$

(29) Sound waves are longitudinal waves.

$f=\frac{v}{\lambda}=\frac{330ms^{-1}}{10cm}=\frac{330}{0.1}=3.3\times10^3\,Hz=3.3\,kHz$

(30) For closed pipe $f_1=\frac{v}{4\ell}\Rightarrow\ell=\frac{v}{4f}=\frac{332}{4\times166}=0.5m$

(31) Fundamental frequency of open pipe $f_1=\frac{v}{2\ell}=\frac{350}{2\times0.5}=350Hz$

(32) $f_{closed}=\frac{v}{4\ell},f_{open}=\frac{v}{2\ell}\Rightarrow f_{open}=2f_{closed}=2f$

(33) $\frac{v_T}{v_o}=\sqrt{\frac{T}{T_o}}\Rightarrow\frac{2v_o}{v_o}=\sqrt{\frac{T}{T_o}}$

$T=4T_o$

(34) Minimum audible frequency $=20Hz\Rightarrow f_{min}=\frac{v}{4\ell_{max}}=20\Rightarrow\ell_{max}=\frac{336}{4\times20}=4.2m$

(35) $f_{open}=\frac{v}{2\ell_{open}}$, $f_{closed}=\frac{v}{4\ell_{closed}}=\frac{v}{4\ell_{open}/2}=\frac{v}{2\ell_{open}}\left(As\,\ell_{closed}=\frac{\ell_{open}}{2}\right)$ i.e. frequency remains unchanged.

(36) $\frac{v_H}{v_o}=\sqrt{\frac{\rho_o}{\rho_H}}=\sqrt{\frac{16\rho_H}{\rho_H}}=\frac{4}{1}$

$v_H=4v_o$

(37) $\left(f_{closed}=\frac{1}{2}f_{open}\right)=\frac{1}{2}\times320=160Hz$

(38)

$n=n_1-n_2\Rightarrow10=\frac{v}{2l_1}-\frac{v}{2l_2}=\frac{v}{2}\left[\frac{1}{l_1}-\frac{1}{l_2}\right]\qquad\Rightarrow10=\frac{v}{2}\left[\frac{1}{0.25}-\frac{1}{0.255}\right]$

$\Rightarrow v=255\,m/s.$

(39) No relative motion between source and observer

(40) Speed can be find by use of doppler shift.

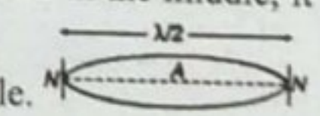
(41) At the middle of pipe, node is formed

(42) For closed organ pipe

$n_1:n_2:n_3....=1:3:5:.....$

(43) $f\propto\sqrt{T}$

(44) $f\propto\sqrt{T}\Rightarrow f_1:f_2:f_3:f_4=\sqrt{1}:\sqrt{4}:\sqrt{9}:\sqrt{16}=1:2:3:4.$

(45) When the string is plucked in the middle, it vibrates in one loop with nodes at fixed ends and an antinode in the middle. 

So that, $\frac{\lambda_1}{2}=\ell\Rightarrow\lambda_1=2\times40=80cm$

(46) $f_c=\left(\frac{v}{v-u_s}\right)f$

Scanned by CamScanner

(47) Doppler's effect is applicable for both light and sound waves

$f = \frac{54}{60} = 0.9\,\text{Hz}$

(48) $v = f\lambda = (0.9)(10)$

$= 9 ms^{-1}$

(49) Given, frequency f_1=256Hz For tuning fork $f_2 - f_1 = \pm 5$, f_2 = frequency of piano f_2 =(256+5)Hz or (256–5) Hz When tension is increased, the beat frequency decreases to 2 beats/s. If we assume that the frequency of piano string is 261 Hz, then on increasing tension, frequency, more than 261 Hz. But it is given that beat frequency decreases to 2, therefore 261 is not possible. Hence, 251 Hz i.e, 256 - 5 was the frequency of piano string before increasing tension.

(50) $f = \frac{1}{2\ell}\sqrt{\frac{T}{m}} \Rightarrow f \propto \sqrt{T}$

(51) $f' = \left(\frac{v}{v+u_s}\right) f$

$\frac{v}{\lambda'} = \left(\frac{v}{v+u_s}\right)\frac{v}{\lambda}$

$\lambda' = \left(\frac{v+u_s}{v}\right)\lambda = \left(\frac{v+v/4}{v}\right)\lambda = \frac{5}{4}\lambda = \frac{5}{4}40 = 50\,cm$

(52) Frequency of stationary wave is equal to frequency of individual waves.

(53) Beat frequency should be less then 10.

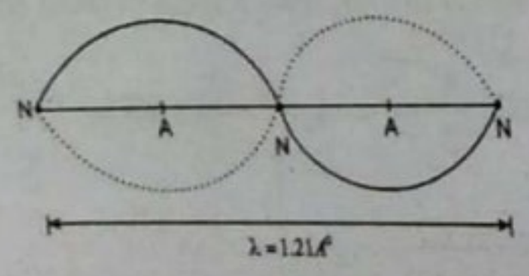
(54) $Frequency = \frac{No.of\ beats}{time} = \frac{2}{0.04} = 50\,Hz$

(55) Supersonic jet produces wave speed in air greater than speed of sound, so wave front shape is conical

(56) $f' = \left(\frac{v}{v-u_s}\right) f \Rightarrow f' = \left(\frac{v}{v-\frac{v}{10}}\right) f$

$\frac{f'}{f} = \frac{v}{\frac{9}{10}v} = \frac{10}{9}$

(57)



(58) $f_n = n\left(\frac{v}{4l}\right) \Rightarrow \left(f \propto \frac{1}{l}\right)$, length of column decrease so frequency will be increase.

(59) $\frac{v_2}{v_1} = \sqrt{\frac{T_2}{T_1}} \Rightarrow \frac{2v_1}{v_1} = \sqrt{\frac{T_2}{273}}$

$4 \times 546K = T_2$

$(1092 - 273)^\circ C = T_2$

$819^\circ C = T_2$

(60) $f = \frac{1}{2\ell}\sqrt{\frac{T}{m}} = \frac{1}{2\ell}\sqrt{\frac{T}{\rho V}} \Rightarrow f \propto \frac{1}{\sqrt{\rho}} \qquad \because \rho = \frac{m}{V}$

$\frac{f_1}{f_2} = \sqrt{\frac{\rho_2}{\rho_1}} = \sqrt{\frac{2}{1}}$

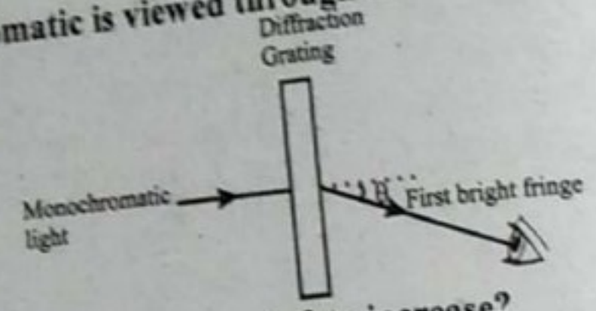
Scanned by CamScanner

Chapter 9 PHYSICAL OPTICS

PRACTICE EXERCISE

(1) **The blue colour of sky is due to**
(a) reflection (b) polarization
(c) diffraction (d) scattering

(2) **A source of monochromatic is viewed through diffracting grating**



Which of the following causes the angle θ to increase?
(a) Decreasing the distance between adjacent slits on the grating
(b) Decreasing the wavelength of the monochromatic light
(c) Increasing the distance of eye from grating
(d) Increasing the number of slits of the grating but keeping the slits spacing the same

(3) **A diffraction pattern is obtained using a beam of red light. If the red light is replaced with blue light then**
(a) Diffraction pattern remains unchanged (b) Diffraction bands becomes narrower
(c) Diffraction bands becomes broader (d) Bands disappears

(4) **When light incident normally on thin film, the path difference depends upon**
(a) Thickness of the film only (b) Nature of the film only
(c) Angle of incidence only (d) All thickness, nature and angle of incidence

(5) **In young's double slit experiment, if the distance between the slits and the screen is doubled and the separation between the slits is reduced to half, the fringe width:**
(a) Is doubled (b) Becomes four times
(c) Is halved (d) Remains unchanged

(6) **Huygen's wave theory cannot explain**
(a) Diffraction (b) Interference
(c) Polarization (d) Photoelectric effect

(7) **In a Young's double-slit experiment the bright fringe occurs whenever waves from the slits differ in phase by a multiple of:**
(a) $3\pi/4$ (b) π
(c) 2π (d) $\pi/2$

(8) **Light from a small region of an ordinary incandescent bulb is passed through a yellow filter and then serves as the source for a Young's double-slit experiment. Which of the following changes would cause the interference pattern to be more closely spaced?**
(a) Use slits that are closer together (b) Use a light source of lower intensity
(c) Use a blue filter instead of a yellow filter (d) Use a light source of higher intensity

(9) **Longitudinal waves do not exhibit**
(a) Reflection (b) Refraction
(c) Diffraction (d) Polarization

(10) **In the equation $\sin\theta = \lambda/a$ for single-slit diffraction, θ is:**
(a) The angle to the second maximum (b) The angle to the first minimum
(c) The phase angle between the extreme rays (d) $N\pi$ where N is an integer

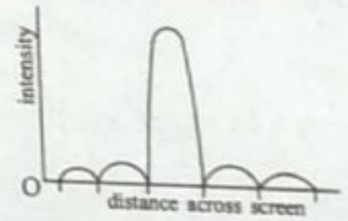
(11) **A Polaroid is placed at 45° to an incoming plane polarized light of intensity I_o, now the intensity of light passing through Polaroid after polarization would be**
(a) I_o (b) $I_o/2$
(c) $I_o/4$ (d) Zero

(12) **A wedge- shaped thin film is illuminated by a parallel beam of monochromatic light. The fringes observed will be**
(a) Straight parallel to the edge of the wedge
(b) Concentric circles with centers at the point of contact
(c) Parabolic
(d) Of a complicated shape.

(13) **Which one of the following is nearly monochromatic light?**
(a) Light from fluorescent tube (b) Light from mercury lamp
(c) Light from sodium lamp (d) Light from simple lamp

(14) **Two interfering beams have intensities in the ratio 9:4. Then the ratio of maximum to minimum intensity in the interference pattern is**
(a) 25 : 1 (b) 13 : 5
(c) 5 : 1 (d) 3 : 2

(15) **Figure represents the intensity distribution produced on a screen by the diffraction of light**



This can be achieved by using
(a) One single wavelength and a single slit
(b) One single wavelength and a double slit
(c) Two separate wavelengths and a single slit
(d) Two separate wavelengths and a double slit

(16) **In Young's double slit experiment, the fringe spacing is equal to (d= slit separation and D = distance of screen from slits)**
(a) $d\lambda D$ (b) $2\lambda d/D$
(c) $\lambda D/d$ (d) $\lambda d/D$

(17) **Under which of the following sets of conditions will the separation of the bright fringes of a double-slit interference pattern be greatest?**

	Distance between slits	Distance from slits to screen	Wavelength of source
(a)	Small	Small	Short
(b)	Small	Large	Long
(c)	Small	Large	short
(d)	Large	Small	Short

(18) **Two monochromatic radiations X and Y are incident normally on a diffraction grating. The second order intensity maximum for X coincides with the third order intensity maximum for Y.**

What is the ratio $\frac{\text{wavelength of X}}{\text{wavelength of Y}}$?

(a) $\frac{1}{2}$ (b) $\frac{3}{2}$
(c) $\frac{2}{3}$ (d) $\frac{2}{1}$

Scanned by CamScanner

(19) **The dispersion of light in a medium implies that**
(a) Lights of different wavelengths travel with different speeds in the medium
(b) Lights of different frequencies travel with different speeds in the medium
(c) The refractive index of the medium is different for different wavelengths of light.
(d) All of the above

(20) **In an interference pattern**
(a) Bright fringes are wider than dark fringes
(b) Dark fringes are wider than bright fringe
(c) Both dark and bright fringes are of equal width
(d) Central fringes are dimmer than the outer fringes

(21) **A two-slit arrangement is set up to produce interference fringes on a screen. The fringes are too close together for convenient observation when a monochromatic source of violet light is used. In which way would it be possible to increase the separation of the fringes?**
(a) Decrease the distance between the screen and the slits
(b) Increase the distance between the two slits
(c) Increase the width of each slit
(d) Use a monochromatic source of red light

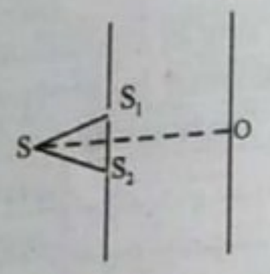
(22) **How many colors comprise in white light?**
(a) Infinite (b) Seven
(c) Three (d) Fourteen

(23) **A light ray traveling from denser to rarer medium suffers a phase change of**
(a) 0° (b) 90°
(c) 180° (d) 45°

(24) **When one mirror of a Michelson Interferometer is moved a distance of 0.5 mm, we observe 2000 fringes. What will be wavelength of light used?**
(a) 5000 nm (b) 5000 A°
(c) 500m (d) 2000μm

(25) **Diffraction effect is**
(a) More for a round edge (b) Less for a round edge
(c) More for a sharp edge (d) Less for a sharp edge.

(26) **In set up shown in the figure, the two slits S_1 and S_2 are equidistance from the slit S. The central fringe at O is then**



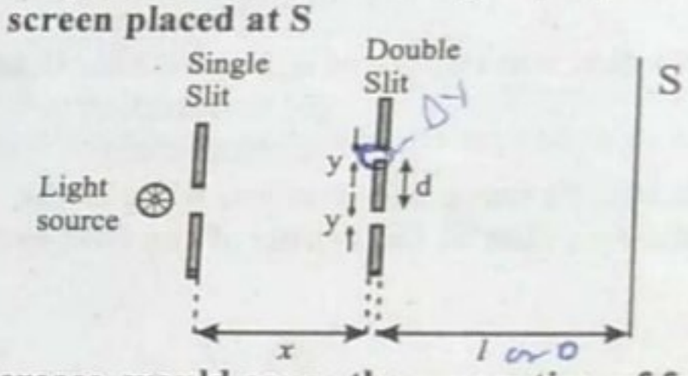
(a) Always bright
(b) Always dark
(c) Either dark or bright depending on the position of S
(d) Neither dark not bright

(27) **Wavelength of X- rays falling at glancing angle of 30° on a crystal with atomic spacing 2×10^{-10}m for the first order diffraction is**
(a) 4×10^{-10}m (b) 2×10^{-10}m
(c) 0.02×10^{-10}m (d) 20×10^{-10}m

(28) **A diffraction grating has 500 lines per mm. Its slit spacing or grating element will be equal to**
(a) 500 mm (b) 5×10^{-3} mm
(c) 2×10^{-5} mm (d) 2×10^{-3}mm

(29) **In a plane polarized light electric vibration are**
(a) In all direction
(b) In two mutually perpendicular directions
(c) Taking place perpendicular to the direction of propagation of light
(d) No vibration at all.

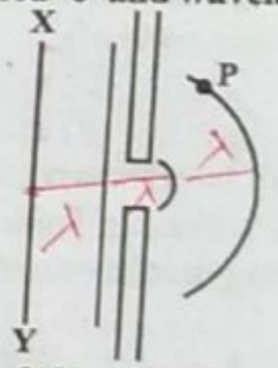
(30) **In the young slit arrangement shown in the figure, a pattern of equally spaced, parallel fringes appear on a screen placed at S**



Which quantity, if increase, would cause the separation of fringes to increase?
(a) x (c) y
(b) d (d) l

(31) **Which one of the following cannot be polarized?**
(a) Radio waves (b) Ultraviolet rays
(c) X-rays (d) Ultrasonic waves

(32) **A monochromatic plane wave of speed 'c' and wavelength λ is diffracted at a small aperture.**



The time during which a portion of the wavefront XY reaches at 'P' will be
(a) $\frac{3\lambda}{2c}$ (b) $\frac{2\lambda}{c}$
(c) $\frac{3\lambda}{c}$ (d) $\frac{4\lambda}{c}$

(33) **In monochromatic red light, a blue book will probably appear to be**
(a) Black (b) Purple
(c) Green (d) No scientific reasoning available

(34) **A polarizer is used to**
(a) Reduce the intensity of light (b) Produce polarized light
(c) Increase intensity of light (d) Both a and b

(35) **In double slit experiment, if one of the two slit is covered then**
(a) No interference fringes are observed (b) No diffraction fringes are observed
(c) No fringes observed (d) Interference pattern not disturbed

(36) **The formula $d\sin\theta = m\lambda$ is used to locate diffraction maxima resulting from diffraction grating. Here "m" is_____**
(a) 0, ±1, ±2, ±3,...
(b) ±1, ±2, ±3,...
(c) 1, 2, 3,...
(d) 0, 1, 2, 3,...

Scanned by CamScanner

(37) In Michelson interferometer to switch the fringe from bright to dark the mirror should be displaced through
(a) λ (b) $\lambda/3$
(c) $\lambda/6$ (d) $\lambda/4$

(38) In the shadow of a ball the central portion appears bright that happens due to
(a) Interference (b) Diffraction
(c) Polarization (d) Refraction

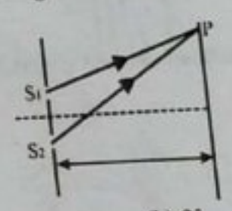
(39) Which experiment shows that wavelength of light is smaller than that of sound
(a) Diffraction (b) Polarization
(c) Interference (d) Reflection

(40) In Young's double-slit interference experiment, what is the difference in path length of the light waves from the two slits at the center of the first bright fringe above the central maximum?
(a) $\frac{1}{2}\lambda$ (b) $\frac{1}{4}\lambda$
(c) $\lambda/3$ (d) λ

(41) Plane polarized light is incident on a analyzer. The intensity then becomes three forth. The angle of the axis of the analyzer with the beam is
(a) 30° (b) 45°
(c) 60° (d) Zero

(42) In a Young's double-slit experiment the center of a bright fringe occurs wherever waves from the slits differ in phase by a multiple of:
(a) $3\pi/4$ (b) π
(c) 2π (d) $\pi/2$

(43) In Young's double slit experiment an interference pattern of bright and dark fringes is obtained on a screen by light of wavelength λ coming from coherent sources S_1 and S_2. At point P on screen second bright fringe (excluding that at center) is formed. The diff. between paths S_1P and S_2P is:



(a) λ (b) 2λ
(c) $\frac{3\lambda}{2}$ (d) $\frac{5\lambda}{2}$

(44) When an upolarized light of intensity I_o is incident on a polarizing sheet, the intensity of the light which does not get transmitted is
(a) I_o (b) zero
(c) $\frac{1}{4}I_o$ (d) $\frac{1}{2}I_o$

(45) Fringe width observed in the Young's double slit experiment is β. If the frequency of the source is doubled, the fringe width will
(a) remain β (b) become $\beta/2$
(c) become 2β (d) become $3\beta/2$

(46) Two sources of light are coherent if they emit rays of
(a) Same wavelength
(b) Same wavelength with constant phase difference
(c) Same amplitude of vibration
(d) Same amplitude and wavelength

(47) Interference and diffraction of light support the:
(a) Electromagnetic nature of light (b) Wave nature of light
(c) Quantum nature of light (d) Longitudinal nature of light waves

(48) Position of dark fringes in Young's double-slit experiment are given by
(a) $Y_m = m\lambda\frac{L}{d}$ (b) $Y_m = m\lambda\frac{d}{L}$
(c) $Y_m = \left(m+\frac{1}{2}\right)\lambda\frac{L}{d}$ (d) $Y_m = 2m\lambda\frac{L}{d}$

(49) For which of the following colours will the fringe-width be minimum in the double-slit experiment:
(a) Violet (b) Red
(c) Green (d) Yellow

(50) Light of wavelength λ is incident normally on a diffraction grating for which the slit spacing is equal to 3λ. What is the sine of the angle between the second order maximum and the normal?
(a) $\frac{1}{6}$ (b) $\frac{2}{3}$
(c) $\frac{1}{3}$ (d) 1

ANSWER KEY

1	d	11	b	21	d	31	d	41	a
2	a	12	b	22	b	32	c	42	c
3	b	13	c	23	a	33	a	43	b
4	d	14	a	24	b	34	d	44	d
5	b	15	a	25	c	35	a	45	b
6	d	16	c	26	a	36	a	46	b
7	c	17	b	27	b	37	d	47	b
8	c	18	b	28	d	38	b	48	c
9	d	19	d	29	c	39	a	49	a
10	b	20	c	30	d	40	d	50	b

Scanned by CamScanner

EXPLANATORY NOTES

(1) Scattering $\alpha \frac{1}{\lambda^4}$

(2) $d\sin\theta = n\lambda$

$\theta = \sin^{-1}\left(\frac{n\lambda}{d}\right)$

If "d" decrease then θ increases

(3) $\Delta y = \frac{\lambda L}{d}$

$\Delta y \propto \lambda$

Since $\lambda_B < \lambda_R$

So $(\Delta y)_{blue} < (\Delta y)_{red}$

(4) In interference of thin film, path difference depends upon nature of film, Thickness and angle of incidence.

(5)

$\Delta y = \frac{\lambda L}{d}$

$d' = \frac{d}{2}$

$L' = 2L$

$So, \Delta y' = 4(\Delta y)$

(6) Huygens's wave theory explains only wave nature of light

(7)

$\varphi = \frac{2\pi x}{\lambda}$

$d\sin\theta = n\lambda$

$n = 0,1,2,3.....$

$\varphi = 0, 2\pi, 4\pi....$

(8)

$\Delta y = \lambda \frac{L}{d}$

$\Delta y \propto \lambda$

$(\lambda)_{yellow} > (\lambda)_{Blue}$

$(\Delta y)_{Blue} < (\Delta y)_{yellow}$

(9) Longitudinal waves do not exhibit polarization because this phenomenon is exhibited by transverse waves only.

(10) In equation

$\sin\theta = \frac{\lambda}{a}$ =?

'θ' represents angle to first minimum.

(11) $I = I_o \cos^2\theta$

$\theta = 45°$

$I = I_o \cos 45°$

$I = I_o\left(\frac{1}{\sqrt{2}}\right)^2$

$I = \frac{I_o}{2}$

(12) Straight parallel lines to the edge of the wedge.

(13) Sodium lamp gives monochromatic light as sodium lamp contains only one colour (yellow).

(14)

$I_{max} = (\sqrt{I_1} + \sqrt{I_2})^2$

$I_{min} = (\sqrt{I_1} - \sqrt{I_2})^2$

$Since, \frac{I_1}{I_2} = \frac{9}{4}$

$\frac{I_{max}}{I_{min}} = \frac{(\sqrt{9}+\sqrt{4})^2}{(\sqrt{9}-\sqrt{4})^2} = \frac{25}{1}$

(15) Diagram is of single slit diffraction and this pattern can be obtain using single wavelength.

(16) Relation for fringe spacing in

YDSE is

$\Delta y = \frac{\lambda D}{d}$

(17)

$\Delta y = \frac{\lambda L}{D}$

$\Delta y \propto \lambda$

$\Delta y \propto L$

$\Delta y \propto \frac{1}{D}$

Scanned by CamScanner

(18)

$d\sin\theta = 2\lambda_x$

$d\sin\theta = 3\lambda_y$

$\frac{\lambda_x}{\lambda_y} = \frac{d\sin\theta/2}{d\sin\theta/3}$

$\frac{\lambda_x}{\lambda_y} = \frac{3}{2}$

(19) Different wavelength and different frequency have different speed in medium (Prism).

(20) In interference pattern Δy is of same width for bright and dark fringes. $\Delta y = \frac{\lambda L}{d}$

(21) $\Delta y = \frac{L\lambda}{d}$

$\Delta y \propto \lambda$

$\lambda_R > \lambda_v$

(22) White light consists of seven colours.

(23) When light travels from denser to rarer medium there will be no change in phase.

(24) $L = m\frac{\lambda}{2}$

$\lambda = \frac{2L}{m}$

(25) More bending of light for sharp edges.

(26) There is no path difference at point o so it is always bright.

(27) $2d\sin\theta = n\lambda$

$\lambda = \frac{2d\sin\theta}{n}$

$= \frac{2\times2\times10^{-10}\times1}{1\times2} = 2\times10^{-10}m$

(28) $d = \frac{L}{N}$

$d = \frac{1}{\frac{500}{10^{-3}}}$

$d = \frac{10^{-3}}{500} = \frac{1}{500\times1000}$

$d = \frac{1}{5\times10^5} = 2\times10^{-3}mm$

(29) In a plane polarized, light electric vibration are taking place perpendicular to direction of propagation of light.

(30) $\Delta y = \frac{\lambda l}{d}$

$\Delta y \propto l$

(31) Ultrasonic waves are longitudinal in nature.

(32) $\lambda = ct$

$t = \frac{\lambda}{c}$

Since there are three waves till point P

So, $t = \frac{3\lambda}{c}$

(33) We see object's colour that is reflected. So blue book appears black in red light as it will absorb red colour.

(34) Polarizer is a device which is used to reduce the intensity and to produce polarized light.

(35) No fringes will be observed if one slit is covered because there is no interference as there is no second source.

(36) m = order of diffraction $(m = 0, \pm1, \pm2, \pm3....)$

(37) To switch the fringes from bright to dark, the mirror should be moved to $\frac{\lambda}{4}$ as double displacement will be $\frac{\lambda}{4} + \frac{\lambda}{4} = \frac{\lambda}{2}$

(38) Light bend from edges and for this reason central portion of ball appears bright.

(39) For diffraction thickness of film should be comparable to wavelength of light.

(40) $\Delta y = n\lambda$ for first bright above the central $n = 1$

$\Delta y = \lambda$

(41) $I = I_o\cos^2\theta$, $I = I_o(\cos30)^2$, $I = I_o\left(\frac{\sqrt{3}}{2}\right)^2$, $I = \frac{3I_o}{4}$

(42) For constructive interference phase difference = $0, 2\pi, 4\pi.....$

(43) For constructive interference

Path difference = $d\sin\theta = m\lambda$ where $m = 2$

Path difference = 2λ

Scanned by CamScanner

(44) 50% of light is not transmitted.

(45) $\Delta Y = \frac{\lambda L}{d}$, $\lambda \propto \frac{1}{f}$

(46) Coherent sources of light produced light of same frequency and constant phase difference.

(47) Experiments shows wave nature of light.

(48) $y_m = \left(m + \frac{1}{2}\right)\frac{\lambda L}{d}$

(49) $\Delta y = \frac{\lambda L}{d} \Rightarrow \Delta y \propto \lambda$

(50) $\because d\sin\theta = n\lambda$.

$3\lambda \sin\theta = (2)(\lambda)$

$\sin\theta = \frac{2}{3}$

9 Chapter PHYSICAL OPTICS

SELF ASSESSMENT TEST

(1) **Two coherent sources produce a dark fringe when the phase difference between interfering waves is:**
(a) Zero (b) 2π
(c) $n\pi$ (d) $(2n-1)\pi$, n = 1, 2, 3, 4

(2) **Monochromatic light of wavelength λ is incident normally on a diffraction grating with the grating element d. At which angle with the normal to the grating is 2nd order diffracted beam observed?**
(a) $\sin^{-1}\frac{2\lambda}{d}$ (b) $\sin^{-1}\frac{\lambda}{2d}$
(c) $\sin^{-1}\frac{d}{\lambda}$ (d) $\sin^{-1}\frac{2d}{\lambda}$

(3) **Huygens' construction can be used only:**
(a) for light (b) for an electromagnetic wave
(c) for transverse waves (d) for all of the above and other situations

(4) **To demonstrate the phenomenon of interference, we require:**
(a) two sources which emit radiation of the same frequency
(b) two sources which emit radiation of nearly the same frequency
(c) two sources which emit radiation of the same frequency and have a definite phase relationship
(d) they are not monochromatic

(5) **The reason there are two slits, rather than one, in a Young's experiment is:**
(a) one slit is for frequency, the other for wavelength
(b) two slits in parallel other for less resistance
(c) to increase the intensity
(d) to create a path length difference

(6) **A slit of size 0.15 cm is placed at 2.1 m from a screen. On illuminated it by a light of wavelength 5×10^{-5} cm. The width of central maxima will be**
(a) 1.4 mm (b) 0.04 mm
(c) 0.4 mm (d) 70 mm

(7) **In a diffraction pattern by a wire, on increasing diameter of wire, fringe width**
(a) remain same
(b) increases
(c) decreases
(d) increasing or decreasing will depend on wavelength

(8) **Two coherent sources of light can be obtained by**
(a) two different lamps
(b) two different lamps but of the same power
(c) two different lamps of same power and having the same colour
(d) none of these

(9) **Which of the following is conserved when light waves interfere with each other?**
(a) energy (b) amplitude
(c) intensity (d) momentum

Scanned by CamScanner

(10) By Huygens's wave theory of light, we cannot explain the phenomenon of
(a) polarization (b) photoelectric effect
(c) interference (d) diffraction

(11) The phenomenon of interference is shown by
(a) longitudinal mechanical waves only (b) transverse mechanical waves only
(c) electromagnetic waves only (d) all of these

(12) The locus of all points in a medium having the same phase of vibration is called
(a) crest (b) trough
(c) wavelength (d) wave front

(13) If torch is used in place of monochromatic light in young's experiment what will happen?
(a) fringe will occur as from monochromatic source
(b) fringe will appear for a moment and then it will disappear
(c) no fringes will appear
(d) only bright fringe

(14) The similarity between the sound waves and light waves is
(a) both are electromagnetic waves (b) both are longitudinal waves
(c) they can produce interference (d) both have the same speed in a medium

(15) Polaroid glass is used as sunglasses because:
(a) it reduces the light intensity to half on account of polarization
(b) it is fashionable
(c) it has good colour
(d) it is cheaper

(16) Two identical light sources S_1 and S_2 emit light of same wavelength l. These light rays will exhibit interference if
(a) their light intensities change randomly (b) their light intensities remain constant
(c) their phase differences remain constant (d) their phases are distributed randomly

(17) In Young's experiment, one slit is covered with a blue filter and the other (slit) with a yellow filter. Then the interference pattern:
(a) will be blue (b) will be yellow
(c) will be green (d) will not be formed

(18) Unpolarised light is converted into partially or plane polarised light by many processes. Which of the following does not do that?
(a) reflection (b) diffraction
(c) double refraction (d) scattering

(19) The condition for constructive interference of two coherent beams is that the path difference should be
(a) integral multiple of $\lambda/2$ (b) integral multiple of λ
(c) odd integral multiple of $\lambda/2$ (d) even integral multiple of λ

(20) In an interference pattern
(a) bright fringes are wider than dark fringes
(b) dark fringes are wider than bright fringe
(c) both dark and bright fringes are of equal width
(d) central fringes are dimmer than the outer fringes

(21) In Young's double slit experiment, the separation between the slit is halved and distance between the slit and screen is doubled. The fringe width is
(a) remain same (b) double
(c) half (d) quadrupled

(22) Wavelength of light of frequency 100Hz
(a) 3×10^6m (b) 2×10^6m
(c) 4×10^6m (d) 5×10^6m

(23) Ray diverging from a point source from a wave front that is
(a) spherical (b) plane
(c) cylindrical (d) cubical

(24) The frequency of light ray having the wavelength 3000 Å is
(a) 9×10^{13} cycles/sec (b) 10^{15} cycles/sec
(c) 90 cycles/sec (d) 3000 cycles/sec

(25) If the distance between a point source and screen is doubled, then intensity of light on the screen will become
(a) half (b) double
(c) one-fourth (d) four times

(26) The wavelength of X- rays is of the order of
(a) 10A° (b) 1000 A°
(c) 1A° (d) 100 A°

(27) Wavelength of X- rays falling at glancing angle of 30° on a crystal with atomic spacing $2x10^{-10}$m for the first order diffraction is
(a) $4x10^{-10}$m (b) $2x10^{-10}$m
(c) $0.02x10^{-10}$m (d) $20x10^{-10}$m

(28) Monochromatic green light of wavelength 5×10^{-7} m illuminates a pair of slits 1 mm apart. The separation of bright lines on the interference pattern formed on a screen 2 m away is
(a) 0.25 mm (b) 0.1 mm
(c) 0.01 mm (d) 1.0 mm

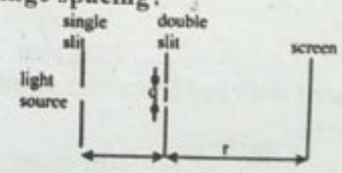
(29) In Young's double slit experiment, if the slit widths are in the ratio 1 : 9, then the ratio of the intensity at minima to that at maxima will
(a) 1 (b) 1/9
(c) ¼ (d) 1/3

(30) Which one of the following cannot be polarized?
(a) radio waves (b) ultraviolet rays
(c) x-rays (d) ultrasonic waves

(31) Bragg's equation is stated as
(a) $d = \frac{2\sin\theta}{m\lambda}$ (b) $d = \frac{m\lambda}{\sin\theta/2}$
(c) $d = \frac{m\lambda}{2\sin\theta}$ (d) $d = \frac{2\sin\theta/2}{m\lambda}$

(32) In monochromatic red light, a blue book will probably appear to be
(a) black (b) purple
(c) green (d) no scientific reasoning available

(33) A teacher sets up the apparatus shown to demonstrate a two slit interference pattern on the screen. The teacher wishes to increase the fringe spacing. Which change to the apparatus will increase the fringe spacing?



(a) decreasing the distance p (b) decreasing the distance q
(c) decreasing the distance r (d) decreasing the wavelength of the light

Scanned by CamScanner

(34) In double slit experiment, if one of the two slit is covered then
(a) no interference fringes are observed (b) no diffraction fringes are observed
(c) no fringes observed (d) interference pattern not disturbed

(35) _____ gives the definition of metre in terms of wavelength of red cadmium light
(a) Newton (b) Einstein
(c) Michelson (d) Galileo

(36) How is the interfering pattern affected if the Young's double slit experiment was performed in still water and then in air?
(a) fewer fringes will be visible (b) fringes will be narrower
(c) fringes will be broader (d) fringes will disappear

(37) In young's double slit experiment, the fringe width depends on
(a) wavelength of the light used (b) distance between the slits and screen
(c) distance between the slits (d) all of them

(38) A diffraction grating contains 5000 lines per centimeter, its grating element will be
(a) 2×10^{-4} nm (b) 2×10^{-14} m
(c) 2×10^{-14} cm (d) 2×10^{-4} cm

(39) As a result of interference of 2 coherent sources of light, energy is
(a) redistributed and distribution does not vary with time
(b) decrease
(c) increased
(d) redistributed and distribution changes with time

(40) When a two-slit arrangement was set up to produce interference fringes on a screen using a monochromatic source of green light, the fringes were found to be too close together for convenient observation. In which of the following ways would it be possible to increase the separation of the fringes?
(a) decrease the distance between the screen and the slits
(b) have larger distance between the two slits.
(c) increase the distance between the source and the slits.
(d) replace the light source with a monochromatic source of red light

(41) When light of different colours move through water they must have different
(a) wavelengths (b) frequencies
(c) velocities (d) all of the above

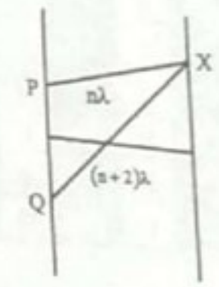
(42) Huygen's principle of secondary wavelets may be used to
(a) find the velocity of light in vacuum (b) explain the particle behaviour of light
(c) find the new position of a wave front (d) explain Snell's law

(43) In a diffraction (single slit experiment), slit is exposed by white light. The fringe surrounding the central fringe is
(a) red (b) yellow
(c) violet (d) green

(44) In YDSE one slit is covered with red filter and another slit is covered by green filter, the interference pattern will be_____
(a) red (b) green
(c) yellow (d) invisible

(45) Intensity of light depends on
(a) amplitude (b) frequency
(c) wavelength (d) velocity

(46) Fig. shows a double slit experiment p and Q are the slits. The path lengths PX and QX are $n\lambda$ and $(n+2)\lambda$ respectively, where n is a whole number and λ is the wavelength. Taking the central fringe as zero, what is formed at X?



(a) First bright (b) Second bright
(c) First dark (d) Second dark

(47) A beam of light consisting of two wavelengths 6500 $\mathring{A}$ and 5200 $\mathring{A}$ is used to obtain interference fringes in YDSE. Suppose the mth bright fringe due to 6500 $\mathring{A}$ coincides with nth bright fringe due to 5200 $\mathring{A}$ at a minimum distance from the central maximum. Then
(a) m = 4 ; n = 5 (b) m = 5 ; n = 4
(c) m = 8 ; n = 10 (d) m = 10 ; n = 8

(48) In YDSE, for light of which colour the fringe width will be minimum
(a) violet (b) red
(c) green (d) yellow

(49) In Young's double slit experiment, the phase difference between the light waves reaching third bright fringe from the central fringe will be
(a) Zero (b) 4π
(c) 2π (d) 6π

(50) A polaroid is placed at 45° to an incoming light of intensity I_o. Now the intensity of light passing through polaroid after polarization would be _____
(a) I_o (b) $\frac{I_o}{2}$
(c) $\frac{I_o}{4}$ (d) zero

Scanned by CamScanner

ANSWER KEY

1	d	11	d	21	d	31	c	41	d
2	a	12	d	22	a	32	a	42	c
3	d	13	c	23	a	33	b	43	c
4	c	14	c	24	b	34	a	44	d
5	d	15	a	25	c	35	c	45	a
6	a	16	c	26	c	36	c	46	b
7	c	17	d	27	b	37	d	47	a
8	d	18	b	28	d	38	d	48	a
9	a	19	b	29	c	39	a	49	d
10	b	20	c	30	d	40	d	50	b

EXPLANATORY NOTES

(1) Phase difference for dark fringe $= \phi = (2n-1)\pi$

$n = 1, 2, 3, 4.....$

$\phi = \pi, 3\pi, 5\pi, ...$

(2) For diffraction grating, $d\sin\theta = n\lambda$

$$\theta = \sin^{-1}\left(\frac{2\lambda}{d}\right)$$

(3) Huygen's principle is used for light which is electromagnetic wave of transverse nature

(4) Interfering beams must be monochromatic and coherent

(5) When two slits will use then YDSE screen pattern will appear due to path differences between light.

(6)

$$\text{Width of central maxima} = \frac{2\lambda D}{d}$$

$$= \frac{2 \times 2.1 \times 5 \times 10^{-7}}{0.15 \times 10^{-2}} = 1.4 \times 10^{-3} m = 1.4\, mm$$

(7) Fringe spacing $= \Delta Y = \frac{\lambda L}{d} \Rightarrow \Delta Y \propto \frac{1}{d}$

(8) The coherent source cannot be obtained from two different light sources.

(9) According to law of conservation of energy, energy cannot be created neither destroyed.

(10) Huygen's wave theory fails to explain the particle nature of light (i.e. photoelectric effect)

(11) Interference is shown by transverse as well as mechanical waves

(12) Definition of wave front.

(13) Torch is the source of white light-colored fringes are observed which are blurred due to overlapping.

(14) Sound wave and light waves both show interference.

(15) Glare reduced by polaroid glass.

(16) For interference phase difference must be constant.

(17) For YDSE screen pattern, light should be monochromatic

(18) Polarization cannot be performed by diffraction

(19) $d\sin\theta = n\lambda$

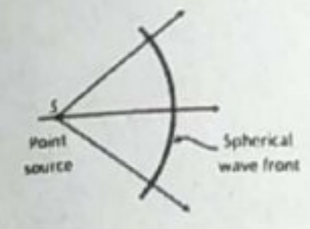
Path difference $= n\lambda \quad \because n = 0, \pm1, \pm2, \pm3.....$

(20) $\Delta y_{bright} = \Delta y_{dark} = \frac{\lambda L}{d}$

(21) $\Delta y' = \frac{\lambda(2L)}{\frac{d}{2}} = 4\Delta y$

(22) $\lambda = \frac{c}{\nu} = \frac{3\times10^8}{100} = 3\times10^6 m$

(23)



(24)

$$\nu = \frac{c}{\lambda} = \frac{3 \times 10^8}{3000 \times 10^{-10}} = 10^{15} \text{cycles/sec}$$

(25) Intensity $\propto \frac{1}{(\text{Distance})^2} \Rightarrow I \propto \frac{1}{r^2} \Rightarrow$ I becomes one-fourth.

(26) $\lambda_{x-ray} \approx 10^{-10} \text{m} = 1\text{Å}$

(27) $2d\sin\theta = n\lambda$

$2\left(2\times10^{-10}\text{m}\right)\sin30° = n\lambda$

$2\left(2\times10^{-10}\text{m}\right)\left(\frac{1}{2}\right) = (1)\lambda$

$2\times10^{-10}\text{m} = \lambda$

(28) $\Delta Y = \frac{\lambda L}{d} = \frac{5\times10^{-7}\times2}{1\times10^{-3}} = 10^{-3} m = 1mm$

(29)

Slit width ratio = 1 : 9 Since slit width ratio is the ratio of intensity and intensity∝ (amplitude)2

$\therefore I_1 : I_2 = 1 : 9 \Rightarrow a_1^2 : a_2^2 = 1 : 9 \Rightarrow a_1 : a_2 = 1 : 3$

$I_{max} = (a_1 + a_2)^2, \; I_{min} = (a_1 - a_2)^2 \Rightarrow \frac{I_{min}}{I_{max}} = \frac{1}{4}$

(30) Sound wave cannot polarized because sound wave is longitudinal wave.

(31) $2d\sin\theta = m\lambda \rightarrow d = \frac{m\lambda}{2d\sin\theta}$

(32) Blue book will appear blue only in blue or white light otherwise it will appear black. For other colours of light it will appear black because color of body is the color of reflected light other colors are absorbed.

(33) $\Delta y = \frac{\lambda L}{d}$

$\Delta y \propto \frac{1}{d}$

Where, $d = q$ = distance between two slits

Scanned by CamScanner

(34) For interference two monochromatic beam light required

(35) Michelson.

(36) In air speed of light increase. As $v\uparrow \propto \lambda\uparrow$

Hence, $\Delta Y = \frac{\lambda L}{d} \rightarrow \Delta Y\uparrow \propto \lambda\uparrow$

(37) $\Delta y = \frac{\lambda L}{d}$

(38) $d = \frac{L}{N} = \frac{1\times10^{-2}}{5000} = 2\times10^{-4}\,cm$

(39) Energy is distributed but remains conserved.

(40) $\Delta y = \frac{\lambda L}{d} \Rightarrow \Delta y \propto \lambda \Rightarrow \lambda_{Red} > \lambda_{Green}$

(41) Speed of light will change. According $v = f\lambda$ all factor will be change.

(42) Huygen's principle is used to find position and location of new wavefront.

(43) Central fringe will white, then violet to red.

(44) Sources are not coherent

(45) $\left(I \propto A^2\right)$

(46) Path difference $= (n+2)\lambda - n\lambda = 2\lambda$

(47) $y = \frac{n\lambda L}{d} \Rightarrow n\lambda = constant$

$n_1\lambda_1 = n_2\lambda_2$

$m\times6500 = n\times5200$

$\frac{m}{n} = \frac{5200}{6500} = \frac{4}{5}$

(48) $\Delta y = \frac{\lambda L}{d} \because \Delta y \propto \lambda$, violet colour wavelength minimum so fringe spacing for violet colour is minimum.

(49) $\Delta\phi = \frac{2\pi}{\lambda}\Delta x = \frac{2\pi}{\lambda}(3\lambda) = 6\pi \qquad \because \Delta x = 3\lambda$

(50) $I = I_0\cos^2\theta \qquad \theta = 45^\circ$

$I = \frac{I_0}{2}$

10 Chapter OPTICAL INSTRUMENTS

PRACTICE EXERCISE

(1) **The resolving power of a telescope can be increased by:**
(a) Increasing the objective focal length and decreasing the eyepiece focal length
(b) Increasing the lens diameters
(c) Decreasing the lens diameters
(d) Inserting a correction lens between objective and eyepiece

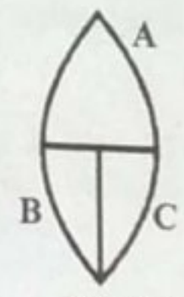
(2) **A point where the incident parallel rays of light converge or appear to diverge after passing through a lens is called**
(a) Center of curvature
(b) Focus
(c) Optical center
(d) Aperture

(3) **A achromatic combination of a concave and convex lens has power 5 D. If the power of convex lens is 4 D, then the magnitude of focal length of concave lens is**
(a) 10 cm
(b) 200 cm
(c) 100 cm
(d) 20 cm

(4) **Light travels with a speed of $2x10^8$ ms^{-1} in crown glass of refractive index 1.5. What is the speed of light in dense flint glass of refractive index 1.8?**
(a) $1.33x10^8$ ms^{-1}
(b) $1.67x10^8$ ms^{-1}
(c) $2.0x10^8$ ms^{-1}
(d) $3.0x10^8$ ms^{-1}

(5) **When a ray of light goes from a denser into a rare medium.**
(a) The wavelength of light is decreased
(b) The frequency of light is increased.
(c) The speed of light is increased
(d) The light undergoes a phase change of

(6) **A thin symmetric double convex lens of power P is cut into three parts A,B and C as shown the power of**



(a) A is P/2
(b) A is 2P
(c) C is P
(d) B is P/2

(7) **If a lens is covered with wax then**
(a) Intensity become double
(b) Image will not formed
(c) Intensity will remain same
(d) Intensity will become half

(8) **The minimum distance between an object and its real image in a convex lens is**
(a) 2 f
(b) 2.5 f
(c) 3f
(d) 4f

(9) **If an object is placed away from '2f' of a converging lens, then the image will be**
(a) Real and erect
(b) Virtual and erect
(c) Real and inverted
(d) Virtual

(10) **If the length of telescope is 96cm the focal lengths of its lenses is**
(a) 100cm, - 4cm
(b) -80cm, -6cm
(c) 90cm, -6cm
(d) 90cm, 6cm

Scanned by CamScanner

(11) **Magnifying power of simple microscope**
(a) Increase with increase in focal length
(b) Increase with decrease in focal length
(c) No effect with decrease or increase with focal length
(d) Least distance of distinct vision

(12) **The equi-convex lens, shown in the figure, has a focal length f. What will be the focal length of each half if the lens is cut along AB?**



(a) $\frac{f}{2}$ (b) f
(c) $\frac{3f}{2}$ (d) 2f

(13) **The speed of light in the medium of refractive index of 1.5 is**
(a) $2 \times 10^8 ms^{-1}$ (b) $3 \times 10^8 ms^{-1}$
(c) $0.5 \times 10^8 ms^{-1}$ (d) $1.5 \times 10^8 ms^{-1}$

(14) **A plane mirror is a approaching you at 10 cm/s. Your image will approach you with a speed of**
(a) 25 cm/s (b) 10 cm/s
(c) 15 cm/s (d) 20 cm/s

(15) **If a convex lens of large aperture fails to converge the light rays incident on it to a single point, it is said to suffer from**
(a) Chromatic aberration (b) Spherical aberration
(c) Both spherical and chromatic (d) Distortion

(16) **A telescope has an objective of focal length 100 cm and an eye piece of focal length 5 cm. What is the magnifying power of the telescope when it is in normal adjustment?**
(a) 0.2 (b) 2.0
(c) 20 (d) 200

(17) **A convex lens of focal length 'f_1' and a concave lens of focal length 'f_2' are placed in contact. The focal length of the combination is**
(a) $f_2 + f_1$ (b) $f_2 - f_1$
(c) $\frac{f_1 f_2}{f_2 + f_1}$ (d) $\frac{f_1 f_2}{f_2 - f_1}$

(18) **Final image produced by a compound microscope with respect to the object is**
(a) Real and inverted (b) Real and erect
(c) Virtual and erect (d) Virtual and inverted

(19) **The magnifying power of telescope is high if**
(a) Both objective and eye-pie have short focal lengths
(b) Both objective and eye-pie have long focal lengths
(c) The objective has a long focal length and the eye-piece has a short focal length
(d) The objective has a short focal length and the eye-piece has a long focal length

(20) **Velocity of light in water, glass and vacuum have the values V_ω, V_g and V_v respectively. Which of the following relations is true?**
(a) $v_\omega = v_g = v_v$ (b) $v_\omega = v_g$ but $< v_\omega < v_v$
(c) $v_\omega > v_g$ but $v_\omega < v_v$ (d) $v_v = v_\omega$ but $< v_\omega < v_g$

(21) **Dispersion effect may produce error in light signals. This type of error is minimum in**
(a) Single mode step index fibre (b) Multimode step index fibre
(c) Multimode graded index fibre (d) Monomode step index fiber

(22) **The tip of a needle does not give a sharp image. It is due to**
(a) Polarization (b) Interference
(c) Diffraction (d) None of these

(23) **A converging lens is used to form an image on a screen. When the upper half of the lens is covered by an opaque screen**
(a) Half the image will disappear (b) Complete image will be formed
(c) Intensity of the image will increase (d) None of these

(24) **Critical angle is that incident angle in denser medium for which angle of refraction is**
(a) 0° (b) 45°
(c) 90° (d) 180°

(25) **When a convex lens of focal length "f" is immersed in such a liquid which has almost the same refractive index as of lens then focal length of lens will**
(a) Increases (b) Decreases
(c) Remains same (d) Becomes infinity



(26) **Spherical aberration in a thin lens can be reduced by**
(a) Using a monochromatic light (b) Using a doublet combination
(c) Using a circular annular mask over the lens (d) Increasing the size of the lens

(27) **A lens, which is thicker at the center and thinner at the edges, is called**
(a) Concave lens (b) Convex lens
(c) Plano convex lens (d) Plano concave lens

(28) **If refractive index of water is $\frac{4}{3}$ and that of glass is $\frac{5}{3}$, then critical angle for light tending to go from glass to water is**
(a) $\sin^{-1}\left(\frac{3}{4}\right)$ (b) $\sin^{-1}\left(\frac{3}{5}\right)$
(c) $\sin^{-1}\left(\frac{4}{5}\right)$ (d) $\sin^{-1}\left(\frac{2}{3}\right)$

(29) **How many images will be formed if two mirrors are fitted on adjacent walls and one mirror on ceiling?** Angle = ?
(a) 5 (b) 7
(c) 11 (d) 2

(30) **A beam of light traveling in medium 1 strikes the interface to another transparent medium 2. If the speed of light is less in medium 2 than in medium 1, the beam will**
(a) Refract toward the normal (b) Refract away from the normal
(c) Undergo total internal reflection
(d) Have an angle of reflection smaller than the angle of incidence

(31) **If the red light is replaced by blue light illuminating the object in a microscope the resolving power of the microscope**
(a) Increases (b) Decreases
(c) Remain same (d) Become half

(32) **The number of images formed, when an object is placed between two plane mirrors inclined at 90^0 is/are.**
(a) 1 (b) 5
(c) 2 (d) 3

Scanned by CamScanner

(33) **The critical angle for a medium with respect to air is 45°. The refractive index of that medium with respect to air is**

(a) $\frac{\sqrt{3}}{2}$ (b) $\frac{2}{\sqrt{3}}$

(c) $\sqrt{2}$ (d) $\frac{1}{\sqrt{2}}$

(34) **In fibre optics which of the following colour has greater speed**

(a) Red (b) Blue

(c) Green (d) All have same speed

(35) **The central image in compound microscope is**

(a) Virtual, erect and magnified (b) Real, inverted and larger than object

(c) Virtual, erected and magnified (d) Erect, virtual and smaller than final image

(36) **Michelson calculated the speed of light using the instrument**

(a) Spectrometer (b) Galvanometer

(c) Interferometer (d) None of these

(37) **Michelson devised the formula to calculate the speed of light**

(a) c = 4fd (b) c = 8fd

(c) c = 16fd (d) $c = \frac{5}{2}$fd

(38) **The function of collimator in spectrometer is**

(a) To produce parallel beam of light (b) To filter the light rays

(c) To make them mutually perpendicular (d) No function

(39) **In optic fiber transmission the repeaters are separated through a distance of _____ km in newer system.**

(a) 300km (b) 200km

(c) 100km (d) 20km

(40) **Which colour has the maximum angle of deviation in prism**

(a) Red (b) Blue

(c) Orange (d) Green

(41) **The magnifying power of a compound microscope increases when:**

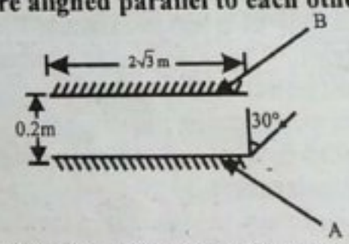
(a) The focal length of objective lens is increased and that of eye lens is decreased

(b) Focal lengths of both objective and eye-piece are increased

(c) The focal length of eye lens is increased and that of objective lens is decreased

(d) Focal lengths of both objective and eye-piece are decreased

(42) **Two plane mirrors A and B are aligned parallel to each other, as shown in fig. A light**

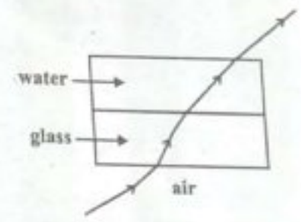


ray is incident at an angle of 30° at a point just inside one end of A. The plane of incidence coincides with the plane of the figure. The maximum number of times the ray under goes reflections (including the first one) before it emerges out is

(a) 28 (b) 30

(c) 32 (d) 34

(43) **A ray of light enters into three different media one after the other air, glass, water as shown in the figure. If v_1 is it speed in air, v_2 in glass and v_3 in water then which of the following is true?**



(a) $v_1 < v_2 < v_3$ (b) $v_1 > v_2 > v_3$

(c) $v_1 > v_2 < v_3$ (d) $v_1 < v_2 > v_3$

(44) **The angular resolution of a 10 cm diameter telescope at a wavelength of 5000 Å is of the order of:**

(a) 10^{-6} rad (b) 10^{-2} rad

(c) 10^{-4} rad (d) 10^{6} rad

(45) **Light signals pass through multimode graded index fibre due to**

(a) Continuous refraction

(b) Total internal reflection

(c) Both continuous refraction and total internal reflection

(d) Diffraction

(46) **The optical fibre in which central core has high refractive index and over it a layer of lower refractive index is called.**

(a) Single mode step index fibre (b) Multi mode step index fibre

(c) Multi mode graded index fibre (d) None of these

(47) **Critical angle of a medium depends upon the:**

(a) Refractive index of the denser medium

(b) Relative refractive index of the two medium

(c) Speed of light in air

(d) Intensity of the beam of light

(48) **Which of the following phenomenon is used in optical fibres?**

(a) Scattering (b) Successive Reflections

(c) Refraction (d) Total internal Reflection

(49) **Two thin lenses of focal lengths 20 cm and 25 cm are placed in contact. The effective power of the combination is**

(a) 45 D (b) 9 D

(c) $\frac{1}{9}$D (d) 6 D

(50) **A point where the incident parallel rays of light converge or appear to diverge after passing through a lens is called**

(a) Center of curvature (b) Focus

(c) Optical center (d) Aperture

Scanned by CamScanner

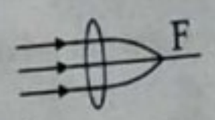
ANSWER KEY

1	b	11	b	21	c	31	a	41	d
2	b	12	d	22	c	32	d	42	b
3	c	13	a	23	b	33	c	43	c
4	b	14	d	24	c	34	a	44	a
5	c	15	b	25	d	35	b	45	c
6	d	16	c	26	c	36	d	46	b
7	d	17	d	27	b	37	c	47	b
8	d	18	d	28	c	38	a	48	d
9	c	19	c	29	b	39	c	49	b
10	d	20	c	30	a	40	b	50	b

EXPLANATORY NOTES

(1) $R=\frac{D}{1.22\lambda}\Rightarrow R\propto D;\ R\propto\frac{1}{\lambda}$

(2)



(3) $P=P_1+P_2$ P_2 isconcave

$P=P_1-P_2$

$P_1-P=P_2$

$4-5=P_2$

$\frac{1}{P_2}=-1m$

$\frac{1}{f_2}=100cm$

(4)

$n=\frac{c}{v}\quad\frac{n_1}{n_2}=\frac{v_2}{v_1}$

$v_2=\frac{1.5}{1.8}\times 2\times 10^8$

$v_2=1.67\times 10^8\,ms^{-1}$

(5) For light going from denser to rare medium speed increases. Because frequency is constant and according to $v\propto\lambda$, speed increases.

(6) If a convex length is cut vertically its power is halved and $f'=2f$

(7) Covering of lens decreases intensity $I\propto A^2$

(8) When object is placed at 2f image formed on opposite side of lens at 2f. So, distance between object and real image is 4f.

(9) If object is away from 2f image is real and inverted.

(10) $L=f_o+f_e$ $90+6=96$

(11) Magnifying power increases with decrease in focal length.

$M=1+\frac{d}{f}$

(12) In vertical cutting power is halved and focal length is doubled.

(13) $n=\frac{c}{v}\Rightarrow v=\frac{c}{n}=\frac{3\times 10^8}{1.5}=2\times 10^8\,ms^{-1}$

(14) Both object and image will move in opposite direction so, $\vec{v}_{rel}=\vec{v}_1+\vec{v}_2$

(15) It is due to defect of lens.

(16)

$M=\frac{f_o}{f_e}=\frac{100}{5}$

$M=20$

(17)

$P=P_1+P_2$

$\frac{1}{f}=\frac{1}{f_1}+\left(\frac{-1}{f_2}\right)$ concave → negative focal length

$\frac{1}{f}=\frac{f_2-f_1}{f_1f_2}$

$f=\frac{f_1f_2}{f_2-f_1}$

(18) Final image is virtual and inverted.

(19) $M=\frac{f_o}{f_e}$

Scanned by CamScanner

(20)

$$As\ n=\frac{c}{v}\ or\ n=\frac{c}{f\lambda}$$

$$So\ n\propto\frac{1}{\lambda}\ therefore\ c=f\lambda$$

(21) Line of the book.

(22) Bending of light does not give sharp image of needle tip.

(23) Complete image with low intensity. $I\propto A^2$

(24) Definition of critical angle.

(25) As we know $n_{eff}=\frac{n_i}{n_w}$, if $n_i=n_w$ then $n_{eff}=1$, this shows that bending of light through convex lens is not possible.

(26) This is the method of removing spherical aberration.

(27) Shape of convex lens.

(28)

$$\theta_c=\sin^{-1}\frac{n_2}{n_1}\quad n_2\rightarrow \text{rare}$$

$$n_1\rightarrow \text{denser}$$

$$=\sin^{-1}\frac{4/3}{5/3}=\sin^{-1}\left[\frac{4}{5}\right]$$

(29) According to the formula $\frac{360}{\theta}-1$, 6 images will be formed by taking two mirrors at a time and 1 image will be formed because of the mirror placed at ceiling hence a total of 7 images.

(30) Light goes rare to denser θ_r decreases so ray will bend towards normal

(31) $R\propto\frac{1}{\lambda}$ $\lambda\downarrow\ R\uparrow$

(32) No of images $=\frac{360}{\theta}$ if odd$\rightarrow$ same

If even $\left[\frac{360}{\theta}-1\right]$

(33) $n=\frac{1}{\sin\hat{C}}=\frac{1}{\sin 45}=\frac{1}{\frac{1}{\sqrt{2}}}=\sqrt{2}$

(34) $v=f\lambda$, $f=$ same, $v\propto\lambda$

(35) Real, inverted and magnified.

(36) He used new apparatus consisting of an octagonal mirror

(37) $c=16fd$

(38) Collimator make light beams parallel

(39) Newer system repeater added after 100 km.

(40) Blue color deviates most.

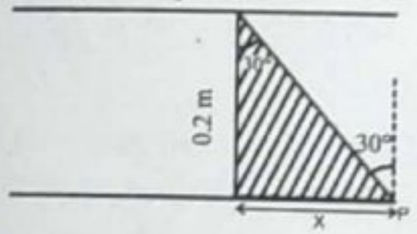
(41) $M=\frac{q_o}{p_o}\left[1+\frac{d}{f_e}\right]$

Suppose; $L\approx q_o$, $p_o\simeq f_o$

$$M=\frac{L}{f_o}\left(1+\frac{d}{f_e}\right)$$

When f_o and f_e will decrease then magnification will increase

(42) Length required for one reflection = x (say)



$$\tan 30°=\frac{x}{0.2}$$

Now,

$$\text{or}\quad x=0.2\tan 30°=\frac{0.2}{\sqrt{3}}m$$

Total number of reflections

$$=\frac{\text{Total length}}{x}=\frac{2\sqrt{3}\times\sqrt{3}}{0.2}=30$$

(43) $v\propto\frac{1}{n}$

(44) Angular resolution,

$$\Delta\theta=\frac{1.22\lambda}{d}$$

$$=\frac{1.22\times5000\times10^{-10}}{10\times10^{-2}}\text{rad}$$

$$=6.1\times10^{-6}\text{rad}\simeq10^{-6}\text{rad}$$

(45) Continuous refraction from the surfaces of smoothly decreasing refractive index and total internal reflection from the boundary of outer surfaces.

Scanned by CamScanner

(46) Line of the book.

(47) $\sin\theta_c = \frac{n_2}{n_1}$

(48) Total internal reflection is a principle through which light travel in fibre optics.

(49)
$$P = \frac{1}{f_1} + \frac{1}{f_2} = \frac{100}{20} + \frac{100}{25}$$
$$= (5+4)D = 9D$$

(50) Definition of principle focus

10 Chapter OPTICAL INSTRUMENTS

SELF ASSESMENT TEST

(1) A diamond sparkles because of its
(a) hardness (b) high refractive index
(c) emission of light by the diamond (d) absorption of light by the diamond

(2) Critical angle of light passing from glass to air is minimum for
(a) green (b) violet
(c) yellow (d) red

(3) In a compound microscope, the intermediate image is
(a) real, inverted, magnified (b) virtual, erect, magnified
(c) real, erect, magnified (d) virtual, erect and reduced

(4) Resolving power of microscope is proportional to
(a) λ (b) $\frac{1}{\lambda}$
(c) λ^2 (d) $\frac{1}{\lambda^2}$

(5) Wavelengths of light used in an optical instrument are $\lambda = 4000$ Å and $\lambda = 5000$ Å. The ratio of their respective resolving powers are:
(a) 16 : 25 (b) 5 : 4
(c) 4 : 5 (d) 9 : 1

(6) To obtain maximum magnification with a simple microscope, one should place his eye:
(a) close to focus (b) close to lens
(c) half way between focus and optical centre (d) at distance of distinct vision

(7) A convex lens of focal length 16cm forms a real image double the size of object. Distance of object from the lens is:
(a) 32 cm (b) 20cm
(c) 24cm (d) 8cm

(8) If the critical angle for total internal reflection from a medium to vacuum is 30^0, the velocity of light in the medium is
(a) 6×10^8 m/s (b) 3×10^8 m/s
(c) 2.5×10^8 m/s (d) 1.5×10^8 m/s

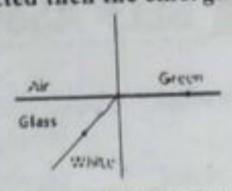
(9) 'Mirage' is a phenomenon due to
(a) dispersion (b) refraction of light
(c) total internal reflection (d) reflection of light

(10) The refractive index of water is 4 / 3 and that of glass is 5/3. What will be the critical angle for the ray of light entering water from the glass
(a) $\sin^{-1}1/2$ (b) $\sin^{-1}(5/4)$
(c) $\text{Sin}^{-1}\,2/1$ (d) $\sin^{-1}(4/5)$

(11) Optical fibres are related with
(a) light (b) communication
(c) computer (d) none of these

Scanned by CamScanner

(12) **White light is incident on the interface of glass and air as shown in the figure. If green light is just totally internally reflected then the emerging ray in air contains**

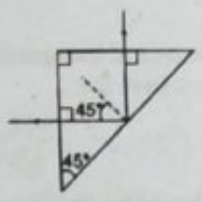


(a) all colours except green (b) all colours
(c) violet, indigo, blue (d) yellow, orange, red

(13) **The speed of light in the medium of refractive index of 1.5 is**
(a) $2 \times 10^8 ms^{-1}$ (b) $3 \times 10^8 ms^{-1}$
(c) $0.5 \times 10^8 ms^{-1}$ (d) $1.5 \times 10^8 ms^{-1}$

(14) **Index of refraction of diamond is 2.0 velocity of light in diamond in cm/s is approximately**
(a) 6×10^{10} (c) 3×10^{10}
(c) 2×10^{10} (d) 1.5×10^{10}

(15) **A light ray is incident perpendicular to one face of a 90° prism and is totally internally reflected at the glass-air interface. If the angle of reflection is45°, we conclude that the refractive index n is**



(a) $n < \frac{1}{\sqrt{2}}$ (b) $n > \sqrt{2}$
(c) $n > \frac{1}{\sqrt{2}}$ (d) $n < \sqrt{2}$

(16) **Two convex lenses of equal focal length 'f ' are placed in contact, the resultant focal length of the combination is**
(a) zero (b) f
(c) 2 f (d) $\frac{f}{2}$

(17) **A convex lens of focal length 'f_1' and a concave lens of focal length 'f_2' are placed in contact. The focal length of the combination is**
(a) $f_2 + f_1$ (b) f_2-f_1
(c) $\frac{f_1 f_2}{f_2 + f_1}$ (d) $\frac{-f_1 f_2}{f_1 - f_2}$

(18) **Final image produced by a compound microscope with respect to the intermediate image is**
(a) real and inverted (b) real and erect
(c) virtual and erect (d) virtual and inverted

(19) **For normal adjustment, length of astronomical telescope is**
(a) $f_o + f_e$ (b) $f_o - f_e$
(c) $\frac{f_o}{f_e}$ (d) $\frac{f_e}{f_o}$

(20) **An astronomical telescope has a length of 110 cm and magnifying power 10. The focal length of the objective is:**
(a) 110 cm (b) 100 cm
(c) 80 cm (d) 70 cm

(21) **If two mirrors are kept at 60° to each other, then the number of images formed by them is**
(a) 4 (b) 3
(c) 5 (d) 7

(22) **What is the cause of "Green house effect"?**
(a) ultraviolet rays (b) x-rays
(c) infrared rays (d) radio-waves

(23) **Which one type of fibre is more suitable for transmission of signals in which white light is used?**
(a) mono mode step index fibre (b) multi mode step index fibre
(c) multi mode graded index fibre (d) single mode step index fibre

(24) **Critical angle is that incident angle in rare medium for which angle of refraction is**
(a) 0° (b) 45°
(c) 90° (d) none of these

(25) **There is no noticeable boundary between core and cladding for**
(a) multi mode step index fibre (b) multi mode graded index fibre
(c) single mode step index fibre (d) all types of fibre

(26) **The electrical signals change into light signals for transmission through optical fibre. A light pulse represent**
(a) zero (0) (b) one (1)
(c) both zero (0) and one (1) (d) either zero (0) or one (1)

(27) **Transmission of light in optical fibre is due to:**
(a) scattering (b) polarization
(c) diffraction (d) multiple total internal reflections

(28) **A spectrometer is used to find**
(a) wave length of light (b) refractive index of the prism
(c) wavelength of different colours (d) all of the above

(29) **If a convex lens of focal length 'f ' is cut into two identical halves along the lens diameter, the focal length of each half is**
(a) f (b) f/2
(c) 2f (d) 3f/2

(30) **Two light rays red and blue passes through the convex lens, then the focal length of red light is**
(a) less than blue light (b) infinite
(c) equal to blue light (d) greater than blue light

Scanned by CamScanner

(31) A 2mm object is placed 20 cm from a converging lens of 10 cm focal length. The size of its image will be:
(a) 1mm (b) 3mm
(c) 2mm (d) 4mm

(32) In optical fiber transmission system, _____ are used to regenerate the dim light signal.
(a) diodes (b) repeaters
(c) laser (d) transformer

(33) Magnification of the astronomical telescope is
(a) f_o+f_e (b) $\left(\frac{f_o}{f_e}\right)^{-1}$
(c) $\left(\frac{f_e}{f_o}\right)^{-1}$ (d) $\left(1+\frac{f_o}{f_e}\right)\frac{L}{f_o}$

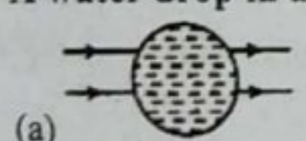
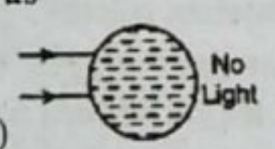
(34) The equation $\alpha_{min} = 1.22\,\lambda/D$ was derived by
(a) Newton (b) Einstein
(c) Raleigh (d) Planks

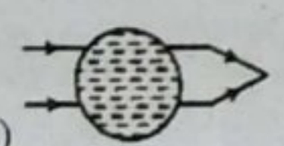
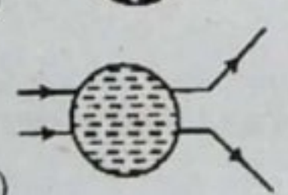
(35) The size and nature of central image in compound microscope is
(a) greater than size of object and Virtual, erect and magnified
(b) greater than size of object and Real, inverted and magnified
(c) less than size of object and Virtual, erected and magnified
(d) greater than size of object and Erect, virtual and smaller than final image

(36) The object is placed at the principle focus of a simple microscope, if the focal length of the lens is 2cm. What is the magnifying power of the microscope
(a) 13.5 (b) Infinity
(c) 12.5 (d) 10

(37) The formula to calculate the speed of light by Michelson device
(a) $c = (2)^2\,fd$ (b) $c = (8)^2\,fd$
(c) $c = \sqrt{\frac{16^2}{16^0}}\,fd$ (d) $c = \sqrt{\frac{16^2}{4}}fd$

(38) The magnifying power of an astronomical telescope is 8 and the distance between the two lenses is54cm. The focal length of eye lens and objective lens will be respectively
(a) 6 cm and 48 cm (b) 48 cm and 6 cm
(c) 8 cm and 64 cm (d) 6 cm and 60 cm

(39) A water drop in air reflects the light rays as
(a) 
(b) 

(c) 
(d) 

(40) A convex lens has focal length of 5 cm, its power in diopter is
(a) 5 (b) 10
(c) 15 (d) 20

(41) A person sees his virtual image by holding a mirror very close to the face. When he moves the mirror away from his face, the image becomes inverted. What type of mirror he is using?
(a) plane mirror (b) convex mirror
(c) concave mirror (d) none of these

(42) Consider a ray of light travelling from a denser to a rarer medium. If it is incident at the critical angle then
(a) it will emerge out into the rarer medium
(b) it will undergo total internal reflection
(c) it will travel along the interface separating the two media
(d) it will retrace its path

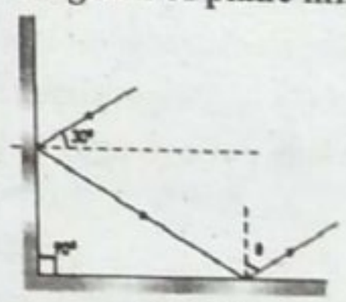
(43) Sun is visible a little before the actual sunrise and until a little after the actual sunset. This is due to
(a) total internal reflection (b) reflection
(c) refraction (d) polarization

(44) How many images will be formed if two mirrors are fitted on opposite walls
(a) 5 (b) infinite
(c) 11 (d) 2

(45) A magnifying glass is also called
(a) compound microscope (b) single curved lens
(c) simple microscope (d) electronic microscope

(46) In compound microscope, as compared to eye piece, objective lens has
(a) negative focal length (b) small focal length
(c) zero focal length (d) large focal length

(47) An object is placed 1.5 m from the plane mirror. How far is the image from the object
(a) 3m (b) 1.5m
(c) 2m (d) 1m

(48) What is the value of θ in the given diagram of plane mirror?

(a) 30^0 (b) 60^0
(c) 90^0 (d) 45^0

(49) Where should an object be placed so that a real and inverted image of the same size is obtained, using a convex lens.
(a) between O and F (b) At F
(c) at 2F (d) at infinity

(50) If the magnification of the objective for a compound microscope in 2 and focal length of eye piece is 5cm, then the magnification of the microscope will be
(a) 3 (b) 4
(c) 7 (d) 12

Scanned by CamScanner

(51) For which of the following colour, the magnifying power of a microscope will be maximum?
(a) white colour (b) red colour
(c) violet colour (d) yellow colour

(52) The magnifying power of a simple microscope can be increased, if we use eye-piece
(a) higher focal length (b) smaller focal length
(c) higher diameter (d) smaller diameter

(53) The power of two convex lenses A and B are 8 diopters and 4 diopters respectively. If they are to be used as a simple microscope, the magnification of
(a) B will be greater than A (b) A will be greater than B
(c) the information is incomplete (d) none of the above

(54) A person using a lens as a simple microscope sees
(a) inverted virtual image (b) inverted real magnified image
(c) upright virtual image (d) up right real magnified image

(55) For a colour of light, the wavelength in air is 6000 Å and in water the wavelength is 4500 Å. Then the speed of light in water will be
(a) $5.0\times10^{14}\,ms^{-1}$ (b) $4.0\times10^{8}\,ms^{-1}$
(c) $2.25\times10^{8}\,ms^{-1}$ (d) zero

(56) A compound microscope has a magnifying power 30. The focal length of its eye-piece is 5 *cm*. Assuming the final image to be at the least distance of distinct vision. The magnification produced by the objective will be
(a) +5 (b) -5
(c) +6 (d) -6

(57) *Consider telecommunication through optical fibres. Which of the following statement is note ture*
(a) optical fibres may have homogeneous core with a suitable cladding
(b) optical fibres can be of graded refractive index
(c) optical fibres are subject to electromagnetic interference from outside
(d) optical fibres have extremely low transmission loss

(58) The ratio of the refractive index of red light to blue light in air
(a) less than unity (b) equal to unity
(c) greater than unity (d) none

(59) Light of different colour propagates through air
(a) with the velocity of air (b) with different velocities
(c) with the velocity of sound (d) having equal velocities

(60) If an object is placed away form 2f of a converging lens then the image will be
(a) real and erect (b) virtual and erect
(c) real and inverted (d) virtual and inverted

ANSWER KEY

1	b	11	b	21	c	31	c	41	c	51	c
2	b	12	d	22	c	32	b	42	c	52	b
3	a	13	a	23	c	33	c	43	c	53	b
4	b	14	d	24	d	34	c	44	b	54	c
5	b	15	b	25	b	35	b	45	c	55	c
6	b	16	d	26	b	36	c	46	b	56	b
7	c	17	d	27	d	37	c	47	a	57	c
8	d	18	c	28	d	38	a	48	b	58	a
9	c	19	a	29	c	39	c	49	c	59	d
10	d	20	b	30	d	40	d	50	d	60	c

EXPLANATORY NOTES

(1) Due to high refractive index its critical angle is very small so that most of the light incident on the diamond is total internally reflected repeatedly and diamond sparkles.

(2) $n=\dfrac{1}{\sin\hat{C}}\Rightarrow \sin C=\dfrac{1}{n}$

As n for violet colour is maximum, so sin C si minimum and hence critical angle C is minimum for voilet colour.

(3) When object is placed in between F and 2F of convex lens then nature of image is real, inverted and magnified.

(4) $R=\dfrac{D}{1.22\lambda}\Rightarrow R\propto\dfrac{1}{\lambda}$

(5) $R=\dfrac{D}{1.22\lambda}\Rightarrow R\propto\dfrac{1}{\lambda}$

$\dfrac{R_1}{R_2}=\dfrac{\lambda_2}{\lambda_1}=\dfrac{5000A^\circ}{4000A^\circ}=5:4$

(6) $M=\dfrac{d}{p}$

Where, p = distance of object from lens

$M\propto\dfrac{1}{p}$

Scanned by CamScanner

(7) Lens formula

$$\frac{1}{f}=\frac{1}{p}+\frac{1}{q}$$

Given $q=2p$

$$\frac{1}{16}=\frac{1}{p}+\frac{1}{2p}\Rightarrow\frac{1}{16}=\frac{3}{2}\left(\frac{1}{p}\right)$$

$$16=\frac{2}{3}p\Rightarrow 48=2p\Rightarrow p=24\text{cm}$$

(8) $n=\frac{1}{\sin C}=\frac{1}{\sin 30}=2$ $\quad\therefore v=\frac{3\times10^8}{2}=1.5\times10^8\,\text{m/s}$

(9) General information

(10) $(n)=\frac{1}{\sin C}\Rightarrow\frac{n_g}{n_w}=\frac{5/3}{4/3}=\frac{1}{\sin C}\Rightarrow\sin C=\frac{4}{5}\Rightarrow C=\sin^{-1}\left(\frac{4}{5}\right)$

(11) Optical fibres are used to send signals from one place to another.

(12) $C=\sin^{-1}\left(\frac{1}{n}\right)$ and $n\propto\frac{1}{\lambda}$ Yellow, orange and red have higher wavelenght than green, so n will be less for these rays, consequently critical angle for these rays will be high, hence if green is just totally internally reflecctd then yellow, orange and red rays will emerge out.

(13) Refractive index

$$n=\frac{c}{v}$$

$$v=\frac{c}{n}=\frac{3\times10^8\text{ms}^{-1}}{1.5}=2\times10^8\text{ms}^{-1}$$

$$n=\frac{c}{v}$$

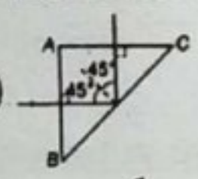
(14) $v=\frac{c}{n}=\frac{3\times10^8\text{ms}^{-1}}{2}$

$$v=1.5\times10^8\times10^2\text{cms}^{-1}$$

$$v=1.5\times10^{10}\text{cms}^{-1}$$

(15)

For total internal reflection from glass-air interface, critical angle C must be less than angle of incidence

i.e., $C<i$ or $C<45^\circ$ $(\because\angle i=45^\circ)$  But, $n=\frac{1}{\sin C}$

$\Rightarrow\quad C=\sin^{-1}\left(\frac{1}{n}\right)\Rightarrow\quad\frac{1}{n}<\sin 45^o\Rightarrow\quad n>\frac{1}{\sin 45^o}\Rightarrow$

$n>\frac{1}{(1/\sqrt{2})}\Rightarrow\quad n>\sqrt{2}$

(16) Power combination of lenses

$$P_{eq}=P_1+P_2$$

$$\frac{1}{f_{eq}}=\frac{1}{f_1}+\frac{1}{f_2}$$

Where $f_1=f_2=f$

$$\frac{1}{f_{eq}}=\frac{1}{f}+\frac{1}{f}\Rightarrow\frac{1}{f_{eq}}=\frac{2}{f}\Rightarrow f_{eq}=\frac{f}{2}$$

(17) Convex lens focal length is positive and concave lens focal length is negative

Power combination of lenses

$$P=P_1+P_2$$

$$\frac{1}{f_{eq}}=\frac{1}{f_1}-\frac{1}{f_2}$$

$$\frac{1}{f_{eq}}=\frac{f_2-f_1}{f_1f_2}$$

$$\frac{1}{f_{eq}}=-\frac{f_1-f_2}{f_1f_2}$$

$$f_{eq}=-\frac{f_1f_2}{f_1-f_2}$$

(18) Final image formed by a compound microscope with respect to object is virtual and errected.

(19) $L=f_o+f_e$

(20) Magnification of telescope

$$M=\frac{f_o}{f_e}\Rightarrow 10=\frac{f_o}{f_e}$$

$$f_o=10f_e$$

Normal adjustment of telescope

$$L=f_o+f_e$$

$$110\text{cm}=10f_e+f_e$$

$$110\text{cm}=11f_e$$

$$\frac{110}{11}\text{cm}=f_e$$

$$f_e=10\text{cm}$$

Now, $L=f_o+f_e$

$$110\text{cm}=f_o+10\text{cm}$$

$$110\text{cm}-10\text{cm}=f_o$$

$$100\text{cm}=f_o$$

Scanned by CamScanner

(21) Number of images, $n = \frac{360^\circ}{\theta} - 1$ where, θ is angle between mirrors. Thus,

$\theta = 60^\circ$ (given) So, number of images $n = \frac{360^\circ}{60^\circ} - 1 = 5$

(22) The green house is a room made of glass which is constructed to grow plants in open space. The glass transmits the infrared radiations of short wavelength and the visible light, but it absorbs infrared radiations of long wavelength. During the day time the light and the infrared radiations of short wavelength enter inside the green house through roof and the walls and they are absorbed by the plants. At night plants emit the infrared radiations through the glass wall and roof. As a result greenhouse remains warm. This is called greenhouse effect.

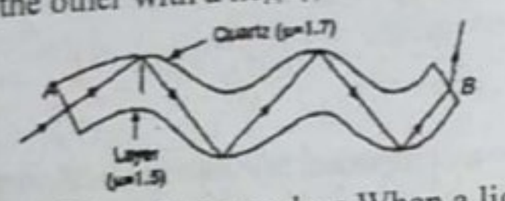
(23) Due to less dispersion effect and less time difference

(24) For total internal refraction light should from denser to rare. i.e; incident angle should be formed in denser medium.

(25) No noticeable boundary, due to continuous smoothly decreasing refractive index between core and cladding in multi-mode graded index fibre.

(26) In digital modulation pulse of light represent the number 1 and absence of light represents zero.

(27) An optical fibre is a device based on total internal reflection by which a light signal can be transferred from one place to the other with a negligible loss of energy.



It consists of a very long and thin fibre of quartz glass. When a light ray is incident at one end A of fibre making a small angle of incidence. It suffers multiple total internal reflections and finally it reaches the point B.

(28) Uses of spectrometer

(29) $f \propto \frac{1}{\text{thickness}}$

(30) $f \propto \lambda$

(31) If object is placed at 2f distance then image is also formed at 2f distance because, minimum distance between object and image is 4f. So, object and image have same size.

(32) Function of repeaters

(33) $M = \frac{f_o}{f_e}$

(34) Raleigh equation

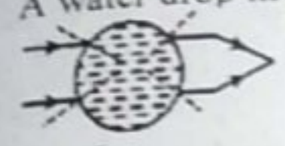
(35) When object is placed between f & $2f$ then image formed away from $2f$ & it nature is real, inverted and enlarged.

(36) $M_\infty = \frac{d}{f} = \frac{25}{2} = 12.5$

(37) Formula of speed of light, c = 16fd

(38) $L = f_o + f_e = 54\ cm$ $|m| = \frac{f_o}{f_e} = 8$ On simplification, we get $f_e = 6\ cm$ and $f_o = +48\ cm$

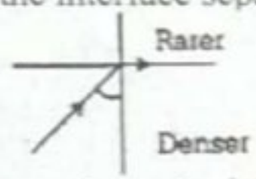
(39) A water drop in air behaves as converging lens.



(40) $P = \frac{1}{f} \rightarrow$ focal length in meters

(41) Plane mirror and convex mirror always form erect images. Image formed by concave mirror may be erected or inverted depending on position of object.

(42) If a ray of light travelling from a denser to a rarer medium with angle of incidence same as critical angle, the ray will travel along the interface separating the two media.



(43) Sun is visible a little before the actual sunrise and until a little after the actual sunset. This is due to refraction.

(44) No of images $= \frac{360^\circ}{\theta}$, '$\theta$' $= 0^0 =$ infinite

(45) General information

(46) General information

(47) In plane mirrors the distance of object from mirror and distance of its image from the mirror remain same.

(48) $\theta = 90^0 - 30^0 = 60^0$.

(49) Same size only formed when the object is placed in front of convex at 2F

(50) $\because M = M_o \times Me$

$M = M_0\left(1 + \frac{d}{f}\right) = 2 \times \left(1 + \frac{25}{5}\right) = 12$

(51) $M \propto \frac{1}{f}$, magnification for violet colour is maximum due to minimum frequency.

(52) $M = 1 + \frac{D}{f}$

(53) $M = 1 + \frac{D}{f} = 1 + DP \Rightarrow M \propto P$

$P_A > P_B$

$M_A > M_B$

(54) Principle of simple microscope.

Scanned by CamScanner

(55) $n=\frac{c}{v}$

Also, $n=\frac{\lambda}{\lambda'}$

By equating, $\frac{c}{v}=\frac{\lambda}{\lambda'}$

$$v=\frac{\lambda'}{\lambda}c$$

$$=\frac{4500}{6000}\times 3\times 10^8 ms^{-1}$$

$$=2.25\times 10^8 ms^{-1}$$

(56) Magnification produced by compound microscope $M=M_o\times M_e$

where M_o= ? and $M_e=\left(1+\frac{D}{f_e}\right)=1+\frac{25}{5}=6\Rightarrow 30=-M_o\times 6\Rightarrow M_o=-5.$

(57) Data transmission rule in fiber optics.

(58) $(n_B>n_R)\Rightarrow\frac{n_P}{n_B}<1$

(59) $v=f\lambda=constant$

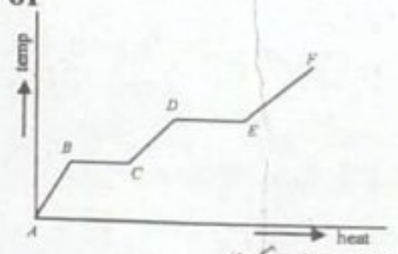
(60) If object placed at distance 2f front of lens then image make at 2f distance behind the lens. It is real and inverted.

11 Chapter HEAT & THERMODYNAMICS

PRACTICE EXERCISE

(1) **At absolute zero, the K.E of the molecules**
(a) Become minimum
(b) Become maximum
(c) Become zero
(d) None of these

(2) **The source of heat supplies heat at a constant rate to a solid cube. The variation of the temperature of the cube with heat supplied is shown in figure. The portion DE of the graph represents conversion of**



(a) Solid into liquid
(b) Liquid into vapour
(c) Solid into vapour
(d) Vapour into liquid

(3) **The melting point of copper is 1,080°C and its heat of fusion is 200 kJ/kg. If a copper coin at this temperature is completely melted by the absorption of 2,000 J of heat, what is the mass of the coin?**

(a) $\frac{1}{1,080}$kg
(b) $\frac{1}{540}$kg
(c) $\frac{1}{108}$kg
(d) $\frac{1}{100}$kg

(4) **The scales of temperature are based on two fixed points, which are**
(a) The temperatures of water at 0°C and 100°C
(b) The temperatures of melting ice and boiling water at atmospheric pressure
(c) The temperatures of ice cold and boiling water
(d) The temperatures of frozen and boiling mercury

(5) **What does V represent in the equation** $\frac{PV}{2}=RT$
(a) Volume of n mole of gas
(b) Mass of 4 g of gas
(c) Mass of 2 g of gas
(d) Volume of 2 mole of gas

(6) **Air is pumped into a bicycle tire at constant temperature. The pressure increases because:**
(a) The molecules are larger
(b) The molecules are farther apart
(c) More molecules strike the tire wall per second
(d) Each molecule is moving faster

(7) **Normal human body temperature 98.6°F corresponds to**
(a) 37°C
(b) 42°C
(c) 55°C
(d) 410°C

(8) **In a system of N gas molecules, the individual speeds are $v_1, v_2, \ldots, v_n$. The rms speed of these molecules is:**

(a) $\sqrt{\frac{v_1^2+v_2^2+.....+v_N^2}{N}}$
(b) $\frac{\sqrt{v_1^2+v_2^2+.....+v_N^2}}{N}$
(c) $\frac{\sqrt{v_1+v_2+.....+v_N}}{N}$
(d) $\frac{\sqrt{v_1^2+v_2^2+.....+v_N^2}}{N^2}$

Scanned by CamScanner

(9) On a cold winter day (5°C), the foundation block for a statue is filled with 2.0 m^3 of concrete. By how much will the concrete's volume increase on a very warm summer day (35°C) if its coefficient of volume expansion is 4.0×10^{-5} per °C?
(a) 160 cm^3 (b) 1,600 cm^3
(c) 1,200 cm^3 (d) 2000 cm^3

(10) Cooking vegetables and other food in a pressure cooker saves time and fuel because
(a) Under increased pressure, water can be made to boil at a temperature much higher than 100°C
(b) Under increased pressure, water can be made to boil at a temperature much lower than 100°C
(c) Heat losses are reduced to a minimum
(d) Condensation of steam is prevented

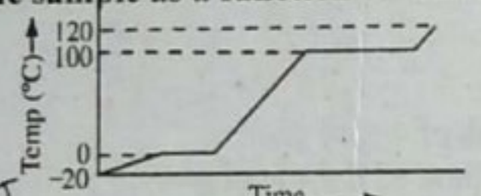
(11) According to Pascal's law the pressure of gas in a vessel is
(a) Different in different direction (b) Same in all direction
(c) Same only along opposite directions (d) Same only along normal directions

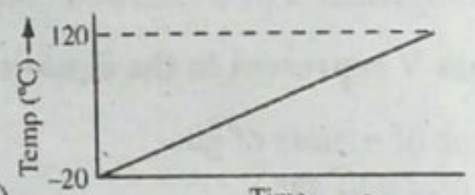
(12) Four molecules have speeds of 2 kms^{-1}, 3 kms^{-1}, 4 kms^{-1} and 5 kms^{-1}. The rms speed of these molecules in kms^{-1} is
(a) $\frac{\sqrt{54}}{4}$ (b) $\frac{\sqrt{54}}{2}$
(c) 3.5 (d) $3\sqrt{3}$

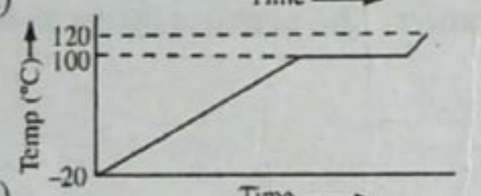
(13) The temperature of a gas is increased from 27C° to 127C°. The ratio of its mean kinetic energy will be
(a) $10/9$ (b) $9/16$
(c) $4/3$ (d) $3/4$

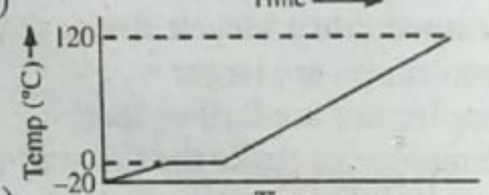
(14) The hot water pipes used to heat up the room are painted
(a) White (b) Yellow
(c) Red (d) Black

(15) A block of ice, initially at –20°C, is heated at a steady rate until the temperature of the sample reaches 120°C. Which of the following graphs best illustrates the temperature of the sample as a function of time?

(a)


(b)


(c)


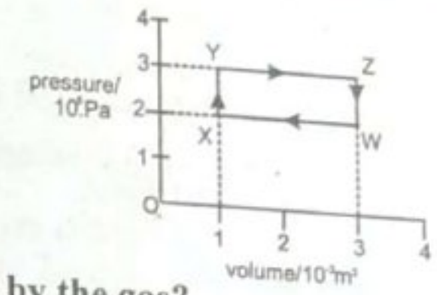
(d)


(16) For which combination of working temperatures the efficiency of Carnot's engine is highest?
(a) 40 K, 20 K (b) 100 K, 80 K
(c) 80 K, 60 K (d) 60 K, 40 K

(17) A Carnot heat engine operates between 400K and 500K. Its efficiency is:
(a) 25% (b) 44%
(c) 79% (d) 20%

(18) The equation of state of n moles of an ideal gas is PV=nRT, where R is a constant. The SI unit for R is
(a) $J\ kg^{-1}K^{-1}$ (b) $Jg^{-1}k^{-1}$
(c) $JK^{-1}\ mol^{-1}$ (d) No unit

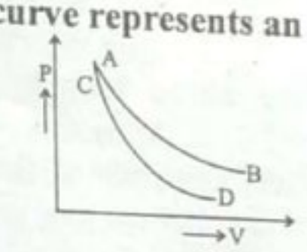
(19) A gas undergoes the cycle of pressure and volume changes W → X → Y → Z → W shown in the diagram.



What is the net work done by the gas?
(a) –600 J (b) 200 J
(c) 0 J (d) -200 J

(20) What happens to the pressure P, of an ideal gas if the temperature is increased by a factor of 2 and the volume is increased by a factor of 8?
(a) P decreases by a factor of 16 (b) P decreases by a factor of 4.
(c) P decreases by a factor of 2 (d) P increases by a factor of 4

(21) In the figure curves AB and CD represent the relation between pressure P and volume V of an ideal gas. One of the curves represents on isothermal expansion and the other represents an adiabatic expansion. Which curve represents an adiabatic expansion?

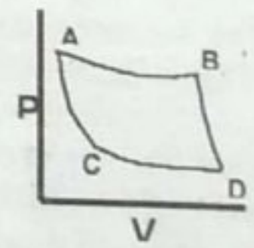


(a) Curve AB (b) Curve CD
(c) Both "a" and "b" (d) None of these

(22) Which one is correct relation?
(a) $C_p+C_v=\gamma$ (b) $C_p=1+\frac{R}{C_v}$
(c) $\gamma=\frac{C_p}{C_v}$ (d) $C_p=1-\frac{R}{C_v}$

(23) The reading on the Fahrenheit scale will be double the reading on the centigrade scale when the temperature on the centigrade scale is
(a) 460°C (b) 280°C
(c) 360°C (d) 160°C

(24) The area enclosed by the curve ABDCA for a Carnot heat engine represents the work done by Carnot engine



(a) At any instant (b) Averagely
(c) During its operation (d) During one cycle

(25) During each cycle, a heat engine with an efficiency of 25% takes in 800 J of energy. How much waste heat is expelled during each cycle?
(a) 100 J (b) 300 J
(c) 200 J (d) 600 J

Scanned by CamScanner

(26) The rms speed of oxygen at room temperature is 500 ms^{-1}. The rms speed of H_2 at room temperature is
(a) 125 ms^{-1} (b) 8000 ms^{-1}
(c) 2000 ms^{-1} (d) 31.25ms^{-1}

(27) Which of the following properties of molecules of a gas is same for all gases at particular temperature?
(a) Momentum (b) Mass
(c) Velocity (d) Kinetic energy

(28) When 20 J of work was done on a gas, 40J of heat energy was released. If the initial internal energy of the gas was 70J, what is the final internal energy?
(a) 50J (b) 60J
(c) 90J (d) 110J

(29) Which of the following phenomenon is the fastest for the transmission of heat
(a) Convection (b) Conduction
(c) Radiation (d) All have same speed for heat transmission

(30) Starting with the same initial conditions, an ideal gas expands from volume V_1 to V_2 in three different ways. The work done by the gas is W_1, if the process is purely isothermal. W_2 if purely isobaric and W_3 if purely adiabatic then
(a) $W_2>W_1>W_3$ (b) $W_2>W_3>W_1$
(c) $W_1>W_2>W_3$ (d) $W_1>W_3>W_2$

(31) Two different metal rods of the same length have their ends kept at the same temperatures T_1 and T_2 with $T_2 < T_1$. If A_1 and A_2 are their cross-sectional areas and K_1 and K_2 their thermal conductivities, the rate of flow of heat in the two rods will be the same if
(a) $\frac{A_1}{A_2}=\frac{K_1}{K_2}$ (b) $\frac{A_1}{A_2}=\frac{K_2}{K_1}$
(c) $\frac{A_1}{A_2}=\frac{K_1T_1}{K_2T_2}$ (d) $\frac{A_1}{A_2}=\frac{K_2T_2}{K_1T_1}$

(32) Which quantity is not a thermodynamic state function?
(a) Internal energy (b) Heat energy
(c) Pressure (d) Volume

(33) The following four gases are at the same temperature. In which gas do the molecules have the maximum root mean square speed?
(a) Hydrogen (b) Oxygen
(c) Nitrogen (d) Carbon dioxide

(34) The work done in the isochoric process is
(a) Constant (b) Variable
(c) Zero (d) Depends on situation

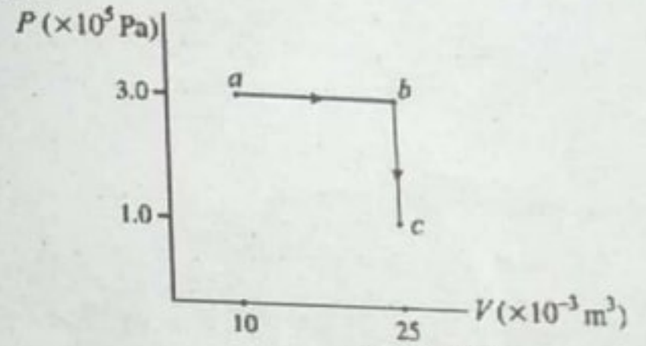
(35) To help keep buildings cool in the summer, dark colored window shades have been replaced by light colored shades. This is because light colored shades:
(a) Reflect more sunlight (b) Absorb more sunlight
(c) Are more pleasing to the eye (d) Transmit more sunlight

(36) For the successful operation of Heat engine which condition should be met?
(a) Cyclic process (b) Operated at certain temperature difference
(c) Both (a) and (b) (d) Petrol must be used

(37) An ideal gas undergoes an expansion in volume from 1.3×10^{-4} m^3 to 3.6×10^{-4} m^3 at a constant pressure of 1.3×10^5 Pa. During this expansion, 24 J of heat is supplied to the gas. What is the overall change in the internal energy of the gas?
(a) Decrease of 54 J (b) Decrease of 6 J
(c) Increase of 6 J (d) Increase of 54 J

(38) Two different samples have the same mass and temperature. Equal quantities of energy are absorbed as heat by each. Their final temperatures may be different because the samples have different:
(a) Heat capacities (b) Volumes
(c) Thermal conductivities (d) Coefficients of expansion

(39) What's the total work performed on the gas as it's transformed from state *a* to state *c*, along the path indicated?



(a) 1,500 J (b) 3,000 J
(c) 4,500 J (d) 5,000 J

(40) The rate of heat flow by conduction through a slab does NOT depend upon the:
(a) Specific heat of the slab
(b) Cross-sectional area of the slab
(c) Thermal conductivity of the slab
(d) Temperature difference between opposite faces of the slab

(41) The ratio of adiabatic bulk modulus and isothermal bulk modulus of a gas is $(\gamma = C_p/C_v)$.
(a) 1 (b) γ
(c) $\frac{\gamma}{(\gamma-1)}$ (d) $\frac{(\gamma-1)}{\gamma}$

(42) Temperature is a property, which determines
(a) How much heat a body contains
(b) Whether a body will feel hot or cold to touch
(c) In which direction heat will flow between two systems
(d) How much total absolute energy a body has

(43) A Carnot engine whose sink is at a temperature of 300 has an efficiency of 40%. By how much should the temperature of the source be increased so as to increase the efficiency to 60%?
(a) 250 K (b) 275 K
(c) 300K (d) 325K

(44) Entropy of a thermodynamic system does not change when the system is used for.
(a) Conduction of heat from a hot reservoir to a cold reservoir
(b) Conversion of heat into work adiabatically
(c) Conversion of heat into internal energy isochronally
(d) Conversion of work into heat isothermally

(45) E_o and E_h respectively represent the average kinetic energy of a molecule of oxygen and hydrogen. If the two gases are at the same temperature, which of the following statements is true?
(a) $E_o > E_h$ (b) $E_o = E_h$
(c) $E_o < E_h$
(d) Nothing can be said about the magnitude of E_o and E_h as the information given is insufficient

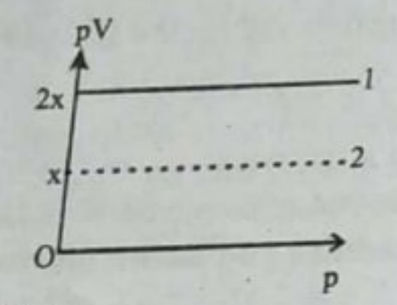
Scanned by CamScanner

(46) The temperature of 1kg of hydrogen gas is same as that of 1kg helium gas, if
(a) gases have same internal energy and same pressure
(b) The gas molecules have the same root means square speed
(c) Gases radiate energy at the same rate
(d) The gas molecules have same mean translational K.E

(47) Which of the following expression is correct for molar volume V_m of an ideal gas?
(a) $\frac{RT}{P}$ (b) $\frac{N_A RT}{P}$
(c) $\frac{nRT}{P}$ (d) $\frac{NkT}{P}$

(48) The K.E of the molecular motion appears as
(a) P.E (b) Heat
(c) Temperature (d) With P.E or heat

(49) The relationship between volume V and pV for a sample of gas at a given temperature is shown by the isotherm marked 1 in figure given below. Isotherm 2 would be followed by the gas if



(a) The mass of the gas was doubled
(b) The thermodynamics temperature of the gas was halved
(c) The thermodynamics temperature of the gas was doubled
(d) The mass of the gas was doubled and its thermodynamics temperature was halved

(50) The average kinetic energy of the molecules of an ideal gas in a closed, rigid container is increased by a factor of 4. What happen to the pressure of the gas?
(a) It remains the same (b) It increases by a factor of 2
(c) It increases by a factor of 4 (d) It increases by a factor of 8

ANSWER KEY

1	c	11	b	21	b	31	b	41	b
2	b	12	b	22	c	32	b	42	c
3	d	13	d	23	d	33	a	43	a
4	b	14	d	24	d	34	c	44	b
5	d	15	a	25	d	35	a	45	b
6	c	16	a	26	c	36	c	46	d
7	a	17	d	27	d	37	b	47	a
8	a	18	c	28	a	38	a	48	c
9	d	19	b	29	c	39	c	49	b
10	a	20	b	30	a	40	a	50	c

EXPLANATORY NOTES

(1) At absolute zero K.E = 0 (because motion of molecules ceases)

(2) $BC \rightarrow$ Solid to liquid

$DE \rightarrow$ liquid to vapours

(3) $\Delta m = \frac{Q}{H_f} = \frac{2000J}{200000JKg^{-1}}$

$\Delta m = \frac{Q}{H_f} = \frac{1}{100} kg$

(4) Temperature is established by two fixed points using certain physical properties of material which varies linearly with temperature.

(5) By ideal gas law

$PV = nRT$ .....(i)

Given

$\frac{PV}{2} = RT$

$PV = 2RT$ .....(ii)

By equating (i) and (ii)

$n = 2$

So, V = Volume of two moles

(6) Due to collision of molecules, pressure increases.

(7) $°C = \frac{5}{9}(°F - 32) = \frac{5}{9}(98.6 - 32) = 37°C$

(8) $v_{rms} = \sqrt{\frac{v_1^2 + v_2^2 + ... + v_n^2}{N}}$

(9) $V_t = V_o(1 + \beta t)$

$V_t = 2.0(1 + 4 \times 10^{-5} \times 35)$

$V_t = 2.0(1 + 140 \times 10^{-5})$

$V_t = 2.0(1 + 0.0014)$

$V_t = 2.0028\, m^3$

$V_t = 2002.8\, cm^3$

(10) Boiling point of water is increased by increasing pressure.

(11) Definition of Pascal's law.

Scanned by CamScanner

(12) $v_{rms} = \sqrt{\frac{v_1^2 + v_2^2 + v_3^2 + v_4^2}{N}}$

$= \sqrt{\frac{(2)^2 + (3)^2 + (4)^2 + (5)^2}{4}} = \sqrt{\frac{54}{4}} = \frac{\sqrt{54}}{2}$

(13) $\frac{T_1}{T_2} = \frac{K.E_1}{K.E_2}$

$\begin{pmatrix} \therefore T_1 = 27 + 273 = 300K \\ \therefore T_2 = 127 + 273 = 400K \end{pmatrix}$

$\frac{K.E_1}{K.E_2} = \frac{300}{400} = \frac{3}{4}$

(14) Black color is good absorber and radiator.

(15) From –20°C to 0°C changes from ice to liquid then from 100°C to 120°C from liquid to vapours.

(16) $\%\eta = \left(1 - \frac{T_2}{T_1}\right) \times 100$

(a) $\%\eta = \left(1 - \frac{20}{40}\right) \times 100 = 50\%$

(b) $\%\eta = \left(1 - \frac{80}{100}\right) \times 100 = 20\%$

(c) $\%\eta = \left(1 - \frac{60}{80}\right) \times 100 = 25\%$

(d) $\%\eta = \left(1 - \frac{40}{60}\right) \times 100 = 33\%$

(17)

$\%\eta = \left(1 - \frac{T_2}{T_1}\right) \times 100$

$= \left(1 - \frac{400}{500}\right) \times 100$

$\eta = 20\%$

(18) Where 'R' Universal gas constant

i.e $R = 8.314\ J\ mol^{-1}K^{-1}$

(19) W = area of P-V graph

$W = \left(3\times10^{-3} - 1\times10^{-3}\right)\left(3\times10^{5} - 2\times10^{5}\right)$

$W = \left(2\times10^{-3}\right)\left(1\times10^{5}\right)$

$W = 2\times10^{2} = 200J$

(20) $PV = nRT$

$P' = \frac{nR(2T)}{(8V)}$

$P' = \frac{nRT/V}{4} = \frac{P}{4}$

(21) CD curve is more steeper represents rapid process.

(22) $\gamma = \frac{C_p}{C_v}$

(23) $\frac{^\circ C}{100} = \frac{F - 32}{180}$

$\frac{x}{100} = \frac{2x - 32}{180}$

$\frac{9}{5}x = 2x - 32 \Rightarrow 160^\circ = x$

(24) The area enclosed by the curve represents the work done during a cycle.

(25) $\eta = 1 - \frac{Q_2}{Q_1}$

$0.25 = 1 - \frac{Q_2}{800}$

$Q_2 = 600J$

(26)

$v_{rms} \propto \frac{1}{\sqrt{M}}$

$\Rightarrow \frac{v_H}{v_O} = \sqrt{\frac{M_O}{M_H}} = \sqrt{\frac{32}{2}} = 4$

$\Rightarrow v_H = 4v_O = 4\times500 = 2000\,ms^{-1}$

(27) $T \propto K.E$

(28) $\Delta Q = \Delta U + \Delta W$

Scanned by CamScanner

$(-40) = \Delta U + (-20)$

$\Delta U = -20 \Rightarrow U_f - U_i = -20$

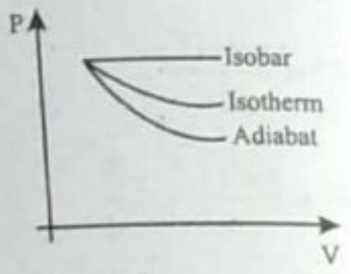
$U_f - 70 = -20$

$U_f = 70 - 20 = 50J$

(29) Radiation transmit heat fastest.

(30) $W_{isobar} > W_{isotherm} > W_{adiabat}$

Because work done is calculated by the area under PV graph



(31)

$$K = \frac{QL}{At\Delta T}$$

$$K \propto \frac{1}{A} \Rightarrow \frac{K_1}{K_2} = \frac{A_2}{A_1}$$

(32) State function are given below

Pressure (P), Temperature (T), Volume (V), Internal energy (U), Enthalpy (H), Entropy (S) and Gibb's free energy (G) PTV UHS-G

(33) $v_{rms} \propto \frac{1}{\sqrt{M}}$ least mass highest v_{rms}.

(34) $\Delta V = 0$ **So,** $W = P\Delta V = 0$

(35) Light colors reflect light.

(36) Heat engine is operating to through cyclic process in having temperature difference.

(37)

$V_1 = 1.3\times10^{-4}\,m^3$

$V_2 = 3.6\times10^{-4}\,m^3$

$P = 1.3\times10^{5}\,Pa$

$Q = 24\,J$

$\Delta U = ?$

$\Delta U = Q - W$

$= Q - P\Delta V$

$= 24 - 1.3\times10^{5}\left(3.6\times10^{-4} - 1.3\times10^{-4}\right)$

$= 24 - 1.3\times10^{5}\times2.3\times10^{-4}$

$= 24 - 29.9J$

$= -5.9J$

$\Delta U = -6J$

(38) $C = \frac{Q}{m\Delta T}$, $\Delta T \propto \frac{1}{C}$

(39)

$W = P\Delta V = P(V_2 - V_1)$

$W = (3\times10^5)(25-10)\times10^{-3} = 4500J$

(40) $\frac{Q}{t} = \frac{KA\Delta T}{L}$ independent of C (Heat capacity).

(41) $E = P$ For isothermal process

$E = \gamma P$ For adiabatic process

So, $\frac{\gamma P}{P} = \gamma$

(42) Heat flows from hotter object to cooler object

(43) Using $\eta = 1 - \frac{T_2}{T_1}$ find T_1 and using $1 - \frac{T_2}{T_1'} = \eta'$ find T_1' then find $T_1' - T$

(44) For adiabatic process, $\Delta Q = 0$. So, entropy remains constant i.e. $\Delta S = 0$

(45) $T \propto < K.E >$, $< K.E >$ of oxygen and hydrogen will be same at same temperature

(46) $T \propto < K.E >$

As both gases have same temperature therefore have same mean translational K.E

(47) $PV = nRT$

For molar volume n = 1 number of mole

$PV_m = 1RT \Rightarrow V_m = \frac{RT}{P}$

(48) $< K.E > \propto T$

(49)

$PV = nRT$

$PV \propto T$

$\frac{(PV)_1}{(PV)_2} = \frac{T_1}{T_2}$

$\frac{2x}{x} = \frac{T}{T_2} \Rightarrow T_2 = \frac{T}{2}$

(50) $P \propto < K.E >$

Scanned by CamScanner

11 Chapter HEAT & THERMODYNAMICS

SELF ASSESMENT TEST

(1) If a cylinder containing a gas at high pressure explodes, the gas undergoes.

(a) irreversible adiabatic change and rise of temperature
(b) irreversible adiabatic change and fall of temperature
(c) reversible adiabatic change and rise of temperature
(d) reversible adiabatic change and fall of temperature

(2) A gas at NTP is suddenly compressed to one-fourth of its original volume. If $\gamma$is supposed to be 3/2, then the final pressure is

(a) 4 atmosphere (b) 8 atmosphere
(c) 8 atmosphere (d) 1/4atmosphere

(3) The force on the walls of a vessel contained gas is due to

(a) the repulsiye force between gas molecules
(b) elastic collisions between gas molecules
(c) a slight loss in the speed of a gas molecule during a collision with the wall
(d) rate of change of momentum of a gas molecule during a collision with the wall

(4) The scales of temperature are based on two fixed points, which are

(a) the temperatures of water at 0°C and 100°C
(b) the temperature of melting ice and boiling water at atmospheric pressure
(c) the temperatures of ice cold and boiling water
(d) the temperatures of frozen and boiling mercury

(5) What does V represent in the equation $\frac{PV}{2} = RT$

(a) volume of n mole of gas (b) mass of 4g of gas
(c) mass of 2gm of gas (d) volume of 2 mole of gas

(6) Two gases A and B having the same temperature T, same pressure P and same volume V are mixed. If the mixture is at the same temperature T and occupies a volume V, the pressure of the mixture is:

(a) 2P (b) P
(c) P/2 (d) 4P

(7) During the adiabatic expansion of 2 moles of a gas, the internal energy of the gas is found to decrease by 2 joules, the work done during the process on the gas will be equal to

(a) - 2 J (b) -2 J
(c) 1 J (d) - 1 J

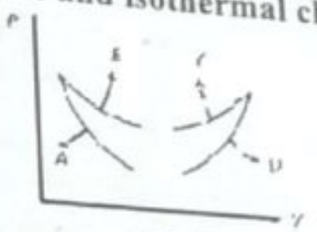
(8) A polyatomic gas (γ=4/3)is compressed to 1/8of its volume adiabatically. If its initial pressure is Po, its new pressure will be:

(a) $16P_0$ (b) $6P_0$
(c) $8P_0$ (d) $2P_0$

(9) The average kinetic energy of the molecular motion appears as

(a) P.E (b) heat
(c) temperature (d) none of these

(10) Four curves A, B, C and D are drawn in the adjoining figure for a given amount of gas. The curves which represent adiabatic and isothermal changes are.



(a) C and D respectively (b) A and B respectively
(c) D and C respectively (d) B and A respectively

(11) According to Pascal's law the pressure of gas in a vessel is

(a) different in different direction (b) same in all direction
(c) same only along opposite directions (d) same only along normal directions

(12) The pressure of an ideal gas is doubled in an isothermal process. The root-mean-square speed of the molecules:

(a) increases by a factor of $\sqrt{2}$ (b) increases by a factor of 2
(c) decreases by a factor of $1/\sqrt{2}$ (d) does not change

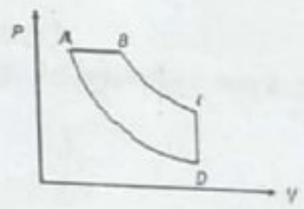
(13) Which one is true for internal energy?

(a) it is sum of all forms of molecular energies of a system
(b) it is a state function of a system
(c) it is proportional to transnational K.E of the molecules
(d) all are correct

(14) The change in entropy is zero for

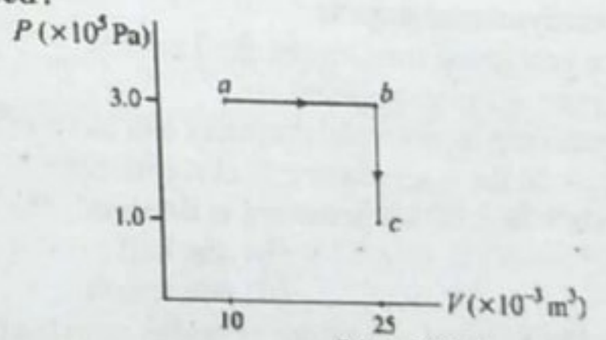
(a) reversible isothermal processes
(b) reversible adiabatic processes
(c) reversible processes during which no work is done
(d) reversible isobaric processes

(15) In pressure-volume diagram given below, the isochoric, isothermal, and isobaric parts respectively, are



(a) AB, BC, CD (b) CD, DA, AB
(c) DC, CB, BA (d) BA, AD, DC

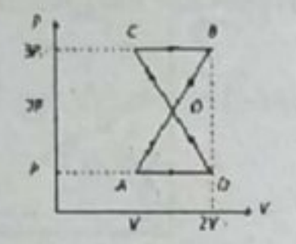
(16) What's the total work performed on the gas as it's transformed from state *a* to state *c*, along the path indicated?



(a) 1,500 J (b) 3,000 J
(c) 4,500 J (d) 5,000 J

Scanned by CamScanner

(17) A thermodynamic system undergoes cyclic process ABCDA as shown in figure. The work done by the system is:

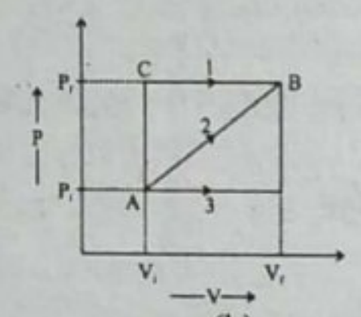


(a) $2P_0V_0$ (b) $P_0V_0/2$
(c) P_0V_0 (d) zero

(18) If the volume of a gas is held constant and we increase its temperature then
(a) its pressure is constant (b) its pressure rises
(c) its pressure falls (d) all of above

(19) Four particles have speed 1 m/s, 2 m/s, 3 m/s and 4 m/s. The root mean square speed of molecules is
(a) 2.5 m/s (b) 2.74 m/s
(c) 1.36 m/s (d) $\sqrt{30}$ m/s

(20) A system is taken from state A to B through three different paths 1, 2, 3. The work done is maximum in



(a) process 3 (b) process 1
(c) process 2 (d) equal in all processes

(21) Gas molecules of different masses in the same container have the same average transnational kinetic energy, which is directly proportional to their
(a) volume (b) pressure
(c) absolute temperature (d) time

(22) At what temperature is the rms velocity of a hydrogen molecule equal to that of an oxygen molecule at 47°C?
(a) 3 K (b) -73 K
(c) 20 K (d) 80 K

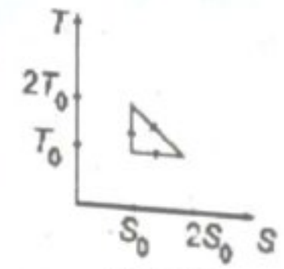
(23) Even Carnot engine cannot give 100% efficiency because we cannot
(a) find ideal sources (b) eliminate friction
(c) prevent radiation (d) reach absolute zero temperature

(24) The second law of thermodynamics implies:
(a) whole of heat can be converted into mechanical energy
(b) no heat engine can have efficiency 100%
(c) some heat engines working in reversible process can have efficiency 100%
(d) a refrigeratior can reduce the temperature to absolute zero

(25) For a gas obeying Boyle's law, if the pressure is doubled, the volume becomes
(a) double (b) one half
(c) four times (d) one fourth

(26) During which process the volume of system remains constant
(a) isothermal (b) isobaric
(c) isochoric (d) adiabatic

(27) The temperature-entropy diagram of a reversible engine cycle is given in the figure. Its efficiency is



(a) 1 (b) 1/2
(c) 2/3 (d) 1/3

(28) Boltzmann's constant K in terms of universal gas constant R and Avagadro's number N_A is given as
(a) $K = RN_A$ (b) $K = \frac{R}{N_A}$
(c) $K = \frac{N_A}{R}$ (d) $K = nRN_A$

(29) The equation of state for 5 g of oxygen at a pressure P and temperature T, when occupying a volume V, will be
(a) $PV = 5\ RT$ (b) $PV = \left(\frac{5}{2}\right)RT$
(c) $PV = \left(\frac{5}{16}\right)RT$ (d) $PV = \left(\frac{5}{32}\right)RT$

(30) Entropy remains constant in
(a) isobaric (b) isochoric
(c) adiabatic cyclic process (d) isothermal

(31) Which statement of second law of thermodynamics is based on heat engine
(a) clauses statement (b) kelvin statement
(c) carnot statement (d) boyles statement

(32) A perfect gas at 27°Cis heated at constant pressure so as to double its volume. The final temperature of the gas will be, close to
(a) 200°C (b) 327°C
(c) 300°C (d) 54°C

(33) The value of γ for diatomic gas is
(a) 1.67 (b) 1.4
(c) 1.3 (d) None

(34) A gas is compressed from a volume of $2m^3$ to a volume of $1m^3$ at a constant pressure of $100N/m^2$.Then it is heated at constant volume by supplying 150 J of energy. As a result, the internal energy of the gas
(a) decreases by 250 J (b) increases by 50 J
(c) increases by 250 J (d) decreases by 50 J

Scanned by CamScanner

(35) Which statement about the first law of thermodynamics is correct?

(a) the heating of a system equal to the increase of its internal energy plus the work done on the system
(b) the increase in the internal energy of system equal the heating of the system plus the work done by the system
(c) the increase in the internal energy of a system equal the heating of the system minus the work done by the system
(d) the work done on a system equals the increase of its thermal energy plus the heating of the system

(36) One mole of a perfect gas in a cylinder fitted with a piston has a pressure P, volume V and temperature T. If the temperature is increased by 1 K keeping pressure constant, the increase in volume is

(a) 2V/273 (b) V/91
(c) V/273 (d) V

(37) The first law of thermodynamics may be expressed as shown.

$$\Delta U = Q + W$$

Where ΔU is the change in internal energy, Q is the heating of the system, W is the work done on the system. A fixed mass of ideal gas at high pressure is contained in a balloon. The balloon suddenly bursts, causing the gas to expand and cool.
In this situation, which row describes the values of ΔU, Q and W?

	ΔU	Q	W
(a)	negative	negative	positive
(b)	negative	zero	negative
(c)	positive	zero	negative
(d)	positive	negative	positive

(38) Which of the following statement is correct for any thermodynamic system?

(a) the internal energy changes in all processes
(b) internal energy and entropy are state functions
(c) the change in entropy can never be zero
(d) the work done in an adiabatic process is always zero

(39) 1st law of thermodynamics is consequence of conservation of

(a) work (b) energy
(c) heat (d) all of these

(40) During an adiabatic expansion of 2 moles of gas, the internal energy was found to decrease by – 100 J. The work done by the gas during the process will be equal to

(a) 100 J (b) zero
(c) -100 J (d) 200 J

(41) The temperature of a gas is increased from 27C° to 127C°. The ratio of its mean kinetic energy will be

(a) $^{10}/_{9}$ (b) $^{9}/_{16}$
(c) $^{4}/_{3}$ (d) $^{3}/_{4}$

(42) The hot water pipes used to heat up the room are painted

(a) white (b) yellow
(c) red (d) black

(43) A gas is compressed at a constant pressure of 50N/m² from a volume of 10m³ to a volume of 4m³. Energy of 100 J then added to the gas by heating. Its internal energy is

(a) increased by 400 J (b) increased by 200 J
(c) increased by 100 J (d) decreased by 200 J

(44) Work done by air when it expands from 50 litres to 150 litres at a constant pressure of 2 atmosphere is

(a) 2×10^4 joules (b) 2×100 joules
(c) $2\times10^5\times100$ joules (d) $2\times10^{-5}\times100$ joules

(45) An ideal gas is heated at constant volume until its pressure doubles. Which one of the following statements is correct?

(a) the mean speed of the molecules doubles
(b) root mean square speed of the molecules doubles.
(c) mean square speed of the molecules doubles
(d) mean square speed of the molecules remains unchanged

(46) Consider boiling water converting into steam. Under this condition, the specific heat of water is

(a) less than zero (b) zero
(c) slightly greater than zero (d) infinite

(47) The Temperature at which the kinetic energy of a gas molecule is double its value at 27°C is

(a) 54°C (b) 300 k
(c) 327°C (d) 108°C

(48) The zeroth law of thermodynamics for three systems A, B and C in contact demands that

(a) molecular potential energy decreases and molecular kinetic energy also decreases, total energy remaining constant
(b) molecular potential energy increases and molecular kinetic energy decreases; total energy remaining constant
(c) molecular potential energy decreases and molecular kinetic energy also decreases, total energy remaining constant
(d) its molecular potential energy increases

(49) Temperature remaining constant, the pressure of gas is decreased by 20. The percentage change in volume

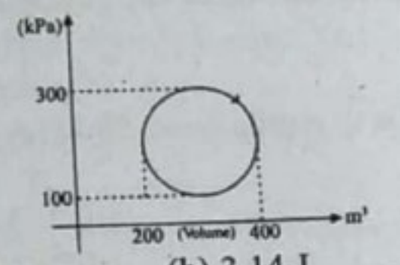
(a) increases by 20 (b) decreases by 20
(c) increases by 25 (d) decreases by 25

(50) In deriving the equation $P=\frac{1}{2}\rho\langle v^2\rangle$ in the simple kinetic theory of gases, which of the following is not taken as a valid assumption?

(a) attractive forces between the molecules are negligible
(b) the molecules suffer negligible change of momentum on collision with the walls of the container
(c) the volume of the molecules is negligible compared with the volume of the gas
(d) the duration of a collision is negligible compared with times between collisions

Scanned by CamScanner

(51) Calculate the heat absorbed by the system in going through the process as shown is figure.



(a) 31.4 J (b) 3.14 J
(c) 31.4×10^6 J (d) none

(52) The efficiency of a Carnot engine operating between reservoirs maintained at 27°C and 123°C is

(a) 0.75 (b) 0.4
(c) 0.25 (d) 0.5

(53) The concept of temperature is related to

(a) Zeroth law of thermodynamics (b) first law of thermodynamics
(c) second law of thermodynamics (d) third law of thermodynamics

(54) If the volume of a gas is deceased by 10% during isothermal process than its pressure will

(a) decrease by 10% (b) increase by 10%
(c) decrease by 11.11% (d) increase by 11.11%

(55) If the door of refrigerator is kept open when which of the following is true

(a) room is cooled (b) room is heated
(c) room is either cooled or heated (d) room is neither cooled nor heated

(56) An ideal gas heat engine operates in Carnot's cycle between 227°C and 127°C. It absorbs 6×10^4J at high temperature. The amount of heat converted into work is_____

(a) 4.8×10^4J (b) 3.5×10^4J
(c) 1.6×10^4J (d) 1.2×10^4J

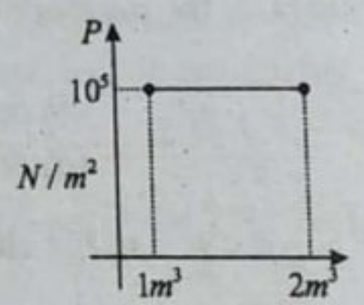
(57) When heat is given to a gas in an isobaric process then

(a) the work is done by the gas (b) internal energy of the gas increases
(c) both a) and b) (d) none from (a) and (b)

(58) Work done by air when it expands from 50 liters to 150 liters at a constant pressure of 2 atmosphere is

(a) 2×10^4J (b) 2×10^2J
(c) 2×10^7J (d) 2×10^{-3}J

(59) The work done in fig: is



(a) 3×10^5J (b) 2×10^5J
(c) 10^5J (d) zero

(60) The root mean square velocity of the gas molecules if 300 ms^{-1}. What will be the root mean square speed of the molecules if the atomic weight is double and absolute temp is halved?

(a) 300 ms^{-1} (b) 150 ms^{-1}
(c) 600 ms^{-1} (d) 75 ms^{-1}

ANSWER KEY

1	b	11	b	21	c	31	b	41	d	51	c
2	c	12	d	22	c	32	b	42	d	52	d
3	d	13	d	23	d	33	b	43	a	53	a
4	b	14	b	24	b	34	c	44	a	54	b
5	d	15	b	25	b	35	c	45	c	55	b
6	a	16	c	26	c	36	c	46	d	56	d
7	a	17	c	27	d	37	b	47	c	57	c
8	a	18	b	28	b	38	b	48	b	58	a
9	c	19	b	29	d	39	b	49	c	59	c
10	b	20	b	30	c	40	a	50	b	60	b

EXPLANATORY NOTES

(1) Gas cylinder suddenly explodes is an irreversible adiabatic change and work done against expansion reduces the temperature.

(2) $PV^\gamma = \text{constant} \Rightarrow \frac{P_2}{P_1} = \left(\frac{V_1}{V_2}\right)^\gamma \Rightarrow \frac{P_2}{1} = \left(\frac{V_1}{V_1/4}\right)^{3/2} = 8 \Rightarrow P_2 = 8 \text{ atm}$

(3) Rate of change of momentum of molecules is equal to the force applied on wall $\left(F = \frac{\Delta P}{\Delta t}\right)$

(4) Temperature is established by two fixed points using certain physical properties of material which varies linearly with temperature.

(5) $PV = nRT$

n represent number of moles of a gas

$\frac{PV}{n} = RT \Rightarrow \frac{V}{2} = \frac{RT}{P}$

(6) PV = constant as V decreases to half then P becomes double.

(7) $Q = \Delta U + W$

$0 = -2 + W$

$W = +2J$

(8)

$\frac{P_2}{P_1} = \left(\frac{V_1}{V_2}\right)^\gamma \Rightarrow P_2 = P_1\left(\frac{V_1}{V_2}\right)^\gamma = P_1(8)^{4/3} = 16P_1$

(9) $T \propto < K.E >$

(10) As we know that slope of isothermal and adiabatic curves are always negative graph curve A and B represents adiabatic and isothermal changes respectively.

(11) Due to ideal gas

$\Rightarrow P \propto < v^2 >$

So,

$P_x = P_y = P_z = P$

Scanned by CamScanner

(12)

$$v_{rms} = \sqrt{\frac{3P}{\rho}}$$

$\frac{P}{\rho} = constant$

so v_{rms} does not change

(13)

(a) U = K.E + P.E

(b) Internal energy does not depend upon path

(c) $T = \frac{2}{3K} < \frac{1}{2}mv^2 >$

(14) $\Delta S = \frac{\Delta Q}{T} (\text{For adiabatic } \Delta Q = 0) \Rightarrow \Delta S = 0$

(15) Process CD is isochoric as volume is constant, Process DA is isothermal as temperature constant and Process AB is isobaric as pressure is constant.

(16)

$W = P\Delta V = P(V_2 - V_1)$

$W = (3\times10^5)(25-10)\times10^{-3} = 4500\,J$

(17) W = Area of ΔADO + Area of ΔOCB

$W = \frac{1}{2}(V_o)(P_o) + \frac{1}{2}(V_o)(P_o)$

$W = P_o V_o$

(18) By using equation: $PV = \frac{2}{3}N < \frac{1}{2}mv^2 >$

$P \propto T$, when volume remains constant

(19) $v_{rms} = \sqrt{\frac{(1)^2 + (2)^2 + (3)^2 + (4)^2}{4}}$

(20) Work done = Area under PV graph, in case of process 1 area is maximum.

(21) $T = \frac{2}{3K} < \frac{1}{2}mv^2 >$

(22)

The rms velocity of the molecule of a gas of molecular weight M at kelvin temperature T is given by

$C_{rms} = \sqrt{\left(\frac{3RT}{M}\right)}$ Let M_O and M_H be molecular weights of oxygen and hydrogen and T_O and T_H the corresponding kelvin temperatures at which C_{rms} is same for both gases. i.e.,

$C_{rms(O)} = C_{rms(H)}$ $\sqrt{\left(\frac{3RT_O}{M_O}\right)} = \sqrt{\left(\frac{3RT_H}{M_H}\right)}$ Hence, $\frac{T_O}{M_O} = \frac{T_H}{M_H}$

Given, $T_O = 273 + 47 = 320\,K$ $M_O = 32,\ M_H = 2$ $\therefore$

$T_H = \frac{2}{32} \times 320 = 20\,K$

(23) The efficiency of Carnot engine is $\eta = 1 - \frac{T_2}{T_1}$ where, T_1 is the temperature of the source and T_2 that of sink. Since, $\frac{T_2}{T_1} = \frac{Q_2}{Q_1}$ So, $\eta = 1 - \frac{Q_2}{Q_1}$ To obtain 100% efficiency (i.e., $\eta = 1$), Q_2 must be zero i.e., if a sink at absolute zero would be available, all the heat taken from the source would have been converted into work. The temperature of sink means a negative temperature on the absolute scale at which the efficiency of engine is greater than unity. This would be a violation of the 2nd law of thermodynamics. Hence, a negative temperature on the absolute scale is impossible. Hence, we cannot reach absolute zero temperature.

(24) According to kelvin statement:

$T_2 = 0K\,(\text{impossible})$

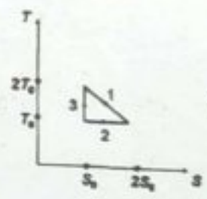
$\eta = \left(1 - \frac{T_2}{T_1}\right) \times 100\%$

$\eta = 100\%$, impossible

(25) $P \propto \frac{1}{V}$

(26) $pv = cons\tan t \Rightarrow T = cons\tan t$

(27)

According to the figure, 

Forpathi,1 $Q_1 = T_0S_0 - \frac{1}{2}T_0S_0 = \frac{3}{2}T_0S_0$ For path $Q_2 = T_0(2S_0 - S_0) = T_0S_0$ For path 3, $Q_3 = 0$ $\therefore$ Efficiency, $\eta = \frac{W}{Q_1} = \frac{Q_1 - Q_2}{Q_1} = 1 - \frac{Q_2}{Q_1} = 1 - \frac{2}{3} = \frac{1}{3}$

(28) $PV = nRT = \frac{N}{N_A}RT = NKT$, Where $K = \frac{R}{N_A}$

(29) PV = nRT, n = given mass / Molar mass

(30) $\Delta S = \frac{\Delta Q}{\Delta T}$, ΔQ is zero in adiabatic process

(31) Kelvin's statement based on the working of a heat engine.

(32) Given $V_1 = V, V_2 = 2V_1$, $T_1 = 27° + 273 = 300\ K$ $T_2 = ?$ From charle's law $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ ($\because$ pressure is constant) or, $\frac{V}{300} = \frac{2V}{T_2}$ $\therefore T_2 = 600K = 600 - 273 = 327°C$

(33) $\gamma = \frac{C_p}{C_v} = 1.4$ where $C_p = 7$, $C_v = 5$

Scanned by CamScanner

(34) As we know, $\Delta Q = \Delta U + \Delta W$ (1^{st} law of thermodynamics)

$\Rightarrow \Delta Q = \Delta U + P\Delta V$

$150 = \Delta U + 100(1-2) = \Delta U - 100 \quad \because \Delta U = 150 + 100 = 250J$

Thus the internal energy of the gas increases by 250 J

(35)

$Q = \Delta U + W$

$\Delta U = Q - W$

(36)

For isobaric process $\frac{V_2}{V_1} = \frac{T_2}{T_1} \Rightarrow V_2 = V \times \frac{274}{273}$ Increase $= \frac{274\,V}{273} - V = \frac{V}{273}$

(37) As for a system which is expand and cool down $\Delta Q = 0$ also $\Delta Q = \Delta U + W$ then $W = \Delta U$

(38) Internal energy and entropy are state function.

(39) $Q = \Delta U + W$, Where $Q, \Delta U$ and W all have unit joule.

(40) In adiabatic expansion,

Decrease in internal energy = work done by system

So, work done will be +100J

(41) $\frac{T_1}{T_2} = \frac{K.E_1}{K.E_2}$

$\begin{pmatrix} \therefore T_1 = 27 + 273 = 300K \\ \therefore T_2 = 127 + 273 = 400K \end{pmatrix}$

$\frac{K.E_1}{K.E_2} = \frac{300}{400} = \frac{3}{4}$

(42) Black color is good absorber and radiator.

(43)

$$\Delta Q = \Delta U + \Delta W = \Delta U + P\Delta V$$

$$\Rightarrow 100 = \Delta U + 50 \times (4 - 10) \Rightarrow \Delta U = 400\ J$$

(44)

$$W = P \times \Delta V = 2 \times 10^5 (150 - 50) \times 10^{-3} = 2 \times 10^4 J$$

(45)

Ideal gas equation is PV = nRT as volume is constant $P \propto T$ when $P' = 2P \rightarrow T' = 2T$ as $v_{rms}^2 \propto T'$, v_{rms}^2 doubles.

(46)

During conversion of water into steam, temperature remains constant $(\Delta T = 0)$ For phase conversion $\Delta Q = mL = mc\Delta T$ or $c = \frac{L}{\Delta T} = \frac{L}{0} = \infty \ [\because L \neq 0]$ where, L is latent heat of steam.

(47) $T \propto <K.E>$

$\frac{T_2}{T_1} = \frac{E_2}{E_1} \quad \because <K.E> = E$

$\frac{T_2}{300} = \frac{2E_1}{E_1} \quad T_1 = 27 + 273$

$T_1 = 300k$

$T_2 = 600k$

$T_2 = 600 - 273$

$T_2 = 327^\circ C$

(48) Definition

(49) According to Boyle's law $p_1V_1 = p_2V_2$ As the pressure is decreased by 20%, so $p_2 = \frac{80}{100}p_1$

$p_1V_1 = \frac{80}{100}p_1V_2 = V_1 = \frac{80}{100}pV_2 \quad \therefore V_2$ percentage increase in volume $= \frac{V_2 - V_1}{V_1} \times 100$

$= \frac{100 - 80}{80} \times 100 = 25$

(50) As we assume elastic collision. In which momentum and kinetic energy remain conserved (constant)

(51) $Q = \Delta U + W$

In cyclic process i.e $\Delta U = 0$

$Q = W = Area\ of\ P - V\ graph = \pi r^2$

$= \pi(P_r)(V_r)$

$= 3.14(100 \times 10^3)(100)$

$= 31.4 \times 10^6 J$

(52) $\eta = 1 - \frac{T_2}{T_1} = 1 - \frac{150}{300} = \frac{1}{2} = 0.5$

(53) Law's statement.

(54) Pressure and volume of gas is inversely proportional according Boyle's law.

(55) Due to work of compressor.

(56) $E = 1 - \frac{T_2}{T_1} = 1 - \frac{400}{500} = \frac{1}{5} = \frac{W}{Q}$

(57) If heat given to system, its gas internal energy increase due to increase temperature and work done by gas due to keep pressure constant.

(58) $W = P\Delta V = 2 \times 10^5 (150 - 50) \times 10^{-3} = 2 \times 10^4 J$

(59) $W = Shaded\ area = 10^5 \times 1 = 10^5 J$

(60) $v_{rms} = \sqrt{\frac{3RT}{M}} = 300 = \sqrt{\frac{3R(T/2)}{2N}} = \frac{300}{2} = v$

Scanned by CamScanner

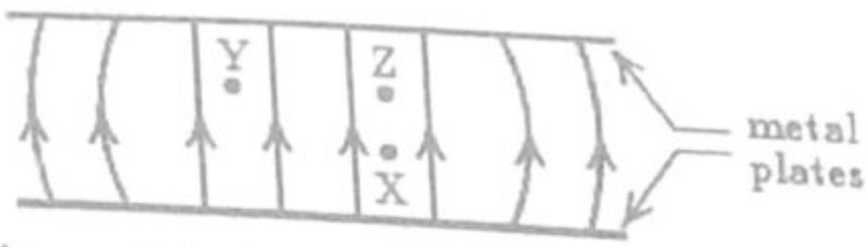
BOOK-II

Scanned by CamScanner

12 chapter ELECTROSTATICS

PRACTICE EXERCISE

(1) **The diagram shows the electric field lines due to two charged parallel metal plates. We conclude that:**



(a) The upper plate is positive and the lower plate is negative
(b) A proton at X would experience the same force if it were placed at Y
(c) A proton at X experiences a greater force than if it were placed at Z
(d) A proton at X experiences less force than if it were placed at Z

(2) **If the distance between the two-point charges become half, then force between them becomes _____**
(a) Double
(b) Half
(c) Four times
(d) Remains same

(3) **If $F = \frac{kq_1q_2}{r^2}$ then $\frac{F}{q_1}$ is**
(a) The force on q_1
(b) Electric field generated by q_2
(c) Electric potential due to q_1
(d) Electric flux

(4) **An isolated charged point particle produces an electric field with magnitude E at a point 2m away. At a point 1m from the particle the magnitude of the field is:**
(a) 2E
(b) 4E
(c) 3E
(d) E

(5) **A positive charge is moved against an electric field. Its P.E**
(a) Increases
(b) Decreases
(c) Remains same
(d) May increase or decrease depending upon magnitude of charge

(6) **Two charges are placed at a certain distance. If the magnitude of each charge is doubled, the force will become**
(a) $1/4^{th}$ of its original value
(b) $1/8^{th}$ of its original value
(c) 4 times of its original value
(d) 8 times of its original value

(7) **The electric force between two charges placed in air is 2N. When placed in a medium of $\in$, 80, the force reduces**
(a) 0.019
(b) 0.029
(c) 0.025
(d) 0.04

(8) **An electric field can deflect _____**
(a) Neutrons
(b) γ-rays
(c) X-rays
(d) None

(9) **An electric charge at rest produces _____**
(a) Only a magnetic field
(b) Only an electric field
(c) Neither electric field nor magnetic field
(d) Both electric and magnetic fields

(10) **A capacitor has a capacitance of 4F in presence of air. Find the capacitance in μF when a medium of dielectric constant 8 is placed between the plates**
(a) 32
(b) 16
(c) 2
(d) none

Scanned by CamScanner

(11) A point particle with charge q is at the center of a Gaussian surface in the form of a cube. The electric flux through any one face of the cube is

(a) $\frac{q}{\varepsilon_o}$ (b) $\frac{q}{6\varepsilon_o}$

(c) $\frac{q}{4\varepsilon_o}$ (d) $\frac{q}{4\varepsilon_o}$

(12) Electric flux linked with a surface will be maximum when surface is held at a angle of

(a) 60° (b) 90°

(c) 30° (d) 0°

(13) Two 1 kg spheres each carry a charge of magnitude 1 C. How does F_E, the strength of the electric force between the spheres, compare with F_G, the strength of their gravitational attraction?

(a) $F_E < F_G$ (b) $F_E > F_G$

(c) $F_E = F_G$ (d) None of these

(14) If an electron is accelerated through a potential difference V, it will acquire energy

(a) $\frac{V}{2}$ (b) Ve

(c) $\frac{E}{V}$ (d) Ve^2

(15) Two 2μF capacitors are connected in parallel then the equivalent capacitance will be

(a) 2μF (b) $\frac{1}{2}$μF

(c) $\frac{1}{4}$μF (d) 4μF

(16) A charge of 10^{-10} C between two parallel plates 1cm apart experiences a force of 10^{-5}N. The potential difference between the plates is

(a) 10 V (b) 10^2V

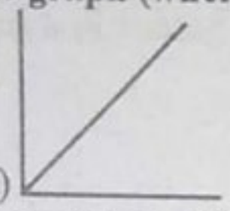
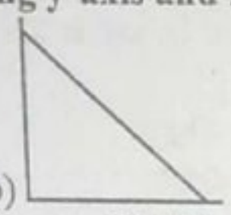
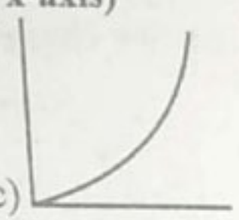
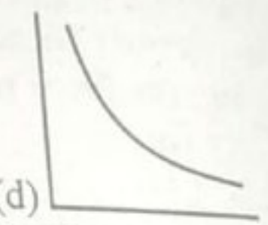
(c) 10^3V (d) 10^5V

(17) Two similar charges each of one coulomb placed in air one meter apart repel each other with a force

(a) 9×10^9N (b) 9.2×10^4N

(c) 9×10^{-9}N (d) 9×10^7N

(18) The variation of electric potential due to a point charge with distance is represented by the graph (where V along y-axis and r along x-axis)

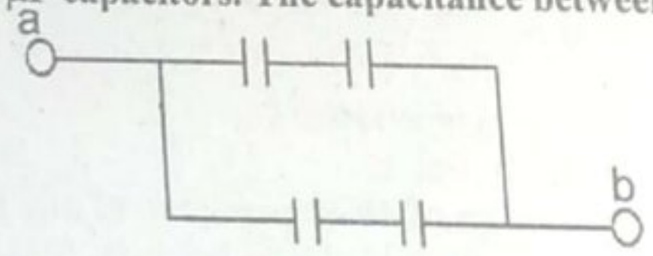
(a)  (b)  (c)  (d) 

(19) A capacitor C "has a charge Q". The actual charges on its plates are

(a) Q, −Q (b) Q, Q

(c) Q/2, −Q/2 (d) Q, 0

(20) The diagram shows four 6-μF capacitors. The capacitance between points a and b is:



(a) 6μF (b) 3μF

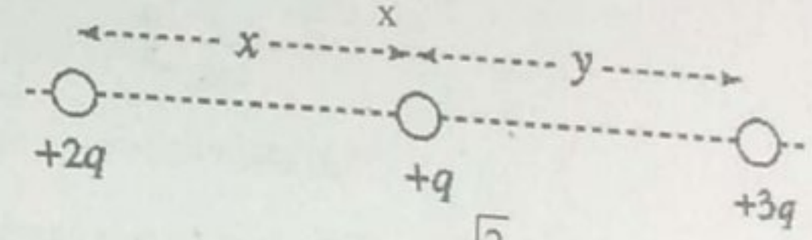
(c) 4μF (d) 9μF

(21) A gold nucleus (radius r) is represented by the symbol $^{197}_{79}Au$. Taking e as the elementary charge and ε_o as the permittivity of free space, what is the electric field strength at the surface of an isolated gold nucleus?

(a) Zero (b) $\frac{197e}{4\pi\varepsilon_o r^2}$

(c) $\frac{79e}{4\pi\varepsilon_o r^2}$ (d) $\frac{79e^2}{4\pi\varepsilon_o r^2}$

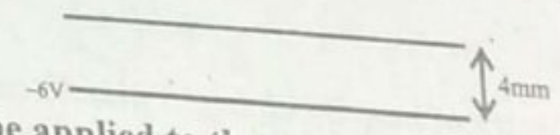
(22) The figure below shows three point charges, all positive. If the net electric force on the center charge is zero, what is the value of $\frac{y}{x}$?



(a) $\frac{4}{9}y$ (b) $\sqrt{\frac{2}{3}}y$

(c) $\sqrt{\frac{3}{2}}y$ (d) $\frac{3}{2}y$

(23) The large horizontal metal plates are separated by 4 mm. The lower plate is at a potential of –6V.



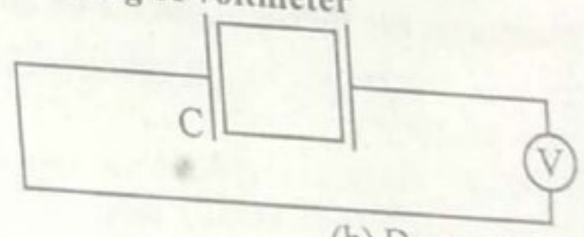
What potential should be applied to the upper plate to create an electric field of strength 4000 Vm^{-1} Upwards in the space between the plates?

(a) +22 V

(b) +10 V (c) −10 V

(d) −22 V

(24) Figure shows a charged capacitor and a voltmeter. When a dielectric slab is inserted between the plates then reading of voltmeter



(a) Increases (b) Decreases

(c) Unchanged (d) First increases then decreases

(25) Potential gradient is defined as

(a) The maximum value of rate of change of potential with distance

(b) The minimum value of rate of change of potential with distance

(c) The maximum value of rate of change of potential with time

(d) None of these

(26) The quantity $\frac{1}{2}\varepsilon_o E^2$ has the significance of:

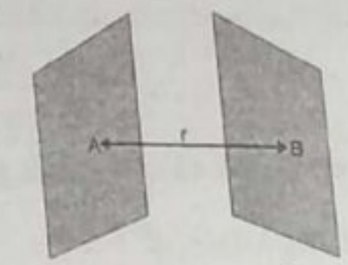
(a) Energy/farad (b) Energy/coulomb

(c) Energy/volume (d) Energy

Scanned by CamScanner

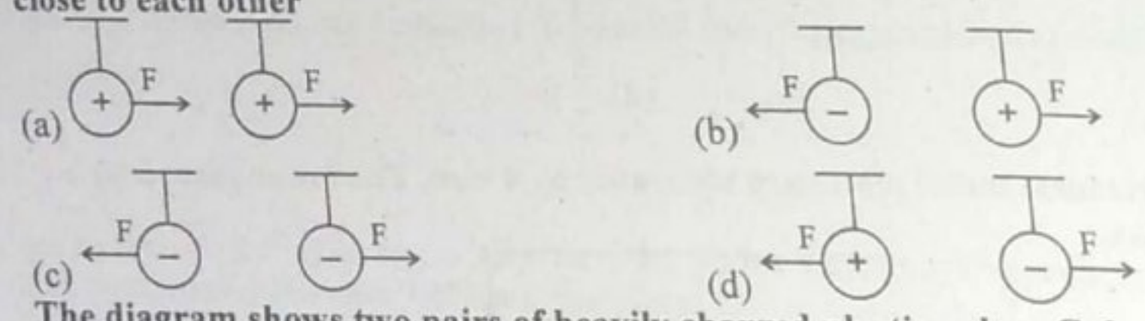
(27) **Equivalent capacitance is greater than individual capacitances in**
(a) Series combination (b) Parallel combination
(c) Both series and parallel combinations (d) None of above

(28) **The figure shows two parallel equipotential surfaces A and B kept a small distance r part from each other. A point charge of q coulomb is taken from the surface A to B. The amount of net work done will be:**

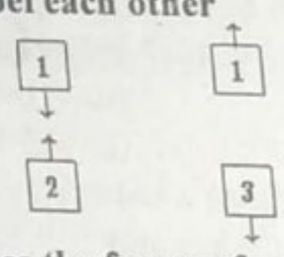


(a) $-\frac{1}{4\pi\varepsilon_o}\frac{q}{r}$ (b) $-\frac{1}{4\pi\varepsilon_o}\frac{q}{r^2}$
(c) $\frac{1}{4\pi\varepsilon_o}\frac{q}{r^2}$ (d) zero

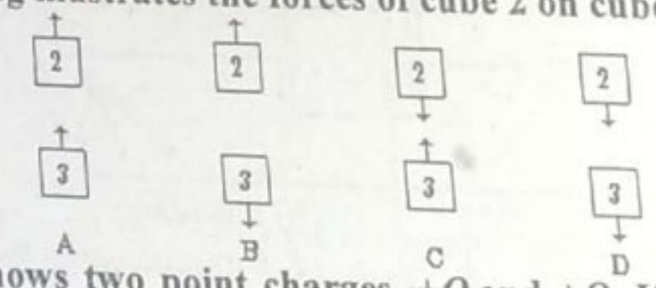
(29) **Which diagram correctly show the force F that act on two charged spheres suspended close to each other**



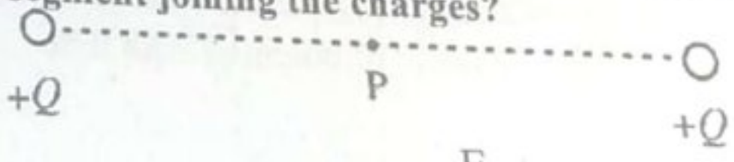
(30) **The diagram shows two pairs of heavily charged plastic cubes. Cubes 1 and 2 attract each other and cubes 1 and 3 repel each other**



Which of the following illustrates the forces of cube 2 on cube 3 and cube 3 on cube 2?



(31) **The figure below shows two point charges, $+Q$ and $+Q$. If the right-hand charge were absent, the electric field at Point P due to $+Q$ would have a strength of E. With the right-hand charge in place, what is the strength of the total electric field at P, which lies at the midpoint of the line segment joining the charges?**

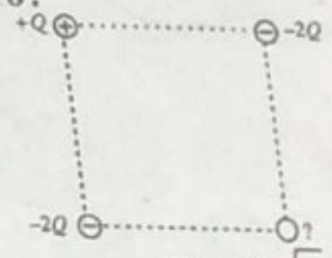


(a) 0 (b) $\frac{E}{4}$
(c) $\frac{E}{2}$ (d) 2E

(32) **A capacitor charges and discharges**
(a) rapidly (b) linearly
(c) exponentially (d) logarithmically

(33) **The leaves of a positively charged electroscope diverge more when an object is brought near the knob of the electroscope. The object must be:**
(a) An insulator (b) A conductor
(c) Negatively charged (d) Positively charged

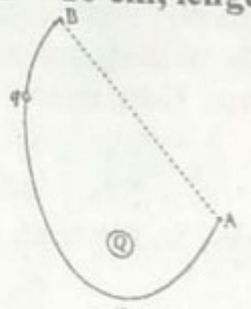
(34) **The figure below shows four point charges fixed in position at the corners of a square. What charge would have to be present at the bottom right location for the electric field at the center of the square to be zero?**



(a) $+Q$ (b) $+Q\sqrt{2}$
(c) $+2Q$ (d) $+3Q$

(35) **Electric flux due to a point charge +q is**
(a) $1/4\pi\varepsilon_o \cdot q/r$ (b) q/ε_o
(c) $1/4\pi\varepsilon_o \cdot q/r^2$ (d) $4\pi\varepsilon_o$

(36) **How much work would the electric field (created by the stationary charge Q) perform as a charge q is moved from point B to A along the curved path shown? ($V_A = 200$ V, $V_B = 100$ V, $q = -0.05$ C, length of line segment AB = 10 cm, length of curved path = 20 cm.)**

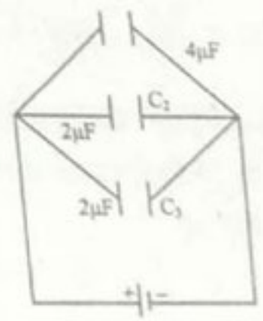


(a) 0J (b) 5J
(c) 15J (d) 10J

(37) **A charge of 0.10C accelerated through a potential difference of 1000V acquires kinetic energy**
(a) 200 J (b) 10 J
(c) 100 J (d) 100 eV

(38) **A capacitor is a perfect insulator for**
(a) Direct current (b) Alternating current
(c) Both for the direct and alternating current (d) Rapidly fluctuating current

(39) **Three capacitors C_1, C_2 and C_3 are connected in parallel as in the Fig. The equivalent capacitance will be**

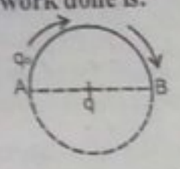


(a) 8μF (b) 0.8μF
(c) 1μF (d) 16μF

Scanned by CamScanner

(40) **In a charged capacitor the energy resides in**
(a) Electric field surrounding the capacitor (b) Electric field between the plates
(c) Both "a" and "b" (d) Gravitational field

(41) **A charged particle of charge q_0 is moved around a charge +q along the circular path from A to B. The work done is:**



(a) $\frac{1}{4\pi\varepsilon_0}\cdot\frac{qq_0}{r}$ (b) $\frac{1}{4\pi\varepsilon_0}\cdot\frac{2qq_0}{r}$
(c) $\frac{1}{4\pi\varepsilon_0}\cdot\frac{qq_0}{r^2}$ (d) Zero

(42) **What would happen to the electrostatic force between a pair of charged particles if both charges were doubled and the distance between them were also doubled?**
(a) It would decrease by a factor of 4 (b) It would decrease by a factor of 2
(c) It would remain unchanged (d) It would increase by a factor of 2

(43) **The purpose of Millikan's oil drop experiment was to determine**
(a) The charge of an electron
(b) The mass of an electron
(c) The ratio of charge to mass for an electron
(d) The sign of the charge on an electron

(44) **Two electric charges originally 4cm apart are brought closer to each other until the force between them becomes of 4 times. How much they separated now?**
(a) 1 cm (b) 2 cm
(c) 0.5 cm (d) 0.25 cm

(45) **If a unit positive charge is placed in air then the flux coming out of it is**
(a) $4\pi\varepsilon_0$ (b) ε_0^{-1}
(c) ε_0 (d) $4\pi\varepsilon_0^{-1}$

(46) **A and B are two points in an electric field. If the work done in carrying 4.0 coulomb of electric charge from A to B is 16.0 joule the potential difference between A and B is**
(a) zero (b) 2.0 V
(c) 4 V (d) 16V

(47) **If the distance between two point charges to becomes double then the coulomb's force will be**
(a) $\frac{F}{2}$ (b) 2F
(c) 4F (d) $\frac{F}{4}$

(48) **A capacitor of capacitance C is connected to battery of emf V_0. Without removing the battery, a dielectric of strength ε_r is inserted between the parallel plates of the capacitor C, then the charge on the capacitor is**
(a) CV_0 (b) $\varepsilon_R CV_0$
(c) $\frac{CV_0}{\varepsilon_r}$ (d) none of these

(49) **A proton (mass = 1.67×10^{-27} kg) on entering in a vertical electric field E is balanced. Then the electric field strength is**
(a) 10^{-9} Vm^{-1}
(b) 10^{+7} Vm^{-1}
(c) 10^{-7} Vm^{-1}
(d) 10^{-8} Vm^{-1}

(50) **The space between the plates of a capacitor is filled by a liquid of dielectric constant k. The capacitance of the capacitor**
(a) increases by a factor k
(b) decreases by a factor k
(c) increases by a factor k^2
(d) decreases by a factor k^2

ANSWER KEY

1	b	11	b	21	c	31	a	41	d
2	c	12	b	22	c	32	c	42	c
3	b	13	b	23	d	33	d	43	a
4	b	14	b	24	b	34	a	44	b
5	a	15	d	25	a	35	b	45	b
6	c	16	c	26	c	36	b	46	c
7	c	17	a	27	b	37	c	47	d
8	d	18	d	28	d	38	a	48	b
9	b	19	a	29	c	39	a	49	c
10	a	20	a	30	c	40	b	50	a

EXPLANATORY NOTES

(1) In uniform electric field electric force between the plates remain same anywhere.

(2) $F = \frac{k q_1 q_2}{r^2} \rightarrow F \propto \frac{1}{r^2}$

(3) Electric field generated by q_1 is $\frac{F}{q_2}$

Electric field generated by q_2 is $\frac{F}{q_1}$

(4) $E = \frac{Kq}{r^2} \rightarrow E \propto \frac{1}{r^2}$

(5) When positive charge moves against electric field then K.E decreases and P.E increases

(6) $F = \frac{Kq_1q_2}{r^2}$ If magnitude of each charge double, then force four times

(7) $F_{med} = \frac{F_{vac}}{\varepsilon_r} = \frac{2}{80} = \frac{1}{40} = 0.025N$

(8) Electric field can deflect only charges

(9) Charges at rest produce electric field only

Scanned by CamScanner

(10) $\frac{1}{\varepsilon_r}=\frac{C_v}{C_M}\Rightarrow C_M=\varepsilon_r C_v=4\times 8=32$

(11) $\phi=\frac{1}{\varepsilon_o}$ (Total charge) $=\frac{Q}{\varepsilon_o}$ $\therefore$ For six surfaces

$\phi_{\text{for one surface}}=\frac{q}{\varepsilon_o}\times\frac{1}{6}=\frac{q}{6\varepsilon_o}$

(12) Flux will maximum when surface is perpendicular to field

(13) Electric force is stronger than gravitational force at the same distance

(14) $K.E_e=eV$

(15) In parallel case $C_{eq}=C_1+C_2=2+2=4\mu F$

(16) $V=dE=d\frac{F}{q}=(0.01)\frac{(10^{-5})}{10^{-10}}=(0.01)(10^5)=10^3V$

(17) $F=\frac{Kq_1q_2}{r^2}=\frac{9\times10^9(1)(1)}{(1)^2}=9\times10^9N$

(18) $V=\frac{Kq}{r}$

$V\propto\frac{1}{r}$

(19) Both plates has opposite charge having magnitude "Q".

(20) $C_{eq}=\frac{6}{2}+\frac{6}{2}=6\mu F$

(21) $E=\frac{Kq}{r^2}=\frac{1}{4\pi\varepsilon_o}\frac{79e}{r^2}$ (Here $Q=79e$)

(22) $F_1=F_2\rightarrow\frac{K(2q)(q)}{x^2}=\frac{K(q)(3q)}{y^2}\rightarrow\frac{2}{x^2}=\frac{3}{y^2}$

$x=\sqrt{\frac{2y^2}{3}}=\sqrt{\frac{2}{3}}y$

$\frac{y}{x}=\sqrt{\frac{3}{2}}$

(23) $E=\frac{\Delta V}{d}$

$4000=\frac{-6-V}{\frac{4}{1000}}$

$4000\times\frac{4}{1000}=-6-V$

$16\div6=-V$

$-22=V$

$V=-22V$

(24) $C=\frac{A\varepsilon_o\varepsilon_r}{d}$

$Q=CV$

$\uparrow C\propto\frac{1}{V\downarrow}$

(25) $E=-\frac{\Delta V}{\Delta d}$

(26) Energy Density $=\frac{Energy}{volume}=\frac{1}{2}\varepsilon_o E^2$

(27) In parallel combination

$C_{eq}=C_1+C_2+\ldots$

$C_{eq}>$ individual capacitance

(28) $W=q(V_A-V_B)=q\times0=0$ $(V_A=V_B$ equipotential$)$

(29) Similar charges repel each other.

(30) 1&2 attract say 1 is positive and 1&3 repel say 3 is also positive hence 2&3 are opposite charges so attract each other

(31) There is no field between the two similar charges at centre

(32) $q=q_o(1-e^{-t/RC})$ For charging

$q=q_oe^{-t/RC}$ For discharging

(33) In case of +ve charge leaves will move apart more as compare to –ve charge because disk is positively charge.

(34) Zero zone can be created between the similar charges having same magnitude.

Scanned by CamScanner

(35) $\phi_e = \frac{1}{\varepsilon_o} q$

(36) $\frac{W}{Q} = \Delta V$

$W = Q\Delta V = (0.05)(200-100) \Rightarrow W = 5\text{J}$

(37) $W = \text{K.E} = QV$

$= (0.10)(1000) = 100\text{J}$

(38) Capacitor does not allow D.C to pass because it behaves as open circuit

(39) $C_{eq} = C_1 + C_2 + C_3 = 8\mu\text{F}$

(40) Energy is stored between the plates of parallel plate capacitor in the form of electric field

(41) No work is done in moving a charge on equipotential surface.

(42) Applying Coulomb's law, we see that the electric force will not change.

$F' = k\frac{Q'q'}{r'^2} = k\frac{(2Q)(2q)}{(2r)^2} = k\frac{4Qq}{4r^2} = k\frac{Qq}{r^2} = F$

(43) The purpose of Millikan's oil droplet experiment was to determine the charge on an electron

(44) $F \propto \frac{1}{r^2} \Rightarrow r \propto \frac{1}{\sqrt{F}}$

(45) $\phi_e = \frac{q}{\varepsilon_o} = \frac{(1)}{\varepsilon_o} = \varepsilon_o^{-1}$

(46) $\Delta V = \frac{W}{q} = \frac{16}{4} = 4\text{V}$

(47)

If $r = 2r$

$F = \frac{kq^2}{r^2}$

$F' = \frac{F}{4}$

(48) As, $Q = CV \rightarrow$ also $C = \epsilon_r C$ and $V = V_o$ then $Q = \epsilon_r CV_o$

(49) $E = \frac{F}{q} = \frac{mg}{q} = \frac{1.67\times10^{-27}\times10}{1.6\times10^{-19}} = 10^{-7} Vm^{-1}$

(50)

$C_{med} = \varepsilon_r . C_{vac}$

$C_{med} = K . C_{vac}$

take form or shape, fulfil

12 chapter ELECTROSTATICS

SELF ASSESMENT TEST

(1) **A charge q_1 exerts some force on a second charge q_2. If third charge q_3 is brought near, the force of q_1 exerted on q_2:**

(a) increases (b) zero
(c) decreases (d) remains unchanged

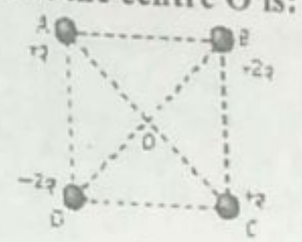
(2) **Two charges are placed at a certain distance apart in air. When a metallic sheet is placed between them, the electrostatic force between them will.**

(a) decrease (b) increase
(c) remain unchanged (d) become zero

(3) **The minimum charge on any object cannot be less than_____**

(a) $1.6\text{x}10^{-19}\text{C}$ (b) $3.2\text{x}10^{-19}\text{C}$
(c) $9.1\text{x}10^{9}\text{C}$ (d) no definite value exist

(4) **Four charges are arranged at the corners of a square ABCD, as shown in the adjoining figure. The force on the charge kept at the centre O is:**

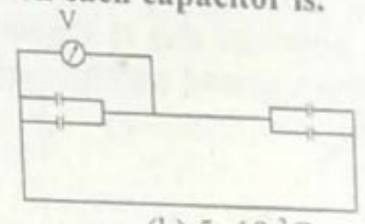


(a) zero (b) along the diagonal BD
(c) along the diagonal AC (d) perpendicular to side AB

(5) **When air is replaced by a dielectric medium of constant k, the maximum force of attraction between two charges separated by a distance**

(a) decreases k times (b) remains unchanged
(c) increases k times (d) increases k−1 times

(6) **Four capacitors, each of capacitance 50 μF are connected as shown in Fig below. If the voltmeter reads 100 V, the charge on each capacitor is.**



(a) $2\times10^{-3}\text{C}$ (b) $5\times10^{-3}\text{C}$
(c) 0.2C (d) 0.5C

(7) **The force per unit charge is known as _____**

(a) electric flux (b) electric intensity
(c) electric potential (d) all of above are same

(8) **Two small conducting spheres of equal radius have charges +10μCand −20μC respectively and placed at a distance R from each other experience force F_1. If they are brought in contact and separated to the same distance, they experience force F_2. The ratio of F_1 to F_2**

(a) 1 : 8 (b) - 8 : 1
(c) 1 : 2 (d) - 2 : 1

Scanned by CamScanner

(9) Uncharged capacitor is connected in a series with resistor, switch and a battery. When switch is closed the potential drop across resistor
(a) remain same (b) initially maximum then decreases to zero
(c) become zero then increase maximum (d) remain zero

(10) Two charges placed in air repel each other by a force of 10^{-4}N. When oil is introduced between the charges, the force becomes 2.5×10^{-5}N. The dielectric constant of oil is
(a) 3 (b) 4
(c) 2 (d) 0.25

(11) Two charges each equal to 2μC are 0.5m apart. If both of them exist inside vacuum, then the force between them is
(a) 2.44 N (b) 0.144 N
(c) 1.89 N (d) 3.144 N

(12) Electric flux linked with a surface will be maximum when θ =?
(a) 60^0 (b) 90^0
(c) 30^0 (d) 0^0

(13) Two capacitor of capacitances 1 μF and 2μF are connected in series with a D.C source of 300 volt. Charge stored by each capacitor
(a) 100 μC, 200 μC (b) 200 μC, 100 μC
(c) 200 μC, 200 μC (d) 100 μC, 100 μC

(14) The electric lines of force are _____
(a) imaginary (b) physically existing every where
(c) physically existing near the charges (d) depends upon case

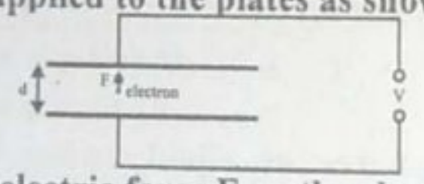
(15) Two point charges +3μC and +8μC repel each other with a force of 40N. If a charge of -5μC is added to each other of them, then the force between them will become
(a) -20N (b) +20N
(c) +10N (d) -10N

(16) A capacitor of capacitance C has charge Q and stored energy is W. If the charge is increase to 2Q. The stored energy will be
(a) W/4 (b) W/2
(c) 2W (d) 4W

(17) A hollow metal sphere of radius 5 cm is charged so that the potential on its surface is 10 V. The potential at the center of the sphere is
(a) 10 V (b) same as at point 5 cm away from the surface
(c) 0 V (d) same as at point 25 cm away from the surface

(18) The variation of electric potential due to a point charge with distance is represented by the graph (where V along y-axis and r along x-axis)
(a) (b) (c) (d)

(19) An electron of charge e is introduced between two metal plates a distance d apart. A potential difference V is applied to the plates as shown in the diagram.



Which expression gives the electric force F on the electron?
(a) $\frac{eV}{d}$ (b) eVd
(c) $\frac{V}{ed}$ (d) $\frac{dV}{e}$

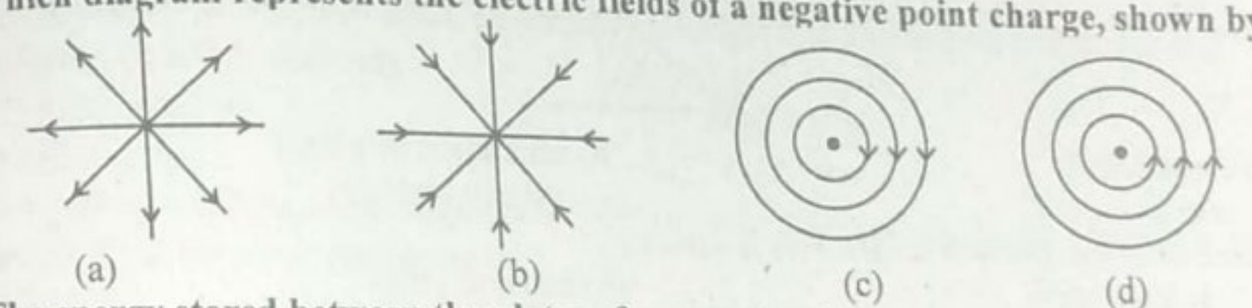
(20) The energy stored per unit volume in an electric field of strength E volt/meter in a medium of dielectric constant K (in Joule/metre^3) is:
(a) $\frac{1}{2}\varepsilon_0 E^2$ (b) $\frac{1}{2}K\varepsilon_0 E^2$
(c) $\frac{1}{2}.\frac{\varepsilon_0 E^2}{K}$ (d) $\frac{1}{2}K^2\varepsilon_0^2 E$

(21) Figure shows the electric lines of force emerging from a charged body. If the electric field at A and B are E_A and E_B respectively and if the displacement between A and B is r then



(a) $E_A < E_B$ (b) $E_A = E_B$
(c) $E_A > E_B$ (d) none of these

(22) Which diagram represents the electric fields of a negative point charge, shown by.



(23) The energy stored between the plates of a capacitor is not represented by
(a) $U=\frac{CV^2}{2}$ (b) $U = 2qV$
(c) $U=\frac{q^2}{2C}$ (d) $U=\frac{qV}{2}$

(24) A charge of 2C experiences a force 2000N in a uniform electric field. In this field the potential difference between two points separated by a distance 1cm is
(a) 2V (b) 5V
(c) 10 V (d) 20V

(25) A 5 μF capacitor has a potential difference across its plates is 200 volts. The charge on the capacitor is
(a) $2.5\text{x}10^{-8}$ C (b) 10^{-3} C
(c) 10^3 C (d) $4\text{x}10^3$ C

(26) Equal amount of charge is given to two sphere A and B of radii 2cm and 3cm respectively. The potential V_A and V_B
(a) $V_A = V_B$ (b) $V_A < V_B$
(c) $V_A > V_B$
(d) depend upon number of material of sphere

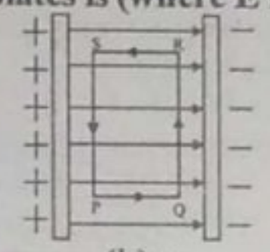
(27) Equivalent capacitance is greater than individual capacitances in
(a) series combination (b) parallel combination
(c) both series and parallel combinations (d) none of above

Scanned by CamScanner

(28) **If the distance between the plates of parallel plates condenser is increased, its potential will**
(a) remain same (b) increase
(c) decrease (d) decreases exponentially

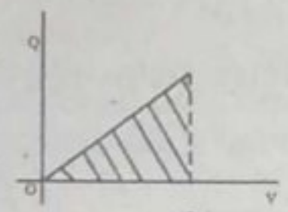
(29) **The number of electrons in one coulomb charge is equal to**
(a) 6.2×10^{18} (b) 1.6×10^{-19}
(c) 6.2×10^{21} (d) 1.6×10^{-27}

(30) **The amount of work done in joule in carrying a charge +q along the closed path PQRSP between the oppositely charged metal plates is (where E is electric field between the plates)**



(a) Zero (b) q
(c) $qE(PQ+QR+SR+SP)$ (d) $\frac{q}{\varepsilon_0}$

(31) **The graph shows the growth of charge with potential difference between plates. The area under the graph shows**



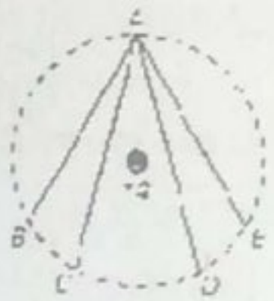
(a) capacitance (b) separation of plates
(c) energy stored (d) electric intensity

(32) **Value of ε_r for various dielectrics is always**
(a) less than unity (b) equal to unity
(c) larger than unity (d) no hard and fast rule

(33) **The leaves of a positively charged electroscope diverge more when an object is brought near the knob of the electroscope. The object must be:**
(a) an insulator (b) a conductor
(c) negatively charged (d) positively charged

(34) **Two thin infinite parallel plates have uniform charge densities + σ and -σ . The electric field in the space between them is**
(a) $\sigma/2\varepsilon_0$ (b) σ/ε_0
(c) σ (d) zero

(35) **In the electric field of a point charge q, a certain charge is carried from point A to B, C, D and E. Then the work done**

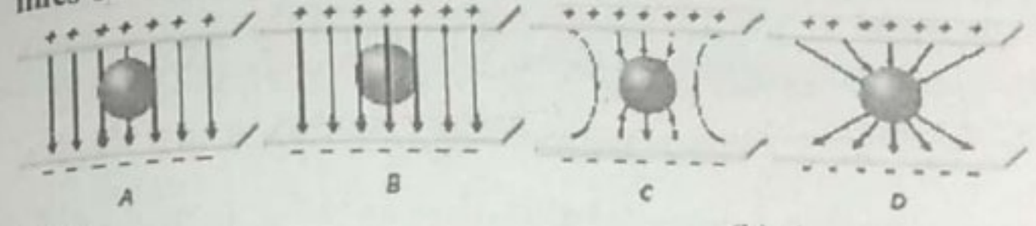


(a) is least along the path AB
(b) is zero along all the paths AB, AC, AD and AE
(c) is least along AE
(d) is least along the path AD

(36) **A hollow metal sphere of radius 6 cm is charged such as the potential on its surface is 40V. The potential at the centre of sphere is**
(a) Zero (b) 40 V
(c) 25 V (d) 50 V

(37) **A charge particle is free to move in an electric field. It will travel**
(a) along a line of force, if it has some initial velocity in the direction of an acute angle with the line of force
(b) always along a line of force
(c) along a line of force, if its initial velocity is zero
(d) none of these

(38) **An uncharged sphere of metal is placed in between two charged plates as shown. The lines of force look like**



(a) C (b) A
(c) D (d) B

(39) **The intensity of electric field required to balance a proton of mass 1.7×10^{-27}kg and charge1.6×10^{-19} C is nearly**
(a) 1×10^{-7} V/m (b) 1×10^{-5} V/m
(c) 1×10^{7} V/m (d) 1×10^{5} V/m

(40) **Two plates are 2cm apart, a potential difference of 10 volt is applied between them, the electric field between the plates is**
(a) 20 N/C (b) 500N/C
(c) 5N/C (d) 250 N/C

(41) **Two identical metal balls with charges +2Q and –Q are separated by some distance, and exert a force F on each other. They are joined by a conducting wire, which is then removed. The force between them will now be**
(a) F (b) F/2
(c) F/4 (d) F/8

(42) **A particle A has charge +q and a particle B has charge +4q with each of them having the same mass m. When allowed to fall from rest through the same electric potential difference, the ratio of their speed v_A/v_B will become**
(a) 1:2 (b) 1:4
(c) 2:1 (d) 4:1

(43) **What would happen to the electrostatic force between a pair of charged particles if both charges were doubled and the distance between them were also doubled?**
(a) It would decrease by a factor of 4 (b) It would decrease by a factor of 2
(c) It would remain unchanged (d) It would increase by a factor of 2.

(44) **A charge of 5C experiences a force of 5000N when it is kept in a uniform electric field. What is the potential difference between two points separated by a distance of 1cm**
(a) 250 V (b) 2500V
(c) 1000V (d) 10V

Scanned by CamScanner

(a) remain same (b) increase
(c) decrease (d) decreases exponentially

(29) The number of electrons in one coulomb charge is equal to
(a) 6.2×10^{18} (b) 1.6×10^{-19}
(c) 6.2×10^{19} (d) 1.6×10^{-17}

(30) The amount of work done in joule in carrying a charge $-q$ along the closed path PQRSP between the oppositely charged metal plates is (where E is electric field between the plates)



(a) Zero (b) q
(c) $qE(PQ - QR + SR - SP)$ (d) $\frac{q}{\epsilon_0}$

(31) The graph shows the growth of charge with potential difference between plates. The area under the graph shows

(a) capacitance (b) separation of plates
(c) energy stored (d) electric intensity

(32) Value of ϵ_r for variows dielectrics is always
(a) less than unity (b) equal to unity
(c) larger than unity (d) no hard and fast rule

(33) The leaves of a positively charged electroscope diverge more when an object is brought near the knob of the electroscope. The object must be:
(a) an insulator (b) a conductor
(c) negatively charged (d) positively charged

(34) Two thin infinite parallel plates have uniform charge densities $+\sigma$ and $-\sigma$. The electric field in the space between them is
(a) $\sigma/2\epsilon_0$ (b) σ/ϵ_0
(c) σ (d) zero

(35) In the electric field of a point charge q, a certain charge is carried from point A to B, C, D and E. Then the work done



(a) is least along the path AB
(b) is zero along all the paths AB, AC, AD and AE
(c) is least along AE
(d) is least along the path AD

(36) A hollow metal sphere of radius 10 cm is charged such as the potential on its surface is 40 V. The potential at the centre of sphere is
(a) Zero (b) 40 V
(c) 25 V (d) 50 V

(37) A charge particle is free to move in an electric field. It will travel
(a) along a line of force, if it has some initial velocity in the direction of an acute angle with the line of force
(b) always along a line of force
(c) along a line of force, if its initial velocity is zero
(d) none of these

(38) An uncharged sphere of metal is placed in between two charged plates as shown. The lines of force look like



(a) C (b) A
(c) D (d) B

(39) The intensity of electric field required to balance a proton of mass 1.7×10^{-27}kg and charge1.6×10^{-19} C is nearly
(a) 1×10^{-7} V/m (b) 1×10^{-5} V/m
(c) 1×10^{7} V/m (d) 1×10^{5} V/m

(40) Two plates are 2cm apart, a potential difference of 10 volt is applied between them, the electric field between the plates is
(a) 20 N/C (b) 500N/C
(c) 5N/C (d) 250 N/C

(41) Two identical metal balls with charges +2Q and –Q are separated by some distance, and exert a force F on each other. They are joined by a conducting wire, which is then removed. The force between them will now be
(a) F (b) F/2
(c) F/4 (d) F/8

(42) A particle A has charge +q and a particle B has charge +4q with each of them having the same mass m. When allowed to fall from rest through the same electric potential difference, the ratio of their speed v_A/v_B will become
(a) 1:2 (b) 1:4
(c) 2:1 (d) 4:1

(43) What would happen to the electrostatic force between a pair of charged particles if both charges were doubled and the distance between them were also doubled?
(a) It would decrease by a factor of 4 (b) It would decrease by a factor of 2
(c) It would remain unchanged (d) It would increase by a factor of 2.

(44) A charge of 5C experiences a force of 5000N when it is kept in a uniform electric field. What is the potential difference between two points separated by a distance of 1cm
(a) 250 V (b) 2500V
(c) 1000V (d) 10V

Scanned by CamScanner

(45) **Two charges 1 μC and 5 μC separated by 20 cm, the ratio of electric forces acting on them will be:**
(a) 1 : 2 (b) 1:1
(c) 1:5 (d) 5:1

(46) **In bringing an electron towards the second electron the electrostatic potential of the system**
(a) increases (b) remains the same
(c) decreases (d) becomes zero

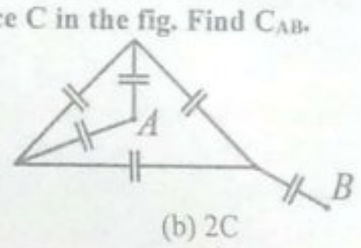
(47) **A capacitor is charged by using a battery which is then disconnected. A dielectric slab is then slipped between the plates, which results in**
(a) reduction of charge on the plates and increase of potential difference across the plates
(b) increase in the potential difference across the plate, reduction in stored energy, but no change in the charge on the plates
(c) decrease in the potential difference across the plates, reduction in the stored energy, but no change in the charge on the plates
(d) none of the above

(48) **An-α-particle is accelerated through a potential difference of 10^6 V. Its K.E will be**
(a) 1 MeV (b) 2MeV
(c) 4 MeV (d) 8MeV

(49) **Unit of energy density of electric field is:**
(a) JC^{-1} (b) Jm^{-3}
(c) JV^{-1} (d) JF^{-3}

(50) **Two charge +q and –q are situated at a certain distance. At the point exactly midway between them**
(a) electric field and potential both are zero
(b) electric field is zero but potential is not zero
(c) electric field is not zero but potential is zero
(d) electric field is not zero but potential is zero

(51) **Each capacitor has capacitance C in the fig. Find C_{AB}.**



(a) C (b) 2C
(c) $\frac{C}{2}$ (d) $\frac{3c}{2}$

(52) **Coulomb's law applicable for_____**
(a) any two charges (b) point charges
(c) both (d) none

(53) **Two charged sphere of radius 10 cm and 15 cm are connected by a thin wire. No current will flow, if they have**
(a) the same charge on each (b) the same potential on each
(c) the same energy (d) the same field on their surface

(54) **Three charges 2q,-q,-q are located at the vertices of an equilateral triangle. At the center of the triangle.**
(a) the field is zero but potential is non-zero (b) the field is non-zero but potential is zero
(c) both field and potential are zero (d) both field and potential are non-zero

(55) **An external agency carries '–5 C' of charge from infinity to a point in an electrostatic field and performs 100 joule of work. The potential at the given point is**
(a) 10 V (b) 20 V
(c) –10 V (d) –20 V

(56) **A tin nucleus has charge + 50e. If the proton is at a distance 10^{-12} m from the nucleus, then the potential V at this position is [charge on the proton = 1.6×10^{-19}C]**
(a) 14.4×10^4 volt (b) 7.2×10^8 volt
(c) 7.2×10^4 volt (d) 14.4×10^8 volt

(57) **A dielectric slab of dielectric constant K = 5 is covered from all sides with a metallic foil. This system is introduced into the space of a parallel plate capacitor of capacitance of 10 pF. The slab fills almost the entire space between the plates, but does not touch the plates. The capacitance will become nearly**
(a) infinity (b) 2 pF
(c) zero (d) 50 pF

(58) **A parallel plate condenser is immersed in an oil of dielectric constant 2. The field between the plates is**
(a) increased proportional to 2 (b) decreases proportional to $\frac{1}{2}$
(c) increased proportional to $\sqrt{2}$ (d) decreased proportional to $\frac{1}{\sqrt{2}}$

(59) **Four charges 2C, –3C, –4C and 5C respectively are placed at all the corners of a square. Which of the following statements is true for the point of intersection of the diagonals?**
(a) Electric field is zero but electric potential is non-zero
(b) **Electric field non-zero but electric potential is zero**
(c) Both electric field and electric potential are zero
(d) Neither electric field nor electric potential is zero

(60) **Two charges are placed at a certain distance. If the magnitude of each charge is doubled the force will become**
(a) $\frac{1}{4}$th of its original value (b) $\frac{1}{8}th$ of its original value
(c) 4 times of original value (d) 8 times of its original value

Scanned by CamScanner

(c) level (d) wate (2 Times)

(c) forever (d) quite

aid the British public send useless and

ANSWER KEY

1	d	11	b	21	c	31	c	41	d	51	c
2	d	12	b	22	b	32	c	42	a	52	b
3	a	13	c	23	b	33	d	43	c	53	b
4	b	14	a	24	c	34	b	44	d	54	b
5	a	15	d	25	b	35	b	45	b	55	d
6	b	16	d	26	c	36	b	46	a	56	c
7	b	17	a	27	b	37	c	47	c	57	a
8	b	18	d	28	b	38	a	48	b	58	b
9	b	19	a	29	a	39	a	49	b	59	b
10	b	20	b	30	a	40	b	50	c	60	c

EXPLANATORY NOTES

(1) The force will still remain same by the relation $F = \frac{kq_1q_2}{r^2}$

(2) $F_{med} = \frac{F_{vac}}{\varepsilon_r}$

$\varepsilon_r = \infty$ for metals

$F_{metal} = 0$

(3) The minimum charge on an object is equal to $\pm 1.6\times10^{-19}C$ because q = ne

(4) We put a unit positive charge at O. Resultant force due to the charge placed at A and C is zero and resultant force due to B and D is towards D along the diagonal BD

(5)

$$F_{air} = \frac{1}{4\pi\varepsilon_o}\frac{q_1q_2}{r^2}$$

$$F_{med} = \frac{1}{4\pi\varepsilon_o k}\frac{q_1q_2}{r^2}$$

$$\Rightarrow F_{med} = \frac{F_{air}}{k}$$

(6) $Q = CV = (50\times10^{-6})(100)$

$= 50\times10^{-4} = 5\times10^{-3}C$

(7) $E = F/Q$

(8)

$$F \propto Q_1Q_2 \; ; \; \frac{F_1}{F_2} = \frac{Q_1Q_2}{Q_1'Q_2'} = \frac{10\times-20}{-5\times-5} = -\frac{8}{1}$$

(9) As capacitor charge, ΔV across resistor decreases

(10) By using $K = \frac{F_a}{F_m} \Rightarrow K = \frac{10^{-4}}{2.5\times10^{-5}} = 4$

(11) By using $F = 9\times10^9 . \frac{Q^2}{r^2}$; $F = 9\times10^9 . \frac{(2\times10^{-6})^2}{(0.5)^2} = 0.144N$

(12) For maximum flux surface making angle 90° with electric field for vector area making angle 0° with electric field

(13) $Q = C_{eq}V = \frac{C_1C_2}{C_1+C_2}V$

$Q = \frac{2}{3}\times10^{-6}\times300 = 200\mu C$

(14)

(15) In second case, charges will be $-2\mu C$ and $+3\mu C$ Since $F \propto Q_1Q_2$ i.e

$$\frac{F}{F'} = \frac{Q_1Q_2}{Q'_1Q'_2} \; ; \; \frac{40}{F'} = \frac{3\times8}{-2\times3} = -4 \; ; F' = 10\,N \text{(Attractive)}$$

(16) $W = \frac{Q^2}{2C}$

$W \propto Q^2$

(17) Since potential inside the hollow sphere is same as that on the surface.

(18) $V = \frac{kq}{r} \Rightarrow V \propto \frac{1}{r}$

(19) $V = \frac{W}{q} = \frac{W}{e}$

$Ve = F_e d \Rightarrow F_e = \frac{eV}{d}$

(20) $\frac{E}{V} = \frac{1}{2}\times\varepsilon_o\varepsilon_r E^2$

Here $\varepsilon_r = k$

$= \frac{1}{2}k\varepsilon_o E^2$

(21) In non-uniform electric field. Intensity is more, where the lines are more denser,

(22) For negative charge electric field lines directed radially inward.

Scanned by CamScanner

(23) $U=\frac{1}{2}CV^2$

$U=\frac{1}{2}CV.V$

$U=\frac{1}{2}QV \qquad \because V=\frac{Q}{C}$

$U=\frac{Q^2}{2C}$

(24) $\Delta V=d.E \Rightarrow d\frac{F}{q}$

$=\frac{10^{-2}\times 2000}{2}=10V$

(25) $Q=CV \Rightarrow 5\times10^{-6}\times200=10^{-3}C$

(26) $V=\frac{kq}{r}\Rightarrow V\propto\frac{1}{r}$

(27) For parallel $C_{eq}=C_1+C_2+C_3+.....C_n$

(28)

$V = Ed$

$E =$ constant

Hence,

$V \propto d$

(29) $Q=ne$

$ne=1\Rightarrow n=\frac{1}{e}=\frac{1}{1.6\times10^{-19}}=6.25\times10^{18}$

(30) Electric field is conservative field so work done in closed path is zero

(31) $E=\frac{1}{2}QV \Rightarrow$ *Area of* Q & V *= energy*

(32) $\varepsilon_r > 1$ always

(33) When positive charge brought near to gold leaf electroscope then separation between leaves increases.

(34) For capacitor $E=\frac{\sigma}{\varepsilon_0}$

(35) ABCDE is an equipotential surface, on equipotential surface no work is done in shifting a charge from one place to another

(36) $E=\frac{\Delta V}{d}$

Here surface are equipotential so $\Delta V = 0$ so

$V_{out} = V_{inside} = 10V$

(37) Because E points along the tangent to the lines of force. If initial velocity is zero, then due to the force, it always moves in the direction of E. Hence will always move on some lines of force.

(38) Electric lines of force never intersect the conductor. They are perpendicular and slightly curved near the surface of conductor.

(39)

Since qE = mg or $E=\frac{mg}{q}=\frac{1.7\times10^{-27}\times9.8}{1.6\times10^{-19}}=10.0\times10^{-8}=1\times10^{7}V/m$

(40)

$$E=\frac{V}{d}=\frac{10}{2\times10^{-2}}=500\,N/C$$

(41) When the two balls are connected by a conducting wire, the net charge is (2Q – Q) i.e Q. Since, the balls are identical therefore charge Q gets shared equally between the two balls.

Now, $F\propto 2Q^2$ -----(i)

$F'\propto\left(\frac{Q}{2}\right)^2$ ----(ii)

Dividing (ii) by (i), we get

$\frac{F'}{F}=\frac{Q^2}{4}\times\frac{1}{2Q^2}=\frac{1}{8}$

$F'=\frac{F}{8}$

(42)

Using $v=\sqrt{\frac{2QV}{m}}$; $v\propto\sqrt{Q}$; $\frac{v_A}{v_B}=\sqrt{\frac{Q_A}{Q_B}}=\sqrt{\frac{q}{4q}}=\frac{1}{2}$

(43) Applying Coulomb's law, we see that the electric force will not change.

$F'=k\frac{Q'q'}{r'^2}=k\frac{(2Q)(2q)}{(2r)^2}=k\frac{4Qq}{4r^2}=k\frac{Qq}{r^2}=F$

(44)

$$F=QE=\frac{QV}{d}\ ;\ 5000=\frac{5\times V}{10^{-2}}\ ;V=10\,volt$$

(45) $\left|\vec{F}_{12}\right|=\left|\vec{F}_{21}\right|\Rightarrow\frac{\left|\vec{F}_{12}\right|}{\left|\vec{F}_{21}\right|}=\frac{1}{1}$

(46) $\uparrow V\propto\Delta P.E\uparrow$

(47)

Battery in disconnected so Q will be constant as $C\propto K$. So with introduction of dielectric slab capacitance will increase using Q = CV, V will decrease and using $U=\frac{Q^2}{2C}$, energy will decrease.

Scanned by CamScanner

(48) $K.E = q\Delta V$

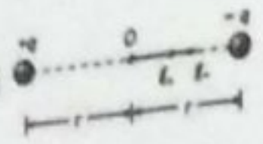
where $q_\alpha = 2e$

$K.E = (2e)(10^6\,V) = 2\times10^6\,eV$

$= 2MeV$

(49) Energy density $= \dfrac{\text{energy}}{\text{volume}}$

(50)



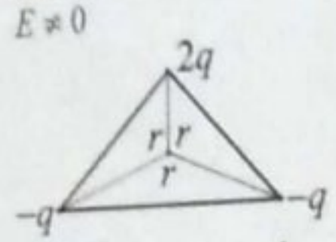
At O, $E \neq 0$, $V = 0$

(51) It is a balanced Wheatstone bridge. Hence $C_{eq} = \dfrac{C}{2}$

(52) Coulombs law is for point charges.

(53) Charge flow due to potential difference.

(54) $E \neq 0$



$V_{2q} = \dfrac{2kq}{r}, V_{-q} = \dfrac{-qk}{r}$

$V = V_{2q} + V_{-q} + V_{-q}$

$V = 0$

(55) $V = \dfrac{W}{q} = \dfrac{100}{-5}\,volt = -20\,volt$

(56) $V = \dfrac{kq}{r} = \dfrac{9\times10^9\times50\times1.6\times10^{-19}}{10^{-12}} = 7.2\times10^4 V$

(57) Metal shield is like $K = \infty$

$C_{med} = KC_{vac} = (\infty)\times C_{vac} = \infty$

(58) $E_{med} = \dfrac{E_{air}}{K} = \dfrac{E}{2}$

(59) $V = \dfrac{Kq_1}{r_1} + \dfrac{Kq_2}{r_2} + \dfrac{Kq_3}{r_3} + \dfrac{Kq_4}{r_4} = K\left(\dfrac{q_1}{r} + \dfrac{q_2}{r} + \dfrac{q_3}{r} + \dfrac{q_4}{r}\right)$

(60) $V = 9\times10^9\left(\dfrac{2}{r} - \dfrac{3}{r} - \dfrac{4}{r} + \dfrac{5}{r}\right) = 0$

$F = \dfrac{Kq_1q_2}{r^2}$

13 chapter CURRENT ELECTRICITY

PRACTICE EXERCISE

(1) For an ohmic conductor, doubling the voltage without changing the resistance will cause the current to

(a) Decrease by a factor of 4 (b) Decrease by a factor of 2

(c) Remain unchanged (d) Increase by a factor of 2

(2) Resistance of a conductor depends upon _____

(a) Charge (b) Current

(c) Power (d) Temperature

(3) A battery whose emf is 40 V has an internal resistance of 5 Ω. If this battery is connected to a 15 Ω resistor R, what will be the voltage drop across R?

(a) 10V (b) 30V

(c) 15V (d) 40V

(4) A wire of uniform area of cross-section 'A' length 'L' and resistance R is cut into two parts. Resistivity of each part _____

(a) Remains the same (b) Is doubled

(c) Is halved (d) Becomes zero

(5) Two resistors, A and B, are in series in a circuit that carries a nonzero current. If the resistance of Resistor A is 4 times greater than the resistance of Resistor B, which of the following correctly compares the currents through these resistors (I_A and I_B, respectively) and the voltage drops across them (V_A and V_B, respectively)?

(a) $I_A = I_B$ and $V_A = V_B$ (b) $I_A = I_B$ and $V_A = 4V_B$

(c) $I_A = I_B$ and $V_B = 4V_A$ (d) $I_A = 4I_B$ and $V_A = 4V_B$

(6) 10^{14} electrons are removed from a neutral metal sphere the charge on it is

(a) 16μC (b) -16μC

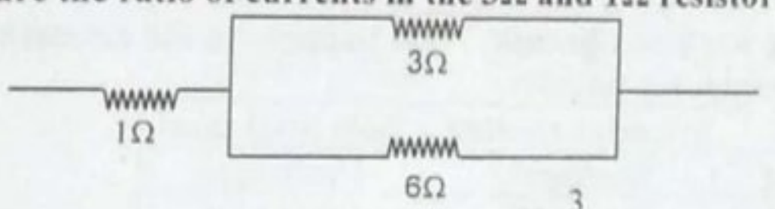
(c) 32μC (d) -32μC

(7) When a current of 1A flows for 5 sec through the lamp. How much charge flows through the lamp?

(a) 10C (b) 5C

(c) 1C (d) Insufficient data

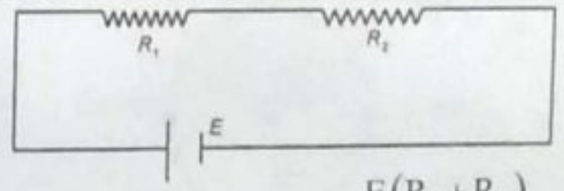
(8) In the figure the ratio of currents in the 3Ω and 1Ω resistor is



(a) $\dfrac{1}{3}$ (b) $\dfrac{3}{2}$

(c) $\dfrac{2}{3}$ (d) $\dfrac{1}{4}$

(9) A battery of emf E is connected across two resistors R_1 and R_2 as shown. What is the P.D across R_1



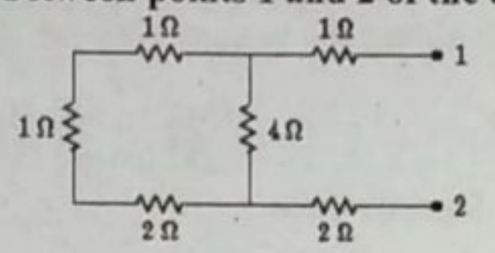
(a) $\dfrac{ER_2}{R_1+R_2}$ (b) $\dfrac{E(R_1+R_2)}{R_1}$

(c) $\dfrac{ER_1}{R_1+R_2}$ (d) None of these

Scanned by CamScanner

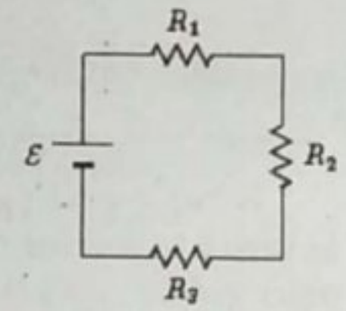
(10) An ordinary light bulb is marked "60W, 120V". Its resistance is:
(a) 240Ω (b) 180Ω
(c) 200Ω (d) 60Ω

(11) The equivalent resistance between points 1 and 2 of the circuit shown is:



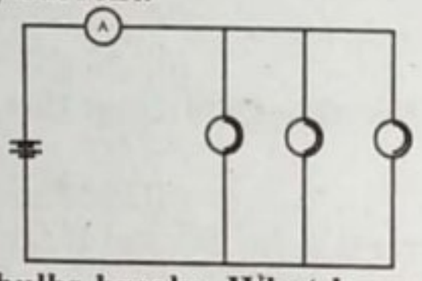
(a) 5Ω (b) 10Ω
(c) 6Ω (d) 3Ω

(12) In the diagram $R_1 > R_2 > R_3$. Rank the three resistors according to the current in them, least to greatest



(a) 3, 1, 3 (b) 1, 2, 3
(c) All are the same (d) 3, 2, 1

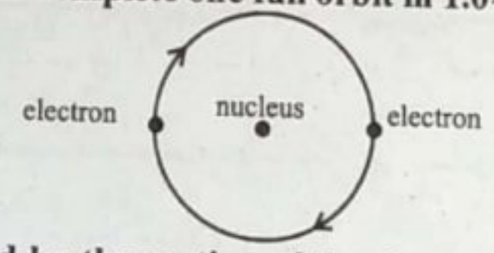
(13) Three similar light bulbs are connected to a constant – voltage d.c. supply as shown in the diagram. Each bulb operates at normal brightness and the ammeter (of negligible resistance) registers a steady current.



The filament of one of the bulbs breaks. What happens to the ammeter reading and to the brightness of the remaining bulbs?

	Ammeter reading	Bulb brightness
(a)	Decreases	Unchanged
(b)	Increases	Unchanged
(c)	Unchanged	Unchanged
(d)	Increases	Unchanged

(14) The diagram shows a model of an atom in which two electrons move round a nucleus in a circular orbit. The electrons complete one full orbit in 1.0×10^{-15} s.



What is the current caused by the motion of the electrons in orbit?
(a) 1.6×10^{-34}A (b) 3.2×10^{-34}A
(c) 1.6×10^{-4}A (d) 3.2×10^{-4}A

(15) Reciprocal of resistivity is called _____
(a) Resistance (b) Inductance
(c) Conductivity (d) Flexibility

(16) When 2Ω, 4Ω and 6Ω resistor are connected in parallel, their resultant equivalent resistance will be_____
(a) 12Ω (b) 11/12Ω
(c) 12/11Ω (d) data is insufficient

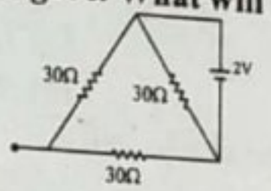
(17) The terminal potential difference is greater than emf of a cell when
(a) $R = \infty$ (b) Battery is supplying current
(c) $r = 0$ (d) When battery is being charged

(18) Drift velocity of electrons in a conductor bearing potential difference V across its terminals is v. if the length of wire is stretched to three times and same potential difference V is applied, then the drift velocity will become/remain.
(a) v (b) v/3
(c) 3v (d) $v/\sqrt{3}$

(19) There are three bulbs of 60W, 100W and 200W which bulb has thickest filament.
(a) 100W (b) 200W
(c) 60W (d) All

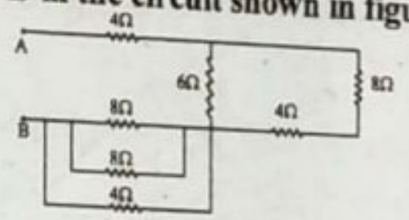
(20) What can be used as the unit of energy
(a) Watt x second (b) Volt x meter
(c) Volt per coulomb (d) Newton per meter

(21) The current in the circuit shown in figure. What will be the current in the circuit?



(a) 1/45A (b) 1/10A
(c) 1/5A (d) 5A

(22) Resistance between points A and B in the circuit shown in figure is



(a) 4Ω (b) 6Ω
(c) 10Ω (d) 8Ω

(23) Two wires made of the same material and of the same length are connected in parallel to the same voltage supply. Wire P has a diameter of 2 mm. Wire Q has a diameter of 1 mm.
What is the ratio $\frac{\text{current in P}}{\text{current in Q}}$?
(a) $\frac{1}{4}$ (b) 4
(c) 2 (d) $\frac{1}{2}$

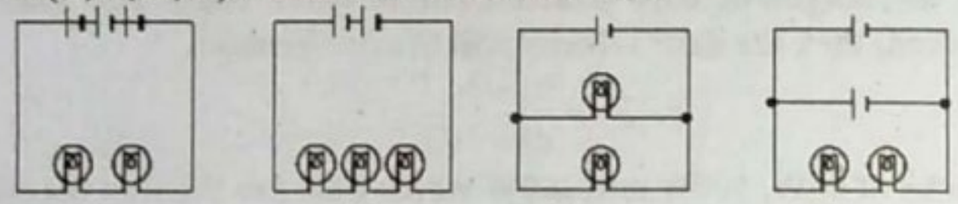
(24) Resistance of a wire on increasing its temperature will
(a) Increase with rise in temperature (b) Decrease with rise in temperature
(c) Will remain same (d) Depends upon altitude of experimentation

Scanned by CamScanner

(25) **Specific resistance of a wire**
(a) Will depend on its length
(b) Will depend on its radius
(c) Will depend on the type of material of the wire
(d) Will depend on none of the above

(26) **An electric iron is marked 20 volts 500W. The units consumed by it in using it for 24 hours will be** _____
(a) 12 (b) 24
(c) 5 (d) 1100

(27) **In the diagrams, all light bulbs are identical and all emf devices are identical. In which circuit (A, B, C, D) will the bulbs be dimmest?**



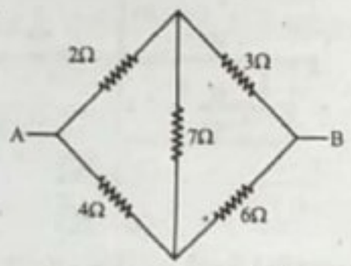
(a) (b) (c) (d)

(28) **In liquids and gases, the current is due to the motion** _____
(a) Negative charges (b) Positive charges
(c) Both negative and positive charges (d) Neutral particles

(29) **A 100W, 200V bulb is connected to a 160V supply. The actual power consumption would be**
(a) 64W (b) 72W
(c) 100W (d) 90W

(30) **The terminal potential difference of a cell is**
(a) E – Ir (b) EI + r
(c) EI/r (d) EIr

(31) **Five resistances are connected as shown in figure. The effective resistance between point A and B is**

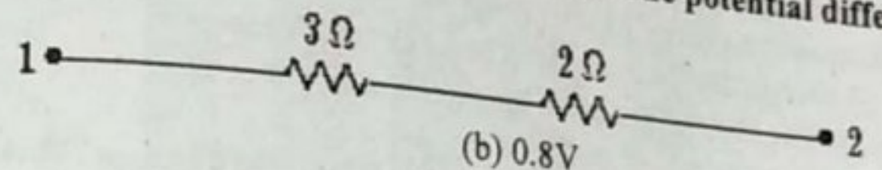


(a) $\frac{10}{3}\Omega$ (b) $\frac{20}{3}\Omega$
(c) 15 Ω (d) 6Ω

(32) **The lower part of a cloud has positive. The cloud discharges in flash of lightning, in which direction do electrons and conventional current flow**

	Electron flow	Conventional current
(a)	Downwards	Downwards
(b)	Upwards	Downwards
(c)	Downwards	Upwards
(d)	Upwards	Upwards

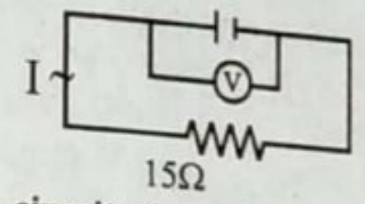
(33) **In the diagram, the current in the 3-Ω resistor is 4A. The potential difference between points 1 and 2 is**



(a) 20V (b) 0.8V
(c) 12V (d) 1.25V

(34) **A 220 V, 100 W bulb is connected to a 110 V source. The power consumed is:**
(a) 25 W (b) 50 W
(c) 100 W (d) 200W

(35)



The emf of the cell in the circuit above is 9V. The reading on the high resistance voltmeter is 7.5V what is the current I?
(a) 0.1A (b) 0.6A
(c) 2A (d) 0.5A

(36) **What would be the equivalent resistance of a circuit having three resistance of 9Ω each, connected in parallel**
(a) 6Ω (b) 27Ω
(c) 3Ω (d) 1Ω

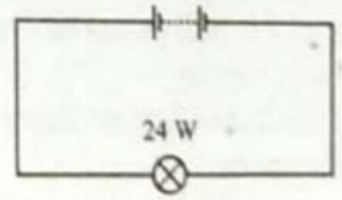
(37) **The equivalent resistance of two wires in parallel is 6/5. if the resistance of one of the wire is 2 ohm that of the other is**
(a) 2 ohm (b) 3 ohm
(c) $\frac{5}{3}$ohm (d) $\frac{3}{5}$ohm

(38) **A 20 ohm resistance takes 5 minutes to boil a given amount of water. How much resistance will be required to boil the same amount of water using the same source in 1 minute?**
(a) 2 ohm (b) 5 ohm
(c) 4 ohm (d) 3 ohm

(39) **A fuse is placed in series with the circuit to protect against** _____
(a) High power (b) High voltage
(c) High current (d) Over heating

(40) **If 1 ampere current flows through 2m long conductor, the charge flow through it in 1 hour will be**_____
(a) 3600C (b) 7200C
(c) 1C (d) 2C

(41) **A battery is used to light a 24 W electric lamp. The battery provides a charge of 120 C in 60 s.**



What is the potential difference across the bulb?
(a) 5 V (b) 12 V
(c) 24 V (d) 120 V

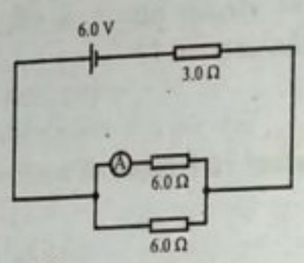
Scanned by CamScanner

(42) **Current is a measure of**
(a) Force that moves a charge past a point
(b) Amount of charge that moves past a point per unit time
(c) Resistance to the movement of a charge past a point
(d) Energy used to move a charge past a point

(43) **When same current passes for same time through a thick and thin wire**
(a) More heat is produced in thick wire
(b) More heat is produced in thin wire
(c) No heat is produced in wire
(d] Equal heat is produced in thick and thin wire

(44) **Thermocouples convert**
(a) Heat energy into electrical energy (b) Heat energy into light energy
(c) Heat energy into mechanical energy (d) Mechanical energy into heat energy

(45) **The following circuit is set up.**

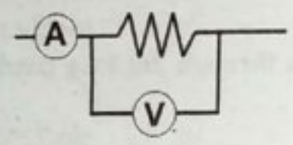


What is the reading on the ammeter?
(a) 0.33 A (b) 0.50 A
(c) 0.67 A (d) 1.0 A

(46) **Three resistance 3Ω, 6Ω and 6Ω are connected in parallel with each other, their effective resistance will be:**
(a) less than 3 Ω (b) equal to 3 Ω
(c) greater than 3 Ω but less than 6 Ω (d) greater than 6 Ω

(47) **What is the smallest total resistance which can be obtained using a 6 ohm and a 12 ohm resistor:**
(a) 2Ω (b) 6Ω
(c) 4Ω (d) 8Ω

(48) **The diagram represents a part of a circuit containing an Ohmic resistor, a voltmeter and an ammeter. If the reading on the ammeter A increases the reading on voltmeter V:**



(a) increases in the same ratio (b) decreases in the same ratio
(c) increases, but not in the same ratio (d) remains unchanged

(49) **When resistances are connected in parallel, the effective resistance will be:**
(a) Product of the reciprocals of the individual resistances
(b) Product of the individual resistances
(c) Sum of the reciprocals of the individual resistances
(d) Sum of the individual resistances

(50) **The unit of ε,**
(a) $Nm^{-1}A^{-1}$ (b) $N^{-1}m^{1}C^{2}$
(c) $Nm^{2}C^{2}$ (d) No unit

ANSWER KEY

1	d	11	a	21	b	31	a	41	b
2	d	12	c	22	c	32	b	42	b
3	b	13	a	23	b	33	a	43	b
4	a	14	d	24	a	34	a	44	a
5	b	15	c	25	c	35	d	45	b
6	a	16	c	26	a	36	c	46	a
7	b	17	d	27	d	37	b	47	c
8	c	18	b	28	c	38	c	48	a
9	c	19	b	29	a	39	d	49	c
10	a	20	a	30	a	40	a	50	d

EXPLANATORY NOTES

(1) By Ohms law

As $I \propto V$

If $V' = 2V$

Then $I' = 2I$

(2) For conductor, $R \propto$ Temp

(3) $$I = \frac{E}{R_{eq}} = \frac{40}{20} = 2A$$

$$V_t = E - Ir$$

$$V_t = 40 - (2)5 = 30V$$

(4) Resistivity does not depend upon dimensions (i.e. length, area etc.) It only depends upon nature of material and temperature.

(5) Series combination of resistors → Current same

$$V = IR \rightarrow V \propto R$$

$$\frac{V_A}{V_B} = \frac{R_A}{R_B}$$

$$\frac{V_A}{V_B} = \frac{4R_B}{R_B} \Rightarrow V_A = 4V_B$$

(6) $$Q = ne = 10^{14} \times 1.6 \times 10^{-19}$$

$$= 1.6 \times 10^{-5}$$

$$Q = 16\mu C$$

Scanned by CamScanner

(7) $I=\frac{Q}{t}$

$Q=I\times t=1\times 5=5C$

(8) $I_1=I_3+I_6$

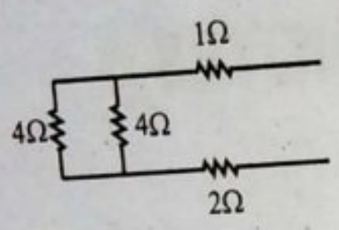
$I=I_1=I_3+0.5I_3\Rightarrow I_1=1.5I_3$

$\frac{I_3}{I_1}=\frac{1\times 2}{1.5\times 2}=\frac{2}{3}$

(9) Potential divider rule.

(10) $P=\frac{V^2}{R}\Rightarrow R=\frac{V^2}{P}=\frac{120\times 120}{60}=240\Omega$

(11)



$R_e=5\Omega$

(12) Series combination of resistor → Current same

(13) When filament breaks $R_e\uparrow$, $I\downarrow$ Brightness = Unchanged

(14) $I=\frac{\Delta Q}{\Delta t}=\frac{2\times 1.6\times 10^{-19}}{1.0\times 10^{-15}}=3.2\times 10^{-4}A$

(15)

(16) $\frac{1}{R_e}=\frac{1}{2}+\frac{1}{4}+\frac{1}{6}$

$=\frac{6+3+2}{12}=\frac{11}{12}$

$R_e=\frac{12}{11}\Omega$

(17) In case of charging: $V_t>E$

In case of discharging: $V_t<E$

(18) $i=neAv_d$

When wire is stretched to three times, resistance becomes 9 times and area becomes one

$\therefore \quad \frac{V}{r}=neAv_d$

$v_d=\frac{V}{RneA}\propto\frac{1}{AR}$

$\frac{v_d'}{v_d}=\frac{AR}{A'R'}=\frac{AR}{\left(\frac{A}{3}\right)(9)R}=\frac{1}{3}$

(19) For parallel combination

$P=\frac{V^2}{R}\Rightarrow P\propto\frac{1}{R}$ (V = constant)

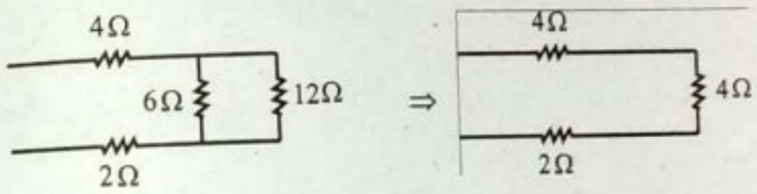
(20) $P=\frac{w}{t}$

$w=P\times t=\text{watt}\times\text{sec}$

(21) $R_e=\frac{60\times 30}{60+30}=20\Omega$

$I=\frac{V}{R_e}=\frac{2}{R_e}=\frac{2}{20}=\frac{1}{10}A$

(22)



$R_e=10\Omega$

(23) $R=\frac{\rho L}{A}=\frac{\rho L}{\pi\left(\frac{D}{2}\right)^2}\Rightarrow R\propto\frac{1}{D^2}\Rightarrow\frac{R_p}{R_q}=\frac{D_q^2}{D_p^2}$

$V=IR\Rightarrow\frac{I_p}{I_q}=\frac{R_q}{R_p}=\frac{D_p^2}{D_q^2}=\frac{(2)^2}{(1)^2}=4$

(24) R increases with increase in temperature

(25) Resistivity depends upon temperature and nature of material.

(26) Number of units $=\frac{P(W)\times t(h)}{1000}$

$=\frac{500\times 24}{1000}=12$

(27) The net current in the circuit (d) is zero because same terminals of both batteries are connected

(28) Liquid and Gases contains both +ve and –ve ions

(29) $\frac{P_1}{P_2}=\frac{V_1^2}{V_2^2}=\frac{100}{P_2}=\frac{200\times 200}{160\times 160}=P_2=64W$

(30) Simple formula $V_t=E-Ir$

(31) Wheat stone bridge $\frac{1}{R_e}=\frac{1}{5}+\frac{1}{10}\Rightarrow R_e=\frac{10}{3}\Omega$

Scanned by CamScanner

(32) Conventional and electronic current flow opposite to each other.

(33) $V = V_1 + V_2$

$= (3)(4) + 4(2) \Rightarrow V = 20V$

(34) $P \propto V^2$

(35) $I = \frac{7.5}{15} = \frac{75}{10 \times 15} = \frac{1}{2} = 0.5\,A$

(36) $R_{eq} = \frac{R}{n} = \frac{9}{3} = 3\Omega$

(37) $\frac{1}{R_e} = \frac{1}{R_1} + \frac{1}{R_2}$

$\frac{5}{6} = \frac{1}{2} + \frac{1}{R_2}$

$\frac{1}{3} = \frac{1}{R_2}$

$3\Omega = R_2$

(38) $Heat = Q = I^2Rt = \frac{V^2}{R}t$

$\Rightarrow \frac{V^2}{R_1}t_1 = \frac{V^2}{R_2}t_2$

$R_2 = \frac{t_2}{t_1}R_1$

$R_2 = \frac{1}{5} \times 20$

$R_2 = 4\Omega$

(39)

(40) $I = \frac{\Delta Q}{\Delta t}$

$\Delta Q = I \times t$

$= 1 \times 3600$

$= 3600C$

(41) $I = \frac{120}{60} = 2A$

$P = IV \rightarrow V = \frac{P}{I} = \frac{24}{2} = 12V$

(42) $I = \Delta Q / \Delta t$

Rate of flow of charges with respect to time.

(43) $R = \rho\frac{L}{A} \Rightarrow R \propto \frac{1}{A}$ (thin wire has more resistance)

$H = I^2Rt \qquad \therefore H \propto R$

(44) Thermocouple converts heat energy into electrical energy

(45) $I = (circuit) = \frac{V}{Req} = \frac{6}{6} = 1A$

$Ameter\ current = \left(\frac{6}{6+6}\right) \times 1$

$= \frac{1}{2}A = 0.5\,A$

(46) $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

$\frac{1}{R_{eq}} = \frac{1}{3} + \frac{1}{6} + \frac{1}{6}$

$\frac{1}{R_{eq}} = \frac{2}{3}$

$R_{eq} = 1.5\Omega \Rightarrow R_{eq} < 3\Omega$

(47) $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$

$\frac{1}{R_{eq}} = \frac{1}{6} + \frac{1}{12}$

$R_{eq} = 4\Omega$

(48) For parallel combination

$V = IR$

$\uparrow V \propto I \uparrow$

(49) Definition of effective resistance in parallel combination.

(50) $\epsilon_r = \frac{\epsilon}{\epsilon_o}$ unit less

Scanned by CamScanner

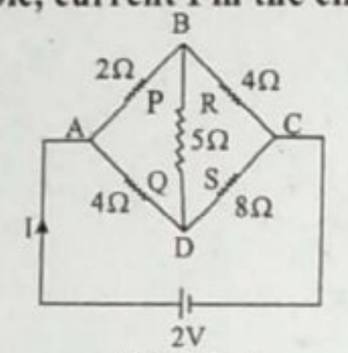
13 Chapter CURRENT ELECTRICITY

SELF ASSESMENT TEST

(1) A 40 W lamp turns half the electrical energy to give light. How much light energy does it give out in 10 s?

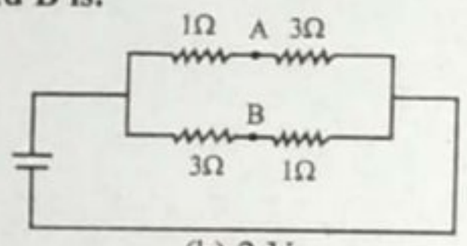
(a) 200 J (b) 400 J
(c) 800 J (d) 40 J

(2) Figure shows a network of resistances connected to a 2V battery. If the internal resistance of the battery is negligible, current I in the circuit is.



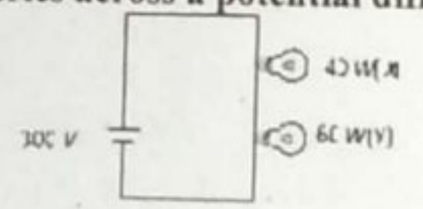
(a) 0.25 A (b) 0.5 A
(c) 0.75 A (d) 1.0 A

(3) A battery of emf 10 V is connected to resistances as shown in Fig. below. The potential difference between points A and B is.



(a) -2 V (b) 2 V
(c) 5 V (d) $\frac{20}{11}V$

(4) Two bulbs X and Y having same voltage rating and of power 40 watt and 60 watt respectively are connected in series across a potential difference of 300 volt, then



(a) X will glow brighter
(b) resistance of Y is greater than X
(c) heat produced in Y will be greater than X
(d) voltage drop in X will be greater than Y

(5) If R_1 and R_2 are respectively the filament resistances of a 200 watt bulb and 100 watt bulb designed to operate on the same voltage, then

(a) R_1 is two times R_2 (b) R_2 is two times R_1
(c) R_2 is four times R_1 (d) R_1 is four times R_2

(6) Two electric bulbs, one of 200 volt 40 watt and the other 200 volt 100 watt are connected in a house wiring circuit

(a) they have equal currents through them
(b) the resistance of the filament in 40 watt bulb is more than the resistance in 100 watt bulb
(c) the resistance of the filaments in both the bulbs is same
(d) the resistance of the filament in 100 watt bulb is more than the resistance in 40 watt bulb

(7) When a current of 1A flows for 5 sec through the lamp. How much charge flows through the lamp?

(a) 10C (b) 5C
(c) 1C (d) insufficient data

(8) An electron of mass m is accelerated from rest through a potential difference V volts. The speed of electron will be

(a) $\sqrt{\frac{eV}{2m}}$ (b) $\frac{eV}{m}$
(c) $\sqrt{\frac{2eV}{m}}$ (d) $\sqrt{\frac{eV}{m}}$

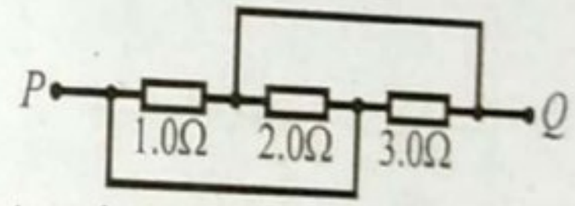
(9) A heater coil is cut into two parts of equal length and one of them is used in the heater. The ratio of the heat produced by this half coil to that by the original coil is

(a) 2 : 1 (b) 1:4
(c) 1:2 (d) 4:1

(10) An ordinary light bulb is marked "60W, 120V". Its resistance is:

(a) 240Ω (b) 180Ω
(c) 200Ω (d) 60Ω

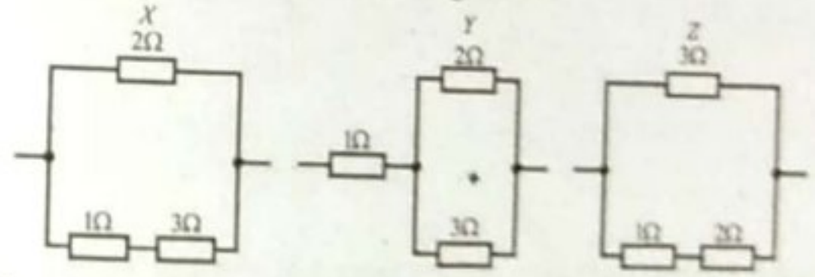
(11) Three resistors are connected as shown in the diagram using connecting wires of negligible resistance.



What is the approximate resistance between point P and Q?

(a) 0.5Ω (b) 2.0Ω
(c) 0.8Ω (d) 2.2Ω

(12) Three resistors of resistance 1Ω, 2Ω and 3Ω respectively are used to make the combinations X, Y and Z shown in the diagrams.

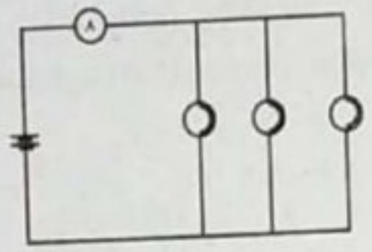


Which of the following gives the combinations in order of increasing resistance?

(a) XYZ (b) YXZ
(c) XZY (d) ZXY

Scanned by CamScanner

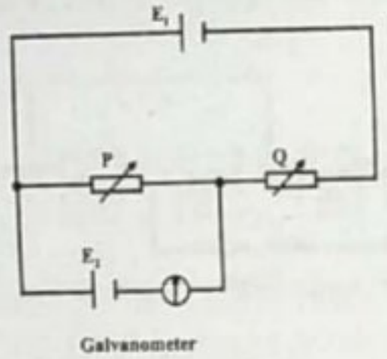
(13) Three similar light bulbs are connected to a constant – voltage d.c. supply as shown in the diagram. Each bulb operates at normal brightness and the ammeter (of negligible resistance) registers a steady current.



The filament of one of the bulbs breaks. What happens to the ammeter reading and to the brightness of the remaining bulbs?

	Ammeter reading	Bulb brightness
(a)	decreases	unchanged
(b)	increases	unchanged
(c)	unchanged	unchanged
(d)	unchanged	increases

(14) Two cells of e.m.f E_1 and E_2 and of negligible internal resistance are connected with two variable resistors as shown in the diagram.



When the galvanometer deflection is zero, the values of both resistances are P and Q. what is the value of the ratio $\frac{E_2}{E_1}$?

(a) $\frac{P}{Q}$ (b) $\frac{Q}{(P+Q)}$

(c) $\frac{P}{(P+Q)}$ (d) $\frac{(P+Q)}{P}$

(15) A wire of uniform area of cross section is cut into two parts of equal lengths. The resistivity of any part
(a) Remain same (b) Is doubled
(c) Is halved (d) one fourth

(16) The resistance of a coil is 4.2 ohm at 100° C and the temperature coefficient of resistance of its material is 0.004/° C. Its resistance at 0o C
(a) 6.5 ohm (b) 5 ohm
(c) 3 ohm (d) 4 ohm

(17) Circuit which gives continuously varying potential is called _____
(a) complex network (b) wheat stone bridge
(c) potential divider (d) all of above

(18) Internal resistance is the resistance offered by _____
(a) source of e.m.f (b) conductor
(c) resistor (d) capacitor

(19) An electric current source is actually source of
(a) Current (b) Charge
(c) Energy (d) Power

(20) What can be used as the unit of energy
(a) watt x second (b) volt x meter
(c) volt per coulomb (d) newton per meter

(21) Combined resistance of two identical resistors in series is 16Ω. If they are connected in parallel, then equivalent resistance is
(a) 2Ω (b) 4Ω
(c) 6Ω (d) 8Ω

(22) The fuse rating for a fuse used in the plug of electric heater should be _____ heater current
(a) Much less than (b) Just less than
(c) Just greater than (d) Exactly equal

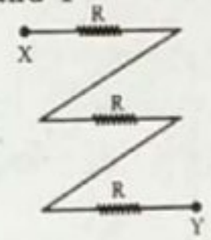
(23) The charge of an electron is 1.6×10^{-19} C. How many electrons strike the screen of a cathode ray tube each second when the beam current is 16 mA
(a) 10^{19} (b) 10^{17}
(c) 10^{-19} (d) 10^{-17}

(24) A nichrome wire 50 cm long and one square millimetre cross-section carries a current of 4A when connected to a 2V battery. The resistivity of nichrome wire in ohm metre is
(a) 1×10^{-6} (b) 4×10^{-7}
(c) 3×10^{-7} (d) 2×10^{-7}

(25) Calculate the amount of charge flowing in 2 minutes in a wire of resistance 10 Ohm when a potential difference of 20 V is applied between its ends
(a) 4 C (b) 20 C
(c) 240 C (d) 120 C

(26) An electric iron is marked 20 volts 500W. The units consumed by it in using it for 24 hours will be
(a) 12 (b) 24
(c) 5 (d) 1100

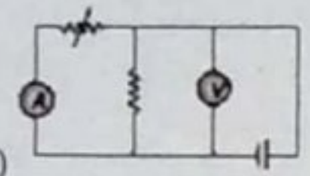
(27) Three resistances each having value 'R' are connected as shown in figure what is the equivalent resistance between X and Y

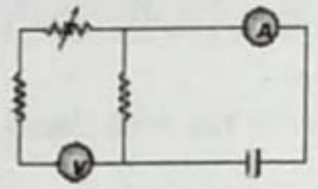


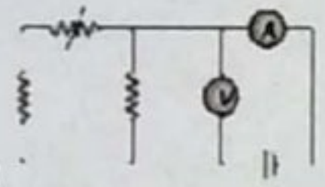
(a) R (b) $\frac{R}{3}$
(c) 3R (d) R^3

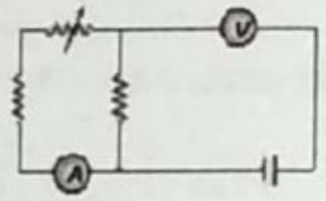
Scanned by CamScanner

(28) Express which of the following setups can be used to verify Ohm's law

(a) 

(b) 

(c) 

(d) 

(29) The electric resistance of a certain wire of iron is R. If its length and radius are both doubled, then

(a) the resistance will be halved and the specific resistance will remain unchanged
(b) the resistance will be doubled and the specific resistance will be halved
(c) the resistance will be halved and the specific resistance will be doubled
(d) the resistance and the specific resistance, will both remain unchanged

(30) The graphical representation of Ohm's law is _____

(a) hyperbola (b) ellipse
(c) parabola (d) straight line

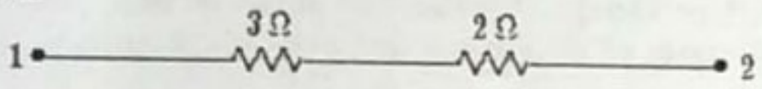
(31) SI unit of resistivity is_____

(a) Ω-m^2 (b) $(\Omega\text{-m})^{-1}$
(c) Ω-m (d) $(\Omega\text{-m})^{-1}$

(32) The following four wires are made of the same material and are at the same temperature. Which one of them has highest electrical resistance

(a) length = 100 cm, diameter = 1 mm (b) length = 50 cm, diameter = 0.5 mm
(c) length = 200 cm, diameter = 2 mm (d) length = 300 cm, diameter = 3 mm

(33) In the diagram, the current in the 3-Ω resistor is 4A. The potential difference between points 1 and 2 is

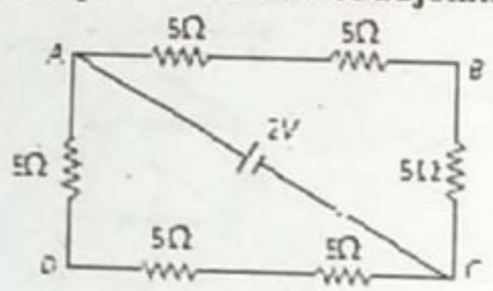


(a) 20V (b) 0.8V
(c) 12V (d) 1.25V

(34) Internal resistance of ideal current source is

(a) Infinite (b) Zero
(c) Very low (d) Very high

(35) The potential difference between points A and B of adjoining figure is



(a) 8/9V (b) 2V
(c) 2/3V (d) 4/3V

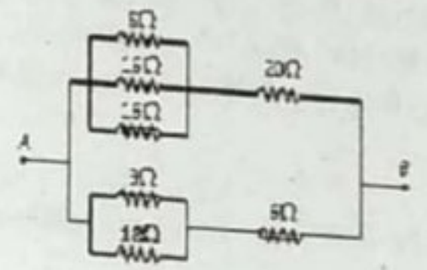
(36) A wire of resistance R is divided in 10 equal parts. These parts are connected in parallel, the equivalent resistance of such connection will be

(a) 10 R (b) 0.1 R
(c) 0.01 R (d) 100 R

(37) Electrical energy is converted to heat at the rate of _____

(a) IRt (b) I^2R
(c) I^2Rt (d) VIt

(38) The equivalent resistance of the arrangement of resistances shown in adjoining figure between the points A and B is

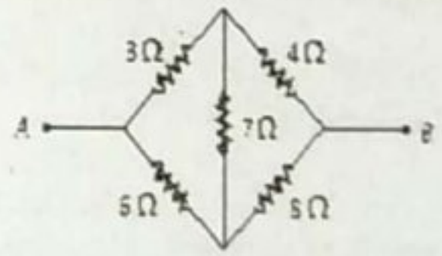


(a) 2 ohm (b) 5 ohm
(c) 8 ohm (d) 3 ohm

(39) In the circuit shown in the adjoining figure, the current between B and D is zero, the unknown resistance is of

(a) 3Ω
(b) 4Ω
(c) e.m.f. of a cell is required to find the value of X
(d) 2Ω

(40) In the given figure, equivalent resistance between A and B will



(a) 14/3 Ω (b) 3/14Ω
(c) 9/14Ω (d) 14/9Ω

(41) Why can birds stand on an overhead high voltage transmission line without suffering any harm?

(a) their bodies have a very high resistance
(b) their feet are very good insulators
(c) the spaces between their feathers act as insulators
(d) they are not connected to earth

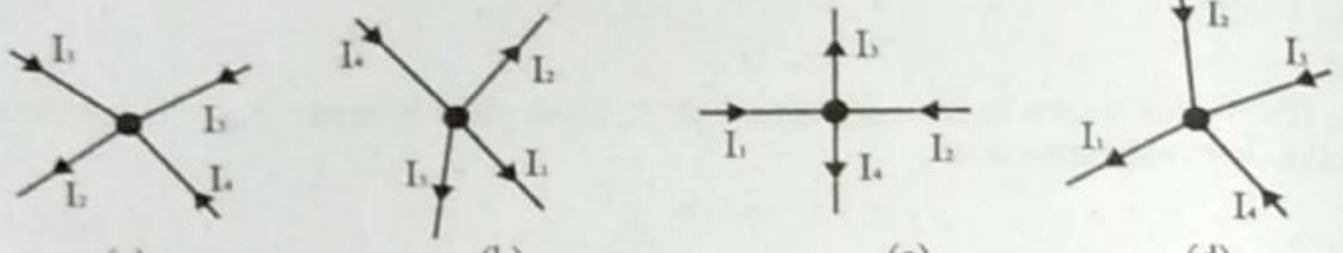
Scanned by CamScanner

(42) **A cell is connected to a resistor. What is the e.m.f of the cell equal to?**
(a) the potential difference across the resistor for each unit of current
(b) the power produced in the circuit for each unit of charge that passes
(c) the work done in the circuit for each unit of charge that passes
(d) the work done in the circuit for each unit of current

(43) **The potential difference between the ends of a conductor is 12 V. How much electrical energy is converted to other forms of energy in the conductor when 100 C of charge flows through it?**
(a) 0.12 J (b) 88 J
(c) 8.3 J (d) 1200 J

(44) **Drift velocity of electrons in a conductor bearing potential difference V across its terminals is v. if the length of wire is stretched to three times and same potential difference V is applied, then the drift velocity will become/remain.**
(a) v (b) v/3
(c) 3v (d) $v/\sqrt{3}$

(45) **The diagrams show five different ways in which currents I_1, I_2, I_3 can combine at a junction.**



(a) (b) (c) (d)

For which of these junction, is the following equation correct? $I_1 + I_2 = I_3 + I_4$
(a) A (b) B
(c) C (d) D

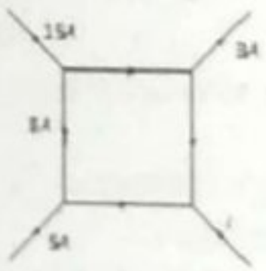
(46) **In carbon resistances if there is no fourth band, then the tolerance will be**
(a) 5% (b) 20%
(c) 10% (d) 2%

(47) **A flow of 10^7 electron per second in a conductor constitutes a current of**
(a) 1.6×10^{-26} A (b) 1.6×10^{12} A
(c) 1.6×10^{-12} A (d) 10^7 A

(48) **A 25 W, 220 V bulb and a 100 W, 220 V bulb are joined in series and connected to mains which bulb will glow brighter**
(a) 25 w (b) 100 watt bulb
(c) first 20 and then 100 w bulb (d) neither bulb will glow

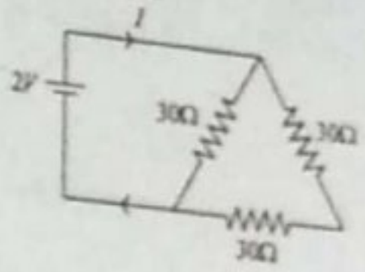
(49) **A typical value of drift velocity is**
(a) 1 mm s^{-1} (b) 1 ms^{-1}
(c) 10 ms^{-1} (d) 1000 km s^{-1}

(50) **The figure shows a network of currents. The magnitude of currents is shown here. The current i will be**



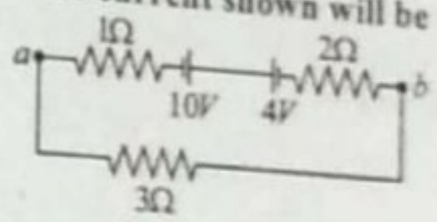
(a) 13A (b) 3A
(c) -3A (d) 23A

(51) **The current in the adjoining circuit will be**



(a) $\frac{1}{45}A$ (b) $\frac{1}{15}A$
(c) $\frac{1}{10}A$ (d) $\frac{1}{5}A$

(52) **The magnitude and direction of the current shown will be**



(a) $\frac{7}{3}A$ from a to b (b) $\frac{7}{3}A$ from b to a
(c) 1A from a to b (d) 15A from a to b

(53) **The specific resistance of wire is $50\times10^{-8}\,\Omega$ m. The resistance of a cube of length 50 cm will be**
(a) $10^{-6}\,\Omega$ (b) $2.5\times10^{-5}\,\Omega$
(c) $10^{-8}\,\Omega$ (d) $5\times10^{-4}\,\Omega$

(54) **The example for non-ohmic resistance is**
(a) copper wire (b) carbon resistance
(c) diode (d) tungsten wire

(55) **5A of current is passed through a metallic conductor. The charge flowing in one minute in coulomb, will be**
(a) 5 (b) 12
(c) $\frac{1}{12}$ (d) 300

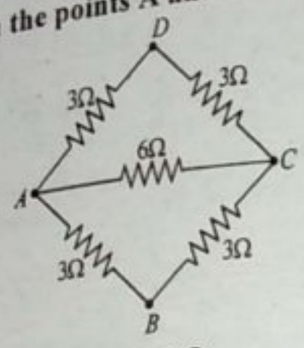
(56) **The length of the wire is doubled. Its conductance will be**
(a) uncharged (b) halved
(c) halved (d) $\frac{1}{4}$ of the original value

(57) **1.6 mA current is flowing in conducting wire then the number of electrons flowing per second**
(a) 10^{11} (b) 10^{16}
(c) 10^{19} (d) 10^{15}

(58) **There are 8 equal resistances each have resistance R. Two are connected in parallel, such four groups are connected in series, the total resistance of the system will be**
(a) $\frac{R}{2}$ (b) 2R
(c) 4R (d) 8R

Scanned by CamScanner

(59) The effective resistance between the points A and B in the figure is



(a) 5Ω (b) 2Ω (c) 3Ω (d) 4Ω

(60) A primary cell has an emf of 1.5V, when short circuited it gives a current of 3A. The internal resistance of the cell is:

(a) 4.5Ω (b) 2Ω (c) 0.5Ω (d) $\frac{1}{4.5}\Omega$

ANSWER KEY

1	a	11	a	21	b	31	c	41	d	51	c
2	b	12	c	22	c	32	b	42	c	52	c
3	c	13	a	23	b	33	a	43	d	53	a
4	a	14	c	24	a	34	b	44	b	54	c
5	b	15	a	25	c	35	d	45	c	55	d
6	b	16	c	26	a	36	c	46	b	56	b
7	b	17	c	27	c	37	c	47	c	57	b
8	c	18	a	28	c	38	c	48	a	58	b
9	a	19	c	29	a	39	d	49	a	59	b
10	a	20	a	30	d	40	a	50	d	60	c

EXPLANATORY NOTES

(1) $E = P \times t \Rightarrow 40 \times 10 \Rightarrow 400\,J$
but it consume half energy into light
so E= 200 J

(2) Bridge is balanced

$$\frac{1}{R_{eq}} = \frac{1}{6} + \frac{1}{12} \Rightarrow \frac{12 \times 6}{12+6}$$

$$\frac{12 \times 6}{18} \Rightarrow \frac{12}{3} \Rightarrow 4\Omega$$

$$I = \frac{V}{R_{eq}} = \frac{2}{4} = 0.5A$$

(3) P.D across $1\Omega = \frac{1}{1+3} \times 10 = 2.5V$

P.D across $3\Omega = \frac{3}{1+3} \times 10 = 7.5V$

P.D across $AB = 7.5 - 2.5 \Rightarrow 5V$

(4) Resistance $\propto$ 1/power
Thus, 40 W bulb has a high resistance. Because of which there will be more potential drop across 40 W bulb. Thus 40 W bulb will glow brighter.

(5)
$$P \propto \frac{1}{R} \Rightarrow \frac{P_1}{P_2} = \frac{R_2}{R_1} \Rightarrow \frac{200}{100} = \frac{R_2}{R_1} \Rightarrow R_2 = 2R_1$$

(6)
$$P = \frac{V^2}{R} \Rightarrow R_1 = \frac{V_1^2}{P_1} = \frac{(200)^2}{40} = 1000\Omega \qquad \text{and } R_2 = \frac{V_2^2}{P_2} = \frac{(200)^2}{100} = 400\Omega$$

(7) $Q = It \Rightarrow 1 \times 5 \Rightarrow 5C$

(8) $\frac{1}{2}mv^2 = eV \Rightarrow v = \sqrt{\frac{2eV}{m}}$

(9)
$$P = \frac{V^2}{R} \Rightarrow P \propto \frac{1}{R} \text{ and } R \propto l \qquad \therefore P \propto \frac{1}{l} \Rightarrow \frac{P_1}{P_2} = \frac{l_1}{l_2} = \frac{2}{1}$$

(10) $P = V^2 / R$

$$R = \frac{V^2}{P} \Rightarrow \frac{(120)^2}{60} \Rightarrow 240\Omega$$

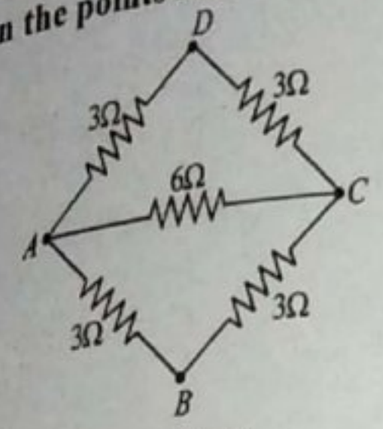
(11) Current divide in each case

So all resistance are parallel so $\frac{1}{R_{eq}} = \frac{1}{1} + \frac{1}{2} + \frac{1}{3}$

$R_{eq} = 0.5\Omega$

Scanned by CamScanner

(59) The effective resistance between the points A and B in the figure is



(a) 5Ω (b) 2Ω
(c)3Ω (d) 4Ω

(60) A primary cell has an emf of 1.5V, when short circuited it gives a current of 3A. The internal resistance of the cell is:

(a) 4.5Ω (b) 2Ω
(c) 0.5Ω (d) $\frac{1}{4.5}\Omega$

ANSWER KEY

1	a	11	a	21	b	31	c	41	d	51	c
2	b	12	c	22	c	32	b	42	c	52	c
3	c	13	a	23	b	33	a	43	d	53	a
4	a	14	c	24	a	34	b	44	b	54	c
5	b	15	a	25	c	35	d	45	c	55	d
6	b	16	c	26	a	36	c	46	b	56	b
7	b	17	c	27	c	37	c	47	c	57	b
8	c	18	a	28	c	38	c	48	a	58	b
9	a	19	c	29	a	39	d	49	a	59	b
10	a	20	a	30	d	40	a	50	d	60	c

EXPLANATORY NOTES

(1) $E = P \times t \Rightarrow 40 \times 10 \Rightarrow 400\,J$
but it consume half energy into light
so E= 200 J

(2) Bridge is balanced
$\frac{1}{R_{eq}} = \frac{1}{6} + \frac{1}{12} \Rightarrow \frac{12 \times 6}{12+6}$
$\frac{12 \times 6}{18} \Rightarrow \frac{12}{3} \Rightarrow 4\Omega$
$I = \frac{V}{R_{eq}} = \frac{2}{4} = 0.5A$

(3) P.D across $1\Omega = \frac{1}{1+3} \times 10 = 2.5V$
P.D across $3\Omega = \frac{3}{1+3} \times 10 = 7.5V$
P.D across $AB = 7.5 - 2.5 \Rightarrow 5V$

(4) Resistance $\propto$1/power
Thus, 40 W bulb has a high resistance. Because of which there will be more potential drop across 40 W bulb. Thus 40 W bulb will glow brighter.

(5) $P \propto \frac{1}{R} \Rightarrow \frac{P_1}{P_2} = \frac{R_2}{R_1} \Rightarrow \frac{200}{100} = \frac{R_2}{R_1} \Rightarrow R_2 = 2R_1$

(6) $P = \frac{V^2}{R} \Rightarrow R_1 = \frac{V_1^2}{P_1} = \frac{(200)^2}{40} = 1000\Omega$ and $R_2 = \frac{V_2^2}{P_2} = \frac{(200)^2}{100} = 400\Omega$

(7) $Q = It \Rightarrow 1 \times 5 \Rightarrow 5C$

(8) $\frac{1}{2}mv^2 = eV \Rightarrow v = \sqrt{\frac{2eV}{m}}$

(9) $P = \frac{V^2}{R} \Rightarrow P \propto \frac{1}{R}$ and $R \propto l$ $\therefore P \propto \frac{1}{l} \Rightarrow \frac{P_1}{P_2} = \frac{l_1}{l_2} = \frac{2}{1}$

(10) $P = V^2 / R$
$R = \frac{V^2}{p} \Rightarrow \frac{(120)^2}{60} \Rightarrow 240\Omega$

(11) Current divide in each case
So all resistance are parallel so $\frac{1}{R_{eq}} = \frac{1}{1} + \frac{1}{2} + \frac{1}{3}$
$R_{eq} = 0.5\Omega$

Scanned by CamScanner

(12) $X=\frac{4\times2}{4+2}\Rightarrow\frac{8}{6}\Rightarrow1.3\Omega$

$Y=1+\frac{3\times2}{3+2}\Rightarrow2.2\Omega$

$Z=\frac{3\times3}{3+3}\Rightarrow\frac{9}{6}\Rightarrow1.5\Omega$

(13) By fusing of one bulb, resistance increases so current will decrease. As potenital remain same so brightness remain unchanged.

(14) At zero deflection, voltage across P due to cells of e.m.f. E_1 must be equal to E_2.

$\therefore E_2=E_1\left(\frac{P}{P+Q}\right)\Rightarrow\frac{E_2}{E_1}=\frac{P}{P+Q}$

(15) Resistivity depends upon material not on geometric dimension.

(16) $R_t=R_0(1+\alpha t)\Rightarrow4.2=R_0(1+0.004\times100)=1.4R_0\Rightarrow R_0=3\Omega$

(17)

(18)

(19) Source of emf provides energy.

(20) $W=P\times t$

(21) As each resistance is of 8 Ohms. Therefore, in parallel combination its equivalent resistance is 8 Ohms.

(22) For safety of electrical appliance fuse rating should be just greater than the require current.

(23) $i=\frac{ne}{t}\Rightarrow16\times10^{-3}=\frac{n\times1.6\times10^{-19}}{1}\Rightarrow n=10^{17}$

(24) $R=\frac{V}{i}=\rho\frac{l}{A}\Rightarrow\frac{2}{4}=\rho\frac{50\times10^{-2}}{(1\times10^{-3})^2}\Rightarrow\rho=1\times10^{-6}\Omega m$

(25) $i=\frac{V}{R}=\frac{Q}{t}\Rightarrow Q=\frac{Vt}{R}=\frac{20\times2\times60}{10}=240C$

(26) $\frac{\text{Power in watt}\times\text{time in hours}}{1000}\Rightarrow\frac{500\times24}{1000}=12$ units

(27) Series combination $R_e=R+R+R=3R$

(28) Ammeter is always connected in series and Voltmeter is always connected in parallel.

(29) $R\propto\frac{l}{r^2}$; $\frac{R_2}{R_1}=\frac{l_2}{l_1}\times\frac{r_1^2}{r_2^2}=\left(\frac{2}{1}\right)\times\left(\frac{1}{2}\right)^2=\frac{1}{2}$; $R_2=\frac{R_1}{2}$, Specific resistance doesn't depend upon length, and radius.

(30) $I\propto V$

(31) $\rho=\frac{RA}{L}=\frac{\Omega m^2}{m}=\Omega m$

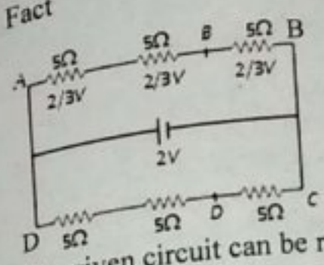
(32) $R\propto\frac{l}{r^2}$. For highest resistance $\frac{l}{r^2}$ should be maximum, which is correct for option

(33) $V=IR_{eq}$

$V=4\times5=20\,V$

(34) Fact

(35)



The given circuit can be redrawn as follows for identical resistances, potential difference distributes equally among all. Hence potential difference across each resistance is 2/3V, and potential difference between A and B is 4/3V.

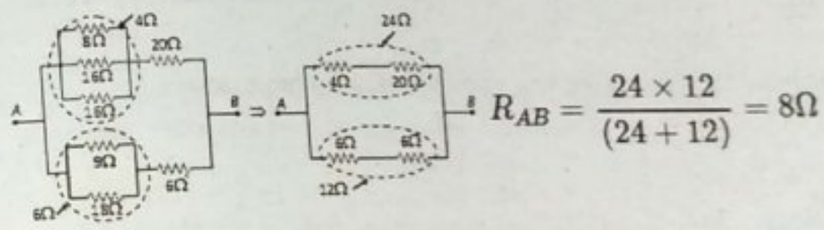
(36) Each part will have a resistance $r=R/10$ Let equivalent resistance be r_R then

$\frac{1}{r_R}=\frac{1}{r}+\frac{1}{r}+\frac{1}{r}$.....10 times

$\therefore\frac{1}{r_R}=\frac{10}{r}=\frac{10}{R/10}=\frac{100}{R}\Rightarrow r_R=\frac{R}{100}=0.01R$

(37) $H=I^2Rt$

(38)

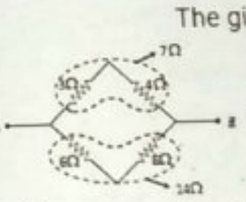


$\therefore R_{AB}=\frac{24\times12}{(24+12)}=8\Omega$

(39) **By balanced Wheatstone bridge condition** $\frac{16}{X}=\frac{4}{0.5}\Rightarrow X=\frac{8}{4}=2\Omega$

(40)

The given circuit is a balanced Wheatstone bridge, hence it can be redrawn as follows



$\Rightarrow\quad R_{eq}=\frac{7\times14}{(7+14)}=\frac{14}{3}\Omega$

(41) Current will not pass from the body of the bird until bird touch a place of low potential like earth from other end of its body.

(42) $\text{emf}=\frac{W}{Q}$

(43) Energy = QV =100×12=1200J

(44) $i=neAv_d$

When wire is stretched to three times, resistance becomes 9 times and area becomes one third

$\therefore\quad\frac{V}{r}=neAv_d$

$v_d=\frac{V}{RneA}\propto\frac{1}{AR}\Rightarrow\frac{v_d'}{v_d}=\frac{AR}{A'R'}=\frac{AR}{\left(\frac{A}{3}\right)(9)R}=\frac{1}{3}$

Scanned by CamScanner

(45) According to Kirchhoff's current rule.

(46) For Gold = $\pm 5\%$

For Silver = $\pm 10\%$

For no 4th band = +20%

(47) $I = \frac{Q}{t} = \frac{ne}{t} = \frac{10^7 \times 1.6 \times 10^{-19}}{1} = 1.6 \times 10^{-12}$

(48) In series combination, Brightness $\propto \frac{1}{P_{rated}}$

(49) Text Book information.

(50) By KCL

incoming current = outgoing current

$15A + 3A + 5A = 23A$

(51) $R_{eq} = 20\Omega \quad I = \frac{V}{R} = \frac{2}{20} = \frac{1}{10} A$

(52) $I = \frac{10-4}{6} = \frac{6}{6} = 1A$ (current flow from a to b)

(53) $R = \frac{\rho L}{A}$

(54) Semiconductor diode is the best example of non-ohmic device.

(55) $Q = I \times t = 300C$

(56) $G = \frac{1}{R} = \frac{A}{Pl} \rightarrow G \propto \frac{1}{l}$

(57) $I = \frac{ne}{t} \Rightarrow \frac{n}{t} = \frac{I}{e} = \frac{1.69 \times 10^{-3}}{1.6 \times 10^{-19}} = 10^{16}$

(58) $R_e = 4 \times \frac{R}{2} = (2R)$

(59) Wheat's stone bridge.

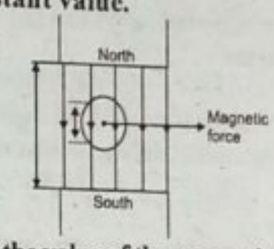
(60) $I = \frac{E}{r}, 3 = \frac{1.5}{r}, r = \frac{1.5}{3} = 0.5\Omega$

14 Chapter ELECTROMAGNETISM

PRACTICE EXERCISE

(1) **In the formula $F = q(v \times B)$**
(a) F must be perpendicular to v but not necessarily to B
(b) v must be perpendicular to B but not necessarily to F
(c) F must be perpendicular to both v and B
(d) All three vectors must be mutually perpendicular

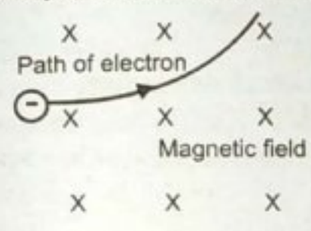
(2) **A current-carrying rod is placed in a magnetic field as shown in the diagram. Assume current flowing is kept at a constant value.**

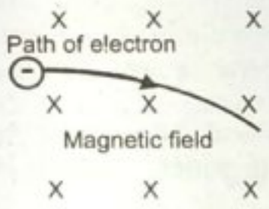


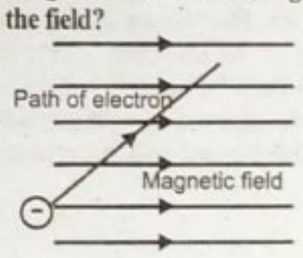
Which one of the factors will affect the value of the magnetic force acting on the rod?
(a) Distance between the north pole and south pole
(b) The position of the rod in the field
(c) Weight of the rod
(d) Length of the rod

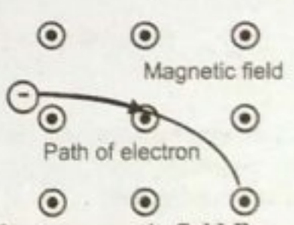
(3) **What is the value of the current in a wire of 10cm length at the right angle to a uniform magnetic field of 0.5 Weber/m^2, when the force acting on the wire is 5N?**
(a) 1A (b) 10A
(c) 100A (d) 1000A

(4) **The following diagrams shows an electron passing through a magnetic field. Which diagram shows the possible path of the electrons as they pass through the field?**

(a)


(b)


(c)


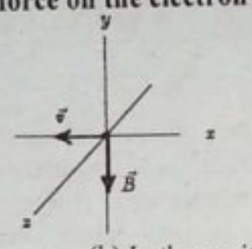
(d)


(5) **When a particle of charge q and mass m enters the uniform magnetic field B moving with velocity v perpendicular to the direction of the field, the time required by a charged particle to make a complete revolution in a magnetic field is given by_____**
(a) $T = 2\pi q/Bm$ (b) $T = 2\pi m/qB$
(c) $T = 2\pi B/qm$ (d) $T = qB/2\pi m$

(6) **Two parallel wires carrying currents in the opposite directions_____**
(a) Repel each other (b) Attract each other
(c) Have no effect upon each other (d) They cancel out their individual magnetic fields

Scanned by CamScanner

(7) **An electron moves in the negative x direction, through a uniform magnetic field in the negative y direction. The magnetic force on the electron is**



(a) In the negative z direction (b) In the positive z direction
(c) In the negative y direction (d) In the positive y direction

(8) **An electron is moving north in a region where the magnetic field is south. The magnetic force exerted on the electron is:**
(a) West (b) Up (c) Down (d) Zero

(9) **A moving coil galvanometer of resistance 100Ω gives half scale deflection for a current of 20mA. What will be the potential difference across it?**
(a) 4 volt (b) 5 volt
(c) 2 volt (d) 0.4 volt

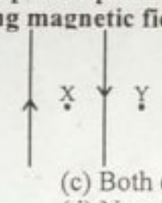
(10) **Which one of the following material is most suitable for making core of an electromagnet?**
(a) Air (b) Steel
(c) Cu-Ni alloy (d) Soft iron

(11) **The magnetic force experienced by a charge particle moving in a magnetic field will be minimum when it moves** _____
(a) Perpendicular to the field (b) Parallel to the field
(c) Inclined at some angle to the field (d) Inclined at an angle of 45°

(12) **The relationship between Tesla and smaller unit Gauss of magnetic induction is given by**
(a) $1T = 10^3$ G (b) $1T = 10^{-4}$ G
(c) $1T = 10^{-2}$ G (d) $1T = 10^4$ G

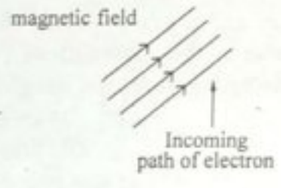
(13) **If the plane of the rectangular coil is parallel to the magnetic field (i.e. radial magnetic field), the torque on the coil is** _____
(a) $\tau = NIAB \cos\alpha$ (b) $\tau = NIAB \sin\alpha$
(c) Both "a" and "b" (d) $\tau = NIAB$

(14) **Two current carrying conductors are placed parallel as shown in figure. Which point will experience the strong magnetic field?**



(a) X (c) Both experience same magnetic field
(b) Y (d) None of these

(15) **The diagram shows an electron as it enters magnetic field. The path of the electron and the magnetic field are in the plane of the paper. In which direction is the electron initially deflected?**

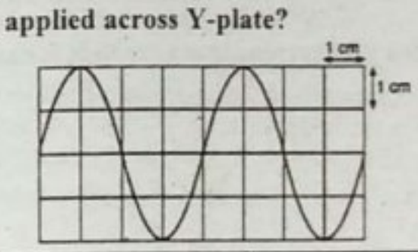


(a) Into the plane of the paper (b) Out of the plane of the paper
(c) To the left of its incoming path (d) To the right of its incoming path

(16) **An electron enters a region of uniform perpendicular $\vec{E}$ and $\vec{B}$ fields. It is observed that the velocity $\vec{v}$ of the electron is undeflected. A possible explanation is:**
(a) $\vec{v}$ is parallel to $\vec{E}$ and has magnitude E/B
(b) $\vec{v}$ is parallel to
(c) $\vec{v}$ is perpendicular to both $\vec{E}$ and $\vec{B}$ and has magnitude B/E
(d) $\vec{v}$ is perpendicular to both $\vec{E}$ and $\vec{B}$ and has magnitude E/B

(17) **The charged particle enters the uniform magnetic field in such a way that its initial velocity is not perpendicular to the field, the orbit will be** _____
(a) A circle (b) A spiral
(c) An ellipse (d) A helix

(18) **The diagram shows a trace on an oscilloscope set at 1.0 V per cm on the vertical axis and 1.0 millisecond per cm on the horizontal axis. What is the peak voltage and frequency of the alternating voltage applied across Y-plate?**



	Peak voltage/V	Frequency/Hz
(a)	1.5	500
(b)	1.5	250
(c)	2.0	125
(d)	2.0	250

(19) **Value of permeability of free space in SI units is** _____
(a) $4\pi x10^{-9}$ $WbA^{-1}m^{-1}$ (b) $4\pi x10^{-7}$ $WbA^{-1}m^{-1}$
(c) $4\pi x10^{-10}$ $WbA^{-1}m^{-1}$ (d) $4\pi x10^{-8}$ $WbA^{-1}m^{-1}$

(20) **The velocity of a particle of charge $+4.0 \times 10^{-9}$ C and mass 2×10^{-4}kg is perpendicular to a 0.1-tesla magnetic field. If the particle's speed is 3×10^4 m/s, what is the acceleration of this particle due to the magnetic force?**
(a) 0.0006 m/s^2 (b) 0.006 m/s^2
(c) 0.06 m/s^2 (d) 0.6 m/s^2

(21) **An instrument, which can measure potential without drawing any current, is** _____
(a) Voltmeter (b) Galvanometer
(c) Cathode ray oscilloscope (CRO) (d) Ammeter

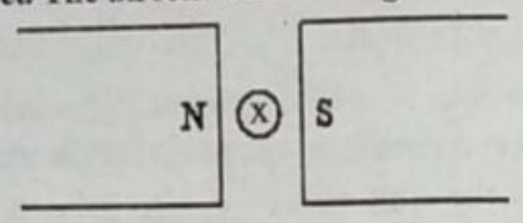
(22) **Electrons (mass m, charge −e) are accelerated from rest through a potential difference V and are then deflected by a magnetic field B that is perpendicular to their velocity. The radius of the resulting electron trajectory is**
(a) $\frac{\sqrt{2mVe}}{B}$ (b) $\frac{\sqrt{2mV}}{eB}$
(c) $\frac{\sqrt{2mV/e}}{B}$ (d) $\frac{\sqrt{2mVB}}{e}$

(23) **When the coil of the galvanometer is in equilibrium, then the deflecting couple is**
(a) Zero (b) Equal to the restoring couple
(c) Greater than the restoring couple (d) Smaller than the restoring couple

Scanned by CamScanner

(24) The sensitivity of a moving galvanometer is given by
(a) BAN/c (b) cAN/B
(c) c/BAN (d) ABC/c

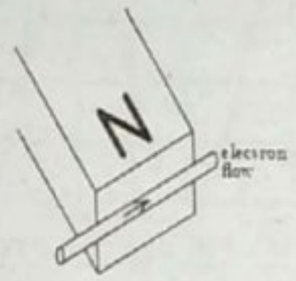
(25) The diagram shows a straight wire carrying a flow of electrons into the page. The wire is between the poles of a permanent magnet. The direction of the magnetic force exerted on the wire is



(a) ↓ (b) →
(c) ← (d) ↑

(26) When charge particle enter a magnetic field then K.E
(a) Remain same (b) Increases
(c) Decreases (d) None of these

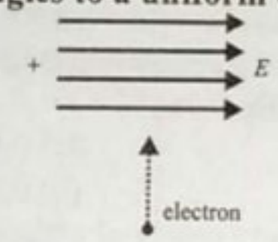
(27) The figure shows the motion of electrons in a wire that is near the N pole of a magnet. The wire will be pushed:



(a) Upwards (b) Away from the magnet
(c) Downward (d) Toward the magnet

(28) The magnitude of force experienced by a stationary charged particle in a uniform magnetic field is
(a) Of $\vec{v}\times\vec{B}$ (b) Minimum
(c) Zero (d) Maximum

(29) An electron is projected at right angles to a uniform electric field E. It will deflect:



(a) Into the plane of the paper (b) Out of the paper
(c) To the left (d) To the right

(30) An ammeter measures the total current flowing through a circuit, when it is connected_____
(a) In series with the circuit
(b) In parallel with the circuit
(c) In series with any of the parallel resistances in the circuit
(d) In parallel with any of the series resistances in the circuit

(31) Coil of a galvanometer is suspended in a radial magnetic field so that the deflecting torque on the coil is always_____, (in usual symbols)
(a) BINA cosα (b) BINA sinα
(c) BINA tanα (d) BINA

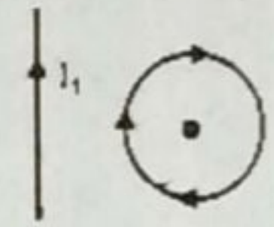
(32) An α-particle, a deuteron and a proton are moving with same momentum in a uniform magnetic field. The ratio of their speeds will be
(a) 1:2:4 (b) 4:2:1
(c) 1:1:1 (d) 2:2:4

(33) A solenoid is 3.0cm long and has a radius of 0.50cm. It is wrapped with 500turns of wire carrying a current of 2.0A. The magnetic field at the center of the solenoid is:
(a) 16T (b) 9.9×10^{-8} T
(c) 1.3×10^{-3} T (d) 4.2×10^{-2} T

(34) An galvanometer has a resistance 72Ω and gives full scale deflection for a current of 1A. it is used to convert into an ammeter of range 25A. The resistance of ammeter thus formed is:
(a) 3Ω (b) $(72/25)\Omega$
(c) $(25/72)\Omega$ (d) 75Ω

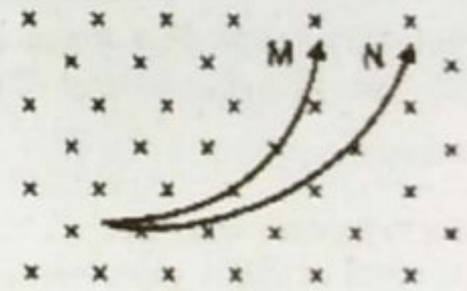
(35) When an electron moving with a uniform speed in a vacuum enters a magnetic field in a direction perpendicular to the field, the subsequent path of the electron is _____
(a) A straight line parallel to the field (b) A parabola in a plane perpendicular to the field
(c) A circle in a plane perpendicular to the field (d) A straight line along its initial direction

(36) In the given figure, the loop is fixed but straight wire can move. The straight wire will



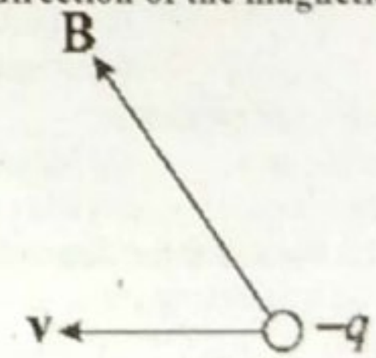
(a) Remain stationary (b) Move towards the loop
(c) Move away from the loop (d) Rotates about the axis

(37) Two charged particles M and N are projected with same velocity in a uniform magnetic field. Then M and N are :



(a) A proton and α-particle respectively (b) A deuteron and an electron respectively
(c) An electron and a proton respectively (d) A protium and a proton respectively

(38) In the figure below, what is the direction of the magnetic force F_B?

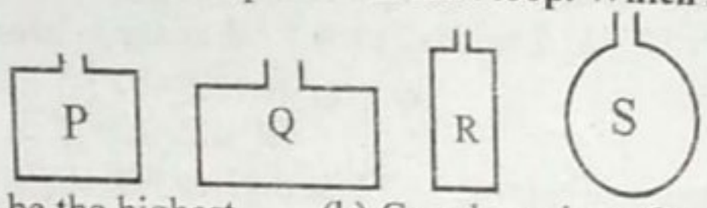


(a) To the right (b) Downward, in the plane of the page
(c) Upward, in the plane of the page (d) Out of the plane of the page

Scanned by CamScanner

(39) **Heating a magnet will _____**
(a) Weaken it (b) Strengthen it
(c) Reverse its polarity (d) Demagnetize it completely

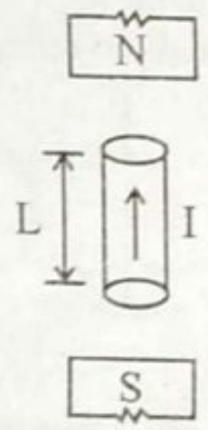
(40) **Four wires each of length 2 m are bent into four loops P, Q, R and S and then suspended into uniform magnetic field. Same current is passed in each loop. Which statement is correct?**



(a) Couple on loop P will be the highest (b) Couple on loop Q will be the highest
(c) Couple on loop R will be the highest (d) Couple on loop S will be the highest

(41) **When a particle of charge q and mass m enters a uniform magnetic field B moving with a velocity v perpendicular to the direction for the field, it describes a circular path of radius_____**
(a) r=qB/mv (b) r=mv/qB
(c) r=qmV/B (d) r=qmB/v

(42) **A wire carrying current (I) is place in a region of magnetic field as shown in figure direction of force is**



(a) into paper (b) out of paper
(c) towards right (d) no force is acting

(43) **A proton (charge + e coulomb) enters in a magnetic field of strength B (Tesla) with speed υ, parallel to the direction of magnetic lines of force. The force on the proton is:**
(a) eυB (b) Zero
(c) ∞ (d) eυB/2

(44) **A galvanometer acting as a voltmeter will have**
(a) a high resistance in series with its coil (b) a low resistance in parallel with its coil
(c) a low resistance in series with its coil (d) a high resistance in parallel with its coil

(45) **An proton is moving northward in a magnetic field directed vertically upward. The electron will be deflected.**
(a) Eastward (b) Westward
(c) Vertically upward (d) Remain undeflected

(46) **Magnetic flux and flux density are related by _____**
(a) Magnetic flux = flux density / area (b) Magnetic flux = flux density x area
(c) Flux density = magnetic flux area (d) Flux density = magnetic flux × area

(47) **The direction of the magnetic lines of force depends upon:**
(a) Nature of the material of the conducting wire
(b) Area of the conducting wire
(c) Amount of the current
(d) Direction of the current

(48) **The direction of the magnetic lines of force can be found by using:**
(a) Right hand rule (b) Henry's law
(c) Left hand rule (d) Faraday's law

(49) **The direction of magnetic field at a point on the magnetic lines of force can be taken along:**
(a) normal at that point
(b) the tangent at that point
(c) axis of the magnetic line of force at that point
(d) can't be taken

(50) $\sum_{r=1}^{n}(B.\Delta L)_r = \mu_o I$ **This is known as**
(a) Coulomb's law (b) Newton's law
(c) Ampere's circuital law (d) Kirchhoff current law

ANSWER KEY

1	c	11	b	21	c	31	d	41	b
2	d	12	d	22	c	32	a	42	d
3	c	13	d	23	b	33	d	43	b
4	b	14	a	24	a	34	b	44	a
5	b	15	b	25	d	35	c	45	a
6	a	16	d	26	a	36	b	46	b
7	a	17	d	27	a	37	a	47	d
8	d	18	d	28	c	38	d	48	a
9	c	19	b	29	c	39	a	49	b
10	d	20	c	30	a	40	d	50	c

EXPLANATORY NOTES

(1) In vector product, all three vectors are mutually perpendicular.

(2)

$$F = ILB\sin\theta$$

$$F \propto L$$

(3)

$$F = ILB\sin\theta$$

$$\theta = 90°$$

$$\Rightarrow I = \frac{F}{LB} = \frac{5}{0.1\times 0.5} = \frac{500}{5} = 100A$$

Scanned by CamScanner

(4) Application of right hand palm rule or Fleming's left hand rule.

(5) $\frac{e}{m}=\frac{v}{Br}$

$\frac{e}{m}=\frac{r\omega}{Br}$

$\frac{e}{m}=\frac{2\pi f}{B}$

$\frac{e}{m}=\frac{2\pi}{BT}$

$T=\frac{2\pi m}{qB}$

(6) In this case, magnetic field between the wires will be strong and outside the wire, magnetic field will be weak, so wires will move from stronger magnetic field to weaker magnetic field.

(7) Right hand palm rule

$\vec{F}=-q(\vec{v}\times\vec{B})$

$=-qvB(-\hat{i}\times-\hat{j})$

$=-qvB\hat{k}=qvB(-\hat{k})$

(8) $\vec{F}=q(\vec{v}\times\vec{B})$

$F=qvB\sin\theta$

$\theta=180°$

$\Rightarrow F=0$

(9) $V=IR$

$=20\times10^{-3}\times100$

$=2V$

(10) Material which have less hysteresis loss is suitable for making core of electromagnet.

(11) $F=qvB\sin\theta$

When $\theta=0°$

$F=0$

(12) $1T=10^4G$

(13) $\tau=NIAB\cos\alpha$

for $\alpha=0°$

$\tau=NIAB$

(14) The magnetic field due to these two current carrying conductors will reinforce each other at the center. So, the point of strong magnetic field will be X.

(15) By right hand palm rule

$\vec{F}=q(\vec{v}\times\vec{B})=-qvB(\hat{j}\times\hat{i})$

$=qvB(-\times-\hat{k})$

$=qvB\hat{k}$

(16) In velocity selector, $\vec{v}$ is perpendicular to both $\vec{E}$ and $\vec{B}$ given as $v=\frac{E}{B}$

(17) At acute angle, the path will be helix.

(18) Peak voltage $=1\times2=2V$

Time period $=4\times1ms=4ms$

$f=\frac{1}{T}=\frac{1}{4\times10^{-3}}=250Hz$

(19) $\mu_o=4\pi\times10^{-7}WbA^{-1}m^{-1}$

(20) $qvB=ma$

$a=\frac{qvB}{m}$

$a=\frac{4\times10^{-9}\times3\times10^4\times0.1}{2\times10^{-4}}$

$a=6\times10^{-2}ms^{-2}=0.06ms^{-2}$

(21)

(22) As $\frac{e}{m}=\frac{2V}{B^2r^2}\Rightarrow r^2=\frac{2mV}{eB^2}$

$r=\frac{\sqrt{2mV/e}}{B}$

(23) When the coil of the galvanometer is in equilibrium then

Deflecting torque = restoring torque

i.e. $IBAN=c\theta$

(24) When $IBAN=c\theta$

$\frac{\theta}{I}=\frac{BAN}{c}$

(25) Right hand palm rule.

Scanned by CamScanner

(26) Magnetic force does not do any work. It is only a deflecting force. So no change in K.E. because speed remains constant

(27) Right hand palm rule

(28) $F = qvB\sin\theta$

$v = 0$

$\Rightarrow F = 0$

(29) Electron will move toward positive side i.e. towards left.

(30) Ammeter is always connected in series.

(31) Deflecting couple = $NIBA\cos 0^\circ = NIBA$

(32) $P = mv$

$P = \text{constant}$

$v \propto \frac{1}{m}$

(33) $B = \mu_o nI$

(34) Shunt required

$$S = \frac{i_g}{i - i_g} G = \frac{1}{25-1} \times 72 = 3\Omega$$

Now G and S are connected in parallel so resistance of ammeter

$$R_A = \frac{SG}{S+G} = \frac{3\times 72}{3+72} = \frac{72}{25}\Omega$$

(35) When $\theta = 90^\circ$

The path of electron is circular.

(36) Current is flowing in same direction so straight wire will be attracted toward fixed loop.

(37) The more the mass of particle, more will be the radius of circle because $r = \frac{mv}{Be}$

As v and B are constant $r \propto \frac{m}{q}$

(38)

(39) When magnet is heated, its domain losses its alignment, so it will weaken the magnet.

(40) As, $\tau = NIAB$

As same current is passing through coils. So the coil having larger area will have more torque

(41) $\frac{e}{m} = \frac{v}{Br}$

$$\frac{q}{m} = \frac{v}{Br} \Rightarrow r = \frac{mv}{qB}$$

(42) $F = ILB\sin\theta \ (\text{where } \theta = 180^\circ)$

$F = 0$

(43) $F = qvB\sin\theta \ (\text{where } \theta = 0^\circ)$

$F = 0$

(44) By applying palm right hand rule

(45) $\vec{F}_m = -e\vec{v} \times \vec{B} = -e\left(\vec{v}\hat{j}\right) \times B\left(-\hat{k}\right) = evB\hat{i}$

i.e direction of force is eastward

(46) $\text{flux density}(B) = \frac{\phi}{A}$

$\phi = BA$

(47) Direction of magnetic field depends upon direction of current according to right hand rule.

(48) Direction of magnetic lines of forces can be found by right hand rule.

(49) Direction of magnetic field is along the tangent on a curve.

(50) $\sum_{i=1}^{n}\left(\vec{B}.\Delta\vec{L}\right) = \mu_o I$

This relation is known as Ampere's law.

Scanned by CamScanner

14 Chapter ELECTROMAGNETISM

SELF ASSESMENT TEST

(1) The galvanometer resistance is 100Ω and gives full scale deflection for 30mA. If it is to changed to voltmeter of 30 V range, the resistance added will be

(a) 900 Ω (b) 1800 Ω

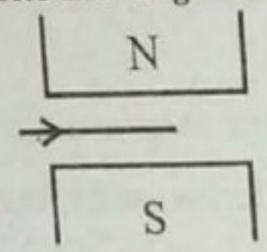
(c) 500 Ω (d) 1000 Ω

(2) A current carrying conductor is placed in a uniform magnetic field parallel to it. The magnetic force experienced by the conductor is_____

(a) F=1/B (b) F=1/Bsinθ

(c) F=0 (d) F=1/Bcosθ

(3) A beam of electron pass between the poles of a magnet as shown, the beam will be deflected



(a) into the plane (b) out of the plane

(c) towards n pole (d) towards south poles

(4) Due to 10 ampere of current flowing in a circular coil of 10 cm length, the magnetic field produced at its centre is 3.14×10^{-3}Weber/m^2. The number of turns in the coil will be

(a) 25 (b) 50

(c) 20 (d) 100

(5) The magnetic lines of force inside a bar magnet

(a) Are from north pole to south pole of the magnet

(b) Does not exist

(c) Depend upon the area of cross-pole of the magnet

(d) Are from south pole to north pole of the magnet

(6) The SI unit of galvanometer constant $\frac{c}{BAN}$ is

(a) $\frac{amp}{radian}$ (b) $N-m/\sec^2$

(c) N-amp/radian (d) none of these

(7) At a distance of 10 cm from a long straight wire carrying current, the magnetic field is 0.04 T. At the distance of 40 cm, the magnetic field will be

(a) 0.02 T (b) 0.01 T

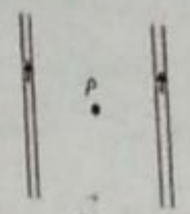
(c) 0.08 T (d) 0.16 T

(8) The magnetic induction in air at a point 1cm away from a long wire that carries a current of 1A, will be:

(a) 3×10^{-5}T (b) 4×10^{-5}T

(c) 1×10^{-5}T (d) 2×10^{-5}T

(9) Two long straight wires are set parallel to each other. Each carries a current i in the same direction and the separation between them is 2r. The intensity of the magnetic field midway between them is



(a) $\mu_o i/r$ (b) $4\mu_o i/r$

(c) Zero (d) $\mu_o i/4r$

(10) A long solenoid carrying a current produces a magnetic field B along its axis. If the current is doubled and the number of turns per cm is halved, the new value of the magnetic field is

(a) 2B (b) B/2

(c) 4B (d) B

(11) A current flows in a conductor from east to west. The direction of the magnetic field at a points above the conductor is

(a) towards south (b) towards north

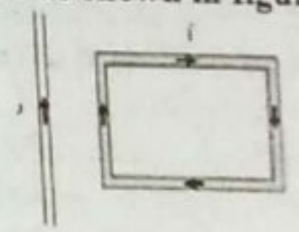
(c) towards east (d) towards west

(12) A electron enters in a uniform magnetic field making an angle 60° with field. The shape of its trajectory in magnetic field is

(a) circle (b) straight line

(c) parabola (d) helix

(13) A rectangular loop carrying a current i is situated near a long straight wire such that the wire is parallel to the one of the sides of the loop and is in the plane of the loop. If a steady current I is established in wire as shown in figure, the loop will



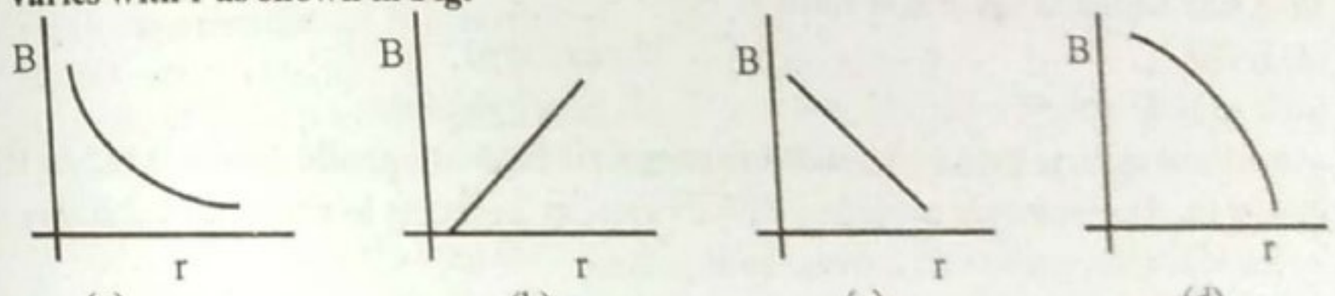
(a) remain stationary

(b) rotate about an axis parallel to the wire

(c) move away from the wire or towards right

(d) move towards the wire

(14) The magnetic flux density B at a distance r from a long straight wire carrying a steady current varies with r as shown in Fig:



(a) (b) (c) (d)

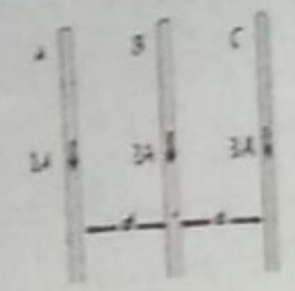
(15) 3 A of current is flowing in a linear conductor having a length of 40 cm. The conductor is placed in a magnetic field of strength 500 gauss and makes an angle of 30°with the direction of the field. It experiences a force of magnitude

(a) 3×10^{-4}newton (b) 3×10^{-2}newton

(c) 3×10^{4}newton (d) 3×10^{2}newton

Scanned by CamScanner

(16) There long straight wires A, B and C are carrying current as shown figure. Then the resultant force on B is directed:



(a) perpendicular to the plane of paper and inward
(b) perpendicular to the plane of paper and outward
(c) towards A
(d) towards C

(17) An electron is moving northward in a magnetic field directed vertically downward. The electron will be deflected.
(a) eastward (b) westward
(c) vertically upward (d) remain undeflected

(18) An electron enters a region where the electric field E is perpendicular to the magnetic field B. It will suffer no deflection if_____
(a) E = Bev (b) B = eE/v
(c) E= Bv (d) E = Bev/2

(19) A one metre long wire is lying at right angles to the magnetic field. A force of 1 N is acting on it in a magnetic field of 0.98 Tesla. The current flowing in it will be
(a) 100A (b) 10A
(c) zero (d) 1A

(20) The magnetic field strength of a solenoid of turns density $n = \frac{N}{L}$ is
(a) $B = \mu_0 NI$ (b) $B = \mu_0 N/I$
(c) $B = \mu_0 nI$ (d) both (b) and (c)

(21) An instrument, which can measure potential without drawing any current, is ___
(a) voltmeter (b) galvanometer
(c) cathode ray oscilloscope (CRO) (d) ammeter

(22) A proton moving with a constant velocity passes through a region of space without any change in its velocity. If E and B represent the electric and magnetic fields respectively, then this region of space may have
(a) E=2B (b) E≠0,B=0
(c) E=0,B=0 (d) all are possible

(23) A uniform electric field and a uniform magnetic field are produced, pointed in the same direction. An electron is projected with its velocity pointing in the same direction
(a) the electron velocity will increase in magnitude
(b) the electron velocity will decrease in magnitude
(c) the electron will turn to its left
(d) the electron will turn to its right

(24) The sensitivity of a moving galvanometer is given by
(a) BAN/c (b) cAN/B
(c) c/BAN (d) ABC/c

(25) Hot air from a hair-dryer contains many positively charged ions. The motion of these ions constitutes an electric current.



The hot air is directed between the poles of a strong magnet, as shown.
What happens to the ions? They are deflected
(a) towards the North pole N (b) downwards
(c) towards the South pole S (d) upwards

(26) A beam of ions with velocity 2×10^5 m/s enters normally into a uniform magnetic field of 4×10^{-2} tesla. If the specific charge of the ion is 5×10^7 C/kg, then the radius of the circular path described will be
(a) 0.10 m (b) 0.16 m
(c) 0.16 m (d) 0.25 m

(27) The acceleration of an electron of mass m and charge e, moving with uniform speed v at right angles to a magnetic field of flux density B, is give by
(a) $\frac{Bev}{m}$ (b) $\frac{Be}{m}$
(c) $\frac{Bv}{m}$ (d) $Bevm$

(28) The radius of curvature of the path of the charged particle in a uniform magnetic field is directly proportional to
(a) the energy of the particle (b) the intensity of the field
(c) the momentum of the particle (d) the charge on the particle

(29) The magnetic field B inside a long ideal solenoid is independent of:
(a) the core material (b) the current
(c) no. of turns (d) the cross-sectional area of the solenoid

(30) A proton (mass m and charge +e) and an α–particle (mass 4m and charge +2e) are projected with the same kinetic energy at right angles to the uniform magnetic field. Which one of the following statements will be true
(a) the α–particle and the proton will be bent in a circular path with the same radius
(b) the α–particle and the proton will go through the field in a straight line
(c) the α–particle will be bent in a circular path with a small radius that for the proton
(d) the radius of the path of the α–particle will be greater than that of the proton

(31) A charged particle moves with velocity v in a uniform magnetic field B. The magnetic force experienced by the particle is
(a) always zero (b) never zero
(c) zero, if b and v are perpendicular (d) zero, if b and v are parallel

(32) A galvanometer basically is an instrument used to _____
(a) detect current in a circuit
(b) measure current flowing through a circuit
(c) measure voltage across a circuit
(d) measure potential difference between two points in a circuit

(33) An electron is moving with a speed of 10^5 m/sec perpendicular to a uniform magnetic field of intensity B. Suddenly intensity of the magnetic field is reduced to B/2. The radius of the path becomes from the original value of r:
(a) no change (b) stops moving
(c) reduces to r / 2 (d) increases to 2r

Scanned by CamScanner

(34) **A strong magnetic field is applied on a stationary electron, then**
(a) the electron moves in the direction of the field
(b) the electron moves in an opposite direction
(c) the electron starts spinning
(d) the electron remains stationary

(35) **A uniform magnetic field acts at right angles to the direction of motion of electrons. As a result, the electron moves in a circular path of radius 2 cm. If the speed of the electrons is doubled, then the radius of the circular path will be**
(a) 1 cm (b) 4 m
(c) 4.0 cm (d) 0.5 cm

(36) **If a proton, deutron and α–particle on being accelerated by the same potential difference enters perpendicular to the magnetic field, then the ratio of their kinetic energies is**
(a) 1 : 2 : 1 (b) 1 : 1 : 2
(c) 2 : 2 : 1 (d) 1 : 2 : 2

(37) **Which of the following statement is true.**
(a) there is no change in the energy of a charged particle moving in a magnetic field although a magnetic force is acting on it
(b) a charged particle enters a region of uniform magnetic field at an angle of 85° to the magnetic lines of force; the path of the particle is a circle
(c) a coil of a metal wire kept stationary in a non-uniform magnetic field has an e.m.f. induced in it
(d) the presence of a large magnetic flux through a coil maintains a current in the coil if the circuit is continuous

(38) **Concave pole faces of the magnet and soft iron cylinder in galvanometer are used to make the field**
(a) strong (b) weak
(c) radial (d) radial and stronger

(39) **A charge of 1C is moving in a magnetic field of 0.5Tesla with a velocity of 10m/sec Perpendicular to the field. Force experienced is**
(a) 5 N (b) 10N
(c) 0.5 N (d) 0N

(40) **The force on charge particle q moving with velocity v in magnetic field $\vec{B}$ is $\vec{F}=q\vec{v}\times\vec{B}$. The work done by magnetic force on the particle**
(a) Depends upon $|\vec{v}|$ (b) Depends upon $|\vec{B}|$
(c) Angle between $\vec{v}$ and $\vec{B}$ (d) Zero

(41) **The magnetic field in a certain region is given by $40\hat{i}-18\hat{k}$. How much flux passes through a 5.0 cm² area loop in this region if loop lies flat in YZ plane?**
(a) 90×10^{-4} Wb (b) 2×10^{-2} Wb
(c) 2×10^{2} Wb (d) 9×10^{-4} Wb

(42) **A power line 10 m higher carries current 200A. Magnetic field of wire at ground is**
(a) 4×10^{-7} T (b) 40×10^{-6} T
(c) 4×10^{-6} T (d) 4×10^{-5} T

(43) **Work done by magnetic force**
(a) qvB sinθ × distance (b) qvB × distance
(c) zero (d) qvB cosθ × distance

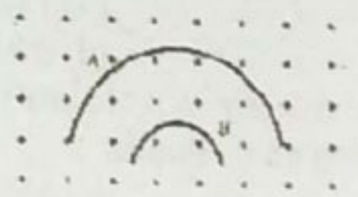
(44) **An electron entered in constant magnetic field at right angle and start moving in circular path of radius r. Time period of revolution is**
(a) $\frac{qB}{2\pi m}$ (b) $\frac{2\pi m}{qB}$
(c) $\frac{2v}{B^2r^2}$ (d) $\frac{2\pi q}{mB}$

(45) **Pattern of wave appears to be stationary on screen of CRO when**
(a) $f_x = nf_y$ (b) $f_x = \frac{n}{2}f$
(c) $f_x = \sqrt{n}\,f_y$ (d) $f_x = 2\sqrt{n}\,f_y$

(46) **Two parallel beams of positrons moving in the same direction will**
(a) repel each other
(b) not interact with each other
(c) attract each other
(d) be deflected normal to the plane containing the two beams

(47) **A proton and an α-particle, moving with the same velocity, enter into a uniform magnetic field, acting normal to the plane of their motion. The ratio of the radii of the circular paths described by the proton and α-particle is**
(a) 1 : 2 (b) 1 : 4
(c) 1 : 16 (d) 4 : 1

(48) **Two particles A and B of masses m_A and m_B respectively and having the same charge are moving in a plane. A uniform magnetic field exists perpendicular to this plane. The speeds of the particles are v_A and v_B respectively, and the trajectories are as shown in the figure. Then**



(a) $m_Av_A > m_Bv_B$ (b) $m_Av_A < m_Bv_B$
(c) $m_A < m_B$ and $v_A < v_B$ (d) $m_A = m_B$ and $v_A = v_B$

(49) **Current I is flowing in a long conducting wire, the magnetic induction at a distance r from it is 0.4 tesla, then its value at double the distance will be**
(a) 1.6 T (b) 0.2 T
(c) 0.8 T (d) 0.1 T

(50) **A conducting rod of 1 meter length and 1 kg mass is suspended by two vertical wires through its ends. An external magnetic field of 2 Tesla is applied normal to the rod. Now the current to be passed through the rod so as to make the tension in the wires zero is [take g = 10 ms-2**
(a) 0.5 Amp (b) 15 Amp
(c) 5 Amp (d) 1.5 Amp

(51) **A galvanometer whose internal resistance is 50Ω and current 50mA, is converted into am-meter of range 5A. What is the resistance required?**
(a) 0.50Ω (b) 5Ω
(c) 1Ω (d) 10Ω

Scanned by CamScanner

(52) An electric current i enters and leaves a uniform circular wire of radius a through diametrically opposite points. A charged particle q moving along the axis of the circular wire passed through its center at speed v. the magnetic force acting on the particle when it passes through the center has a magnitude

(a) $qv\frac{\mu_0 i}{2a}$ (b) $qv\frac{\mu_0 i}{2\pi a}$

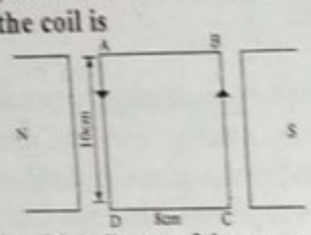
(c) $qv\frac{\mu_0 i}{a}$ (d) zero

(53) A proton and α particle with the same K.E. enter a region of uniform magnetic field B moving at right angles to the field. What is the ratio of the radii of their circular paths?

(a) $1:\sqrt{2}:1$ (b) $1:\sqrt{2}:\sqrt{2}$

(c) $\sqrt{2}:1:1$ (d) $\sqrt{2}:\sqrt{2}:1$

(54) A 100 turns coil shown in figure carries a current of 2 A in a magnetic field B of 0.2 Wbm^{-2}. The torque acting on the coil is



(a) 0.32 Nm tending to rotate the side AD out of the page
(b) 0.32 Nm tending to rotate the side AD into the page
(c) 0.0032 Nm tending to rotate the side AD out of the page
(d) 0.0032 Nm tending to rotate the side AD into the page

(55) A galvanometer with resistance 100 Ω gives full scale deflection with a current of 10mA. The value of shunt, in order to convert it into an ammeter of 10A range will be

(a) -10 Ω (b) 1 Ω

(c) 0.1 Ω (d) 0.01 Ω

(56) A proton is moving with a velocity of $3\times10^{7}ms^{-1}$ in the direction of a uniform magnetic field of 0.5T. The force acting on proton is

(a) 2N (b) 4N

(c) 6N (d) zero

(57) A proton and α-particle enter a uniform magnetic field at right angles to it with same velocity. The time period of α-particle as compared to that of proton, will be

(a) four times (b) two times

(c) half times (d) one-fourth

(58) If a solenoid of length "L" is cut into two equal parts then magnetic field produced due to solenoid will be_____

(a) same (b) become half

(c) double (d) four times

(59) For a current carrying solenoid the term 'n' has units as:

(a) m^{-1} (b) m^{-3}

(c) m^{-2} (d) no units

(60) In ohmmeter circuit, the zero value of galvanometer scale is marked as ____ resistance?

(a) 0 Ω (b) 10 kΩ

(c) 100 Ω (d) infinite

ANSWER KEY

1	a	11	b	21	c	31	d	41	b	51	a
2	c	12	d	22	c	32	a	42	c	52	d
3	b	13	d	23	b	33	d	43	c	53	c
4	a	14	a	24	a	34	d	44	b	54	a
5	d	15	b	25	d	35	c	45	a	55	c
6	a	16	d	26	a	36	b	46	c	56	d
7	b	17	a	27	a	37	a	47	a	57	b
8	d	18	c	28	c	38	d	48	a	58	a
9	c	19	b	29	d	39	a	49	b	59	a
10	d	20	c	30	a	40	d	50	c	60	d

EXPLANATORY NOTES

(1) $R_h = \frac{V}{I_g} - R_g$

$R_h = \frac{30V}{30\times10^{-3}A} - 100 \Rightarrow 900\Omega$

(2) $F = ILB\sin\theta$

$F = ILBSin\theta \qquad \therefore \theta = 0$

$F=0$

(3) By using right hand palm rule

(4) $B = \mu_o \frac{NI}{L}$

$N = \frac{BL}{\mu_o I} = \frac{3.14\times10^{-3}\times\frac{10}{100}}{4\pi\times10^{-7}\times10}$

$= \frac{10^{-2}}{4\times10^{-4}} = \frac{100}{4}$

$= 25$

(5) Outside the magnet field lines are from N to S and inside the magnet it is from S to N.

(6) As we have already studied that

$BINA = c\theta$

$\frac{I}{\theta} = \frac{c}{BAN}$

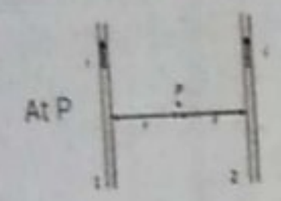
$\frac{Amp}{radian} = \frac{c}{BAN}$

(7) $B \propto \frac{1}{r} \Rightarrow \frac{B_1}{B_2} = \frac{r_2}{r_1} \Rightarrow \frac{0.04}{B_2} = \frac{40}{10} \Rightarrow B_2 = 0.01T$

Scanned by CamScanner

(8) $B=\frac{\mu_0}{4\pi}\times\frac{2i}{r}=10^{-7}\times\frac{2\times1}{10^{-2}}=2\times10^{-5}$ Tesla

(9)

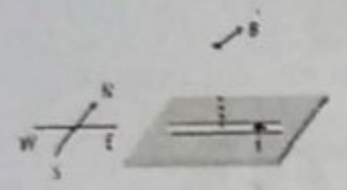


$\Rightarrow B_{net}=B_1-B_2$ Since $|B_1|=|B_2|$ So,

Bnet = 0

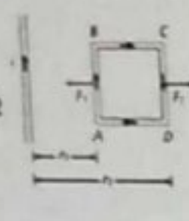
(10) $B=\mu_0 ni\Rightarrow\frac{B}{B'}=\frac{n}{n'}\times\frac{i}{i'}=\frac{1}{\left(\frac{1}{2}\right)}\times\frac{1}{2}=1\Rightarrow B'=B$

(11)



(12) If angle equal to 90°, then trajectory will be circle and $90°>\theta>0°$ trajectory will be helix.

(13)



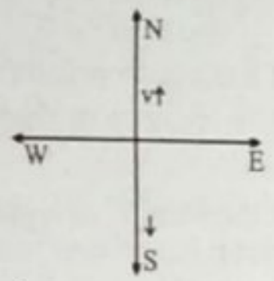
$\because r_1<r_2$ So F1 > F2 $\Rightarrow F_{net}=(F_1-F_2)$ towards the wire.

(14) $B\propto\frac{1}{r}$

(15) $F=Bil\sin\theta=500\times10^{-4}\times3\times\left(40\times10^{-2}\right)\times\frac{1}{2}=3\times10^{-2}N$

(16) $F\propto i_1 i_2$, so force on B due to C will be greater than that due A. Hence net force on B acts towards C.

(17)



$\vec{F}_m=-e\vec{v}\times\vec{B}=-e\left(\vec{v}\hat{j}\right)\times B\left(-\hat{k}\right)=evB\hat{i}$

i.e direction of force is eastward

(18) qvB=Eq

E=Bv

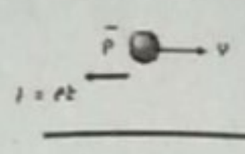
(19) $F=Bil\Rightarrow i=\frac{F}{BL}=\frac{1}{(0.98)(1)}=1$

(20) $B=\mu_0 nI$

(21) In CRO electrons move in space.

(22) Here the proton has no acceleration so E=B=0.When E=0but B≠0,but parallel to the motion of proton, there will be no force acting. When E≠0and B≠0and E, B and motion of proton (v) are mutually perpendicular, there may be no net force. Forces due to E and B cancel each other.

(23) Since electron is moving is parallel to the magnetic field, hence magnetic force on it



$F_m=0$ The only force acting on the electron is electric force which reduces it's speed

(24) $NIBA=c\theta\Rightarrow\frac{\theta}{I}=\frac{NAB}{c}$

(25) By using Right hand Palm Rule

(26) $r=\frac{mv}{Bq}=\frac{v}{(q/m)B}=\frac{2\times10^5}{5\times10^7\times4\times10^{-2}}=0.1m$

(27) ma=qvB

$a=\frac{evB}{m}$

(28) $r=\frac{p}{qB}\rightarrow r\propto p$

(29) $B=\mu_0 nI$, so it is independent of area of cross section

(30) $r=\frac{\sqrt{2mK}}{qB}$ i.e. $r\propto\frac{\sqrt{m}}{q}$ Here kinetic energy K and B are same.

$\therefore\frac{r_p}{r_\alpha}=\frac{\sqrt{m_p}}{\sqrt{m_\alpha}}.\frac{q_\alpha}{q_p}=\frac{\sqrt{m_p}}{\sqrt{4m_p}}.\frac{2q_p}{q_p}=1$

(31) $\vec{F}=q\left(\vec{v}\times\vec{B}\right)$; if $\vec{v}\parallel\vec{B}$ then $\vec{F}=0$

(32) Definition of galvanometer

(33) $r\propto\frac{1}{B}$ i.e $\frac{r_1}{r_2}=\frac{B_2}{B_1}\Rightarrow r_2=\frac{B_1}{B_1/2}\times r=2r$

(34) Magnetic force acts on a moving charge only if v = 0 so, F = qvB = 0

(35) $r=\frac{mv}{qB}\Rightarrow r\propto v,\Rightarrow r_2=2r_1=2\times2=4cm$

(36) Kinetic energy in magnetic field remains constant and it is $K=qV\Rightarrow K\propto q(V=\text{constant})$

$\therefore K_p:K_d:K_\alpha=q_p:q_d:q_\alpha=1:1:2$

(37) When charged particle enters perpendicularly in a magnetic field, it moves on a circular path with a constant speed. Hence, it's kinetic energy also remains constant.

(38) Book statement

(39) $F=qBv=1\times0.5\times10=5N$

(40) Fact

Scanned by CamScanner

(41) $B = 40\hat{i} + 0\hat{j} - 18\hat{k}$

$A = (5\hat{i} + 0\hat{j} + 0\hat{k}) \times 10^{-4}\ m^2$

$\phi_B = \vec{B}.\vec{A}$

$= 40 \times 5 \times 10^{-4}$

$= 2 \times 10^{-2}\ Wb$

(42) $B = \frac{\mu_o I}{2\pi r}$

Where r = h

$B = \frac{4\pi \times 10^{-7} \times 200}{2\pi(10)}$

$B = 4 \times 10^{-4} T$

(43) $W = \vec{F}_B \vec{d}$

$W = F_B d \cos 90°$

$W = 0$

(44) $\frac{e}{m} = \frac{v}{Br}$

$\frac{e}{m} = \frac{r\omega}{Br}$

$\frac{e}{m} = \frac{2\pi f}{B}$

$\frac{e}{m} = \frac{2\pi}{BT}$

$T = \frac{2\pi m}{qB}$

(45) Sychronization

$T_x = n T_y$

$\Rightarrow f_x = n f_y$

(46) Similar case, two wires carrying current in same direction.

(47) $Bqv = \frac{mv^2}{r}$ or $r = \frac{mv}{Bq}$

v and B are constants

$\therefore r \propto \frac{m}{q}$

$\frac{r_p}{r_\alpha} = \frac{m_p}{q_p} \times \frac{q_\alpha}{m_\alpha} = \frac{m_p}{q_p} \times \frac{2q_p}{4m_p} = \frac{1}{2}$

(48) $e = \frac{mv}{qB} \Rightarrow r \propto mv$ (q and B are constant) $\because r_A > r_B \Rightarrow m_A v_A > m_B v_B$

(49) Magnetic field of long straight conductor can be determined by the following formula $B = \frac{\mu_o I}{2\pi r}$ if we double the distance, magnetic field becomes half.

(50) $F_{magnetic} = F_{gravitational}$

$BIl = mg \quad I = \frac{mg}{Bl} \qquad (\theta = 90°)$

$= 5\ Amp.$

(51) $R_s = \frac{I_g R_g}{I - I_g} = 0.5\Omega$

(52) $\vec{B} \perp \vec{v} \quad \vec{F}_m = 0$

$F_c = Bqv = \frac{mv^2}{r} \qquad or \qquad r = \frac{mv}{Bq} \qquad or \qquad r = \frac{p}{Bq} = \frac{\sqrt{2mE}}{Bq}$

(53) In the given problem

$r \propto \frac{\sqrt{m}}{q}$

$\frac{r_p}{r_\alpha} = \frac{\sqrt{m}}{1} \times \frac{2}{\sqrt{4m}} \frac{1}{1}$

(54) $\tau = NBIA$

$= 100 \times 0.2 \times 2 \times 0.10 \times 0.08\ N\,m \qquad = 0.32\ N\,m$

(55) $R_s = \frac{IgRg}{I - Ig}$

(56)

$F = qvB \sin\theta \qquad \theta = 0°$

$= Zero$

(57) $\frac{mv^2}{r} = qvB \Rightarrow v = \frac{qBr}{m} \Rightarrow r\omega = \frac{qBr}{m} \Rightarrow \frac{2\pi}{T} = \frac{qB}{m}$

$T \propto \frac{m}{q} \Rightarrow \frac{T_\alpha}{T_p} = \frac{\frac{4m_p}{m_p}}{\frac{2q}{q}} \Rightarrow T_\alpha = 2T_p$

(58) $B = \mu_o \frac{N}{L} I \Rightarrow B' = u_o \frac{\frac{N}{2}}{\frac{L}{2}} I = u_o \frac{N}{L} I = B$ (Remain unchanged)

(59) $n = \frac{N}{L}$

(60) No deflection hence, $I = 0 \Rightarrow R = \infty$

Scanned by CamScanner

15 Chapter ELECTROMAGNETIC INDUCTION

PRACTICE EXERCISE

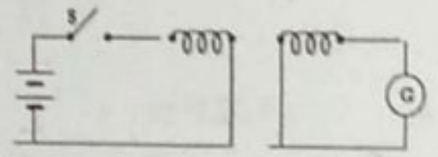
(1) **An inductor coil of inductance L is divided into two equal parts and both parts are connected in parallel. The net inductance is:**
(a) L/4 (b) 4L
(c) 2L (d) L/2

(2) **Faraday's law states that an induced emf is proportional to:**
(a) The rate of change of the magnetic field (b) The rate of change of the electric field
(c) The rate of change of the magnetic flux (d) The rate of change of the electric flux

(3) **Value of induced EMF is directly proportional to**
(a) Current through coil (b) Voltage applied
(c) No. of field lines (d) Resistivity

(4) **When current of coil changes from 8A to 2A in 3×10^{-2} s, the emf induced in the coil is 2V. The self inductance of the coil (in mH)**
(a) 1 (b) 5
(c) 20 (d) 10

(5) **For the experiment shown below**



(a) There is a steady reading in G as long as S is closed
(b) A motional emf is generated when S is closed
(c) The current in the battery goes through G
(d) There is a current in G just after S is opened or closed

(6) **Which of the following circuit elements will oppose the change in circuit current?**
(a) Capacitance (b) Inductance
(c) Resistance (d) All of the above.

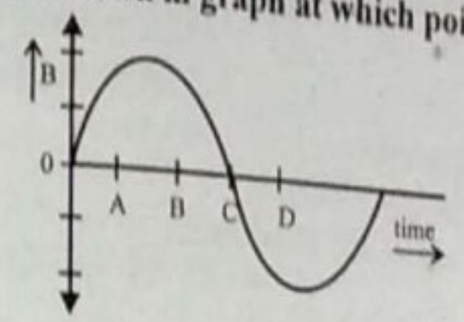
(7) **The primary and secondary coils of a transformer are linked**
(a) Electrically (b) Magnetically
(c) Chemically (d) Are not linked at all

(8) **Which one of the following functions, like a motor?**
(a) Galvanometer (b) Ammeter
(c) Voltmeter (d) All of above

(9) **Self inductance of solenoid is increased by**
(a) Increasing current in the coil (b) Increasing area of cross-section of the coil
(c) Passing A.C instead of D.C (d) All of the above

(10) **Which of the following works on torque on the current carrying conductor placed in magnetic field?**
(a) Galvanometer (b) Ammeter
(c) Voltmeter (d) All of the above

(11) **An emf is induced in a wire subjected to a changing magnetic field. The magnetic induction B of this field varies with time as shown in graph at which point is the induced emf maximum**

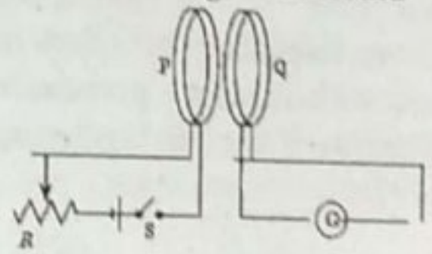


(a) A (b) B
(c) C (d) Both b and c

(12) **If the coil is wound on an iron core, the flux through it will_____**
(a) Decrease (b) Become zero
(c) Remain the same (d) Increase

(13) **Energy stored in a magnetic field is given by _____**
(a) LI^2 (b) $\frac{1}{2}L^2I$
(c) $\frac{1}{2}LI^2$ (d) IL^2

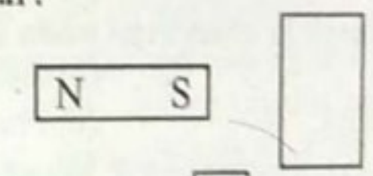
(14) **Coils P and Q each have a large number of turns of insulated wire. When switch S is closed, the pointer of galvanometer G is deflected toward the left. With S now closed, to make the pointer of G deflect toward the right one could**

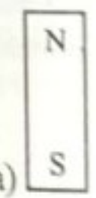


(a) Move coil P toward coil Q
(b) Open S
(c) Move coil Q toward coil P
(d) Move the slide of the rheostat R quickly to the right

(15) **A long narrow solenoid has length and a total of N turns, each of which has cross-sectional area A. Its inductance is**
(a) $\frac{\mu_0 N^2 A}{l}$ (b) $\frac{\mu_0 N A}{l}$
(c) $\frac{\mu_0 N^2 l}{A}$ (d) $\frac{\mu_0 N^3 A}{l}$

(16) **An iron bar is placed near a magnet as shown, which diagram correctly shows the induced magnetism of the iron bar?**



(a) 

(b) 

(c) 

(d) 

Scanned by CamScanner

(17) The maximum value of induced emf in a coil rotating in magnetic field does not depend on
(a) the resistance of coil (b) the number of turns in the coil
(c) the area of the coil (d) rotational frequency of the coil

(18) The stored energy in an inductor:
(a) Depends on the rate of change of current
(b) Is proportional to the square of the inductance
(c) Has units J/H
(d) None of the above

(19) If the secondary coil has N_s turns and the primary N_p turns, the relation between secondary and primary voltages is given by _____
(a) $V_s/V_p = N_p/N_s$ (b) $V_s/V_p = N_s/N_p$
(c) $V_p/V_s = N_s/N_p$ (d) $V_p/V_s = N_pN_s$

(20) Why does a transformer have a core made of iron
(a) Iron has a high melting point (b) Iron is a conductor of electricity
(c) Iron is a conductor of heat (d) Iron is a magnetic material

(21) A metal rod of length 30cm is moving at a speed of 0.5ms^{-1} in a direction perpendicular to a 0.25T magnetic field. Find the emf produced in the rod.
(a) 3.13×10^{-2}V (b) 3.75×10^{-2}V
(c) 4.13×10^{-2}V (d) 4.75×10^{-2}V

(22) An open coil has
(a) Zero resistance and inductance (b) Infinite resistance and zero inductance
(c) Infinite resistance and normal inductance (d) Zero resistance and high inductance

(23) A coil of wire is arranged with its plane perpendicular to a uniform magnetic field of flux density B. when the radius of the coil increases from r_1 to r_2 in time Δt, then what is the emf induced in the coil?
(a) $\frac{\pi B(r_2^2-r_1^2)}{\Delta t}$ (b) $\frac{\pi B(r_2-r_1)^2}{\Delta t}$
(c) $\frac{B(r_2^2-r_1^2)}{\Delta t}$ (d) $\frac{\pi B(r_2^2+r_1^2)}{\Delta t}$

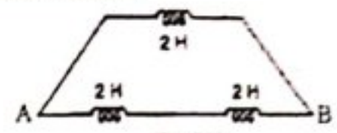
(24) The emf induced in a conductor of unit length moving with unit velocity at right angles to a magnetic field is equal to
(a) Magnetic flux density (b) Torque
(c) Mutual induction (d) Motional emf

(25) A step-up transformer has transformation ratio of 3:2. What is the voltage in secondary if the primary voltage is 30V?
(a) 20V (b) 60V
(c) 45V (d) 15V

(26) Eddy currents are produced in a material when it is
(a) Heated (b) Placed in a time varying magnetic field
(c) Placed in an electric field (d) Placed in a uniform magnetic field

(27) The coils of a stepdown transformer have 500 and 5000 turns. In the primary coil an AC of 4 A at 2200 volt is sent. The value of the current and potential difference in the secondary will be.
(a) 20 A, 22V (b) 0.4 A, 22000 A
(c) 40 A, 220V (d) 40 A, 22000V

(28) Three pure inductors each of 2 H are connected as shown in the figure. The equivalent inductance of the circuit across A and B is



(a) 6 H (b) 2H
(c) 8/6 H (d) 3/4H

(29) In a step, up transformer the number of turns in
(a) Primary are less (b) Primary are more
(c) Primary and secondary are equal (d) Primary are infinite

(30) A metal rod of length 25 cm is moving at a speed of 0.5 m / s in a direction perpendicular to a 0.25 T magnetic field. Find the e.m.f produced in the rod.
(a) 6.9×10^{-2}V (b) 4.6×10^{-2}V
(c) 5.7×10^{-2}V (d) 3.13×10^{-2}V

(31) The alternating current has frequency of 10^6 Hz, in such a way that time period for completion of cycle is
(a) 1μs (b) 1.5μs
(c) 10^6sec (d) 1sec

(32) Which of the following quantity remain same in the transformer?
(a) Current (b) Frequency
(c) Voltage (d) All of these

(33) In an iron cored coil, the iron core is removed so that the coil becomes an air-cooled coil. The inductance of the coil will
(a) Increase (b) Decreases
(c) Remain same (d) Initially increases then decreases

(34) The current in a coil of 1000 turns changed from 5A to Zero in 0.5 sec. If an average emf of 50V is induced during this interval, what is the inductance of the coil?
(a) 2H (b) 3H
(c) 4H (d) 5H

(35) For long distance transmission, the transformer used is
(a) Step down (b) Input voltage and output voltage remain same
(c) Step up (d) Amplifier is used

(36) Self inductance of a long solenoid is
(a) $\mu_0n^2\ell A$ (b) μ_0n^2A/ℓ
(c) $\mu_0N^2\ell A$ (d) BAℓN

(37) When north pole of a magnet is moved towards the face of a coil then the face of coil act as
(a) North pole (b) South pole
(c) Neutral (d) We cannot predict about it

(38) The direction of induced current is such that it opposes the every cause that has produced it. This is law of
(a) Faraday (b) Lenz
(c) Ampere (d) Fleming

(39) Which of the following circuit element stores energy in the magnetic field?
(a) Inductor (b) Variable resistor
(c) Condenser (d) Resistance

(40) When back emf is 22.5 volts and voltage is 24 volts and resistance is 20ohm, then the current through the coil is
(a) 0.85A (b) 0.65A
(c) 0.075A (d) 0.95A

Scanned by CamScanner

(41) **Current produced by moving the loop of wire across a magnetic field is called ___**
(a) A.C current (b) D.C current
(c) Induced current (d) Mean square current

(42) **emf induced in a circuit according to Faraday's law depends on the _____**
(a) Maximum magnetic flux
(b) Rate of change of Electric flux
(c) Change in magnetic flux
(d) Time rate of change of magnetic flux

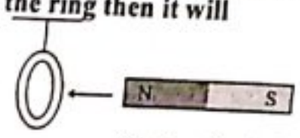
(43) **An alternating current or voltage _____**
(a) Fluctuates off and on
(b) Varies in magnitude alone
(c) Changes its direction again and again
(d) Changes its magnitude continuously and reverses its direction of flow after regularly recurring intervals.

(44) **A dynamo converts _____**
(a) Mechanical energy into electrical energy
(b) Electrical energy into mechanical energy
(c) Magnetic energy into electrical energy
(d) All of these

(45) **Self-inductance of a coil depends upon _____**
(a) Current flowing (b) Number of turns per unit length
(c) Voltage produced (d) All

(46) **The unit of magnetic flux density is**
(a) Wbm^{-2} (b) Tesla
(c) $NA^{-1}m^{-1}$ (d) all of these

(47) **A metallic circular ring is suspended by a string and is kept in a vertical plane. When a magnet is approached towards the ring then it will**



(a) Remain stationary (b) Get displaced away from the magnet
(c) Get displaced towards the magnet (d) Nothing can be said

(48) **A transformer is used to**
(a) convert DC into AC (b) convert AC into DC
(c) obtain the required *DC* voltage (d) obtain the required *AC* voltage

(49) **A straight copper wire is moved in a uniform magnetic field such that it cuts the magnetic lines of force. Then**
(a) emf will not be induced
(b) emf will be induced
(c) sometimes emf will be induced and sometimes not
(d) nothing can be predicted

(50) **When a coil of cross-sectional area *A* and number of turns *N* is rotated in a uniform magnetic field *B* with angular velocity ω, then the maximum emf induced in the coil will be**
(a) *BNA* (b) $\frac{Ba\omega}{N}$
(c) $BNA\omega$ (d) zero

ANSWER KEY

1	a	11	c	21	b	31	a	41	c
2	c	12	d	22	b	32	b	42	d
3	c	13	c	23	a	33	b	43	d
4	d	14	b	24	a	34	d	44	a
5	d	15	a	25	c	35	c	45	b
6	b	16	c	26	b	36	a	46	d
7	b	17	a	27	c	37	a	47	b
8	d	18	d	28	c	38	b	48	d
9	b	19	b	29	a	39	a	49	b
10	d	20	d	30	d	40	c	50	c

EXPLANATORY NOTES

(1) $L_{net} = \frac{\frac{L}{2}\times\frac{L}{2}}{\frac{L}{2}+\frac{L}{2}} = \frac{L}{4}$

(2) $\varepsilon_s = -N\frac{\Delta\phi}{\Delta t}$

(3) Induced emf depends upon number of field lines.

(4) We can determine self-inductance "L" by the following formula

$$\varepsilon = \frac{L\Delta I}{\Delta t} \Rightarrow L = \frac{\varepsilon \times \Delta t}{\Delta I}$$

$$L = \frac{2 \times 3 \times 10^{-2}}{6} = 10mH$$

(5) When there will be change in flux, current will flow in G. It happens only when the switch is just open or closed.

(6) When current in a circuit changes, it induces back emf.

(7) Primary and secondary coil are magnetically linked they are not linked electrically.

(8) These devices use current as input and produce rotation as output just like motor.

(9) $L=\mu_o n^2 AL$

(10) These instruments are based on principle that whenever a loop carrying current is placed in a magnetic field, it experiences a torque which tends to rotate it

(11) $\varepsilon = -N\frac{\Delta\phi}{\Delta t}$

At point "C", the slope is maximum, so emf will be maximum.

Scanned by CamScanner

(12) Iron is ferromagnetic material, so if coil is wounded on iron core, magnetic flux can be increased.

(13) Energy stored = $U_m = \frac{1}{2}LI^2$

(14) The direction of induced current is always so as to oppose the cause of its production.

(15) $L = \mu_o n^2 \ell A \qquad \left(\therefore n = \frac{N}{\ell}\right)$

$$L = \frac{\mu_o N^2 A}{\ell}$$

(16) Lenz's law

(17) $\varepsilon \propto \frac{\Delta\phi}{\Delta t}$

(18) $U_m = \frac{1}{2}LI^2$

OR

$$U_m = \frac{1}{2}\frac{B^2}{\mu_o}A\ell$$

(19) $\frac{N_s}{N_p} = \frac{V_s}{V_p}$

Because $V_s \propto N_s$, $V_p \propto N_p$

(20) Iron is magnetic material. It has less hysteresis loss.

(21) $\varepsilon = vBL\sin\theta$

(22) An open coil has infinite resistance.

(23) $\varepsilon = \frac{N\Delta\phi}{\Delta t} = \frac{B.\Delta A}{\Delta t} = \frac{B.\pi\left(r_2^2 - r_1^2\right)}{\Delta t}$

$\varepsilon = vBL\sin\theta$

$\sin\theta = 1$

(24) $v = 1ms^{-1}$

$L = 1m$

$\varepsilon = B$

(25) $\frac{N_s}{N_p} = \frac{V_s}{V_p}$

$\frac{3}{2} = \frac{V_s}{30}$

$V_s = \frac{90}{2} = 45V$

(26) When magnetic flux changes, current is induced perpendicular to flux, known as eddy current.

(27) $\frac{E_s}{E_p} = \frac{N_s}{N_p}$

$\Rightarrow E_s = \frac{N_S}{N_p}E_p = \frac{500}{5000}\times 2200$

$= 220\,V$

As $E_s i_s = E_p i_p \Rightarrow i_s = \frac{E_p}{E_s}i_p$

Or $i_s = \frac{N_p}{N_s}i_p = \frac{5000}{500}\times 4 = 40A$

(28) $L_e = 2H + 2H = 4H$

$L_e = \frac{8}{6}H$

(29) As $V_s \propto N_s$

So, in step up transformer, no of turns in primary coil will be less and secondary turns will be more.

(30) $\varepsilon = vBL\sin\theta$

(31) $f = 10^6 Hz$

$T = \frac{1}{f} = \frac{1}{10^6} = 1\mu s$

(32) Frequency remains constant in transformer.

(33) $N\phi = LI$

$L = \frac{N\phi}{I}$

$L \propto \phi$

(34) $L = \frac{\varepsilon_L}{\Delta I/\Delta t}$

(35) Step up transformer is used for long distance electrical transmission.

(36) $L = \mu_o nNA$

$N = n\ell$

$\Rightarrow L = \mu_o n^2 \ell A$

Scanned by CamScanner

(37) According to Lenz's law when North pole of magnet is pushed towards the coil, induced current opposes it and creates north pole towards the coil.

(38) Statement of Lenz's law.

(39) Inductor stores energy in magnetic field.

(40) $I = \frac{V - \varepsilon}{R}$

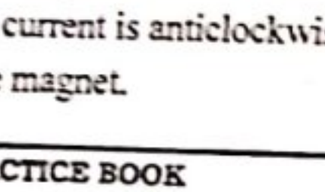
$I = \frac{24 - 22.5}{20}$

$I = 0.075A$

(41) Definition of induced current

(42) $\varepsilon = -\frac{N\Delta\phi_B}{\Delta t}$

(43)



As

$I = I_o \sin\theta = I_o \sin\omega t$

$V = V_o \sin\theta = V_o \sin\omega t$

Since I and V are function of sin θ.

(44) Dynamo acts like A.C generator, which converts mechanical energy in to electrical energy.

(45) $L = \mu_o n^2 Al$

(46) As

$\text{Flux density} = \frac{\phi}{A}$

So

$\text{Unit of flux denstiy} \frac{Wb}{m^2}$

$= Wbm^{-2}$

$= NmA^{-1}m^{-2} \quad \because Wb = NmA^{-1}$

$= Nm^{-1}A^{-1}$

$= T \quad (\because 1T = Nm^{-1}A^{-1})$

(47) North pole should be formed by the current in the ring.
∴ current is anticlockwise and North will repel the North, hence ring is displaced away from the magnet.

(48) A transformer is a device which changes the given alternating emf into low or high alternating emf (i.e. required A.C voltage)

(49) When wire cuts the magnetic field then emf will be induced due to flux changing.

(50)

As

$\varepsilon = N\omega AB\sin\theta$

For maximum induced emf $\theta = 90°$

$\varepsilon = N\omega AB$

Scanned by CamScanner

15 Chapter ELECTROMAGNETIC INDUCTION

SELF ASSESMENT TEST

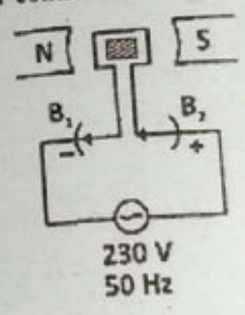
(1) **The turns ratio of a transformer is $\frac{1}{2}$. If a dry cell of emf 1.5 volt is connected with primary coil then emf establish in secondary coil is?**

(a) 0.75 V (b) 3 V
(c) 1.5 V (d) Zero

(2) **Faraday's law states that an induced emf is proportional to:**

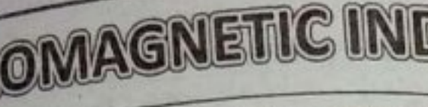
(a) the rate of change of the magnetic field (b) the rate of change of the electric field
(c) the rate of change of the magnetic flux (d) the rate of change of the electric flux

(3) **What is wrong with the D.C. motor connections shown in the figure?**



(a) polarity of the magnets is wrong.
(b) polarity of the carbon brushes B_1 and B_2, is not correct
(c) nothing is wrong with it.
(d) supply voltage is not correct

(4) **Two current-carrying wires (P and Q) are placed between two magnets and their currents are equal but in opposite directions as shown below. What is the direction of the force acting on each wire?**



(a)

Force on P	Force on Q
upwards	upwards

(b)

Force on P	Force on Q
downwards	downwards

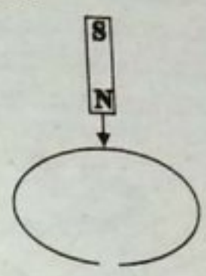
(c)

Force on P	Force on Q
upwards	downwards

(d)

Force on P	Force on Q
downwards	upwards

(5) **A copper ring having a cut such as not to form a complete loop is held horizontally and a bar magnet is dropped through the ring with its length along the axis of the ring. Then acceleration of the falling magnet is:**



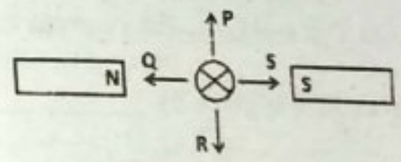
(a) g (b) Less than g
(c) More than g (d) 0

(6) **Which of the following increases the turning speed of a simple D.C. motor?**

(i) An increase in the number of turns of the coil
(ii) An increase in the input of D.C. voltage
(iii) The inserting of a copper core in the coil

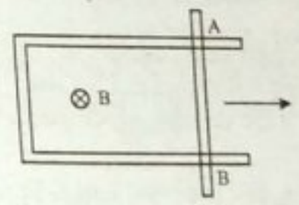
(a) (i), (ii) and (iii) (b) Only (ii) and (iii)
(c) Only (i) and (iii) (d) Only (ii)

(7) **The figure given below shows a current- carrying conductor placed between two magnets. Which of the given arrows correctly indicates the direction of the force acting on the conductor?**



(a) R (b) Q
(c) P (d) S

(8) **A 50 cm long bar AB is moved with a speed of 4 ms^{-1} in a magnetic field B=0.01 T as shown in Fig. The emf generated is.**



(a) 0.01 V (b) 0.02 V
(c) 0.03 V (d) 0.04 V

(9) **The emf developed in a coil X due to the current in a neighboring coil Y is proportional to the:**

(a) thickness of the wire in X (b) resistance of X
(c) rate of change of magnetic field in X (d) magnetic field in X

Scanned by CamScanner

(10) The diagram given below shows a simple D.C. motor. How can the direction of its rotation be reversed?

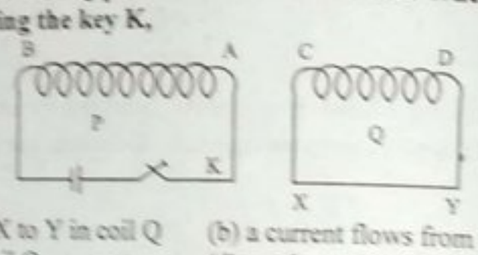
	Direction of magnetic field	Direction of current
(i)	maintain	reverse
(ii)	reverse	maintain
(iii)	reverse	reverse



(a) Only (i) (b) Only (ii)
(c) Only (iii) (d) Only (i) and (ii)

(11) Self inductance of a coil depends upon _____
(a) current flowing (b) number of turns per unit length
(c) voltage produced (d) all

(12) Figure shows two coils P and Q placed close to each other. When the circuit of coil P is suddenly broken by lifting the key K,



(a) a current flows from X to Y in coil Q (b) a current flows from Y to X in coil Q
(c) no current flows in coil Q (d) an alternating current flows in coil Q

(13) Energy stored in a magnetic field is given by _____
(a) LI^2 (b) $\frac{1}{2}L^2I$
(c) $\frac{1}{2}LI^2$ (d) IL^2

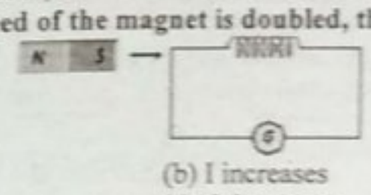
(14) In the equation $\varepsilon = -N\frac{\Delta\phi}{\Delta t}$ the negative sign indicates that
(a) The self-induced current opposes its cause
(b) The accordance of equation with the Lenz's Law
(c) The induced e.m.f opposes the change which produces it.
(d) All of the above

(15) In electromagnetic induction, the induced e.m.f. in a coil is independent of
(a) resistance of the circuit (b) time
(c) change in the flux (d) nones

(16) Which of the following uses electric energy and does not convert it into any other form?
(a) transformer (b) motor
(c) D.C generator (d) A.C generator

(17) The only difference between construction of D.C generator and A.C generator is that of _____
(a) carbon brushes (b) coil
(c) commutator (d) magnetic field

(18) As shown in the figure, a magnet is moved with a fast speed towards a coil at rest. Due to this induced electromotive force, induced current and induced charge in the coil is E, I and Q respectively. If the speed of the magnet is doubled, the incorrect statement



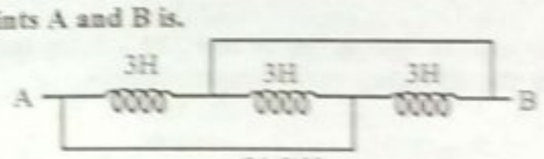
(a) E increases (b) I increases
(c) Q remains same (d) Q increases

(19) Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon:
(a) the materials of wires of the coils
(b) the currents in the two coils
(c) the rates at which currents are changing in the two coil
(d) relative position and orientation of two coils

(20) Power loss in transformer is due to_____
(a) small output (b) eddy currents and magnetic hysterises
(c) soft iron core (d) back emf

(21) Lenz's law is a manifestation of the conservation of
(a) current (b) voltage
(c) Energy (d) all of these

(22) Three pure inductances each of 3H are connected as shown in Fig. The equivalent inductance between points A and B is.



(a) 1 H (b) 2 H
(c) 3 H (d) 9 H

(23) A current in an inductor is reduced to one half. The energy stored in it:
(a) becomes half (b) becomes one-fourth
(c) becomes four times (d) remains unchanged

(24) A coil having 500 square loops each of side 10 cm is placed normal to a magnetic flux which increases at the rate of 1.0 tesla/second. The induced e.m.f. in volts is
(a) 5 (b) 1
(c) 0.1 (d) 0.5

(25) A metallic circular ring is suspended by a string and is kept in a vertical plane. When a magnet is approached towards the ring then it will



(a) Remain stationary (b) Get displaced away from the magnet
(c) Get displaced towards the magnet (d) Nothing can be said

Scanned by CamScanner

(10) The diagram given below shows a simple D.C. motor. How can the direction of the rotation be reversed?

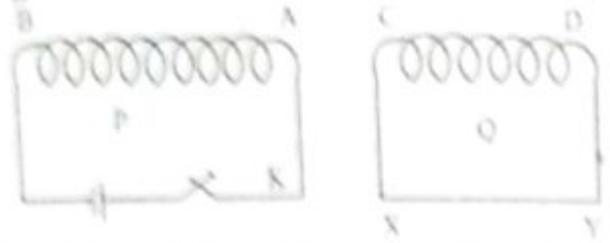
	Direction of magnetic field	Direction of current
(i)	maintain	reverse
(ii)	reverse	maintain
(iii)	reverse	reverse



(a) Only (i) (b) Only (ii)
(c) Only (iii) (d) Only (i) and (ii)

(11) **Self inductance of a coil depends upon** _____
(a) current flowing (b) number of turns per unit length
(c) voltage produced (d) all

(12) **Figure shows two coils P and Q placed close to each other. When the circuit of coil P is suddenly broken by lifting the key K,**



(a) a current flows from X to Y in coil Q (b) a current flows from Y to X in coil Q
(c) no current flows in coil Q (d) an alternating current flows in coil Q

(13) **Energy stored in a magnetic field is given by** _____
(a) LI^2 (b) $\frac{1}{2}LI^2$
(c) $\frac{1}{2}LI$ (d) IL^2

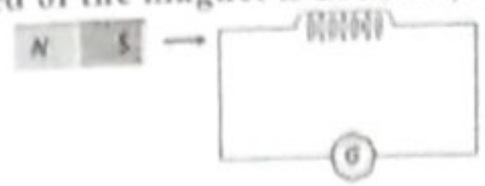
(14) **In the equation** $\varepsilon = -N\frac{\Delta\phi}{\Delta t}$ **the negative sign indicates that**
(a) The self-induced current opposes its cause
(b) The accordance of equation with the Lenz's Law
(c) The induced e.m.f opposes the change which produces it.
(d) All of the above

(15) **In electromagnetic induction, the induced e.m.f. in a coil is independent of**
(a) resistance of the circuit (b) time
(c) change in the flux (d) nones

(16) **Which of the following uses electric energy and does not convert it into any other form?**
(a) transformer (b) motor
(c) D.C generator (d) A.C generator

(17) **The only difference between construction of D.C generator and A.C generator is that of** _____
(a) carbon brushes (b) coil
(c) commutator (d) magnetic field

(18) **As shown in the figure, a magnet is moved with a fast speed towards a coil at rest. Due to this induced electromotive force, induced current and induced charge in the coil is E, I and Q respectively. If the speed of the magnet is doubled, the incorrect statement**



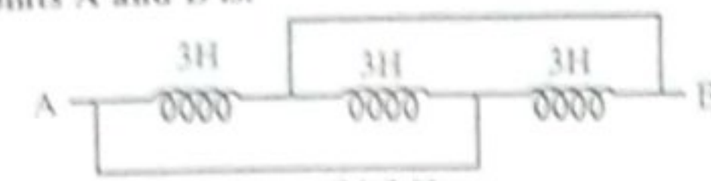
(a) E increases (b) I increases
(c) Q remains same (d) Q increases

(19) **Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon:**
(a) the materials of wires of the coils
(b) the currents in the two coils
(c) the rates at which currents are changing in the two coil
(d) relative position and orientation of two coils

(20) **Power loss in transformer is due to** _____
(a) small output (b) eddy currents and magnetic hysterises
(c) soft iron core (d) back emf

(21) **Lenz's law is a manifestation of the conservation of**
(a) current (b) voltage
(c) Energy (d) all of these

(22) **Three pure inductances each of 3H are connected as shown in Fig. The equivalent inductance between points A and B is.**

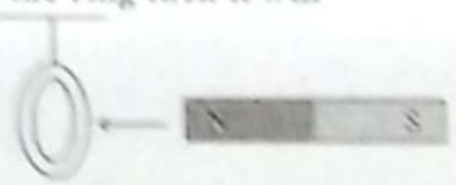


(a) 1 H (b) 2 H
(c) 3 H (d) 9 H

(23) **A current in an inductor is reduced to one half. The energy stored in it:**
(a) becomes half (b) becomes one-fourth
(c) becomes four times (d) remains unchanged

(24) **A coil having 500 square loops each of side 10 cm is placed normal to a magnetic flux which increases at the rate of 1.0 tesla/second. The induced e.m.f. in volts is**
(a) 5 (b) 1
(c) 0.1 (d) 0.5

(25) **A metallic circular ring is suspended by a string and is kept in a vertical plane. When a magnet is approached towards the ring then it will**

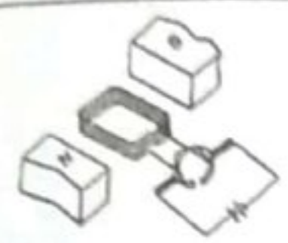


(a) Remain stationary (b) Get displaced away from the magnet
(c) Get displaced towards the magnet (d) Nothing can be said

Scanned by CamScanner

(10) The diagram given below shows a simple D.C. motor. How can the direction of its rotation be reversed?

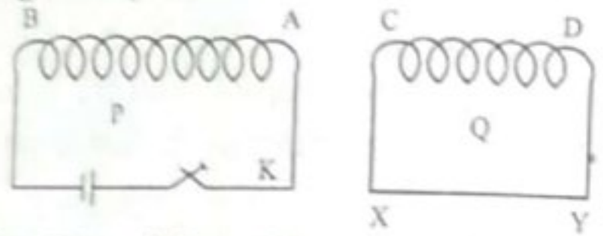
	Direction of magnetic field	Direction of current
(i)	maintain	reverse
(ii)	reverse	maintain
(iii)	reverse	reverse



(a) Only (i) (b) Only (ii)
(c) Only (iii) (d) Only (i) and (ii)

(11) **Self inductance of a coil depends upon** _____
(a) current flowing (b) number of turns per unit length
(c) voltage produced (d) all

(12) **Figure shows two coils P and Q placed close to each other. When the circuit of coil P is suddenly broken by lifting the key K,**



(a) a current flows from X to Y in coil Q (b) a current flows from Y to X in coil Q
(c) no current flows in coil Q (d) an alternating current flows in coil Q

(13) **Energy stored in a magnetic field is given by** _____
(a) LI^2 (b) $\frac{1}{2}L^2I$
(c) $\frac{1}{2}LI^2$ (d) IL^2

(14) **In the equation** $\varepsilon = -N\frac{\Delta\phi}{\Delta t}$ **the negative sign indicates that**
(a) The self-induced current opposes its cause
(b) The accordance of equation with the Lenz's Law
(c) The induced e.m.f opposes the change which produces it.
(d) All of the above

(15) **In electromagnetic induction, the induced e.m.f. in a coil is independent of**
(a) resistance of the circuit (b) time
(c) change in the flux (d) nones

(16) **Which of the following uses electric energy and does not convert it into any other form?**
(a) transformer (b) motor
(c) D.C generator (d) A.C generator

(17) **The only difference between construction of D.C generator and A.C generator is that of** _____
(a) carbon brushes (b) coil
(c) commutator (d) magnetic field

(18) **As shown in the figure, a magnet is moved with a fast speed towards a coil at rest. Due to this induced electromotive force, induced current and induced charge in the coil is E, I and Q respectively. If the speed of the magnet is doubled, the incorrect statement**



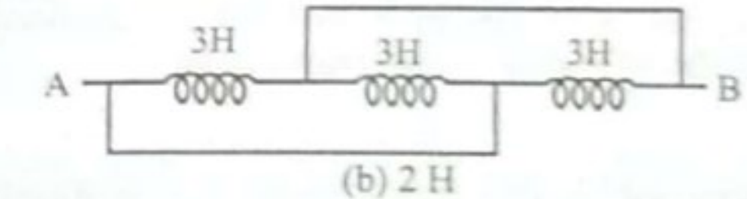
(a) E increases (b) I increases
(c) Q remains same (d) Q increases

(19) **Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon:**
(a) the materials of wires of the coils
(b) the currents in the two coils
(c) the rates at which currents are changing in the two coil
(d) relative position and orientation of two coils

(20) **Power loss in transformer is due to** _____
(a) small output (b) eddy currents and magnetic hysterises
(c) soft iron core (d) back emf

(21) **Lenz's law is a manifestation of the conservation of**
(a) current (b) voltage
(c) Energy (d) all of these

(22) **Three pure inductances each of 3H are connected as shown in Fig. The equivalent inductance between points A and B is.**

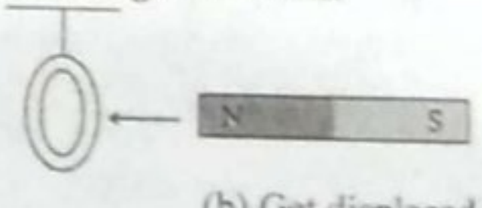


(a) 1 H (b) 2 H
(c) 3 H (d) 9 H

(23) **A current in an inductor is reduced to one half. The energy stored in it:**
(a) becomes half (b) becomes one-fourth
(c) becomes four times (d) remains unchanged

(24) **A coil having 500 square loops each of side 10 cm is placed normal to a magnetic flux which increases at the rate of 1.0 tesla/second. The induced e.m.f. in volts is**
(a) 5 (b) 1
(c) 0.1 (d) 0.5

(25) **A metallic circular ring is suspended by a string and is kept in a vertical plane. When a magnet is approached towards the ring then it will**



(a) Remain stationary (b) Get displaced away from the magnet
(c) Get displaced towards the magnet (d) Nothing can be said

Scanned by CamScanner

(10) The diagram given below shows a simple D.C. motor. How can the direction of the rotation be reversed?

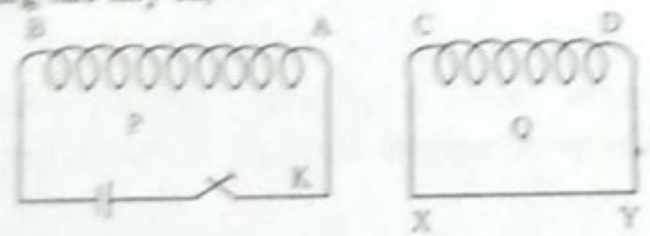
	Direction of magnetic field	Direction of current
(i)	maintain	reverse
(ii)	reverse	maintain
(iii)	reverse	reverse



(a) Only (i) (b) Only (ii)
(c) Only (iii) (d) Only (i) and (ii)

(11) **Self inductance of a coil depends upon** _____
(a) current flowing (b) number of turns per unit length
(c) voltage produced (d) all

(12) **Figure shows two coils P and Q placed close to each other. When the circuit of coil P is suddenly broken by lifting the key K,**



(a) a current flows from X to Y in coil Q (b) a current flows from Y to X in coil Q
(c) no current flows in coil Q (d) an alternating current flows in coil Q

(13) **Energy stored in a magnetic field is given by** _____
(a) LI^2 (b) $\frac{1}{2}L^2I$
(c) $\frac{1}{2}LI^2$ (d) IL^2

(14) **In the equation $\varepsilon = -N\frac{\Delta\phi}{\Delta t}$ the negative sign indicates that**
(a) The self-induced current opposes its cause
(b) The accordance of equation with the Lenz's Law
(c) The induced e.m.f opposes the change which produces it.
(d) All of the above

(15) **In electromagnetic induction, the induced e.m.f. in a coil is independent of**
(a) resistance of the circuit (b) time
(c) change in the flux (d) nones

(16) **Which of the following uses electric energy and does not convert it into any other form?**
(a) transformer (b) motor
(c) D.C generator (d) A.C generator

(17) **The only difference between construction of D.C generator and A.C generator is that of** _____
(a) carbon brushes (b) coil
(c) commutator (d) magnetic field

(18) **As shown in the figure, a magnet is moved with a fast speed towards a coil at rest. Due to this induced electromotive force, induced current and induced charge in the coil is E, I and Q respectively. If the speed of the magnet is doubled, the incorrect statement**



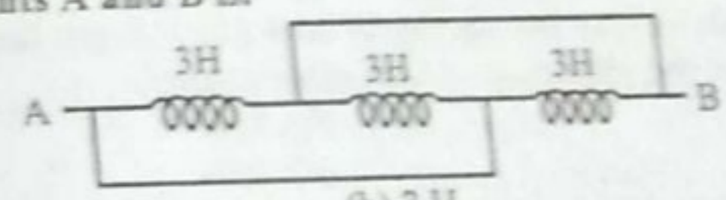
(a) E increases (b) I increases
(c) Q remains same (d) Q increases

(19) **Two coils are placed close to each other. The mutual inductance of the pair of coils depends upon:**
(a) the materials of wires of the coils
(b) the currents in the two coils
(c) the rates at which currents are changing in the two coil
(d) relative position and orientation of two coils

(20) **Power loss in transformer is due to** _____
(a) small output (b) eddy currents and magnetic hysterises
(c) soft iron core (d) back emf

(21) **Lenz's law is a manifestation of the conservation of**
(a) current (b) voltage
(c) Energy (d) all of these

(22) **Three pure inductances each of 3H are connected as shown in Fig. The equivalent inductance between points A and B is.**

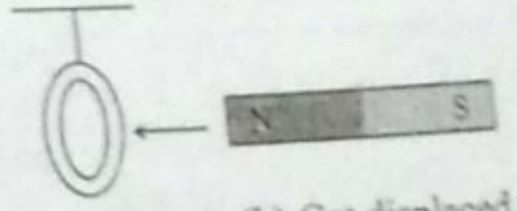


(a) 1 H (b) 2 H
(c) 3 H (d) 9 H

(23) **A current in an inductor is reduced to one half. The energy stored in it:**
(a) becomes half (b) becomes one-fourth
(c) becomes four times (d) remains unchanged

(24) **A coil having 500 square loops each of side 10 cm is placed normal to a magnetic flux which increases at the rate of 1.0 tesla/second. The induced e.m.f. in volts is**
(a) 5 (b) 1
(c) 0.1 (d) 0.5

(25) **A metallic circular ring is suspended by a string and is kept in a vertical plane. When a magnet is approached towards the ring then it will**

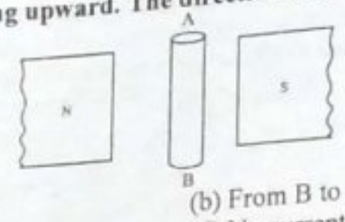


(a) Remain stationary (b) Get displaced away from the magnet
(c) Get displaced towards the magnet (d) Nothing can be said

Scanned by CamScanner

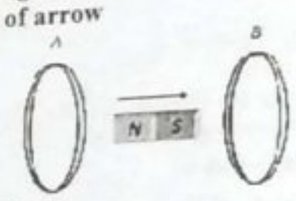
(26) **The north pole of a magnet is brought near a metallic ring. The direction of the induced current in the ring will be**
(a) clockwise (b) anticlockwise
(c) towards north (d) towards south

(27) **In the conductor is moving upward. The direction of induced e.m.f. is.....**



(a) From A to B (b) From B to A
(c) None of the above (d) No current flows

(28) **In the diagram shown if a bar magnet is moved along the common axis of two single turn coils A and B in the direction of arrow**



(a) current is induced only in A & not in B
(b) induced currents in A & B are in the same direction
(c) induced currents in A & B are in opposite directions
(d) current is induced only in B and not in A

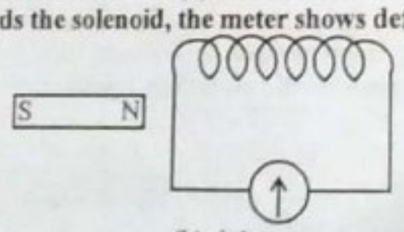
(29) **If the magnetic flux linked with a coil varies at the rate of 1 wb/min, the induced emf is**
(a) 1V (b) 60 V
(c) 1/60 V (d) .5 V

(30) **The transformer is used to light a 100 W and 220 V lamp from 220 V mains. If the main current is 0.5 amp, the efficiency of the transformer is**
(a) 11% (b) 55%
(c) 50% (d) 90%

(31) **A coil having an area $2m^2$ is placed in a magnetic field which changes from $1Wb/m^2$ to $4Wb/m^2$ in a interval of 2 second. The e.m.f. induced in the coil will be**
(a) 3 V (b) 1.5V
(c) 2 V (d) 4V

(32) **A magnet is brought towards a coil (i) speedily (ii) slowly then the induced e.m.f./induced charge will be respectively**
(a) more in first case / more in first case (b) more in first case/equal in both case
(c) less in first case/more in second case (d) less in first case/equal in both case

(33) **In pushing the magnet towards the solenoid, the meter shows deflection towards**



(a) left (b) right
(c) no deflection (d) vibration

(34) **The out put voltage of a transformer is 3 times the input voltage then turns ratio will be**
(a) 1/3 (b) 3
(c) 1 (d) 6

(35) **When a dc motor operates at 200 V, the initial current is 5A, but when it runs at maximum speed, the current is only 3A. What is the back emf?**
(a) 80 V (b) 120 V
(c) 200 V (d) Zero

(36) **A copper ring is held horizontally and a bar magnet is dropped through the ring with its length along the axis of the ring. The acceleration of the falling magnet while it is passing through the ring is**
(a) depends on the diameter of the ring and the length of the magnet
(b) more than that due to gravity
(c) equal to that due to gravity
(d) less than that due to gravity

(37) **An electric current induced within the body of a conductor when that conductor either moves through a non-uniform magnetic field or in a region where there is a change in magnetic flux is called**
(a) induced current (b) eddy current
(c) back emf (d) none of the above

(38) **A cylindrical bar magnet is kept along the axis of a circular coil. If the magnet is rotated about its axis, then**
(a) a current will be induced in a coil
(b) no current will be induced in a coil
(c) only an e.m.f. will be induced in the coil
d) an e.m.f. and a current both will be induced in the coil

(39) **Transformer works on the principle of**
(a) Lenz's law (b) Faraday's Law
(c) Mutual induction (d) Law of conservation of power

(40) **When the motor is at its maximum speed, then back emf will be**
(a) maximum (b) zero
(c) intermediate values (d) no back emf

(41) **A transformer is used to light a 55 W and 110 V lamp from a 220 V mains. If the main current is 0.5 A, the efficiency of the transformer is approximately.**
(a) 10% (b) 30%
(c) 50 % (d) 90 %

(42) **When current of coil changes from 8A to 2A in 3×10^{-2} s, the emf induced in the coil is 2V. The self-inductance of the coil (in mH)**
(a) 1 (b) 5
(c) 20 (d) 10

(43) **The self-inductance of straight wire is**
(a) zero (b) infinity
(c) negative (d) positive

(44) **A loss free transformer has 500 turns on its primary winding and 2500 in secondary. The meters of the secondary indicate 200 volts at 8 amperes under these conditions. The voltage and current in the primary is**
(a) 100 V, 16 A (b) 160 V, 10 A
(c) 40 V, 40 A (d) 80 V, 20 A

Scanned by CamScanner

(45) In a transformer 220 ac voltage is increased to 2200 volts. If the number of turns in the secondary are 2000, then the number of turns in the primary will be.
(a) 100 (b) 200
(c) 200 (d) 20

(46) If the current in the primary coil and number of turns in it are I_P and N_P respectively and the number of turns and current in the secondary are N_S and I_S respectively then the value the of $N_S:N_P$
(a) $I_S : I_P$ (b) $I_P : I_S$
(c) $I_S^2 : I_P^2$ (d) $I_P^2 : I_S^2$

(47) Primary secondary coils of a transformer have 50 and 200 turns respectively. When primary is connected to 9 V battery secondary voltage is
(a) 90 (b) 36
(c) 18 (d) Zero

(48) Eddy currents are produced in a material when it is
(a) heated (b) placed in an electric field
(c) placed in a time varying magnetic field (d) placed in a uniform magnetic field

(49) A step-up transformer is used on a 120 V line to provide a potential difference of 2400 V. If the primary coil has 75 turns, the number of turns in the secondary coil is
(a) 1500 (b) 150
(c) 1200 (d) 1575

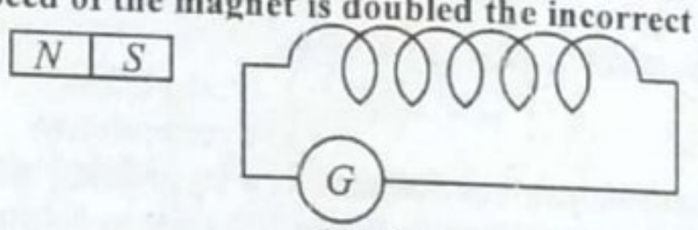
(50) In which of the following the commutators are used
(a) A.C generator (b) D.C generator
(c) D.C motor (d) both b and c

(51) The energy stored in an inductance is 1 joule when a current of 0.1 ampere is established in it. The self-inductance of the coil is
(a) 200 H (b) 50 H
(c) 25 H (d) 2.59 H

(52) Two inductors each equal to L are joined in parallel. The equivalent inductance is
(a) zero (b) 2L
(c) L (d) $\frac{L}{2}$

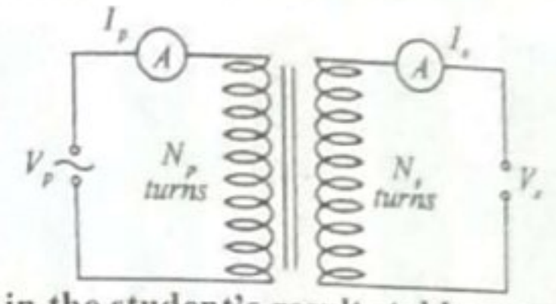
(53) A square coil 10^{-2} m^2 area is placed perpendicular to a uniform magnetic field of intensity $10^3 wb/m^2$ the magnetic flux through the coil is
(a) 10 wb (b) 10^{-5} wb
(c) 10^{-5} wb (d) 100 wb

(54) As shown in fig. a magnet is moved with a fast speed towards a coil at rest. Due to this induced electromotive force, induced current and induced charge in the coil is E, I and Q respectively. If the speed of the magnet is doubled the incorrect statement is



(a) E increases (b) I increases
(c) Q increase (d) Q remains same

(55) In a laboratory experiment to test a transformer, a student used the circuit shown in the diagram to take measurements.



Two of the original entries in the student's results table are missing as shown:

V_p/V	I_p/mA	N_p turns	V_s/V	I_s/mA	N_s turns
240	2.0	?	?	50	50

Assuming the transformer was 100% efficient, what are the missing results?

	N_p turns	V_s/V
(a)	2	6000
(b)	50	9.6
(c)	480	1.0
(d)	1250	9.6

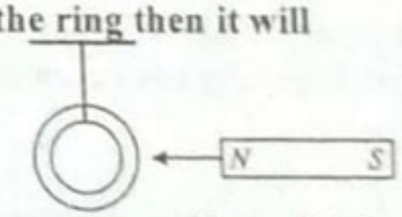
(56) The north pole of a long horizontal bar magnet is being brought closer to a vertical conducting plane along the perpendicular direction. The direction of the induced current in the conducting plane will be
(a) horizontal (b) vertical
(c) clockwise (d) anticlockwise

(57) The dimensions of magnetic flux are
(a) $\left[MLT^{-2}A^{-2}\right]$ (b) $\left[ML^2T^{-2}A^{-2}\right]$
(c) $\left[ML^2T^{-1}A^{-2}\right]$ (d) $\left[ML^2T^{-2}A^{-1}\right]$

(58) The armature of a generator consist of a flat square coil of side 4 cm and 200 turns. The coil rotates in a magnetic field of 0.75T. The angular speed so that a maximum emf of 1.6V is generated is _____
(a) $\frac{20}{3} rads^{-1}$ (b) $\frac{20}{3} rotations/s$
(c) $\frac{20}{3} rpm$ (d) none

(59) The areas of cross-section of two solenoids A and B of equal length are equal are equal but the number of turns in the solenoid A is double than that of B. If the coefficient of self-induction of B is 6 mH, then the coefficient of self-induction of A will be
(a) 12 mH (b) 3 mH
(c) 24 mH (d) 1.5 mH

(60) A metallic circular ring is suspended by a string and is kept in a vertical plane. When a magnet is approached towards the ring then it will



(a) remain stationary (b) get displaced away from the earth
(c) get displaced towards the magnet (d) nothing can be said

Scanned by CamScanner

ANSWER KEY

1	d	11	b	21	c	31	a	41	c	51	a
2	c	12	b	22	a	32	b	42	d	52	d
3	d	13	c	23	b	33	b	43	a	53	a
4	d	14	d	24	a	34	b	44	c	54	c
5	a	15	a	25	b	35	a	45	c	55	d
6	d	16	a	26	b	36	d	46	b	56	d
7	a	17	c	27	b	37	b	47	d	57	d
8	b	18	d	28	c	38	b	48	c	58	a
9	c	19	d	29	a	39	c	49	a	59	c
10	d	20	b	30	d	40	a	50	d	60	b

EXPLANATORY NOTES

(1) Transformer does not operate on D.C
So, emf establish in secondary is zero

(2) $\varepsilon = -\frac{N\Delta\phi_B}{\Delta t} \Rightarrow \varepsilon \propto \frac{\Delta\phi_B}{\Delta t}$

(3) D.C motor required D.C supply.

(4) According to Fleming's left-hand rule, the force on P are acting downward and the force on Q are acting upward.

(5) When loop incomplete, induced current is zero. Magnet is freely falling $(a = g)$

(6) $\varepsilon = N\omega AB\sin\theta \Rightarrow \varepsilon \propto \omega \Rightarrow$ Applied voltage $\propto$ speed of coil

(7) According to Fleming's left-hand rule, arrow R correctly indicates the direction of force acting on the conductor

(8) $\varepsilon = vBL\sin\theta$
Where $\theta = 90°$
$\varepsilon = vBL$

(9) $\varepsilon_s = -\frac{M\Delta I_p}{\Delta t}$

(10) The direction of current and the direction of magnetic field are both the factors affecting the direction of force acting on the coil. If both reverse simultaneously then there will be no effect

(11) $L=\mu_0 n^2 Al$

(12) When circuit P On direction of induced current x to y in circuit Q. When circuit P Off suddenly, direction of induced current will reverse y to x according Lenz's law.

(13) $U_m = \frac{1}{2}LI^2$

(14) Negative sign is according Lenz's law, it represents the induced e.m.f opposes the change which produces it and direction of induced current.

(15) $\varepsilon = N\frac{\Delta\phi}{\Delta t}$

(16) A transformer is an electrical device used to change a given alternating emf into a larger or smaller alternating emf.

(17) Commutator is only use in DC generator

(18) Induced charge magnitude will remain constant but speed of induce charge will increase.

(19) Mutual inductance depends upon
1) Number of turns of the coils
2) Area of cross-section
3) Relative position, orientation and closeness of primary and secondary coil
4) Nature of core of material

(20) Two main causes of power loss in transformer
a) Eddy current
b) Hysteresis loss

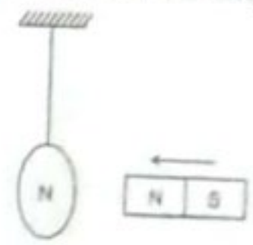
(21) It obeys law of conservation of energy.

(22) Parallel combination of inductor
$\frac{1}{L_{eq}} = \frac{1}{L_1} + \frac{1}{L_2} + \frac{1}{L_3}$

(23) $U_m = \frac{1}{2}LI^2$
$U_m = \frac{1}{2}L\left(\frac{I}{2}\right)^2$
$U_m = \frac{1}{4}\left(\frac{1}{2}LI^2\right)$
$U_m = \frac{1}{4}U_m$

(24) $\varepsilon = N\left(\frac{\Delta\phi}{\Delta t}\right) = N\left(\frac{\Delta B}{\Delta t}\right)A\cos\theta = 500\times1\times\left(10\times10^{-2}\right)^2\cos\theta = 5V$

(25) According to Lenz's law, the current induced in the ring oppose the cause that produce it



(26) According to Lenz's law.

(27) $F = q\left(\vec{V}\times\vec{B}\right)$, emf is in the direction of force

(28) $\varepsilon = \frac{\Delta\phi}{\Delta t} = \frac{1Wb}{\min} = \frac{1Wb}{60s} = \frac{1}{60}V$

(29) Faraday's laws involve conversion of mechanical energy into electric energy. This is in accordance with the law of conservation of energy

(30) Efficiency$=\frac{\text{output power}}{\text{input power}}\times100\%$
$\therefore$ input power$=V\times I$
$=\frac{100}{220\times0.5}\times100\%$
$=0.90\times100\%$
$=90\%$

Scanned by CamScanner

(31) $\varepsilon = -N\frac{\Delta\phi}{\Delta t} = -N\frac{\Delta B.A}{\Delta t}$

$= -(1)\frac{(4-1)}{2}2 = 3V$

(32) $\varepsilon = vBL\sin\theta \rightarrow \varepsilon \propto v$

(33) When magnet push toward solenoid, flux change with respect to time will increase and induced current will also increase, it increases show deflection of meter towards right.

(34) $V_S = 3V_P$

$\frac{V_S}{V_P} = \frac{3}{1}$

$\frac{N_S}{N_P} = \frac{V_S}{V_P} = \frac{3}{1}$

(35) V=IR

$R = \frac{V}{I} = \frac{200}{5} = 40\Omega$

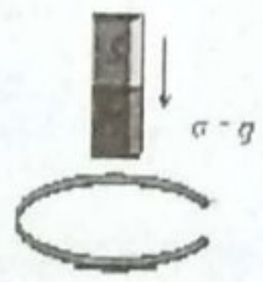
We know,

$V = \varepsilon + IR$

$\varepsilon = 200 - 3(40)$

$\varepsilon = 80V$

(36) When the magnet is allowed to fall vertically along the axis of loop with its north pole towards the ring. The upper face of the ring will behave north pole according Lenz's law Therefore the acceleration in the magnet is less than g. Note: If coil is broken at any point then induced emf will be generated in it but no induced current will flow. In this condition the coil will not oppose the motion of magnet and the magnet will fall freely with acceleration g. (i.e. a = g)



(37) Definition of Eddy current

(38) Because there is no change in flux linked with coil

(39) Transformer works on the principle of mutual induction between two coils

(40) $\varepsilon = N\omega AB \rightarrow \varepsilon \propto \omega$

(41) $\eta = \frac{output\ power}{input\ power}$

$= \frac{55W}{(220\times 0.5)W} = \frac{55}{110}$

$\%\ \text{efficiency} = \frac{55}{110}\times 100\% = 50\%$

(42) We can determine self-inductance "L" by the following formula

$\varepsilon = \frac{L\Delta I}{\Delta t} \Rightarrow L = \frac{\varepsilon \times \Delta t}{\Delta I}$

$L = \frac{2\times 3\times 10^{-2}}{6^2} = 10mH$

(43) $L = \mu_0 n^2 AL$, self-inductance depends upon number of turns, area and length.

For straight wire, n = 0 ⇒ L = 0

(44) $\frac{V_p}{V_s} = \frac{N_p}{N_s} = \frac{500}{2500} = \frac{1}{5} \Rightarrow V_p = \frac{200}{5} = 40V$ Also $i_p V_p = i_s V_s \Rightarrow i_p = i_s \frac{V_s}{V_p} = 8\times 5 = 40A$

(45) $\frac{V_p}{V_s} = \frac{N_p}{N_s} \Rightarrow N_p = \left(\frac{220}{2200}\right)2000 = 200$

(46) $\frac{N_S}{N_P} = \frac{V_S}{V_P}$

As we know that

$P_P = P_S \Rightarrow V_P I_P = V_S I_S$

$\frac{I_P}{I_S} = \frac{V_s}{V_P}$

So, $\frac{N_S}{N_P} = \frac{I_P}{I_S}$

(47) Transformer does not operate on D.C.

(48) Eddy currents are produced due to varying magnetic field in direction perpendicular to magnetic flux.

(49) $\frac{N_S}{N_P} = \frac{V_S}{V_P}$

$\frac{N_S}{75} = \frac{2400}{120}$

$N_S = 20\times 75 = 1500$

(50) In case of D.C motor and D.C generator, commutators are used to prevent change in polarity.

(51) $E = \frac{1}{2}LI^2$ or $L = \frac{2E}{I^2} = \frac{2\times 1}{0.1\times 0.1}H = 200H$

(52) $\frac{1}{L_e} = \frac{1}{L_1} + \frac{1}{L_2} = \frac{L}{2}$

(53) $(\phi = BA = 10wb)$

(54) Induced charge does not depend upon the speed of magnet.

(55) Assume the transformer to be tested is an ideal one then

$\frac{V_p}{V_s} = \frac{N_p}{N_s} = \frac{I_s}{I_p}$

Given $V_p = 240V\ N_s = 50\ turns,$

$I_s = 50mA.\ I_p = 2.0mA$

$\Rightarrow \frac{240}{V_s} = \frac{N_p}{50} = \frac{50}{2} = 25.$

$\therefore\ V_s = 9.6\ V\ and\ N_p = 1250\ turns.$

Scanned by CamScanner

(56) (According to Lenz's law)

(57) $\phi = BA = \frac{F}{IL}A = \frac{Kgms^{-2}}{Am}m^2 = \left[ML^2T^{-2}A^{-1}\right]$

(58) $\varepsilon_{max} = N\omega AB \Rightarrow \omega = \frac{\varepsilon}{NAB} = \frac{1.6}{(200)\left(\frac{4\times4}{100\times100}\right)(0.75)} = \frac{20}{3} rad/s$

(59) $L = \frac{\mu_0 N^2 A}{l}$

μ_0, A and l are constants.

$L \propto N^2$

$L_s = 2\times2\times L_s = 4\times6mH = 24mH$

(60) Statement of Lanz's law.

16 chapter ALTERNATING CURRENT

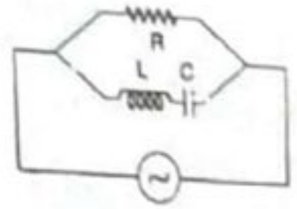
PRACTICE EXERCISE

(1) **In pure inductive circuit, the power is** $P=VI,\ I^2R^{no}$
(a) Infinite
(b) Zero
(c) Maximum
(d) Minimum

(2) **At resonance the value of the power factor in an L-C-R series circuit is _____**
(a) Zero
(b) $\frac{1}{2}$
(c) 1
(d) Not definite

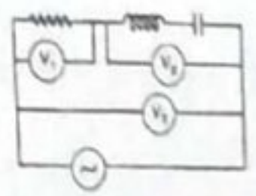
(3) **An A.C series circuit contain 4Ω resistance and 3-Ω inductive reactance. The impedance of the circuit is _____**
(a) 1 Ω
(b) 5 Ω
(c) 7 Ω
(d) $7/\sqrt{2}$ Ω

(4) **The current in resistance R at resonance is**



(a) Zero
(b) Minimum but finite
(c) Maximum but finite
(d) Infinite

(5) **A resistor R, an inductor L, a capacitor C and voltmeters V_1, V_2 and V_3 are connected to an oscillator in the circuit as shown in the following diagram. When the frequency of the oscillator is increased, then at resonance frequency, the voltmeter reading is zero in the case of:**



(a) Voltmeter V_1
(b) All the three voltmeters
(c) Voltmeter V_3
(d) Voltmeter V_2

(6) **The phase angle between the voltage and the current in an AC circuit consisting of a resistance is _____**
(a) Zero
(b) 45°
(c) 90°
(d) 180°

(7) **In an LCR series circuit, if V is the effective value of the applied voltage, V_R is the voltage across R, V_L is the effective voltage across L & V_c is the effective voltage across C then _____**
(a) $V = V_R+V_L+V_C$
(b) $V^2=V_R^2+V_L^2+V_C^2$
(c) $V^2=V_R^2+(V_L-V_C)^2$
(d) $V^2=V_L^2+(V_R-V_C)^2$

(8) **When a voltage $V = V_o \cos \omega t$ is applied across a resistor of resistance R, the average power dissipated per cycle in the resistor is given by_____**
(a) $\frac{V_o}{\sqrt{2}R}$
(b) $\frac{V_o}{\sqrt{2}\omega R}$
(c) $\frac{V_o^2}{2R}$
(d) $\frac{V_o^2}{2\omega R}$

Scanned by CamScanner

(9) Radio receivers are usually tuned by adjusting the capacitor of an LC circuit. If $C = C_1$ for a frequency of 600kHz, then for a frequency of 1200kHz one must adjust C to
(a) $C_1/2$ (b) $C_1/4$
(c) $2C_1$ (d) $4C_1$

(10) In a metal detector, in absence of any metal the inductance L_A and L_B have the relation
(a) $L_A > L_B$ (b) $L_A < L_B$
(c) $L_A = L_B$ (d) None of these

(11) At what time the instantaneous voltage is half of the maximum voltage (T is time period)
(a) $\frac{T}{2}$ (b) $\frac{T}{12}$
(c) $\frac{T}{6}$ (d) $\frac{T}{4}$

(12) If the frequency of A.C supply across an inductor is doubled then its reactance
(a) Remains same (b) Is doubled
(c) Halved (d) Quadrupled

(13) At what frequency will an inductor of 1.0H have a reactance of 500Ω
(a) 50 Hz (b) 60 Hz
(c) 70 Hz (d) 80 Hz

(14) In acceptor circuit at resonance the impedance of the circuit is
(a) Zero (b) Minimum
(c) Maximum (d) Infinite

(15) Which of the following statements is wrong regarding electromagnetic waves
(a) Travel in free space at the speed of light (b) Travel with same speed in all media
(c) Are transverse (d) Are produced by accelerating charge

(16) In an alternating voltage the instantaneous value is equal to $-V_0$. The phase angle at this instant is equal to
(a) 0^0 (b) 90^0
(c) 180^0 (d) 270^0

(17) If the instantaneous current in a circuit is given by $I=2\sin(\omega t+0)$ amperes, the rms value of the current is
(a) $\sqrt{2}$A (b) 2A
(c) $2\sqrt{2}$ A (d) zero

(18) Hot wire ammeter can be used for measuring
(a) A.C only (b) D.C only
(c) Both a.c and d.c (d) Neither a.c nor d.c

(19) The impedance of a circuit consist of 3Ω resistance and 4Ω reactance. The power factor of circuit is
(a) 0.4 (b) 0.6
(c) 0.8 (d) 1

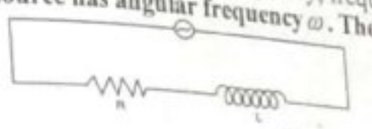
(20) The same alternating current is flowing in two circuits A&B. A contains only capacitor, B contains only inductor. If the frequency of the supply is increased in both, the current
(a) Increases in both (b) Decreases in both
(c) Increases in A decreases in B (d) Decreases in A increases in B

(21) Dimension of L/CR is same as that of
(a) L (b) R
(c) C (d) None of these

(22) In an A.C circuit average value of
(a) Current is zero (b) Power dissipation is zero
(c) Square of current is zero (d) None of these

(23) In frequency modulation _____ of carries waves changes with _____ of audio signal
(a) Amplitude, amplitude (b) Amplitude, frequency
(c) Frequency, amplitude (d) Frequency, frequency

(24) In the given LR circuit, the source has angular frequency ω. The power factor of the circuit is



(a) $\frac{L}{R}$ (b) $\frac{R}{\sqrt{R^2+\omega^2L^2}}$
(c) $R/\omega L$ (d) $R+\omega L$

(25) An alternating current of r.m.s value of 4.0 A and frequency 50Hz flows in a circuit containing 10Ω resistor. The peak current is then
(a) 20A (b) 20.66A
(c) 6.66A (d) 5.66A

(26) An alternating current of r.m.s value of 2A and a steady direct current I flowing through identical resistors dissipate heat at the same rate. What is the current I?
(a) 2A (b) $\sqrt{2}$A (c) 1A (d) $2\sqrt{2}$A

(27) An alternating current is represented by the equation $I = I_o\sin\omega t$, which of the following equation represents an alternating current of frequency and amplitude twice that of the above current?
(a) $I = 2I_oSin(\omega t/2)$ (b) $I=2I_oSin(2\omega t)$
(c) $I=2I\sin\omega t$ (d) $I=I_o\sin(2\omega t)$

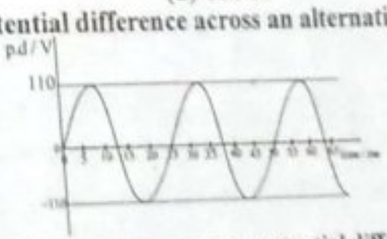
(28) In pure resistor circuit, the voltage and current are
(a) Lagging each other (b) At 90° phase difference
(c) Zero phase difference (d) No phase difference

(29) The power factor of an ac circuit has the value
(a) Unity when the circuit contains only an inductance
(b) Unity when the circuit contains only a resistance
(c) Unity when the circuit contains resistance and capacitor
(d) Unity when the circuit contains only a capacitance

(30) In capacitive circuit, the current
(a) Lags behind voltage by $\pi/2$ (b) Is in phase with voltage
(c) Opposite in phase of voltage by π (d) Leads the voltage by $\pi/2$

(31) A 100μF capacitor with 12V source in series having frequency 50Hz, will offer a capacitive reactance of about
(a) 32Ω (b) 60 Ω
(c) 50 Ω (d) 100 Ω

(32) The graph shows how the potential difference across an alternating supply varies with time.



What are the frequencies f and the root-mean square potential difference V_{rms} of the a.c. supply?

	f / Hz	V_{rms} / V
(a)	40	156
(b)	40	78
(c)	400	156
(d)	400	78

Scanned by CamScanner

(33) **The impedance of an RLC series circuit is definitely increased if:**
(a) C decreases (b) R increases
(c) L decreases (d) L increases

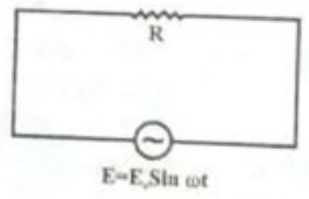
(34) **A wire of resistance R is coiled inductively so that its inductance is L. The impedance of the coil at a frequency of f is**
(a) $(R+2\pi fL)^{1/2}$ (b) $R+1/2\pi fL$
(c) $(R^2+f^2L^2)^{1/2}$ (d) $(R^2+4\pi^2f^2L^2)^{1/2}$

(35) **Ammeter connected in an AC circuit measures**
(a) Exact value of current (b) rms value of current
(c) Net value of current (d) Peak value of current

(36) **When a pure inductor of inductance L, and a pure capacitor of capacitance C are connected in parallel to a sinusoidal potential difference V, the potential difference across both L&C will be**
(a) Same (b) Different
(c) At L will be more than at C (d) At L will be less than at C

(37) **When the frequency of the oscillator in a series RLC circuit is doubled**
(a) The capacitive reactance is doubled (b) The capacitive reactance is halved
(c) The impedance is doubled (d) The current amplitude is halved

(38) **In the following circuit diagram if the frequency of the source is double then the value of current flowing in R will become**



(a) Double (b) Remain unchanged
(c) Half (d) Four times

(39) **The rms value of an ac current is**
(a) Its peak value
(b) Is average value
(c) That steady current that produces the same rate of heating in a resistor as the actual current
(d) That steady current that will charge a battery at the same rate as the actual current

(40) **A 10Ω electric heater is connected to a 220V, 50Hz mains supply. What is the peak value of the potential difference across the heater element?**
(a) 220V (b) $\frac{220}{\sqrt{2}}$ V
(c) 110V (d) $220\sqrt{2}$ V

(41) **An alternating current *I*/*A* varies with time *t*/*s* according to the equation $I = 5\sin(100\pi t)$ What is the mean power developed by the current in a resistive load of resistance 10Ω**
(a) 125W (b) 160W
(c) 250W (d) 500W

(42) **The frequency of AC is 50 Hz. How many times the current becomes zero in one second?**
(a) 50 times (b) 100 times
(c) 200 times (d) 25 times

(43) **Average value of current and voltage over a cycle of AC is**
(a) Positive (b) Negative
(c) Both (d) Zero

(44) **A changing magnetic flux produces around itself an induced _____**
(a) Magnetic field (b) Electric field
(c) Electromagnetic force (d) Artificial gravitational field

(45) **An electromagnetic wave consists of _____**
(a) Electric and magnetic fields moving parallel to each other
(b) Magnetic field moving with velocity of light in space
(c) Electric field moving with velocity of light
(d) Electric and magnetic fields moving perpendicular to each other

(46) **A constant current of 2.8 A exists in a resistor. The rms current**
(a) 2.8 A (b) 1.4 A
(c) about 2 A (d) undefined for a direct current

(47) **The peak value of AC is $2\sqrt{2}$ ampere. Its apparent value will be**
(a) 1 ampere (b) 2 ampere
(c) 4 ampere (d) zero

(48) **The power dissipated in a resistor is the same for a constant potential difference V as for a sinusoidal potential difference with peak value V_0. Which of the following is the correct relationship between V and V_0?**
(a) $V_0 = \frac{V}{2}$ (b) $V_0 = V$
(c) $V_0 = \frac{V}{\sqrt{2}}$ (d) $V_0 = \sqrt{2}V$

(49) **A sinusoidal current has rms value 10 A. what is the peak value of current?**
(a) 14.14 A (b) 0.14 A
(c) 1.14 A (d) 144.1 A

(50) **The rms value of a sinusoidal current is given by the square root of the mean value of**
(a) $\frac{I_0}{2}$ (c) $\frac{I_0^2}{2}$
(b) $\frac{I_0^2}{\sqrt{2}}$ (d) I_0^2

ANSWER KEY

1	b	11	b	21	b	31	a	41	a
2	c	12	b	22	a	32	b	42	b
3	b	13	d	23	c	33	d	43	d
4	c	14	b	24	b	34	d	44	b
5	d	15	b	25	d	35	b	45	d
6	a	16	d	26	a	36	a	46	a
7	c	17	a	27	b	37	b	47	b
8	c	18	c	28	c	38	b	48	d
9	b	19	b	29	b	39	c	49	a
10	c	20	c	30	d	40	d	50	c

Scanned by CamScanner

EXPLANATORY NOTES

(1) $\theta = 90°$ for pure inductor so $P = VI\cos\theta$

$\boxed{P = 0}$

(2) At resonance $X_L = X_C$

$\xrightarrow{i}$

$\xrightarrow{v}$

$\therefore \theta = 0°$

$\boxed{\cos\theta = 1}$

(3) $Z = \sqrt{R^2 + X_L^2}$

$Z = 5\Omega$

(4) Because $X_L = X_C$ and in opposite direction so they cancel each other

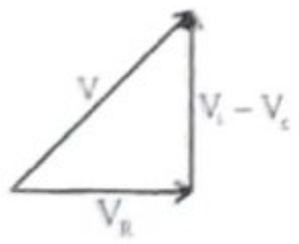
(5) Because $X_L = X_C$ and in opposite direction so they cancel each other, so V_2 shows zero reading

(6) $\xrightarrow{I}$

$\xrightarrow{V}$

$\theta = 0°$

(7)



$V^2 = V_R^2 + (V_L - V_C)^2$

(8) $P_{av} = V_{rms} I_{rms}$

$P = \frac{V_0 I_0}{\sqrt{2}\sqrt{2}} = \frac{P_{max}}{2} = \frac{V_0^2}{2R}$

(9) $f \propto \frac{1}{\sqrt{C}} \Rightarrow 1200\sqrt{C_2} = 600\sqrt{C_1}$

$C_2 = C_1/4$

(10) It is general function of metal detector that whenever there is no metal around it then the inductance of both inductors remains same i.e. $L_A = L_B$

(11) $V_{ac} = V_0 \sin\frac{2\pi}{T} \times t$

$\frac{V_0}{2} = V_0 \sin\frac{2\pi}{T} \times t$

$\frac{\pi}{6} = \frac{2\pi}{T} \times t$

$t = \frac{T}{12}$

(12) $X_L = 2\pi fL$

$X_L \propto f$

(13) $\boxed{X_L = 2\pi fL}$

(14) $f = \frac{X_L}{2\pi L}$

$Z = \sqrt{R^2 + (X_L - X_C)^2}$

at resonance $X_L = X_C$

$Z_{min} = R$

(15) Speed depends upon nature of medium.

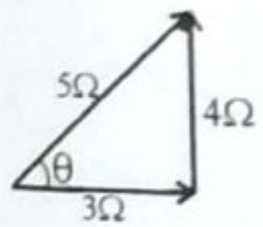
$v \propto \frac{1}{n}$

(16) $V_{ins} = V_0 \sin\theta$

(17) $I_{rms} = \frac{I_0}{\sqrt{2}}$

(18) Hot wire ammeter read rms value of A.C.

(19)



$\cos\theta = \frac{3}{5} = 0.6$

(20) $X_c \propto \frac{1}{f}$

$X_L \propto f$

Scanned by CamScanner

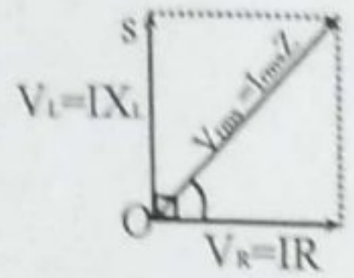
(21) $\frac{L}{RC}=\frac{L}{t}=\frac{VsA^{-1}}{s}$

$\frac{V}{A}=\Omega$

(22) $I_{ave}=\frac{+I_o+(-I_o)}{2}=0$

(23) In frequency modulation frequency of carries waves changes with amplitude of audio signal.

(24) From R–L series circuit



Power Factor $=\cos\theta=\frac{IR}{IZ}=\frac{R}{Z}=\frac{R}{\sqrt{R^2+\omega^2L^2}}$

(25) $I_o=\sqrt{2}I_{rms}$

(26) Steady current should be of same value so that heat dissipates at same rate.

(27)

$I=I_o\sin\omega t$

$I_o\rightarrow 2I_o$

$\omega\rightarrow 2\omega$

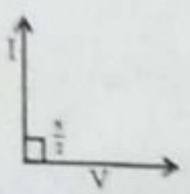
(28) $\xrightarrow{I}$ $\xrightarrow{V}$

(29) $\xrightarrow{I}$ $\xrightarrow{V}$

$\theta=0°$

$\cos\theta=1$

(30)



(31) $X_c=\frac{1}{2\pi fC}$

(32)

$I_e=110\,V$

$I_{rms}=\frac{I_e}{\sqrt{2}}=\frac{110}{\sqrt{2}}=\frac{110}{1.4}=78.5\,A$

$T=25\times10^{-3}\Rightarrow f=\frac{1}{25\times10^{-3}}=40\,Hz$

(33) $Z=\sqrt{R^2+(X_L-X_C)^2}$

(34) $Z=\sqrt{R^2+X_L^2}$

(35) Ammeter connected in AC circuit measures rms value of current.

(36) Parallel combination.

(37) $X_C\propto\frac{1}{f}$

(38) In A.C circuit, 'R' is independent of frequency.

(39) The rms value of an ac current is that steady current that produces the same rate of heating in a resistor as the actual current.

(40) $V_{rms}=\frac{V_o}{\sqrt{2}}$

$220\times\sqrt{2}=V_o$

(41) We know,

$I=I_o\sin\theta$

Given, $I=5\sin(100\pi t)$

Comparing equations

$I_o=5A$

We know

$I_{rms}=\frac{I_o}{\sqrt{2}}=\frac{5}{\sqrt{2}}A$

$P=(I_{rms})^2R$

$=\left(\frac{5}{\sqrt{2}}\right)^2R=\frac{25}{2}\times10\Rightarrow P=125W$

(42) Current become zero in one cycle = 2times

Current becomes zero in one second = $2\times f=2\times50=100$ times

Scanned by CamScanner

(43)



$$< V >= \frac{V_0 + (-V_0)}{2}$$

$$< V >= 0$$

(44) Changing magnetic flux produces electric field.

(45) Electromagnetic waves are produced due to continues oscillation of electric and magnetic fields which are at right angle to each other.

(46) In case of D.C $I_{rms} = I$

(47) As

$$I_{rms} = \frac{I_0}{\sqrt{2}}$$

$$= \frac{2\sqrt{2}}{\sqrt{2}}$$

$$= 2A$$

(48) The power dissipated in a resistor for a constant potential difference V is the same as for a sinusoidal alternating potential difference or rms value V.

$$V_{rms} = \frac{V_0}{\sqrt{2}}$$

$$V = \frac{V_0}{\sqrt{2}} \Rightarrow V_0 = \sqrt{2}\,V$$

(49) As

$$I_{rms} = \frac{I_0}{\sqrt{2}}$$

$$\Rightarrow I_0 = \sqrt{2}\, I_{rms}$$

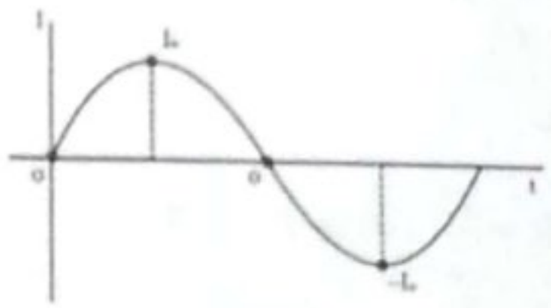
$$= (1.414)(10)$$

$$= 14.14A$$

(50) $$I^2_{mean} = \frac{0 + (I_0)^2 + 0 + (-I_0)^2}{4}$$

$$= \frac{2I_0^2}{4} = \frac{I_0^2}{2}$$

$$\Rightarrow I_{rms} = \sqrt{\frac{I_0^2}{2}}$$



16 Chapter ALTERNATING CURRENT

SELF ASSESMENT TEST

(1) **Current in A.C circuit has peak value 2.83A. The rms current is**
(a) 0.2 A (b) 4A
(c) $\sqrt{2}$A (d) 2A

(2) **Choke coil is used to control**
(a) D.C (b) both A.C and D.C
(c) A.C (d) none of these

(3) **An A.C series circuit contain 4Ω resistance and 3-Ω inductive reactance. The impedance of the circuit is** _____
(a) 1 Ω (b) 5 Ω
(c) 7 Ω (d) $7/\sqrt{2}$ Ω

(4) **In RLC series circuit when frequency is increased then**
(a) X_C will increase (b) X_L will increase
(c) R will increase (d) Z remain constant

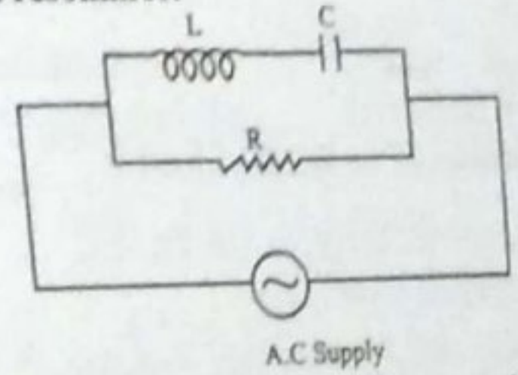
(5) **The average power dissipation in a pure capacitance is:**
(a) $\frac{1}{2}CV^2$ (b) CV^2
(c) $2CV^2$ (d) Zero

(6) **In an A.C circuit instantaneous current is $-I_0$ it is possible when t =?**
(a) $t=\frac{T}{2}$ (b) $t=\frac{3T}{4}$
(c) $t=\frac{T}{4}$ (d) $t=T$

(7) **In an ac circuit, peak value of voltage is 423 volts. Its effective voltage is**
(a) 400 volts (b) 300 volts
(c) 323 volts (d) 340 volts

(8) **The peak value of an Alternating current is 6 amp, then r.m.s. value of current will be**
(a) $3\sqrt{3}$A (b) 3 A
(c) $3\sqrt{2}$A (d) $2\sqrt{3}$A

(9) **In the circuit shown here, at resonance:**



(a) the power factor is zero (b) the current through A.C source is minimum
(c) the current through A.C source is maximum (d) currents through R and L are equal

(10) **A generator produces a voltage that is given by V=240sin120t, where t is in seconds. The frequency and r.m.s. voltage are**
(a) 754 Hz and 70 V (b) 19 Hz and 120 V
(c) 19 Hz and 170 V (d) 60 Hz and 240 V

Scanned by CamScanner

(11) The peak value of 220 volts of A.C mains is
(a) 155.6 volts (b) 440 volts
(c) 220.0 volts (d) 311.0 volts

(12) A 40 W electric heater is connected to a 200 V, 50 Hz mains supply. The peak value of electric current flowing in the circuit is approximately
(a) 5 A (b) 7 A
(c) 2.5 A (d) 10 A

(13) Maxwell derived mathematically that the velocity of the electromagnetic waves is _____
(a) $\frac{1}{\epsilon_o}$ (b) $\frac{1}{\sqrt{\frac{\mu_o}{\epsilon_o}}}$
(c) $\sqrt{\mu_o \epsilon_o}$ (d) $\frac{1}{\sqrt{\mu_o \epsilon_o}}$

(14) Electromagnetic waves travel in free space with the speed of _____
(a) γ-rays (b) positive rays
(c) cathode rays (d) β-rays

(15) The direction of propagation of an electromagnetic waves is _____
(a) perpendicular to electric field
(b) perpendicular to both electric and magnetic field
(c) perpendicular to magnetic field
(d) parallel to electric and magnetic field

(16) The r.m.s. value of an ac of 50 Hz is 10 amp. The time taken by the alternating current in reaching from zero to maximum value and the peak value of current will be
(a) $2 \times 10^{+2}$ sec and 14.14 amp (b) 1×10^{-2} sec and 7.07 amp
(c) 5×10^{-3} sec and 7.07 amp (d) 5×10^{-3} sec and 14.14 amp

(17) Electromagnetic waves transport _____
(a) energy (b) mass
(c) heat (d) none

(18) Waves which are not emitted from the antenna are _____
(a) sound waves (b) electromagnetic waves
(c) radio waves (d) modulated waves

(19) A choke coil has
(a) high inductance and high resistance (b) high inductance and low resistance
(c) low inductance and high resistance (d) low inductance and low resistance

(20) Natural or resonant frequency of an RLC circuit is _____
(a) $\frac{1}{4\pi\sqrt{LC}}$ (b) $2\pi\sqrt{LC}$
(c) $\frac{1}{\sqrt{LC}}$ (d) $\frac{1}{2\pi\sqrt{LC}}$

(21) If capacitance of L-C circuit is made four times then frequency of the circuit becomes _____
(a) Twice (b) One half
(c) Four times (d) None

(22) In a purely capacitive circuit the current:
(a) leads the voltage by one-fourth of a cycle
(b) 15sec leads the voltage by one-half of a cycle
(c) lags the voltage by one-fourth of a cycle
(d) lags the voltage by one-half of a cycle

(23) The value of the steady current, which when flowing through the same resistor produces heat at the same rate as the mean rate of heat produced by the alternating current, is _____
(a) average current (b) sinusoidal current
(c) r.m.s current (d) net current

(24) The capacitive reactance of a capacitor in D.C circuit is
(a) 0 (b) ωC
(c) $\frac{1}{\omega C}$ (d) ∞

(25) In an ac circuit, the instantaneous values of e.m.f. and current are $\varepsilon = 200 \sin 314\ t$ volt and $I=\sin(314t+\pi/3)$ ampere. The average power consumed in watt is
(a) 20 (b) 100
(c) 200 (d) 50

(26) An electric lamp is connected to 220 V, 50 Hz supply. Then the peak value of voltage is
(a) 311 V (b) 210 V
(c) 320 V (d) 211 V

(27) A 1 μF capacitor is connected across an AC source whose voltage amplitude is 50 V and angular frequency is 100 rad/s. The current amplitude will be
(a) 2.5 mA (b) 5 mA
(c) 10 mA (d) 15 mA

(28) Power factor of AC circuit can be written as
(a) $\frac{R}{Z}$ (b) $\frac{X_C}{Z}$
(c) $\frac{X_L}{Z}$ (d) $\frac{Z}{R}$

(29) In an ac circuit with voltage V and current I, the power dissipated is
(a) VI (b) depends on the phase between V and I
(c) 1/2 VI (d) $1/\sqrt{2}$ VI

(30) A 280 ohm electric bulb is connected to 200V electric line. The peak value of current in the bulb will be
(a) zero (b) about four ampere
(c) about two ampere (d) about one ampere

(31) If an alternating voltage is represented as $\varepsilon=141\sin(628t)$, then the rms value of the voltage and the frequency are respectively
(a) 100V,100Hz (b) 141V,100Hz
(c) 100V,50Hz (d) 141V,628Hz

(32) The maximum value of A.C voltage in a circuit is 707V. Its rms value
(a) 400V (b) 500 V
(c) 707V (d) 70.7

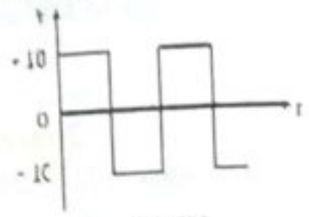
Scanned by CamScanner

(33) The average power dissipation in pure inductive circuit is

(a) $\frac{1}{2}LI$ (b) $2LI^2$

(c) $\frac{1}{4}LI^4$ (d) zero

(34) The r.m.s. voltage of the wave form shown is



(a) 20V (b) 5V

(c) 6.67V (d) 10V

(35) The frequency of an alternating voltage is 50 cycles/sec and its amplitude is 120V. Then the r.m.s. value of voltage is

(a) 101.3V (b) 84.8V

(c) 70.7V (d) 56.5V

(36) For an ac circuit V=15sinωt and I=20cosωt the average power consumed in this circuit is

(a) zero (b) 300 Watt

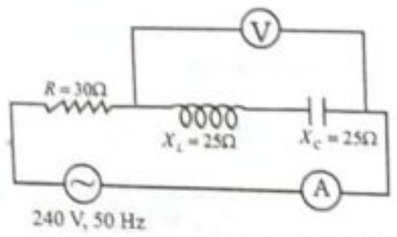
(c) 150 Watt (d) 50 Watt

(37) When the frequency of the oscillator in a series RLC circuit is doubled

(a) the capacitive reactance is doubled (b) the capacitive reactance is halved

(c) the impedance is doubled (d) the current amplitude is halved

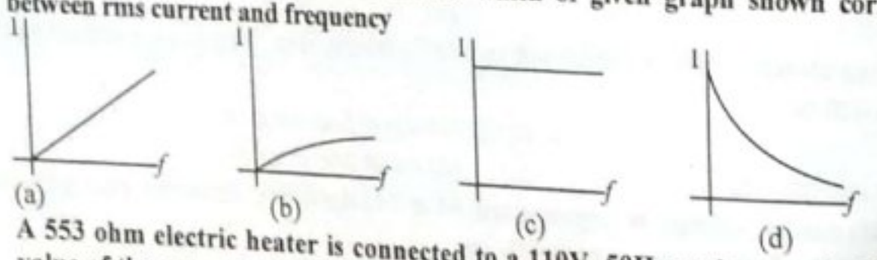
(38) In the circuit shown in fig., neglecting source resistance, the voltmeter and ammeter reading will respectively be:



(a) 0 V, 3A (b) 150 V, 3A

(c) 150 V, 8A (d) 0 V, 8A

(39) A resistor is connected with A.C source which of given graph shown correct relationship between rms current and frequency



(40) A 553 ohm electric heater is connected to a 110V, 50Hz mains supply. What is the peak value of the potential difference across the heater element?

(a) 100V (b) $110/\sqrt{2}$ V

(c) 110/2V (d) $110\sqrt{2}$ V

(41) The current and voltage in an AC circuit are respectively given by $I = I_o \sin \omega t$. The power consumed in the circuit is

(a) V_oI_o (b) $\frac{V_oI_o}{2}$

(c) $\frac{V_oI_o}{\sqrt{2}}$ (d) zero

(42) An AC circuit consists of an inductor of inductance 0.5 H and a capacitor of capacitance 8μF in series. The current in the circuit is maximum when the angular frequency of AC source is

(a) 5000 rad s^{-1} (b) 4000 rad s^{-1}

(c) 2×10^5 rad s^{-1} (d) 500 rad s^{-1}

(43) The reactance of a capacitor at 50 Hz is 10Ω. Its reactance at 100 Hz is

(a) 2.5 Ω (b) 5 Ω

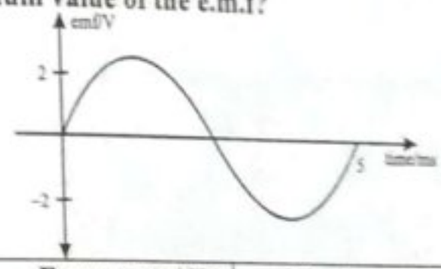
(c) 10 Ω (d) 20 Ω

(44) If the instantaneous current in a circuit is gives by $V = 2\cos(\omega t + \Phi)$ ampere, the rms value of the voltage is

(a) 2V (b) $2\sqrt{2}$ V

(c) $\sqrt{2}$ V (d) zero

(45) The diagram shows how the e.m.f. of a simple generator varies with time. What is the frequency and the maximum value of the e.m.f?



	Frequecny / Hz	Maximum e.m.f. / V
(a)	200	2.0
(b)	400	2.0
(c)	200	4.0
(d)	400	4.0

(46) The r.m.s. voltage of domestic electricity supply is 220 volt. Electrical appliances should be designed to withstand an instantaneous voltage of

(a) 220 V (b) 310V

(c) 330V (d) 440V

(47) In an A.C. circuit, a resistance R is connected in series with an inductance L. If the phase angle between voltage and current be 45°, the value of inductive reactance will be

(a) $\frac{R}{4}$ (b) $\frac{R}{2}$

(c) R (d) cannot of found with the given data

(48) An LCR series circuit contains L = 8H, C = 0.5 μ F and R = 100 Ω. The resonant frequency of the circuit is

(a) $\frac{1000}{\pi}$ Hz (b) $\frac{250}{\pi}$ Hz

(c) $\frac{500}{\pi}$ Hz (d) $\frac{125}{\pi}$ Hz

Scanned by CamScanner

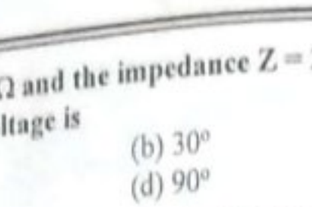
(49) In a series LCR circuit R = 10 Ω and the impedance Z = 20 Ω. Then the phase difference between the current and the voltage is
(a) 60° (b) 30°
(c) 45° (d) 90°

(50) What is the directions of $\vec{E}\times\vec{B}$ in an electromagnetic waves?
(a) same as that of $\vec{E}$
(b) same as that of $\vec{B}$
(c) same as the direction of propagation of electromagnetic waves
(d) none of these

(51) A capacitor of capacitance C farad is charged by a battery of emf V_0 volt. The battery is then disconnected and a pure inductor of L henry is connected across it so that LC oscillations are set up. Then the value of the maximum current in the inductor coil is
(a) $V_0\sqrt{LC}$ (b) $\frac{V}{\sqrt{LC}}$
(c) $V_0\sqrt{\frac{C}{L}}$ (d) $V_0\sqrt{\frac{L}{C}}$

(52) The square root of the product of inductance and capacitance has dimensions of
(a) length (b) mass
(c) time (d) dimensionless

(53) Two sinusoidal voltages of the same frequency are shown in fig.



What is the frequency and the phase relationship between the voltages?

	Frequency /Hz	Phase lead of N
(a)	0.4	$-\frac{\pi}{4}$
(b)	2.5	$-\frac{\pi}{2}$
(c)	2.5	$+\frac{\pi}{2}$
(d)	2.5	$-\frac{\pi}{4}$

(54) Alternating current cannot be measured by D.C ammeter
(a) A.C cannot pass through the ammeter (b) average value of complete cycle is zero
(c) A.C is virtual (d) A.C changes its direction

(55) An AC source is of $\frac{200}{\sqrt{2}}$ volt, 50 hertz. The value of voltage after $\frac{1}{600}$ second from the start is
(a) 200 volt (b) $\frac{200}{\sqrt{2}}$ volt
(c) 100 volt (d) 50 volt

(56) At resonance frequency in RLC series circuit the power factor will be_____
(a) maximum (b) zero
(c) 1 (d) none

(57) In an RLC circuit the capacitance is made $\frac{1}{4}th$ then what should be the change in inductance that the circuit remains in resonance again?
(a) 8 times (b) $\frac{1}{4}$ times
(c) 2 times (d) 4 times

(58) A pure capacitor is connected in AC circuit. The power factor of the circuit will be
(a) 1 (b) infinity
(c) zero (d) 0.5

(59) If in an A.C circuit $X_L = X_c$ then the value of power factor will be
(a) 1 (b) 0
(c) infinity (d) $\frac{1}{2}$

(60) An alternating emf of angular frequency ω is applied across an inductance. The instantaneous power developed in the circuit has an angular frequency.
(a) $\frac{\omega}{4}$ (b) $\frac{\omega}{2}$
(c) 2ω (d) 4ω

ANSWER KEY

1	d	11	d	21	b	31	a	41	b	51	c
2	c	12	b	22	a	32	b	42	d	52	c
3	b	13	d	23	c	33	d	43	b	53	b
4	b	14	a	24	d	34	c	44	c	54	b
5	d	15	b	25	d	35	b	45	a	55	c
6	b	16	d	26	a	36	a	46	b	56	c
7	b	17	a	27	b	37	b	47	c	57	d
8	c	18	a	28	a	38	d	48	b	58	c
9	b	19	b	29	b	39	c	49	a	59	a
10	c	20	d	30	d	40	d	50	c	60	c

Scanned by CamScanner

EXPLANATORY NOTES

(1) $I_{rms} = \frac{I_o}{\sqrt{2}} = \frac{2.8}{1.4} = 2A$

(2) The choke coil can be used only in A.C circuits, not in D.C circuits, because for D.C ($\omega = 0$) the inductive reactance $X_L = \omega L$ of the coil is zero, only the resistance of the coil remains effective which is almost zero.

(3) $Z = \sqrt{R^2 + X_L^2}$

$Z = \sqrt{(4)^2 + (3)^2}$

$Z = \sqrt{16+9}$

$Z = 5\Omega$

(4) $X_L = 2\pi fL$

$\uparrow X_L \propto f \uparrow$

X_L is directly proportional to "f". If "f" increase then X_L will increase

(5) Power dissipation

$P = V_{rms} I_{rms} \cos\theta$

In capacaitive circuit phase between alternating voltage and current is 90°

$P = V_{rms} I_{rms} \cos 90°$

$P = 0$

(6) As

$I = I_o \sin\theta$

$I = I_o \sin\left(\frac{2\pi}{T} \times t\right) \quad \because \theta = \omega t = \frac{2\pi}{T} \times t$

$-I_o = I_o \sin\left(\frac{2\pi}{T} \times t\right)$

$\sin^{-1}(-1) = \frac{2\pi}{T} \times t$

$\frac{3\pi}{2} = \frac{2\pi}{T} \times t \quad \because \sin^{-1}(-1) = 270° = \frac{3\pi}{2}$

$\Rightarrow t = \frac{3T}{4}$

(7) Effective voltage $= V_{rms} = \frac{V_o}{\sqrt{2}} = \frac{423}{\sqrt{2}} = 300V$

(8) $I_{rms} = \frac{6}{\sqrt{2}} = 3\sqrt{2}A$

(9) In parallel resonance circuit at resonance, current minimum and impendence is maximum.

(10) $f = \frac{\omega}{2\pi} = \frac{120 \times 7}{2 \times 22} = 19Hz, V_{rms} = \frac{240}{\sqrt{2}} = 120\sqrt{2} \approx 170V$

(11) Peak value $= 220\sqrt{2} = 311\,V$

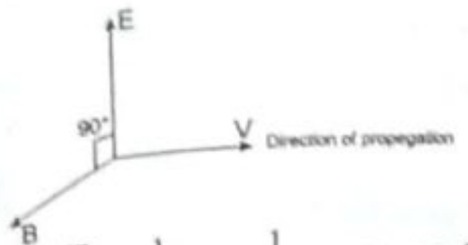
(12) $I_{rms} = \frac{V_{rms}}{R} = \frac{200}{40} = 5A,\ I_o = I_{rms}\sqrt{2} = 7.07A$

(13) Speed of electromagnetic wave = $c = \frac{1}{\sqrt{\mu_o \varepsilon_o}}$

(14) Speed of electromagnetic wave = $c = 3 \times 10^8 ms^{-1}$

Speed of γ – rays = c

(15)



(16) $t = \frac{T}{4} = \frac{1}{4f} = \frac{1}{4 \times 50} = 5 \times 10^{-3} s\ ,\ I_o = I_{rms}\sqrt{2} = 10\sqrt{2} = 14.14A$

(17) Wave transfer energy without transporting matter

(18) Sound waves are mechanical waves

(19) A chock coil has high inductance and low resistance.

(20) Resonance frequency $f_r = \frac{1}{2\pi\sqrt{LC}}$

(21) $f_r = \frac{1}{2\pi\sqrt{LC}}$

If $C = 4C$

$f_r' = \frac{1}{2\pi\sqrt{L(4C)}}$

$f_r' = \frac{1}{2} f_r$

(22) In AC through capacitor current lead the applied voltage by angle 90°, so it is one fourth of cycle.

(23) $I_{rms} = I_{D.C}$

(24) $X_C = \frac{1}{2\pi fC}$ For DC $f = 0$

$X_C = \frac{1}{2\pi(0)C} = \infty$

(25) $V_{rms} = \frac{200}{\sqrt{2}},\ I_{rms} = \frac{1}{\sqrt{2}} \quad \therefore P = V_{rms} I_{rms} \cos\theta = \frac{200}{\sqrt{2}} \frac{1}{\sqrt{2}} \cos\frac{\pi}{3} = 50\,\text{watt}$

(26) $V_o = V_{rms} \times \sqrt{2} = 220 \times \sqrt{2} = 310$

(27)

$V_C = I_C X_C \Rightarrow I_C = \frac{V_C}{X_C} = V_C 2\pi fC = V_C 2\pi \frac{\omega}{2\pi} C = V_C \omega C$

$I_C = 50 \times 100 \times 10^{-6} = 5\text{mA}$

Scanned by CamScanner

(28) R-L circuit:



Power factor $= \cos\theta = \frac{R}{Z}$

Or similarly R-C circuit

(29) $P = V_{rms} I_{rms} \cos\theta \Rightarrow P \propto \cos\theta$, where θ is phase between V & I

(30) $I_{rms} = \frac{200}{280} = \frac{5}{7}$A. So $I_o = I_{rms} \times \sqrt{2} = \frac{5}{7} \times \sqrt{2} \approx 1$A

(31) $V = 141\sin(628t)$, $V_{rms} = \frac{V_o}{\sqrt{2}} = \frac{141}{1.41} = 100$ V and $2\pi f = 628 \Rightarrow f = 100\,Hz$

(32) $V_{rms} = \frac{V_o}{\sqrt{2}} = \frac{707}{1.41} = 500$ V

(33) In inductive circuit, phase between voltage and current is 90°

$P_d = V_{rms} I_{rms} \cos 90°$

$P_d = 0$

(34) $V_{rms} = \frac{V_o}{\sqrt{2}} = \frac{10}{1.4} = 7$V

(35) $V_{rms} = \frac{V_o}{\sqrt{2}} = \frac{120}{1.414} = 84.8\,V$

(36) $P = V_{rms} I_{rms} \cos\phi$; since $\phi = 90°$. So $P = 0$

(37) $X_C = \frac{1}{2\pi fL}$

$X_C' = \frac{1}{2\pi(2f)L} = \frac{1}{2} X_C$

Oscillation will double then capacitive reactance will halved

(38) In RLC series circuit when $X_L = X_C$, this condition is called resonance. At resonance the inductive reactance being equal and opposite to capacitor reactance cancel each other. So, $Z = R$, so $V = 0$

$I = \frac{V}{Z} = \frac{V}{R} = \frac{240}{30} = 8$A

(39) In case of resistive circuit, rms current is independent of frequency

(40) $V = \frac{V_o}{\sqrt{2}}$

$\sqrt{2} \times V = V_o$

$V_o = 110\sqrt{2}$V

(41) $P = V_{rms} I_{rms} \cos\phi$

Here, power factor = 1

$\therefore P = \frac{V_o}{\sqrt{2}} \cdot \frac{I_o}{\sqrt{2}} = \frac{V_o I_o}{2}$

(42) $\omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{0.5 \times 8 \times 10^{-6}}} = 500\,\text{rad s}^{-1}$

(43) $X_C = \frac{1}{2\pi fC}$, $X_C \propto \frac{1}{f}$

$\frac{X_{C_1}}{X_{C_2}} = \frac{f_2}{f_1} \Rightarrow X_{C_2} = \frac{X_{C_1} \times f_1}{f_2} = \frac{10 \times 50}{100} = 5\Omega$

(44) $V = 2\cos(\omega t + \phi)$

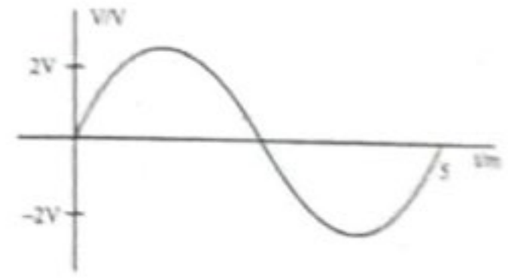
$\Rightarrow V_o = 2$V, $V_{rms} = \frac{V_o}{\sqrt{2}} = \frac{2}{\sqrt{2}} = \frac{\sqrt{2}.\sqrt{2}}{\sqrt{2}} = \sqrt{2}$V

(45) From graph

$V_o = 2$V

$T = 5$ms

$= 5 \times 10^{-3}$ sec



As

$f = \frac{1}{T} = \frac{1}{5 \times 10^{-3}}$

$= \frac{10^3}{5} = \frac{1000}{5}$

$= 200$ Hz

(46) Peak voltage $= \sqrt{2} \times 220 = 311\,V$

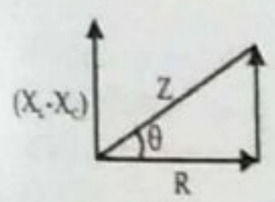
(47) $\tan\theta = \frac{X_L}{R}$

$\tan 45° = \frac{X_L}{R} \quad \Rightarrow \quad X_L = R$

(48) $f_r = \frac{1}{2\pi\sqrt{LC}} \Rightarrow f_r = \frac{1}{2\pi\sqrt{8 \times \frac{1}{2} \times 10^{-6}}} = \frac{1}{2\pi\sqrt{\frac{4}{1000000}}}$

$f_r = \frac{1}{2\pi\frac{2}{1000}} = \frac{1000}{4\pi} = \frac{250}{\pi}$ Hz

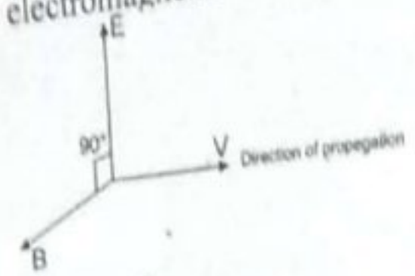
(49)



$\text{Cos}\theta = \frac{R}{Z} \quad \Rightarrow \quad \cos\theta = \frac{10}{20} \Rightarrow \theta = \cos^{-1}\left(\frac{1}{2}\right) = 60°$

Scanned by CamScanner

(50) According right-hand rule $\vec{E}\times\vec{B}$ direction is along the direction of propagation of electromagnetic wave.



(51) $\frac{1}{2}LI_0^2=\frac{1}{2}CV_0^2$ or $I_0=\sqrt{\frac{C}{L}}V_0$

(52) $f_r=\frac{1}{2\pi\sqrt{LC}}$

(53) Period of the sinusoidal voltage, T = 0.4 s

The frequency for the voltage is thus

$$f=\frac{1}{T}=\frac{1}{0.4}=2.5\,Hz$$

N lags M by 0.1 s which is equivalent to $\left(\frac{0.1}{0.4}\right)2\pi$ or $\frac{\pi}{2}$ rad. Thus, the lead of N over M is

$-\frac{\pi}{2}$ rad.

(54) D.C ammeter measure average voltage that will remain zero in case of A.C.

(55) $E=E_0\sin\omega t=\sqrt{2}E0_v\sin 2\pi\times 5\times\frac{1}{600}volt$

$$=\sqrt{2}\times\frac{200}{\sqrt{2}}\sin\frac{\pi}{6}volt=100volt$$

(56) $\cos\theta=1$

(57) $f=\frac{1}{2\pi\sqrt{LC}}\Rightarrow L\propto\frac{1}{C}$

(58) For pure capacitor $\theta=90^\circ$ so, $\cos 90^\circ=0$

(59) $X_c=X_L$ hence resonance is achieved so, $\cos 0^\circ=1$.

(60) P=EI

$$P=E_0\sin\omega t I_0\sin\left(90^\circ-\omega t\right)$$

$$P=\frac{E_0I_0}{2}\left[2\sin\omega t\cos\omega t\right]$$

$$P\propto\sin 2\omega t$$

Clearly, the angular frequency for instantaneous power is 2ω.

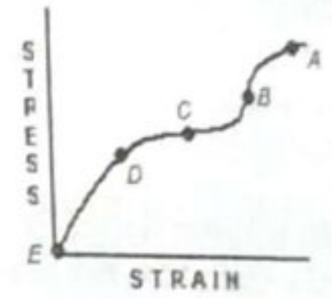
17 Chapter PHYSICS OF SOLIDS PRACTICE EXERCISE

(1) **The majority current carriers are**
(a) electrons in p-type semiconductors and holes in n-types semi-conductors
(b) electrons in n-type semiconductors and holes in p-type semiconductors
(c) electrons in both p and n type semiconductors
(d) holes in both p and n type semiconductors.

(2) **At absolute zero of temperature, the electrical conductivity of a pure semiconductor**
(a) Zero
(b) About $10^3\ (\Omega m)^{-1}$
(c) About $10^7\ (\Omega m)^{-1}$
(d) Infinity

(3) **What are the dimensions of stress?**
(a) $[MLT^{-2}]$
(b) $[ML^{-2}T^{-1}]$
(c) $[ML^{-1}T^{-2}]$
(d) $[ML^{0}T^{-1}]$

(4) **The figure shows the stress-strain graph of a certain substance. Over which region of the graph is Hook's law obeyed?**



(a) AB
(b) BC
(c) CD
(d) ED

(5) **Choose the only incorrect statement from the following**
(a) In conductors, the valence and conduction bands may overlap
(b) Substances with an energy gap of the order of 10eV are insulators
(c) The resistivity of a semiconductor increases with increase in temperature
(d) The conductivity of a semiconductor increases with increase in temperature

(6) **If a wire is stretched to double of its length then the strain will be**
(a) Zero
(b) 1
(c) ½
(d) Double

(7) **A wire of length L is stretched by a length ℓ when a force F is applied at one end. If the elastic limit is not exceeded, the amount of energy stored in the wire is**
(a) Fℓ
(b) ½ (Fℓ)
(c) $F\ell^2/L$
(d) $\frac{1}{2}Fl^2$

(8) **When a force is applied at one end of an elastic wire, it produces a strain ϵ in the wire. If Y is the young's modulus of the material of the wire, the amount of energy stored per unit volume of the wire is given by**
(a) Yϵ
(b) ½ Yϵ
(c) $Y\epsilon^2$
(d) ½ $Y\epsilon^2$

(9) **A wire, suspended vertically from one end, is stretched by attaching a weight of 20 N to the lower end. The weight stretches the wire by 1mm. How much energy is gained by the wire?**
(a) 0.01J
(b) 0.02J
(c) 0.04J
(d) 1.0J

Scanned by CamScanner

(10) **The area method to find energy stored in deformed material is valid for**
(a) Elastic region (b) Non-elastic region
(c) Both a & b (d) Elastic for small force

(11) **N-type crystals have**
(a) Positive charge (b) Negative charge
(c) Neutral (d) None of these

(12) **The resistivity of semiconductor is of the order of**
(a) 10^{-8} to 10^{-4} Ωm (b) 10^{4} to 10^{6} Ωm
(c) 10^{-10} to 10^{-20} Ωm (d) 10^{7} Ωm

(13) **Materials that undergo plastic deformation before breaking are called**
(a) Brittle (b) Ductile
(c) Amorphous (d) Polymers

(14) **How does the Young's modulus relates with the temperature**
(a) Inversely (b) Directly
(c) Does not depend (d) None of these

(15) **At 0 K a piece of Si has**

Conduction band	Valence band
(a) Filled	Filled
(b) Empty	Filled
(c) Empty	Empty
(d) Filed	Empty

(16) **If a rubber ball is taken down to a 100m deep lake its volume decreases by 0.1% if it is 10m.sec^2 then bulk modulus of elasticity for rubber in N/m^2 is**
(a) 10^5 (b) 10^6
(c) 10^8 (d) 10^9

(17) **Any alteration produced in shapes, length or volume when a body is subjected to some external force is called**
(a) Stiffness (b) Toughness
(c) Extension (d) Deformation

(18) **The energy band occupied by the valence electrons is called**
(a) Energy state (b) Valence band
(c) –ve energy state (d) Conduction band

(19) **The addition of a minute quantity of antimony to a silicon crystal makes it**
(a) a good insulator (b) a good conductor
(c) a p-type semiconductor (d) an n-type semiconductor

(20) **A piece of copper and another of germanium are cooled from room temperature to 80 K. The resistance of**
(a) each of them increases
(b) each of them decreases
(c) copper increases and that of germanium decreases
(d) copper decreases and that of germanium increases

(21) **Which of the following produce magnetic field**
(a) Orbital motion of electron (b) Spin motion of electron
(c) Spin motion of nucleus (d) All

(22) **Materials in which valence electrons are tightly bound to their atoms at low temperature are called _____**
(a) Semi conductor (b) Super conductors
(c) Insulators (d) Conductor

(23) **The value of bulk modulus of elasticity of liquids is**
(a) 1 (b) Zero
(c) Non zero (d) None of these

(24) **The young's modulus of wire of length L and radius r is Y. If the length is reduced to L/2 and radius to r/2, its Young's modulus will be**
(a) Y/2 (b) 2Y
(c) Y (d) 4Y

(25) **Which of the following is true for a crystalline substance?**
(a) Short range order (b) No definite melting point
(c) Sharp melting point (d) both a and b

(26) **A hole in a p – type semiconductor is**
(a) An excess electron (b) A missing electron
(c) A missing atom (d) A donor level

(27) **Super conductors offers**
(a) Little resistance to electric current (b) Large resistance to electric current
(c) No resistance to electric current (d) Moderate resistance to electric current

(28) **A vacant or partially filled band is called**
(a) Conduction band (b) Valence band
(c) Forbidden band (d) Empty band

(29) **A completely filled band is called**
(a) Conduction band (b) Valence band
(c) Forbidden band (d) Core band

(30) **The following four wires are made of the same material. Which of the these will have the largest extension when the same tension is applied**
(a) Length = 50 cm, diameter = 0.5 mm (b) Length = 200 cm, diameter = 2 mm
(c) Length = 100 cm, diameter = 1 mm (d) Length = 300 cm, diameter = 3 mm

(31) **If the work done in stretching a wire by 1mm is 2 J, the work necessary for stretching another wire of the same material but double the radius and half the length by 1 mm is**
(a) 16 J (b) 4 J
(c) 8 J (d) (1/4) J

(32) **With increase in temperature the electrical conductivity of intrinsic semi conductor**
(a) Decreases (b) Increases
(c) Remains same (d) First increases then decreases

(33) **Holes can exist in**
(a) Conductors (b) Insulators
(c) Semi conductors (d) All of the above

(34) **Young's modulus is a proportionality constant that relates the force per unit area applied perpendicularly at the surface of an object to:**
(a) The shear (b) The fractional change in volume
(c) The fractional change in length (d) The pressure

(35) **In a semiconductors, the charge carriers are _____**
(a) Holes only (b) Electrons only
(c) Electron and holes both (d) All of the above

(36) **The ultimate strength of a sample is the stress at which the sample:**
(a) Remains underwater
(b) Returns to its original shape when the stress is removed
(c) Bends 180◦
(d) Breaks

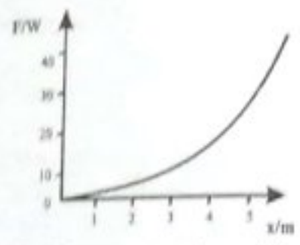
Scanned by CamScanner

(37) A copper wire and a steel wire of the same diameter and length are connected end to end and a force is applied which stretches their combined length by 1 cm. Then the two wires have
(a) The same stress and strain (b) The same strain but different stresses
(c) The same stress but different strain (d) Different stresses and strains

(38) Energy needed to magnetize and demagnetize is represented by
(a) Hysteresis curve (b) Hysteresis loop area
(c) Hysteresis loop (d) Straight line

(39) For a constant hydraulic stress on an object, the fractional change in the object's volume $\left(\frac{\Delta V}{V}\right)$ and its bulk modulus (B) are related as
(a) $\frac{\Delta V}{V} \propto B$ (b) $\frac{\Delta V}{V} \propto B^2$
(c) $\frac{\Delta V}{V} \propto B^{-1}$ (d) $\frac{\Delta V}{V} \propto B^{-2}$

(40) The force F required to extend a sample of rubber by a length x was found to vary as shown in diagram:

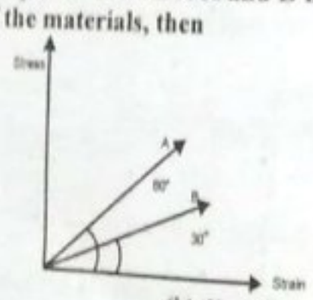


The energy stored in the rubber for an extension of 5m was:
(a) More than 200 J (b) 100 J
(c) 200 J (d) Less than 100 J

(41) Two wires of the same material have diameters in the ratio 2 : 1 and lengths in the ratio 1 : 2. If they are stretched by the same force, their elongations will be in the ratio
(a) 8 : 1 (b) 2 : 1
(c) 1 : 8 (d) 1 : 4

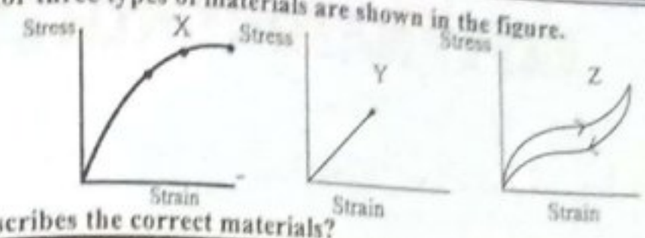
(42) If "a" be original area, "Δa" be change in area and 0 be deforming angle then shear strain can be defined as:
(a) Tan0 (b) 0 (For small deformation)
(c) Δa/a (d) All of above

(43) The stress versus strain graph for two wires A and B is shown in the figure. If Y_A and Y_B are the young's moduli of the materials, then



(a) $Y_A = 2Y_B$ (b) $Y_A = Y_B$
(c) $Y_B = 3Y_A$ (d) $Y_A = 3Y_B$

(44) Three graphs for three types of materials are shown in the figure.



Which row describes the correct materials?

	X	Y	Z
(a)	Brittle	Ductile	Polymer
(b)	Brittle	Polymer	Ductile
(c)	Polymer	Brittle	Ductile
(d)	**Ductile**	**Brittle**	**Polymer**

(45) All the magnetic materials lose their magnetic properties when
(a) Dipped in water (b) Brought near a piece of iron
(c) Dipped in oil (d) Strongly heated

(46) Tensile stress addresses to the:
(a) Volume changes due to the applied stress
(b) Length changes due to the applied stress
(c) Shape changes due to the applied stress
(d) Angle changes due to applied stress

(47) Shear stress addresses to the:
(a) volume changes due to the applied stress
(b) length changes due to the applied stress
(c) shape changes due to the applied stress
(d) length changes due to compressive stress

(48) Which one of the following quantities does not have the unit of force per unit area?
(a) stress (b) Young's modulus of elasticity
(c) strain (d) pressure

(49) A wire fixed at the upper end and stretches by length 'l' by applying a force 'F'. The work done in stretching is
(a) 2 F*l* (b) $\frac{F}{2l}$ (c) F*l* (d) $\frac{Fl}{2}$

(50) The nominal strength of a material under the action of a certain stress:
(a) mechanical strength (b) elastic strength
(c) absolute tensile strength (d) ultimate tensile strength

ANSWER KEY

1	b	11	c	21	d	31	a	41	c
2	a	12	b	22	a	32	b	42	d
3	c	13	b	23	c	33	c	43	d
4	d	14	a	24	c	34	c	44	d
5	c	15	b	25	c	35	c	45	d
6	b	16	d	26	b	36	d	46	b
7	b	17	d	27	c	37	c	47	c
8	d	18	b	28	a	38	b	48	c
9	a	19	d	29	d	39	c	49	d
10	c	20	d	30	a	40	d	50	d

Scanned by CamScanner

EXPLANATORY NOTES

(1)

(2) Electrons or holes are not available at absolute zero.

(3) $\text{Stress} = \frac{F}{A} = \left[\frac{MLT^{-2}}{L^2}\right] = \left[ML^{-1}T^{-2}\right]$

(4) Hook's law obey in elastic region i.e. (straight line portion)

(5) $\rho \propto \frac{1}{T}$ more electrons/hole pairs are available at high temperature, so conductivity increases and resistivity decreases.

(6) $\varepsilon = \frac{\Delta\ell}{L} = \frac{2L-L}{L} = \frac{L}{L} = 1$

(7) $W = \frac{1}{2}F\ell$

(8) Strain energy density $= \frac{1}{2}\sigma \times \varepsilon = \frac{1}{2}(Y\varepsilon) \times \varepsilon = \frac{1}{2}Y\varepsilon^2$

(9) $E = \frac{1}{2}F\Delta\ell$

(10)

(11) Both N-type and P-type are neutral

(12)

(13)

(14) $Y \propto \frac{1}{T}$

(15) Si is insulator at zero kelvin. Electron hole pair are not available at zero Kelvin.

(16)

$$K = \frac{\rho gh}{\frac{\Delta V}{V}} = \frac{1000 \times 10 \times 100}{10^{-3}} = 10^9 \, N/m^2 \qquad \text{As } \Delta V = 0.1\%$$

$$\Rightarrow \frac{\Delta V}{V} = \frac{0.1}{100} = 1 \times 10^{-3}$$

(17)

(18)

(19) Antimony belongs to V group, when we add impurity from group V to group IV, N-type substance is formed

(20) Resistance of Cu is directly proportional to temperature but resistance of Ge is inversely proportional to temperature.

(21) Magnetic field is produced due to spin and orbital motion of electron as well as spin motion of nucleus.

(22) Semiconductor have tightly bounded valence electrons at low temperature.

(23) Non-zero. Bulk modulus of fluids is measured.

(24) Young's modulus is independent from dimensions of material.

(25) Crystalline substance has sharp melting point.

(26) Hole is vacancy of electron.

(27) Super conductors have zero resistance below critical temperature.

(28) Conduction band may be partially filled or empty.

(29)

(30)

(31) $W = \frac{1}{2}\left[\frac{EA \times \Delta\ell^2}{\ell}\right]$, same material $\Rightarrow E_1 = E_2$

Same material $\Rightarrow \Delta\ell_1 = \Delta\ell_2$

$$W \propto \frac{A}{\ell} \Rightarrow \frac{W_1}{W_2} = \frac{A_1\ell_2}{A_2\ell_1} \Rightarrow W_2 = \frac{W_1A_2\ell_1}{A_1\ell_2} = \frac{24A_1\ell_1}{A_1\frac{\ell_1}{2}} = \frac{(2)(4)(2)A_1\ell_1}{A_1\ell_1} \quad \boxed{W_2 = 16J}$$

(32) Intrinsic semi-conductor is pure. Its conductivity is directly proportional to temperature.

(33) Semi-conductor has holes, when electron break the bond.

(34)

$$Y = \frac{\text{stress}}{\text{strain}}$$

$$Y = \frac{F/A}{\Delta\ell/L} \qquad (Y = \text{constant})$$

(35) Semi-conductors have holes and free electron as charge carrier.

(36)

(37) Materials are of different nature. So, same stress and different strain.

(38)

(39)

(40)

Scanned by CamScanner

(41)

$$Y=\frac{F/A}{\Delta\ell/\ell}$$

$$\Delta\ell=\frac{F}{A}\times\frac{\ell}{Y}$$

$$\frac{\Delta\ell_1}{\Delta\ell_2}=\frac{F_1}{F_2}\times\frac{A_2}{A_1}\times\frac{\ell_1}{\ell_2}\times\frac{Y_2}{Y_1}$$

Where, $F_1=F_2$, $Y_1=Y_2$

$$\frac{\Delta\ell_1}{\Delta\ell_2}=\frac{\pi r_2^2}{\pi r_1^2}\times\frac{\ell_1}{\ell_2}$$

$$\frac{\Delta\ell_1}{\Delta\ell_2}=\frac{\left(\frac{d_2}{2}\right)^2}{\left(\frac{d_1}{2}\right)^2}\times\frac{\ell_1}{\ell_2}$$

$$\frac{\Delta\ell_1}{\Delta\ell_2}=\left(\frac{d_2}{d_1}\right)^2\times\frac{\ell_1}{\ell_2}$$

$$=\left(\frac{1}{2}\right)^2\times\frac{1}{2}$$

$$\Delta\ell_1:\Delta\ell_2=1:8$$

(42) Shear strain $=\frac{\Delta a}{a}=\tan\theta\approx\theta$ 'd' is correct

(43) $\frac{Y_A}{Y_B}=\frac{\tan 60^\circ}{\tan 30^\circ}=\frac{\sqrt{3}}{\frac{1}{\sqrt{3}}}=\left(\sqrt{3}\right)^2=3\Rightarrow\boxed{Y_A=3Y_B}$

(44) Graph X is from text book which is of a ductile material. Brittle materials are those which just break after the elastic limit is reached. So, graph Y is of brittle material. Graph Z is of a polymer which do not obey Hook's law.

(45) By heating a material loses his magnetic property.

(46)

$$Y=\frac{F/A}{\Delta l/l}$$

$\frac{F}{A}\propto\frac{\Delta l}{l}$, where Y = constant

Tensile stress $\propto \Delta l$

(47)

$$G=\frac{F/A}{\frac{\Delta a}{a}}$$

$F/A\propto\frac{\Delta a}{a}$, where G = constant

Shear stress $\propto$ shape change

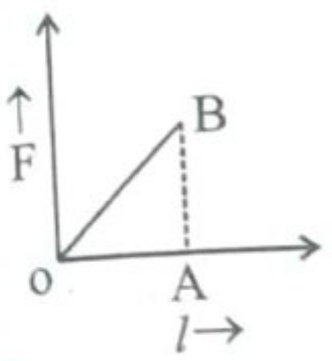
(48) Strain has no unit, because it is ratio of similar quantities.

$$\text{stress}=\frac{F}{A}\Rightarrow Nm^{-2}$$

$$Y=\frac{F/A}{\text{strain}}Nm^{-2}$$

$$P=F/A\Rightarrow Nm^{-2}$$

(49) In such a situation the work is calculated by graphical method.



Work done = Area $\Delta 0AB$

$$W=\frac{1}{2}Fl$$

(50) UTS is defined as maximum stress that a material can withstand and can be regardless as the nominal strength of material.

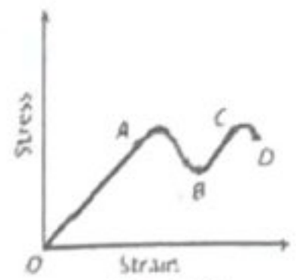
Scanned by CamScanner

17 Chapter PHYSICS OF SOLIDS

SELF ASSESMENT TEST

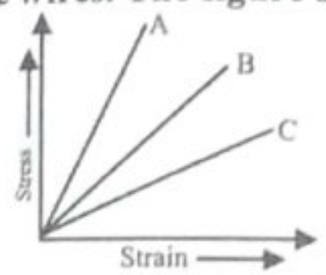
(1) **Which of the following substances possesses the highest elasticity?**
(a) rubber (b) glass
(c) copper (d) steel

(2) **A graph is shown between stress and strain for a metal. The part in which Hooke's law holds good is**



(a) AB (b) BC
(c) OA (d) CD

(3) **The strain-stress curves of three wires of different materials are shown in the figure. A, B and C are the elastic limits of the wires. The figure shows that**



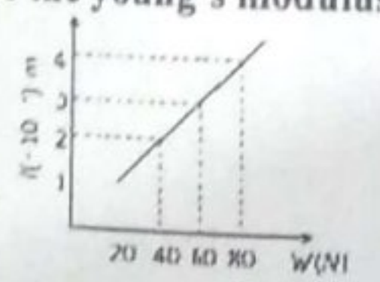
(a) elasticity of wire B is maximum (b) tensile strength of C is maximum
(c) elasticity of wire A is maximum (d) none of the above is true

(4) **Two wires of the same material and same length but diameters in the ratio 1:2 are stretched by forces F_1 and F_2 respectively, to produce equal elongations. The ratio F_1/F_2 is**
(a) 1/4 (b) 1/2
(c) 4 (d) 2

(5) **Which one of the following physical quantities does not have the dimensions of force per unit area?**
(a) stress (b) strain
(c) Young's modulus (d) pressure

(6) **If a wire is stretched to four times of its length then the strain will be**
(a) zero (b) 3
(c) ½ (d) double

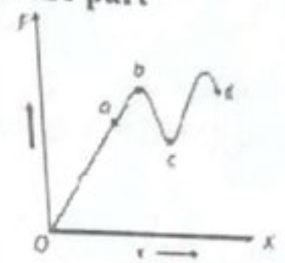
(7) **The adjacent graph shows the extension (ΔI) of a wire of length 1m suspended from the top of a roof at one end with a load W connected to the other end. If the cross sectional area of the wire is $10^{-6}m^2$, calculate the young's modulus of the material of the wire**



(a) $2\times10^{-11}N/m^2$ (b) $2\times10^{11}N/m^2$
(c) $3\times10^{-12}N/m^2$ (d) $2\times10^{-13}N/m^2$

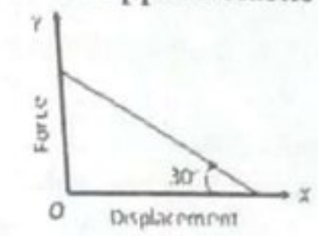
(8) **Energy per unit volume of a stretched wire is:**
(a) (1/2) × load × extention (b) Load × stress
(c) Stress × strain (d) (1/2) × stress × strain

(9) **The graph is drawn between the applied force F and the strain (x) for a thin uniform wire. The wire behaves as a liquid in the part**



(a) bc (b) ab
(c) oa (d) cd

(10) **The value of force constant between the applied elastic force F and displacement will be**

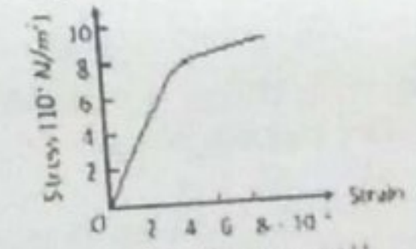


(a) 1/3 (b) √3/2
(c) $1/\sqrt{3}$ (d) 1/2

(11) **Young's Modulus of steel is $2\times10^{11}\ N/m^2$. A steel wire has a length of 1m and area of cross-section 1 mm^2 the energy stored is, when extension is 1mm.**
(a) 100 J (b) 10 J
(c) 1 J (d) 0.1 J

(12) **The energy stored per unit volume of a strained wire is (Y is the Young's modulus of the material of the wire)**
(a) $\frac{1}{2}\times\text{load}\times\text{extension}$ (b) $\frac{1}{2}Y\times(\text{strain})^2$
(c) $\frac{1}{2}\times Y\times\frac{Y}{(\text{Strain})^2}$ (d) stress × strain

(13) **Which one of the following is the Young's modulus (in N/m^2) for the wire having the stress-strain curve shown in the figure**



(a) 10×10^{11} (b) 2.0×10^{11}
(c) 8.0×10^{11} (d) 24×10^{11}

(14) **How does the Young's modulus relates with the temperature**
(a) inversely (b) directly
(c) does not depend (d) none of these

(15) **The shear modulus of a liquid is:**
(a) zero (b) infinite
(c) 1 (d) some other finite value

Scanned by CamScanner

(16) **Which of the following group represents donor atoms**
(a) indium, aluminum, phosphorous (b) aluminum, indium, gallium
(c) phosphorus, antimony, arsenic (d) none

(17) **Any alteration produced in shape, length or volume when a body is subjected to an external force is called**
(a) stiffness (b) toughness
(c) extension (d) deformation

(18) **A certain force increases the length of a wire by 1 mm. The force required to increase its length by 2 mm is**
(a) 2F (b) 8F
(c) 4F (d) 16F

(19) **The curie temperature is that at which**
(a) semi-conductor becomes conductors (b) ferromagnetic becomes paramagnetic
(c) paramagnetic becomes diamagnetic (d) metals become super conductor

(20) **A ferromagnet will become fully magnetized when**
(a) high voltage A.C (b) low voltage A.C
(c) alternating current at its peak value (d) D.C current at peak value

(21) **Which of the following produces magnetic field?**
(a) orbital motion of electron (b) spin motion of electron
(c) spin motion of nucleus (d) both a and b

(22) **Calculate the work done, if a wire is loaded by 'Mg' weight and the increase in length is l**
(a) Mgl/2 (b) 2Mgl
(c) Mgl (d) zero

(23) **The modulus of elasticity at constant temperature is**
(a) γP (b) $\frac{P}{\gamma}$
(c) P (d) $\frac{P}{V}$

(24) **Two wires of same diameter of the same material having the length l and 2l. If the force F is applied on each, the ratio of the work done in the two wires will be**
(a) 1:2 (b) 2:1
(c) 1:1 (d) 1:4

(25) **Which of the following is not true for a crystalline substance?**
(a) short range order (b) no definite melting point
(c) sharp melting point (d) all

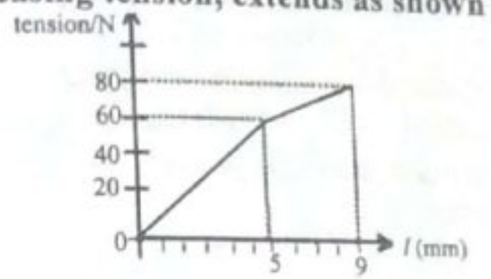
(26) **5 metre long wire is fixed to the ceiling. A weight of 10 kg is hung at the lower end and is 1 metre above the floor. The wire was elongated by 1 mm. The energy stored in the wire due to stretching is**
(a) 100 joule (b) 0.05 joule
(c) zero (d) 500 joule

(27) **Two wires of same material and cross-sectional area have length is the ratio 1:2, if they are stretched by same force, the ratio of tensions in them will be**
(a) 1 : 2 (b) 2 : 1
(c) 1 : 4 **(d) 1 : 1**

(28) **If the force constant of a wire is K, the work done in increasing the length of the wire by L is**
(a) $KL^2/2$ (b) KL
(c) KL/2 (d) KL^2

(29) **A completely filled band is called**
(a) conduction band (b) valence band
(c) forbidden band (d) core band

(30) **A wire, subjected to increasing tension, extends as shown in the figure below.**



What is the work done on the wire in extending it by 5mm?
(a) 0.72J (b) 0.36J
(c) 0.20J (d) 0.15J

(31) **Two identical wires of substances A and B are taken. Equal stretching forces are applied on them along the length. It is observed that elongation of A is more than of B. Then**
(a) A is more elastic than B (b) B is more elastic than A
(c) A and B are equally elastic (d) A is elastic and B is plastic

(32) **If the tension on a wire is removed at once, then**
(a) it will break (b) its temperature increases
(c) its temperature will reduce (d) there will be no change in its temperature

(33) **Soft iron is used for the construction of electromagnets because for iron**
(a) hysteresis is more
(b) coercive force is high
(c) retentivity is high
(d) magnetic saturation limit is high and coercivity is low

(34) **When strain is produced in a body within elastic limit, its internal energy:**
(a) remain same (b) decreases
(c) Increases (d) none of these

(35) **On stretching a wire, the elastic energy stored per unit volume is**
(a) FA/2L (b) FL/2A
(c) Fl/2AL (d) FL/2

(36) **Two bars A and B of circular cross-section and of same volume made of same material are subjected under same tension. If the diameter of A is half that of B, the ratio of extension of A to that of B will be:**
(a) 4 (b) 1/4
(c) 2 (d) 16

(37) **Very weak magnetic fields are detected by _____**
(a) squids (b) magnetic resonance imaging (MRI)
(c) magnetometer (d) oscilloscope

(38) **The length of an iron wire is L and area of cross-section is A. The increase in length is l on applying the force F on its two ends. Which of the statement is correct?**
(a) increase in length is proportional to Young's modulus
(b) increase in length is inversely proportional to A
(c) increase in length is inversely proportional to its length L
(d) increase in length is proportional to area of cross-section A

Scanned by CamScanner

(39) A cube of each of length 3m is subjected to a normal force of 36N. The stress on a cube is
(a) 12 Nm^{-2} (b) 4 Nm^{-2}
(c) 2 Nm^{-2} (d) 8 Nm^{-2}

(40) The bulk modulus is a proportionality constant that relates the pressure acting on an object to:
(a) the fractional change in volume (b) the shear
(c) the fractional change in length (d) the spring constant

(41) To double the length of an iron wire having 0.5 cm^2 area of cross-section, the required force will be ($Y = 10^{12}$ dyne/cm^2)
(a) 1.0×10^{-7}N (b) 1.0×10^{7}N
(c) 0.5×10^{-7}N (d) 0.5×10^{12}dyne

(42) The ratio of diameters of two wires of same material is n : 1. The length of each wire is m. On applying the same load, the increase in length of thin wire will be ($n > 1$)
(a) n^2 times (b) n times
(c) 2n times (d) (2n + 1) times

(43) The elasticity limit for a gas
(a) exists (b) exists only at absolute zero
(c) exists for a perfect gas (d) does not exist

(44) The Young's modulus for a liquid is
(a) 0 (b) 1
(c) ∞ (d) some finite, non-zero constant

(45) The change in the shape of a regular body is due to
(a) Bulk strain (b) Shear strain
(c) Longitudinal strain (d) Metallic strain

(46) The breaking stress of a wire depends upon
(a) length of wire (b) radius of wire
(c) shape of cross-section (d) material of wire

(47) Energy stored per unit volume of a stretched wire is
(a) $\left(\frac{1}{2}\right)$ × load × extension (b) stress × strain
(c) load × stress (d) $\left(\frac{1}{2}\right)$ × stress × strain

(48) When a certain weight is suspended from a long uniform wire, its length increases by l cm. If the same weight is suspended from another wire of the same material and length but having a diameter half of the first one then the increase in length will be
(a) 4 cm (b) 10cm
(c) 2 cm (d) 0.5cm

(49) A and B are two wires. The radius of A is twice that of B. They are stretched by the same some load. Then the stress on B is
(a) four times that on A (b) two times that on A
(c) half that on A (d) equal to A

(50) The area of cross-section of a wire of length 1.1 meter is 1 mm^2. It is loaded with 1 kg. If Young's modulus of copper is $1.1\times10^{11}N/m^2$, then the increase in length will be ($g=10m/s^2$)
(a) 0.075 mm (b) 0.1 mm
(c) 0.01 mm (d) 0. 15 mm

(51) Tick the one which is not a crystalline solid?
(a) Copper (b) Ionic compound
(c) Zircona (d) Glass

(52) A semiconductor is known to have an electron concentration of 8×10^{13} and hole concentration of $5\times10^{12}/cm^3$. The semiconductor is
(a) N-type (b) P-type
(c) intrinsic (d) insulator

(53) A rubber cord of cross-sectional area 2 cm^2 has a length of 1m. When a tensile force of 10N is applied the length of the cord increase by 10 cm .What is the young's modulus of rubber?
(a) 2×10^{8} Nm^{-2} (b) 0.5×10^{6} Nm^{-2}
(c) 0.5×10^{-6} Nm^{-2} (d) 0.2×10^{-6} Nm^{-2}

(54) In MRI _____ are used.
(a) semi conductor (b) super conductor
(c) conductor (d) insulators

(55) The ratio of the length of two wires A and B of same material is 1:2 and the ratio of their diameter is 2:1 then are stretched by the same force, then the ratio of increase in length will be.
(a) 2:1 (b) 1:4
(c) 1:8 (d) 8:1

(56) On increasing the length by 0.5 mm in a steel wire of length 2m and area of cross-section 2mm^2, the force required is $\left(Y = 2.2\times10^{11}Nm^{-2}\right)$
(a) 1.1×10^{5} N (b) 1.1×10^{4} N
(c) 1.1×10^{3} N (d) 1.1×10^{2} N

(57) The materials suitable for making electromagnets should have
(a) high retentivity and low coercivity (b) low Retentivity and low coercivity
(c) high retentivity and high coercivity (d) low Retentivity and high coercivity

(58) Two wires of same radius and length are subjected to the same load. Young's Modulus of steel is twice that of copper, the ratio of elastic energy stored per unit volume in steel to that of copper wire is
(a) 1:2 (b) 2:1
(c) 1:4 (d) 4:1

(59) A fixed volume of iron is drawn into a wire of length l, the extension x produced in this wire by a constant force F, is proportional to
(a) $\frac{1}{l^2}$ (b) $\frac{1}{l}$
(c) l^2 (d) l

(60) The material of permanent magnet has
(a) high retentivity, low coercivity (b) low retentivity, high coercivity
(c) low retentivity, low coercivity (d) high retentivity, high coercivity

Scanned by CamScanner

ANSWER KEY

1	d	11	d	21	d	31	b	41	d	51	d
2	c	12	b	22	a	32	b	42	a	52	a
3	c	13	b	23	c	33	d	43	d	53	b
4	a	14	a	24	c	34	c	44	a	54	b
5	b	15	a	25	d	35	c	45	b	55	c
6	b	16	c	26	b	36	a	46	d	56	d
7	b	17	d	27	d	37	a	47	d	57	b
8	d	18	a	28	a	38	b	48	a	58	a
9	a	19	b	29	d	39	b	49	a	59	c
10	c	20	c	30	d	40	a	50	b	60	d

EXPLANATORY NOTES

(1) Young modulus of steel is high

(2) In the region OA, stress ∝ strain i.e. Hooke's law holds good.

(3) As strain is shown on x-axis and stress on y-axis so we can say that $Y = \frac{\text{stress}}{\text{strain}} = \text{slope}$ ∝ elasticity of wire A is maximum.

(4) $Y = \frac{F/A}{\Delta\ell/\ell}$

$F = Y \times A \times \frac{\Delta\ell}{\ell}$

$\frac{F_1}{F_2} = \frac{Y_1}{Y_2} \times \frac{A_1}{A_2} \times \frac{\Delta\ell_1}{\Delta\ell_2} \times \frac{\ell_2}{\ell_1}$

Given $Y_1 = Y_2$, $\ell_1 = \ell_2$, $\Delta\ell_1 = \Delta\ell_2$

$\frac{F_1}{F_2} = \frac{\pi r_1^2}{\pi r_2^2}$

$\frac{F_1}{F_2} = \frac{\left(\frac{d_1}{2}\right)^2}{\left(\frac{d_2}{2}\right)^2}$

$\frac{F_1}{F_2} = \left(\frac{d_1}{d_2}\right)^2$

$\frac{F_1}{F_2} = \left(\frac{1}{2}\right)^2$

$F_1 : F_2 = 1 : 4$

(5) Force per unit area:

$= \frac{[F]}{[A]} = \frac{[MLT^{-2}]}{[L^2]} = [ML^{-1}T^{-2}]$

Stress:

$[\sigma] = \frac{[F]}{[A]} = [ML^{-1}T^{-2}]$

Young modulus:

$Y = \frac{\sigma}{\varepsilon} = \frac{F/A}{\Delta\ell/\ell}$

$[Y] = \frac{[F]}{[A]} \times \frac{[L]}{[L]}$

$[Y] = [ML^{-1}T^{-2}]$

Pressure:

$[P] = \frac{[F]}{[A]} = [ML^{-1}T^{-2}]$

Strain:

$[\varepsilon] = \frac{[\Delta\ell]}{[\ell]} = \frac{[L]}{[L]}$

$[\varepsilon]$ = no dimension

(6) $[\varepsilon] = \frac{\Delta\ell}{\ell} = \frac{4\ell - \ell}{\ell}$

$= \frac{3\ell}{\ell} = 3$

(7) From the graph $l = 10^{-4}\,m$, $F = 20N$ $A = 10^{-4}\,m^2$, $L = 1m$ / $Y = \frac{FL}{Al}$

$= \frac{20 \times 1}{10^{-4} \times 10^{-4}} = 20 \times 10^{10} = 2 \times 10^{11}\ N/m^2$

(8) $E = \frac{1}{2} F \times \Delta\ell$

$\frac{E}{V} = \frac{1}{2} \frac{F \times \Delta\ell}{V}$

$\frac{E}{V} = \frac{1}{2} \frac{F}{A} \times \frac{\Delta\ell}{\ell}$

$\frac{E}{V} = \frac{1}{2}(\text{Stress})(\text{Strain})$

(9) At point b, yielding of material starts.

(10) Force constant, $K = \tan 30° = \frac{1}{\sqrt{3}}$

Scanned by CamScanner

(11) $E = W = \frac{1}{2}\left[\frac{YA \times \ell^2}{L}\right]$

$= \frac{1}{2}\left[\frac{2\times10^{11}\times10^{-6}\times10^{-6}}{1}\right]$

$= \frac{1}{2}\left(2\times10^{-1}\right)$

$= 0.1J$

(12) $\frac{E}{V} = \frac{1}{2}$ Stress x Strain

$\frac{E}{V} = \frac{1}{2} Y \times (\text{Strain})^2$

(13) Young's modulus is defined only in elastic region and $Y = \frac{\text{Stress}}{\text{Strain}} = \frac{8\times10^7}{4\times10^{-4}} = 2\times10^{11} N/m^2$

(14) $Y \propto \frac{1}{T}$

(15) For water:
$Y = 0, K = 2.2 Nm^{-2}$ and $G = 0$

(16) Phosphours, antimony and arsenic donates a free electron in crystal, when covalent bonds complete.

(17) $\Delta\ell$, Δa and $\Delta V \Rightarrow$ Deformation

(18) Force $\propto$ extension
If force double then extension also double

(19) Above curie temperature iron is paramagnetic but not ferromagnetic, because orderliness of domain disturb due to increase thermal vibration of domain's atoms.

(20) When alternating current is at positive peak value, ferromagnet fully magnetize in one direction and when the current is at negative peak, it fully magnetized in opposite direction.

(21) Magnetic field created by the electrons within an atom is due to combined field created by their orbital and spin motions.

(22) Work done $= \frac{1}{2} Fl = \frac{Mgl}{2}$

(23) Newton assumption: When a sound wave travel through air, the temperature of air during compression remain constant and pressure changes from P to $(P + \Delta P)$ and volume changes from V to $(V - \Delta V)$.

According to Boyle's law,
$PV = (P + \Delta P)(V - \Delta V)$

$PV = PV - P\Delta V + V\Delta P - \Delta P\Delta V$

"$\Delta P\Delta V$" neglected

$PV - PV = -P\Delta V + V\Delta P$

$P\Delta V = V\Delta P$

$P = \frac{\Delta P}{\Delta V / V} = \frac{\text{Stress}}{\text{Strain}}$

$E = P(T = \text{const.})$

(24) $W = \frac{1}{2} Fl \,/\, W \propto l$ (F is constant) $/ \frac{W_1}{W_2} = \frac{l_1}{l_2} = \frac{l}{2l} = \frac{1}{2}$

(25) They are properties of glassy and polymeric solids.

(26) $W = \frac{1}{2} \times F \times l = \frac{1}{2} mgl = \frac{1}{2} \times 10 \times 10 \times 1 \times 10^{-1} = 0.05J$

(27) $\frac{Y_1}{Y_2} = \frac{F_1}{F_2} \times \frac{\ell_1}{\ell_2} \times \frac{A_2}{A_1} \times \frac{\Delta\ell_2}{\Delta\ell_1}$ Forces are same $\frac{F_1}{F_2} = \frac{T_1}{T_2} \Rightarrow \frac{F}{F} = \frac{T_1}{T_2}$ $\left(Y = \frac{F \times \ell}{A \times \Delta\ell}\right)$

$\boxed{\frac{1}{1} = \frac{T_1}{T_2}}$

(28) $K = \frac{F}{L}$ and $W = \frac{1}{2} FL = \frac{1}{2} KL \times L = \frac{1}{2} KL^2$

(29) It is property of core band.

(30) W= Area under the curve

$W = \frac{1}{2}\left(5\times10^{-3}\right)(60)$

$W = \frac{5}{1000} \times 30 = \frac{15}{100} = 0.15J$

(31) Elasticity $\propto \frac{1}{\text{Elongation}}$

(32) Due to tension, intermolecular distance between atoms is increased and therefore potential energy of the wire is increased and with the removal of force inter atomic distance is reduced and so is the potential energy. This change in potential energy appears as heat in the wire and thereby increases the temperature.

(33) Soft magnetic material such as iron which can be magnetized or demagnetized. The energy dissipated per cycle for iron (soft magnetic material) is less than for steel (hard magnetic material). Soft material have high magnetic saturation limit and low correctivity.

(34) Due to increase in intermolecular distance

(35) Energy stored per unit volume $= \frac{1}{2}\left(\frac{F}{A}\right)\left(\frac{l}{L}\right) = \frac{Fl}{2AL}$

(36) $Y = \frac{F/A}{\Delta\ell/\ell} \Rightarrow \Delta\ell \propto \frac{1}{A}$

$\frac{\Delta\ell_A}{\Delta\ell_B} = \frac{A_B}{A_A} \Rightarrow \frac{\Delta\ell_A}{\Delta\ell_B} = \frac{\pi r_B^2}{\pi r_A^2}$

$\frac{\Delta\ell_A}{\Delta\ell_B} = \frac{\left(\frac{d_B}{2}\right)^2}{\left(\frac{d_A}{2}\right)^2} \Rightarrow \frac{\Delta\ell_A}{\Delta\ell_B} = \left(\frac{d_B}{d_A}\right)^2 \Rightarrow \frac{\Delta\ell_A}{\Delta\ell_B} = \left(\frac{d_B}{d_B/2}\right)^2 \Rightarrow \Delta\ell_A = 4\Delta\ell_B$

(37) Squids (or super conducting quantum interference devices) are used to detect very weak magnetic field such as produced by the brain.

(38) $l = \frac{FL}{YA} \Rightarrow l \propto \frac{1}{A}$

Scanned by CamScanner

(39) $\sigma = \frac{F}{A} \Rightarrow \sigma = \frac{F}{\ell \times \ell} \Rightarrow \sigma = \frac{36}{3\times 3} \Rightarrow \sigma = 4\,Nm^{-2}$

(40) $K = \frac{F/A}{\Delta V/V}$

Where $\frac{\Delta V}{V}$ = fraction change in volume

Bulk modulus $\propto \frac{1}{\text{fractional charge in volume}}$

(41) $Y = \frac{\frac{F}{A}}{\frac{\Delta \ell}{\ell}}$

$\Delta \ell = \ell, F = AY$ or $F = 0.5\times 10^{12}$ dyne

(42) $Y = \frac{\frac{F}{A}}{\frac{\Delta \ell}{\ell}} = \frac{F\ell}{A\,\Delta \ell}$

or $Y = \frac{F\ell \times 4}{\pi D^2 \times \Delta \ell}$ or $\Delta \ell \propto \frac{1}{D^2}$ or $\frac{\Delta \ell_2}{\Delta \ell_1} = \frac{D_1^2}{D_2^2} = \frac{n^2}{1}$

(43) Gases expand when their temperature increases.

(44) No internal force

(45) Shearing strain causes change in shape of regular body.

(46) Breaking stress is different for different materials.

(47) $\frac{E}{V} = \frac{1}{2}\left(\frac{F}{A}\right)\left(\frac{\Delta L}{L}\right) = \frac{1}{2}$ stress × strain

(48) $l = \frac{FL}{AY} \Rightarrow l \propto \frac{1}{r^2}$ (F, L and Y are constant) $\frac{l_2}{l_1} = \left(\frac{r_1}{r_2}\right)^2 = (2)^2 = 4 \Rightarrow l_2 = 4l_1 = 4cm$

(49) Stress $= \frac{\text{force}}{\text{Area}}$ / Stress $\propto \frac{1}{\pi r^2}$ $\frac{S_B}{S_A} = \left(\frac{r_A}{r_B}\right)^2 = (2)^2 \Rightarrow S_B = 4S_A$

(50) $l = \frac{mgL}{AY} = \frac{1\times 10\times 1.1}{1.1\times 10^{11}\times 10^{-4}} m = 0.1mm$

(51) Glass is a amorphous solid.

(52) In N-type semiconductor, free electrons are the majority charge carries.

(53) $Y = \frac{F\times \ell}{A\Delta \ell}$

(54) Super conductor are used in MRI. (Information of the book)

(55) $\Delta l = \frac{F\times L}{AY}$ $\frac{\Delta l_1}{\Delta l_2} = \frac{L_1}{L_2}\times\left(\frac{d_1}{d_2}\right)^2 = \frac{1}{2}\times\left(\frac{1}{2}\right)^2 = \frac{1}{8}$

(56) $F = \frac{YA\Delta \ell}{L} = 1.1\times 10^2\,N$

(57) Materials used for making electromagnets should have the following properties:

(i) Low Retentivity

(ii) High value of saturation magnetization

(iii) Low coercivity

(iv) Small hysteresis loss

(58) $Y_s = 2Y_{Cu}$, *Elastic energy stored per unit volume*

$E = \frac{(Stress)^2}{2Y}$ $\frac{E_s}{E_{Cu}} = \frac{(Stress)^2\times 2Y_{Cu}}{2Y_s\times(Stress)^2}$

$\left[Stress = \frac{Load}{Area\ of\ cross\ section}\ is\ same\right]$

$\frac{E_s}{E_{Cu}} = \frac{Y_{Cu}}{2Y_{Cu}} = \frac{1}{2}$

(59) If force is constant and volume is fixed, then

$Y = \frac{F\times l}{A\Delta l} \Rightarrow \Delta l = \frac{Fl}{YA}\times\frac{l}{l} \Rightarrow \Delta l \propto l^2$

(60) Permanent magnet should have high retentivity and high coercivity.

Scanned by CamScanner

18 Chapter ELECTRONICS

PRACTICE EXERCISE

(1) **In p-type semiconductor the majority and minority charge carriers are**
(a) Holes and electrons (b) Electrons and holes
(c) Electrons and proton (d) Holes and protons

(2) **In a pnp transistor, the p-type crystal acts as**
(a) Emitter only (b) Collector only
(c) Either emitter or collector (d) Neither emitter nor collector

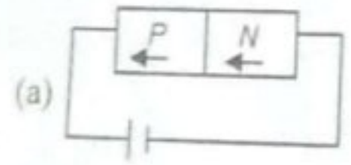
(3) **Diode can work as**
(a) Oscillator (b) Transformer
(c) Generator (d) Rectifier

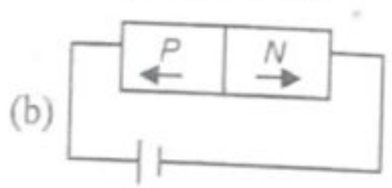
(4) **In an intrinsic semi conductor the number of**
(a) Electrons are greater (b) Holes are greater
(c) Electrons and holes are equal (d) None of these

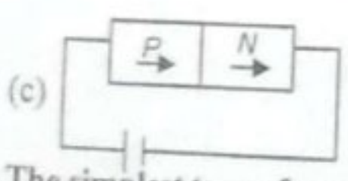
(5) **p-n junction when reversed biased acts as a** _____
(a) Capacitor (b) Inductor
(c) On switch (d) Off switch

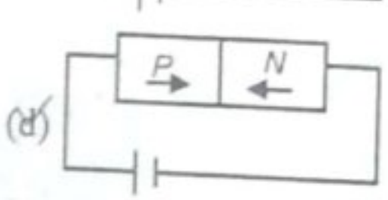
(6) **In p-n-p transistor, the collector current is** _____
(a) Equal to emitter current (b) Slightly less than emitter current
(c) Greater than emitter current (d) Any of above

(7) **In the case of forward biasing of pn junction, which one of the following figures correctly depicts the direction of the flow of charge carriers?**

(a) 

(b) 

(c) 

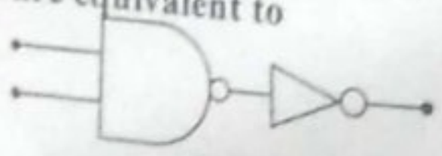
(d) 

(8) **The simplest type of rectification known as half wave rectification is obtained by** _____
(a) Using a transistor
(b) Suppressing the harmonics in A.C voltage
(c) Suppressing half wave of A.C supply by using diode
(d) Using a Coolidge tube

(9) **Identify the correct statement about minority carriers-**
(a) Holes in n-type and free electrons in p-type (b) Holes in n-type and p-type
(c) Free electrons in n-type and holes in p-type (d) Free electrons in n-type and p-type

(10) **Depletion region of a junction is formed** _____
(a) During the manufacturing process (b) Under forward bias
(c) Under reverse bias (d) When temperature varies

(11) **The combination of these gates are equivalent to**



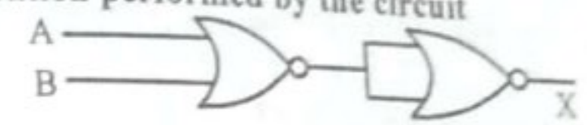
(a) NAND gate (b) NOT gate
(c) AND gate (d) XNOR gate

(12) **On increasing the reverse biased voltage to a large value in a pn junction diode, the current**
(a) Increases slowly (b) Remains fixed
(c) Increases suddenly (d) Decreases slowly

(13) **Which one of the following has the greatest energy gap?**
(a) Insulator (b) Conductor
(c) Semi conductor (d) All of above

(14) **If a voltage of 3.5V is applied on a gate, it will recognize it as logic** _____.
(a) High (b) Between High and Low
(c) Low (d) None of above

(15) **Identity the logic operation performed by the circuit**



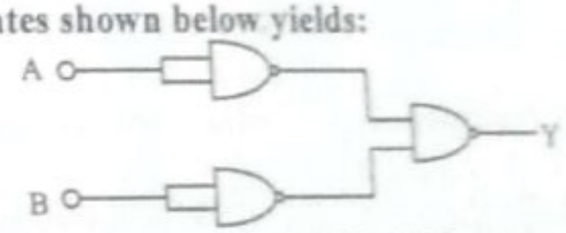
(a) NOT (b) NAND
(c) OR (d) NOR

(16) **Hole is equivalent to** _____
(a) A positive charge (b) A negative charge
(c) A neutral particle (d) An electron

(17) **Which one of the following is not a donor impurity?**
(a) Antimony (b) Phosphorus
(c) Aluminium (d) Arsenic

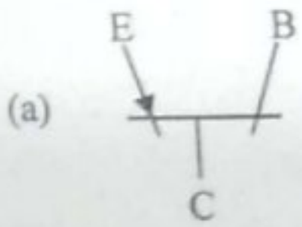
(18) **Forward current through a semi conductor diode circuit is due to** _____
(a) Minority carriers (b) Majority carriers
(c) Holes (d) Electrons

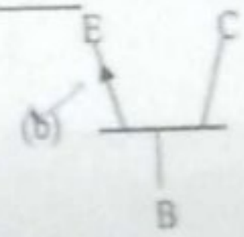
(19) **The combination of gates shown below yields:**

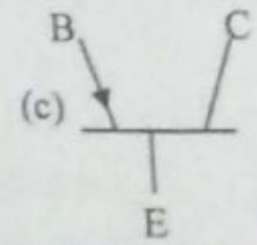


(a) NAND gate (b) AND gate
(c) OR gate (d) XOR gate

(20) **The symbol of n-p-n transistor is** _____

(a) 

(b) 

(c) 

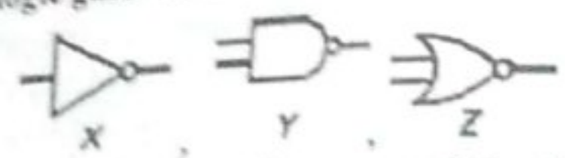
(d) None of these

(21) **In full wave rectification, the output D.C. voltage across the load is obtained for** _____
(a) The positive half cycle of input A.C. (b) The negative half cycle of input A.C.
(c) The complete cycle of input A.C. (d) All of the above.

Scanned by CamScanner

(22) **The semiconductor diode can be used as a rectifier because** _____
(a) It has low resistance to the current flow when forward biased & high resistance when reverse biased.
(b) It has low resistance to the current flow when forward biased.
(c) It has high resistance to the current flow when reverse biased.
(d) Its conductivity increases with rise of temperature.

(23) **Diagram shows three logic gates X, Y and Z.**

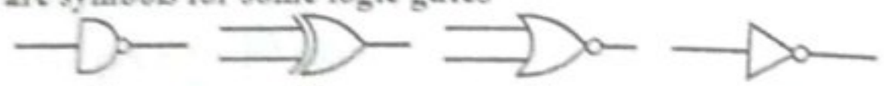


Which of the following is correct about the names of the three logic gates?

	X	Y	Z
(a)	NAND	NOR	NOT
(b)	NOT	NAND	NOR
(c)	NOR	AND	NOT
(d)	NAND	NOT	NOR

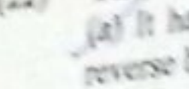
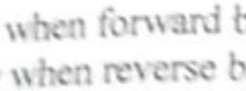
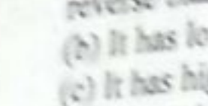
(24) **The device or circuit used for conversion of A.C. into D.C. is called** _____
(a) An amplifier. (b) A rectifier
(c) Filtering circuit (d) Converter.

(25) **Given below are symbols for some logic gates**



The XOR Gate and NOR gate respectively are
(a) 1 and 2 (b) 2 and 3
(c) 3 and 4 (d) 1 and 4

(26) **The specially designed semiconductor diodes used as indicator lamps in electronic circuits are** _____
(a) The switch (b) The light emitting diode
(c) The photo diodes (d) Solar cells.

(27) **Which of the following can act as inverter**
(a) 
(b) 
(c) 
(d) All of these

(28) **The alternating voltage is an example of** _____
(a) A digital waveform (b) An analogue waveform
(c) Discrete waveform (d) None at all

(29) **The output of 2 inputs OR gate is 0 only when**
(a) Both inputs are 1 (b) Either input is 1
(c) Both inputs are 0 (d) Either input is 0

(30) **AND operation can be represented by**
(a) Two switches in series (b) Two switches in parallel
(c) Both "a" and "b" (d) None of these

(31) **NAND gate is a combination of**
(a) AND gate and NOT gate (b) AND gate and OR gate
(c) OR gate and NOT gate (d) NOT gate and NOT gate

(32) **To obtain an n-type semiconductor germanium crystal, it must be doped with foreign atoms whose valency is**
(a) 2 (b) 3
(c) 4 (d) 5

(33) **The gate which changes the logic level to its opposite level**
(a) NOR gate (b) NOT gate
(c) NAND gate (d) Any of these

(34) $X = \overline{A\overline{B} + \overline{A}B}$ **is Boolean expression for**
(a) OR gate (b) X NOR gate
(a) NAND gate (d) X-OR gate

(35) **In forward bias the width of potential barrier**
(a) Increases (b) Decreases
(c)Remains same (d) No effect

(36) **For the manipulation of the quantities, which have values 1 and 0, special algebra is used called:**
(a) Simple Algebra (b) Newton Algebra
(c) Leibnitz Algebra (d) Boolean algebra

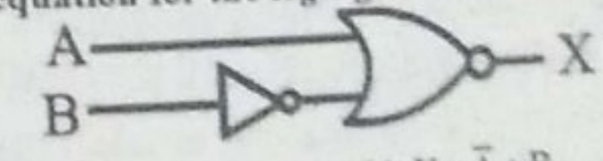
(37) **The electronic circuits which implement the various logic operations are called**
(a) Logic gates (b) Boolean algebra
(c) Amplifier gain (d) Logic functions

(38) **An OP-AMP as a comparator is a circuit that compares the signal voltage on one of its inputs with a**
(a) Non-inverting voltage at output (b) Reference voltage on the other
(c) Virtual input (d) Output

(39) **Complement operation is** _____.
(a) $\overline{A}$ (b) A.B
(c) A + B (d) None of these

(40) **In common emitter amplifier the phase difference between input signal voltage and out put voltage is**
(a) 0 (b) $\frac{\pi}{4}$
(c) $\frac{\pi}{2}$ (d) π

(41) **What is the Boolean equation for the logic gate shown?**

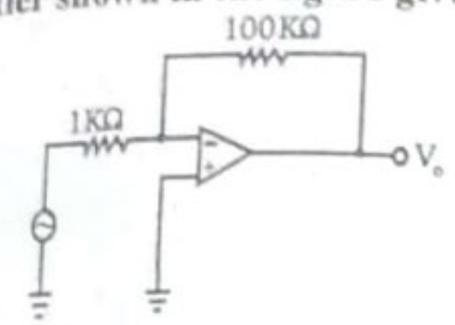


(a) $X = \overline{A + \overline{B}}$ (b) $X = \overline{A} + B$
(c) $X = \overline{A + B}$ (d) $Y = \overline{A} + \overline{B}$

(42) **In a transistor, collector current is controlled by**
(a) Collector voltage (b) Base current
(c) Collector resistance (d) All of the above

Scanned by CamScanner

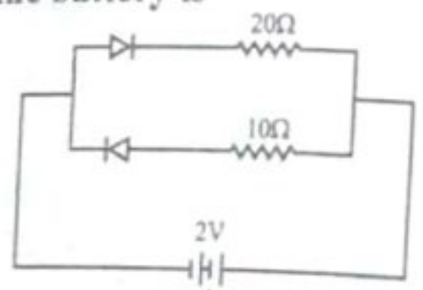
(43) The voltage gain of the amplifier shown in the figure given below is



(a) $-\frac{10^{0}}{10^{-2}}$ (b) $-10^{3}\times10^{-5}$

(c) $-\frac{10^{-3}}{10^{-5}}$ (d) $-10^{0}\times10^{-2}$

(44) In fig. the current supplied by the battery is



(a) 0.1 A (b) 0.2 A

(c) 0.3 A (d) 0.4 A

(45) The value of resistivity for conductor is of the order of

(a) 10^{-5} ohm metre (b) 10^{-6} ohm metre

(c) 10^{-7} ohm metre (d) 10^{-8} ohm metre

(46) The width of base in transistor is of the order of

(a) micron (b) micrometer

(c) $(10^{-2})^{3}$ m (d) all of these

(47) By which process the depletion region is formed around the junction

(a) diffusion (b) emission

(c) fusion (d) fission

(48) Non-inverting amplifier circuits have

(a) a very high input impedance (b) a very low input impedance

(c) a low output impedance (d) both a and c

(49) If a full wave rectifier circuit is operating from 50 Hz mains, the fundamental frequency in the ripple will be

(a) 50 Hz (b) 100 Hz

(c) 70.7 Hz (d) 25 Hz

(50) With zero volts on both inputs, an OP-amp ideally should have an output .....

(a) equal to the positive supply voltage (b) equal to zero

(c) equal to the negative supply voltage (d) equal to CMRR

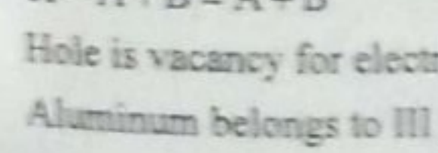
ANSWER KEY

1	a	11	c	21	c	31	a	41	a
2	c	12	c	22	a	32	d	42	d
3	d	13	a	23	b	33	b	43	c
4	c	14	a	24	b	34	b	44	b
5	d	15	c	25	b	35	b	45	c
6	b	16	a	26	b	36	d	46	d
7	d	17	c	27	d	37	a	47	a
8	c	18	b	28	b	38	b	48	d
9	a	19	c	29	c	39	a	49	b
10	a	20	b	30	a	40	d	50	b

EXPLANATORY NOTES

(1) P type substance has holes as majority charge carries and electron as minority charge carriers.

(2)



(3) Diode conduct only one-half cycle so it acts as rectifier.

(4) Intrinsic is pure form of semi-conductor so it has equal holes and electrons.

(5) PN junction in reverse biasing has high resistance in order of MΩ so it acts as off switch.

(6)

$I_E = I_B + I_C$

$I_E > I_C$

(7) Holes move along electric field and electron in opposite direction.

(8) Diode conduct during one half cycle.

(9) In n-type semi-conductor holes and in p-type semi-conductor free electrons are minority charge carriers.

(10) Depletion region formed when different region fused during manufacturing.

(11) $X = \overline{A.B} = \overline{\overline{A.B}} = A.B$

(12) As voltage increases in reverse biasing current suddenly increase and PN junction breaks. Large number of electron hole pair are produced due to break of covalent bond.

(13) In insulator energy gap is maximum in order of several eV.

(14) Voltage > 2Volts is considered as high.

(15) $X = \overline{\overline{A+B}} = A+B$

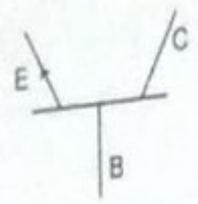
(16) Hole is vacancy for electron having positive charge.

(17) Aluminum belongs to III group so, it is acceptor.

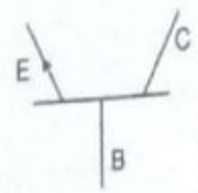
Scanned by CamScanner

(18) Forward current is due to majority carriers.

(19)



(20)



The arrow shows the direction of conventional current.

(21) In full wave rectification, complete cycle of A.C is rectified.

(22) Its reverse biased resistance is very high in order $M\Omega$ and forward biased resistance is very low in order few ohms.

(23) X is NOT gate, Y is NAND gate and Z is NOR gate.

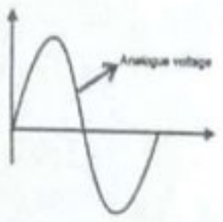
(24) Rectifier converts AC to DC current.

(25) Simple symbols.

(26) LED is used in indicator lamps.

(27)

(28)

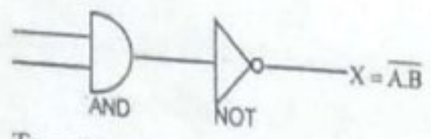


Alternating voltage increases or decreases continuously.

(29) $X = A + B \Rightarrow X = 0$ if $A = 0$ and $B = 0$

(30) AND acts as two switches in series.

(31)



(32) To get n-type semi-conductor, pure semi-conductor is doped with pentavalent element.

(33) $X = \overline{A}$

A	X
0	1
1	0

(34) $X = \overline{A}\overline{B} + \overline{A}B$ it is expression of X NOR gate.

(35) In case of forward biasing width of potential barrier decreases.

(36)

(37)

(38)

(39)

(40)

$$\Delta V_o = -\beta \frac{R_c}{r_{ie}} \Delta V_{in}$$

$\theta = 180°$



(41) Here is a NOR gate between A and $\overline{B}$, so $\overline{A + \overline{B}}$

(42)

- V_{CC} battery attracted charge carriers toward collector
- Base current flow toward collector
- Collector resistance-controlled collector current

(43) Voltage gain $= -\frac{R_2}{R_1} = -100$

(44) $I = \frac{2V}{10\Omega} = 0.2A$ one is forward base and other is reverse biased.

(45) The value of resistivity for conductor is order of $10^{-4}\Omega m$.

(46) By definition.

(47) Some electrons diffuse to the p-region. So, process is diffusion.

(48) Due to high value of input impendence, no current flows between the two input terminals of amplifier. Large value of current flow between output terminal of amplifier due to low output impendence.

(49) In full wave rectifier, frequency of output wave is double of input wave.

(50) For ideal amplifier: Input voltage = output voltage

Scanned by CamScanner

18 Chapter ELECTRONICS

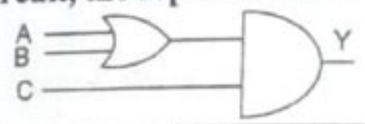
SELF ASSESMENT TEST

(1) **The electrical conductivity of semiconductors:**
(a) is independent of temperature
(b) decreases with increase of temperature
(c) increases with increase of temperature
(d) first increases and then decreases with increase of temperature

(2) **Semi-conductors with donor atoms and free electrons belong to the type _____**
(a) N
(b) P
(c) mix
(d) any of above

(3) **Which of the following is true for expression $\overline{A}.\overline{B}$ is equal to?**
(a) $\overline{\overline{A}.\overline{B}}$
(b) $\overline{A+B}$
(c) $\overline{A.B}$
(d) A + B

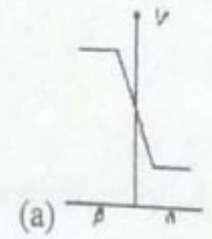
(4) **To get an output Y = 1, from the circuit, the input must be**

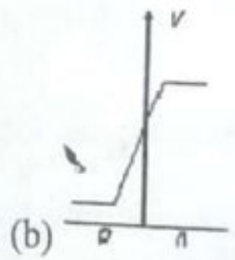


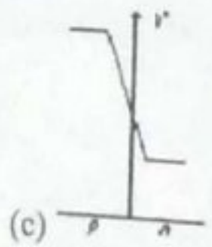
	A	B	C
(a)	0	1	0
(b)	0	0	1
(c)	1	0	1
(d)	1	0	0

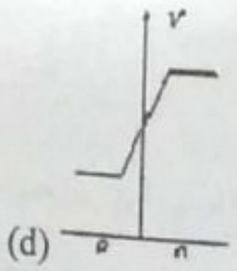
(5) **P-N junction when reversed biased acts as a _____**
(a) capacitor
(b) inductor
(c) ON switch
(d) OFF switch

(6) **In a forward biased PN-junction diode, the potential barrier in the depletion region is of the form ?**

(a) 

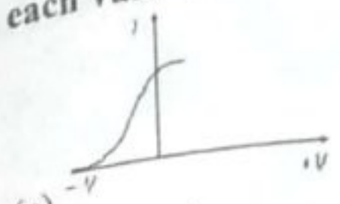
(b) 

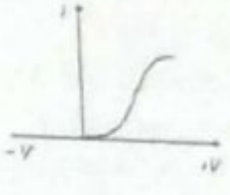
(c) 

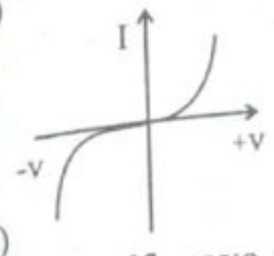
(d) 

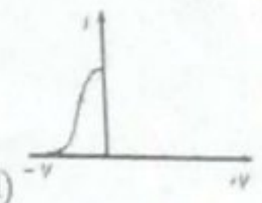
(7) **In N.P.N transistor, P works as _____**
(a) collector
(b) emitter
(c) base
(d) any of above

(8) **Different voltages are applied across a P-N junction and the currents are measured for each value. Which of the following graphs is obtained between voltage and current?**

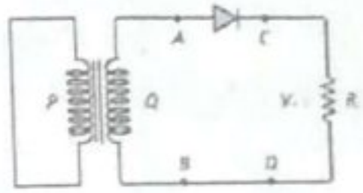
(a) 

(b) 

(c) 

(d) 

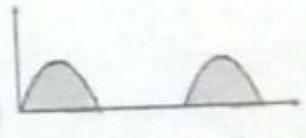
(9) **In the half-wave rectifier circuit shown. Which one of the following wave forms is true for VCD, the output across C and D?**



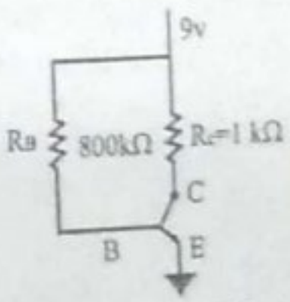
(a) 

(b) 

(c) 

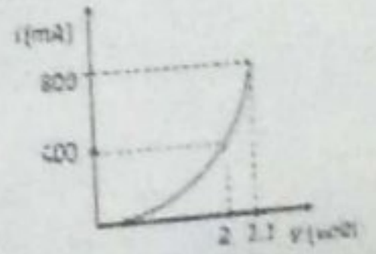
(d) 

(10) **In given circuit, there is negligible potential drop between B and E. If β = 100 calculate Base current**



(a) 11.25 μA
(b) 1.125μA
(c) 10mA
(d) 10.1 mA

(11) **The I-V characteristic of a P-N junction diode is shown below. The approximate dynamic resistance of the P-N junction when a forward bias of 2volt is applied**



(a) 0.25 Ω
(b) 0.5 Ω
(c) 5 Ω
(d) 1 Ω

Scanned by CamScanner

(12) **In a PN-junction**
(a) the current in the reverse biased condition is small but the forward biased current is independent of the bias voltage
(b) the reverse biased current is strongly dependent on the applied bias voltage
(c) the current in the reverse biased condition is generally very small
(d) the forward biased current is very small in comparison to reverse biased current

(13) **The given truth table is for**

A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

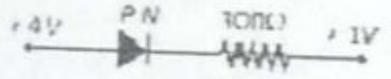
(a) NAND gate (b) XNOR gate
(c) NOR gate (d) OR gate

(14) **The value of resistivity for conductor is of the order of _____**
(a) 10^{-5} ohm metre (b) 10^{-6} ohm metre
(c) 10^{-7} ohm metre (d) 10^{-8} ohm metre

(15) **PN-junction diode works as a insulator, if connected**
(a) in reverse bias
(b) in forward bias
(c) in forward bias and in reverse bias
(d) none of these

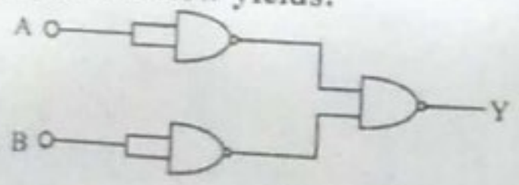
(16) **The reverse biasing in a PN junction diode**
(a) increases the potential barrier
(b) increases the number of minority charge carriers
(c) decreases the potential barrier
(d) increases the number of majority charge carriers

(17) **In the circuit given below, the value of the current is**



(a) 0 (b) 10^{2}amp
(c) 10^{-2}amp (d) 10^{-3}amp

(18) **The combination of gates shown below yields:**

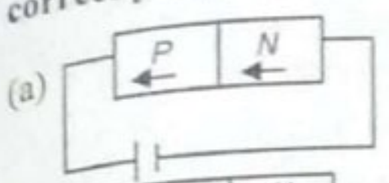


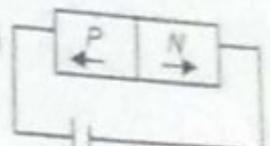
(a) NAND gate (b) AND gate
(c) OR gate (d) XOR gate

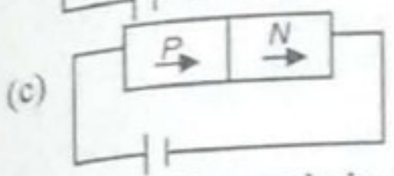
(19) **The PN junction diode is used as**
(a) a rectifier (b) an oscillator
(c) an amplifier (d) a modulator

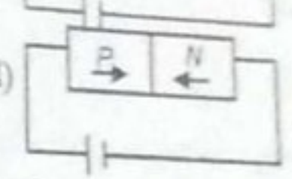
(20) **In the middle of the depletion layer of a reverse biased PN junction, the:**
(a) electric field is maximum (b) potential is zero
(c) electric field is zero (d) potential is maximum

(21) **In the case of forward biasing of PN-junction, which one of the following figures correctly depicts the direction of flow of charge carriers.**

(a) 

(b) 

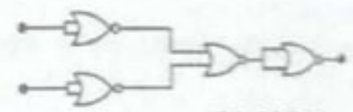
(c) 

(d) 

(22) **What is voltage gain in a common emitter amplifier when input resistance is 3 Ω and the load resistance 24 Ω with $\beta = 60$:**
(a) 8.4 (b) 4.8
(c) 2.4 (d) 480

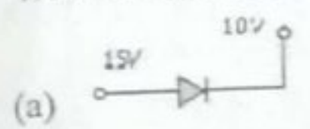
(23) **In a PN-junction diode not connected to any circuit**
(a) the P-type is a higher potential than the N-type side
(b) there is an electric field at the junction directed from the N- type side to the P- type side
(c) there is an electric field at the junction directed from the P-type side to the N-type side
(d) the potential is the same everywhere

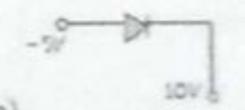
(24) **Identify the Gate in Fig.**

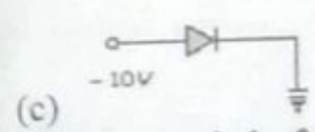


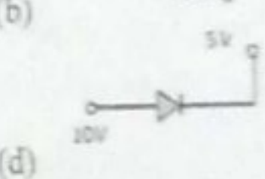
(a) AND (b) XOR
(c) NOR (d) NAND

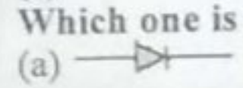
(25) **Which one is reverse-biased?**

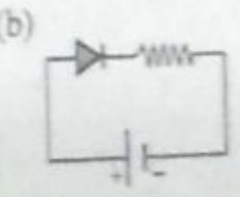
(a) 

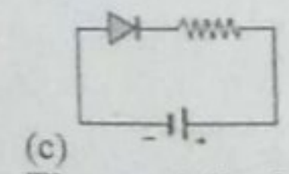
(b) 

(c) 

(d) 

(26) **Which one is in forward bias?**
(a) 

(b) 

(c) 

(d) none of these.

(27) **The specially designed semi-conductor diodes used as fast counters in electronic circuits are _____**
(a) the light emitting diodes (b) photo diodes
(c) photo voltaic cell (d) solar cells.

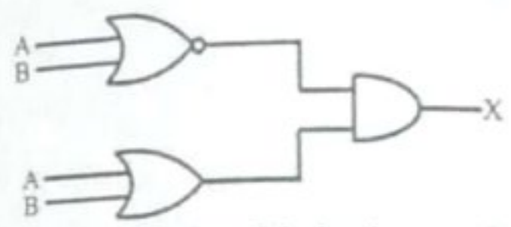
(28) **If no external voltage is applied across P-N junction, there would be**
(a) no electric field across the junction
(b) an electric field pointing from N-type to P-type side across the junction
(c) an electric field pointing from P-type to N-type side across the junction
(d) a temporary electric field during formation of P-N junction that would subsequently disappear

Scanned by CamScanner

(29) For amplification by a transistor the signal to be amplified is connected between the
(a) emitter and collector (b) emitter and base
(c) base and collector (d) any of the above

(30) If A = B = 1 then which of the following equation gives the output one
(a) $X = \overline{(A+B)} + \overline{A}$ (b) $X = (A.B) + \overline{(A+B)}$
(c) $X = \overline{(A.B)} + \overline{B}$ (d) $X = \overline{(A.B) + \overline{(A+B)}}$

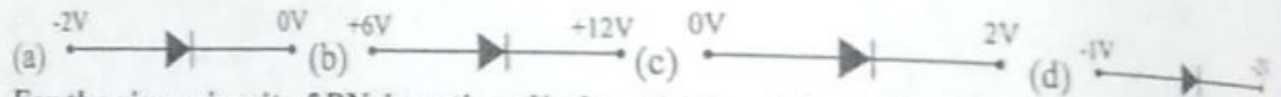
(31) The fundament logic gates are connected as shown



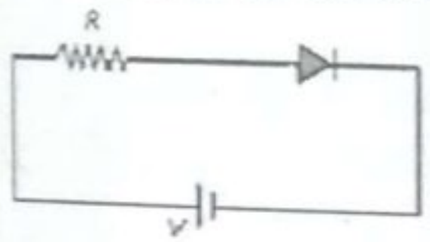
What are the mathematical notation for this logic gate?
(a) $\overline{(A+B)} + (A+B)$ (b) $\overline{(A+B)}\,\overline{(A+B)}$
(c) $\overline{(A+B)}.(A+B)$ (d) $\overline{(A.B)} + (A.B)$

(32) To obtain an N-type semiconductor germanium crystal, it must be doped with foreign atoms whose valency is
(a) 2 (b) 3
(c) 4 (d) 5

(33) In which case is the junction diode forward biased



(34) For the given circuit of PN-junction diode, which of the following statement is correct



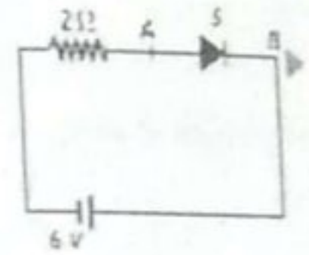
(a) in forward biasing the voltage across R is 2V
(b) in forward biasing the voltage across R is V
(c) in reverse biasing the voltage across R is V
(d) in reverse biasing the voltage across R is 2V

(35) The truth table shown is for:

A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

(a) OR gate (b) AND gate
(c) NOR gate (d) NAND gate

(36) The diode shown in the circuit is a silicon diode. The potential difference between the points A and B will be



(a) 0.7V (b) 0.6V
(c) 0 V (d) 6 V

(37) No biasing is applied to a P-N junction, then the current
(a) is zero because the charge carriers do not move
(b) is zero because the number of charge carriers flowing on both sides is same
(c) is non-zero
(d) none of these

(38) An OP-AMP as a comparator is a circuit that compares the signal voltage on one of its inputs with a/an
(a) non-inverting voltage at output (b) reference voltage on the other
(c) virtual input (d) output

(39) If $R_2 = 500\ \Omega$ and $R_1 = 50\ \Omega$ then gain of inverting amplifier is
(a) 10 (b) 0.1
(c) 2.5 (d) 2.5×10^4

(40) NPN transistors are preferred to PNP transistors because they have
(a) low lost
(b) low dissipation
(c) capable of handling large power
(d) electrons have high mobility than holes and hence high mobility of energy

(41) 0.6V applied to gate, it will accept as
(a) high (b) low
(c) in between high and low (d) depends upon type of gate

(42) In certain circuit a collector current of 10 mA and a base current of 40μA. What is the current gain of the transistor
(a) 500 (b) 250
(c) 125 (d) 75

(43) NAND and NOR gate are called universal gates primarily because they
(a) are available universally
(b) can be combined to produce OR, AND and NOT gate
(c) are widely used in integrated circuit packages
(d) are easiest to manufacture

(44) The colour of LED depends upon
(a) its forward biased (b) its reverse biased
(c) type of semi-conductor material used (d) type of doping

(45) For normal operation of transistor

	E.B Junction	B.C Junction
(a)	forward	forward
(b)	forward	reversed
(c)	reversed	forward
(d)	reverse	reversed

Scanned by CamScanner

(46) In a full wave rectifier input AC current has a frequency f, the output frequency of current is
(a) 2f (b) f/2
(c) f (d) 1.5 f

(47) By which process the depletion region is formed around the junction
(a) diffusion (b) fusion
(c) emission (d) fission

(48) The resistance between (+) and (-) inputs in ideal case of amplifier
(a) very low (b) very high
(c) zero (d) infinity

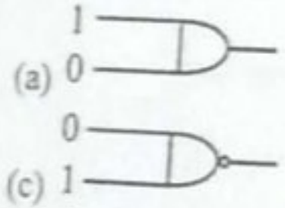
(49) Most of the op-amp operate with _____ supply
(a) $V_{CC} = \pm 1.5V$ (b) $V_{CC} = \pm 3.5V$
(c) $V_{CC} = \pm 12V$ (d) $V_{CC} = \pm 9V$

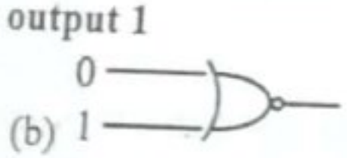
(50) Photodiodes can be used:
(a) for detecting of light
(b) automating switching
(c) logic circuits and optical communication devices
(d) all of these

(51) What is the voltage gain in a common emitter amplifier where input resistance is 3Ω and load resistance is 24Ω, $\beta = 0.6$?
(a) 8.4 (b) 4.8
(c) 2.4 (d) 480

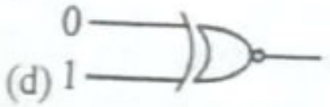
(52) A logic gate is an electronic circuit which
(a) makes logic decisions (b) allows electrons flow only in one direction
(c) works binary algebra (d) alternates between and 1 values

(53) How many NAND Gates are used to form an AND gate
(a) 1 (b) 2
(c) 3 (d) 4

(54) Which of the following gates will have an output 1
(a) 

(b) 

(c)

(d) 

(55) For an Op-Amp with negative feedback, the output is _____
(a) equal to the input (b) increased
(c) feedback to the inverting input (d) feedback to the non-inverting input

(56) For typical transistor as an Amplifier
(a) $\frac{V_o}{V_{in}} = -\beta \frac{R_c}{r_{ie}}$ (b) $\frac{V_o}{V_{in}} = \beta$
(c) $\frac{V_o}{V_{in}} = \beta \frac{R_{ic}}{R_c}$ (d) $\frac{V_o}{V_{in}} = \beta \frac{R_{ie}}{R_c}$

(57) Current gain of a transistor which has collector of 10 mA and a base current of $40\,\mu A$ is.
(a) 25 (b) 250
(c) 2500 (d) 25000

(58) In full wave rectifier with input frequency 50Hz the ripple in the output is mainly of frequency:
(a) 25 Hz (b) 50 Hz
(c) 100 Hz (d) zero

(59) A semiconductor device is connected in a series circuit with a battery and a resistance. If the battery is reversed, the current drops almost to zero. The device may be
(a) P-type semiconductor (b) N-type semiconductor
(c) P-N junction (d) intrinsic semiconductor

(60) A p-n junction cannot be used for
(a) rectification (b) amplification
(c) obtaining light radiation (d) detecting light intensity

ANSWER KEY

1	c	11	a	21	c	31	c	41	b	51	b
2	a	12	c	22	d	32	d	42	b	52	a
3	d	13	c	23	b	33	d	43	b	53	b
4	c	14	d	24	d	34	b	44	c	54	c
5	d	15	a	25	c	35	a	45	b	55	c
6	d	16	a	26	d	36	d	46	a	56	a
7	c	17	c	27	b	37	a	47	a	57	b
8	c	18	c	28	b	38	b	48	d	58	c
9	d	19	a	29	b	39	a	49	c	59	c
10	a	20	a	30	b	40	d	50	d	60	b

Scanned by CamScanner

EXPLANATORY NOTES

(1) With increase in temperature the electrical conductivity of semi-conductor increase due to break covalent bonds, more electron hole pairs generated.

(2) When a silicon crystal is doped with penta valent element, four valence electrons of the impurity atom form covalent bond with four neighboring Si atoms, while the fifth valence electron provides a free electron in the crystal. Such a doped semi-conductor is called N-type semi-conductor.

(3) Rules:

$\overline{A.B} = \overline{A} + \overline{B}$ and $\overline{\overline{A}} = A$

Now, $\overline{\overline{A}.\overline{B}} = \overline{\overline{A}} + \overline{\overline{B}} = A + B$

(4) $Y = (A + B).C$

(5) In reversed biasing

$I \approx 0$

Ordinary circuits:

When switch is OFF, current is zero

(6) Potential across the PN junction varies symmetrically linear, having P side negative and N side positive.

(7) The central region is called base and other two regions are called collector and emitter

(8) PN junction has low resistance in one direction of potential difference +V, so a large current flows (forward biasing). It has a high resistance in the opposite potential difference direction V, so a very small current flows (Reverse biasing)

(9) Half wave rectifier, rectifies only the half cycle of input ac signal and it blocks the other half

(10) $V_{cc} = I_B R_B + V_{BE} \Rightarrow I_B = \dfrac{9}{800\times10^3}$

(11) The current at 2V is 400 mA and at 2.1 V it is 800 mA. The dynamic resistance in this region

$$R = \frac{\Delta V}{\Delta i} = \frac{(2.1-2)}{(800-400)\times10^{-3}} = \frac{1}{4} = 0.25\Omega$$

(12) In forward biased PN-junction, external voltage decreases the potential barrier, so current is maximum. While in reversed biased PN-junction, external voltage increases the potential barrier, so the current is very small.

(13) Mathematical notation for NOR operation

$X = \overline{A+B}$

(14) The value of resistivity for conductor is order of $10^{-8}\Omega m$.

(15) In reverse bias very small current flows across the junction of the order of micro ampere due to minority charge carriers.

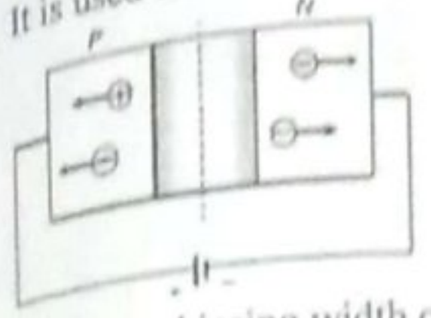
(16) In reverse biasing, width of depletion layer increases

(17) $i = \dfrac{V}{R} = \dfrac{(4-1)}{300} = 10^{-2}A$

(18) 3 NAND gate = 1 OR gate And 3 NOR gate = 1 AND gate

$\overline{A.B} = \overline{A+B} = A+B$

(19) It is used to convert ac into dc (rectifier)

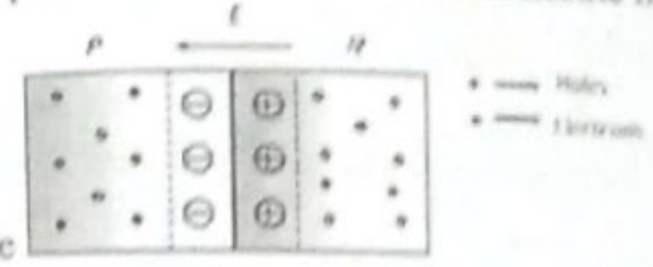


(20) In reverse biasing width of depletion region (potential difference) increase. Therefore, electric field is maximum

(21) Holes move along electric field and electron in opposite direction.

(22) $A_v = \beta\dfrac{R_C}{r_{ie}} \Rightarrow A = 60\times\dfrac{24}{3} \Rightarrow A = 480$

(23) At junction a potential barrier/depletion layer is formed, with N-side at higher potential and P-side at lower potential. Therefore there is an electric field at the junction directed from the N-side to P-side



(24) 3 NOR gate = 1 AND gate

= A.B

$Y = \overline{A.B}$

Y = NAND gate

(25) Only in option (c), P-side is more negative as compared to N-side.

(26) In forward biasing P-side is connected with positive terminal and N-side with negative terminal of the battery

(27) Photo diode is used for detection of light, it is one of the fastest photo detection devices

(28) Across the P–N junction, a barrier potential is developed whose direction is from N region to P region

(29) For signal amplification, it applied between emitter-base junction and output obtain at collector

(30) $X = (A.B) + (\overline{A+B})$

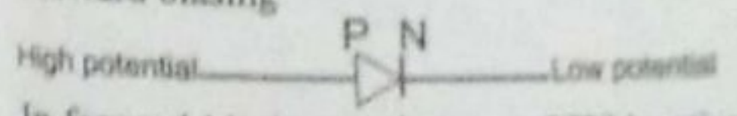
$X = (1.1) + (\overline{A}.\overline{B}) \Rightarrow X = 1 + (\overline{1}.\overline{1}) \Rightarrow X = 1 + (0.0) \Rightarrow X = 1$

(31) $X = (\text{NOR gate}).(\text{OR gate})$

$X = (\overline{A+B}).(A+B)$

(32) For N-type semiconductor pentavalent impurity will be added.

(33) Forward biasing



(34) In forward biasing, resistance of PN junction diode is zero, so whole voltage appears across the resistance.

(35) X= A+B

Scanned by CamScanner

(36) In the given condition diode is in reverse biasing so it acts as open circuit. Hence potential difference between A and B is 6V

(37) In unbiased condition of PN-junction, depletion region is generated which stops the movement of charge carriers

(38) In comparator, reference voltage is connected with +ve terminal of OP-amp and V voltage (signal voltage) which is to be compared with the reference voltage, it is connected with –ve terminal.

(39) $G = -\frac{R_2}{R_1} \Rightarrow G = -\frac{500}{50} = -10$ and (–) representing inverting amplifier

(40) In case of NPN transistor more charge carrier electrons are present than PNP transistors. So it is prefer to use NPN transistor.

(41) Voltage between 0 – 0.8V considered.

(42) As current gain

$$\beta = \frac{I_C}{I_B} \Rightarrow \beta = \frac{10\times10^{-3}A}{40\times10^{-6}A} = \frac{1}{4}10^3 = \frac{1000}{4} = 250$$

(43) We can obtain OR, AND and NOT gates from NAND and NOR, that's why these are called universal gate.

(44) LED colour depends upon energy gap that is basically depends upon semiconductor material.

(45) Text Book line

(46) In case of FWR frequency becomes double and in case of HWR frequency remains the same.

(47) Some electrons diffuse to the p-region. So, process is diffusion.

(48) Basic information

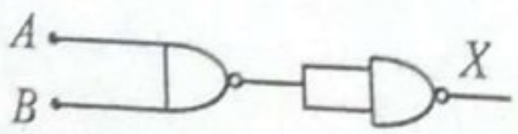
(49) Text book information.

(50) Text book information.

(51) $G = \beta\frac{R_c}{r_{ie}}$

(52) Logic gates based upon logic operations or decisions.

(53)



(54) NAND gate will give output 1 when inputs are 0 and 1.

(55) In OP-Amp negative feedback is given to the inverting input.

(56) Mathematical relation for gain of amplifier $G = \frac{V_o}{V_{in}} = -\beta\frac{R_c}{r_{ie}}$.

(57) $\beta = \frac{I_c}{I_B}$

(58) In full wave frequency of the output is 2f

(59) When PN junction is reverse-biased, there is practically no flow of current.

(60)

19 Chapter DAWN OF MODERN PHYSICS

PRACTICE EXERCISE

(1) **U.V radiation of 6.2eV falls on an aluminium surface, K.E of fastest electron emitted is (work function = 4.2eV)**
(a) 3.2×10^{-21} J (b) 7×10^{-25} J
(c) 9×10^{-32} J (d) 3.2×10^{-19} J

(2) **A photoelectric cells converts**
(a) Light energy to elastic energy (b) Electric energy to light energy
(c) Light energy to mechanical energy (d) Light energy to electric energy

(3) **The frequency of light beam A is twice that of light beam B. The ratio E_A/E_B of photon energies is**
(a) 1 (b) 4
(c) 1/2 (d) 2

(4) **An observer shoots parallel to a meter stick at very high (relativistic) speed and finds that the length of meter stick is**
(a) Greater than one meter (b) Less than one meter
(c) One meter (d) Zero

(5) **What is the de Broglie wavelength of a proton whose linear momentum has a magnitude of 3.3×10^{-23} kg • m/s?**
(a) 0.0002 nm (b) 0.002 nm
(c) 0.02 nm (d) 0.2 nm

(6) **Which one of the following radiations has the strongest photon?**
(a) T.V waves (b) Micro waves
(c) X-rays (d) γ-rays

(7) **At which relativistic speed the mass of an object will become double than its rest mass**
(a) $\frac{c}{2}$ (b) $\frac{\sqrt{3}c}{2}$
(c) $\frac{2c}{\sqrt{3}}$ (d) $\sqrt{\frac{2}{3}}c$

(8) **Two spaceships are traveling directly toward each other, one traveling at a speed of $\frac{c}{6}$ and the other at a speed of $\frac{c}{3}$, as measured by observers on a nearby planet. The faster ship emits a radar pulse directed toward the approaching ship. What is the speed of this radar pulse, as measured by observers on the planet?**
(a) c/2 (b) c/4
(c) c (d) 2c

(9) **A device based on photoelectric effect is called**
(a) Photo sensitive detection (b) Photo cell
(c) Photosynthesis (d) Photo diode

(10) **As the intensity of incident light increases**
(a) Photoelectric current increases (b) Photo electric current decreases
(c) K.E of emitted photo electrons decreases (d) K.E of emitted photo electrons increases

(11) **Stopping potential for a metal surface in case of photoelectric emission depends on**
(a) The threshold frequency for the metal surface
(b) The intensity of incident light
(c) The frequency of incident light and work function of the metal surface
(d) All of the above

Scanned by CamScanner

(12) **Select an alternative form of uncertainly principle from the following**

(a) $\Delta\lambda \approx \frac{h}{m_o c}(1-\cos\phi)$ (b) $\Delta E \cdot \Delta t \approx h$

(c) $mc^2=hv$ (d) Any of above

(13) **The slope of frequency of incident light and stopping potential for a given surface will be**

(a) h (b) hc

(c) e/h (d) h/e

(14) **If a material object moves with speed of light, its mass becomes**

(a) Equal to its rest mass (b) Double of its rest mass

(c) Infinite (d) Zero

(15) **As the temperature of black body is raised, the wavelength corresponding to maximum intensity**

(a) Shifts towards longer wavelength

(b) Shifts towards shorter wavelength

(c) Remain the same

(d) Shifts towards longer as well as shorter wavelengths

(16) **According to special theory of relativity, an expression for mass variation is given by:**

(a) $m=m_o\sqrt{1-\frac{v^2}{c^2}}$ (b) $m=m_o\sqrt{1-\frac{c^2}{v^2}}$

(c) $m=\frac{m_o}{\sqrt{1-\frac{v^2}{c^2}}}$ (d) $m=\frac{m_o}{\sqrt{1-\frac{c^2}{v^2}}}$

(17) **The name of the photon for quantum of light was proposed by**

(a) Ampere (b) Plank

(c) Thomson (d) Einstein

(18) **The electron, accelerated by a potential difference V has de-Broglie wavelength λ. If the electron is accelerated by a p.d 4V, its de-Broglie wavelength will be**

(a) 2λ (b) 4λ

(c) $\frac{\lambda}{2}$ (d) $\frac{\lambda}{4}$

(19) **In Compton scattering, the change in wave length is max. if**

(a) Angle of scattering is 90° (b) Angle of scattering is 60°

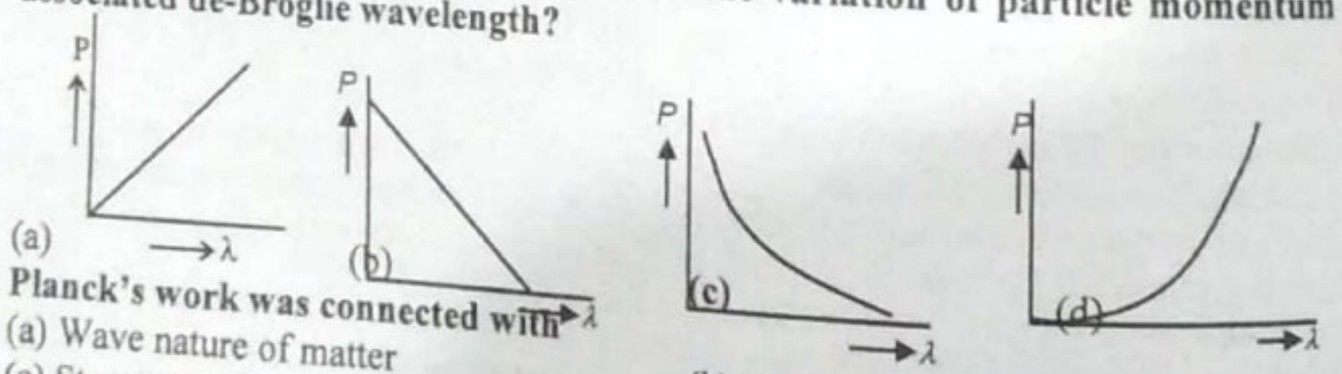
(c) Angle of scattering is180° (d) Angle of scattering is zero

(20) **Davison Germer experiment indicates**

(a) Interference (b) Polarization

(c) Electron diffraction (d) Refraction

(21) **Which of the following graphs represent the variation of particle momentum and the associated de-Broglie wavelength?**



(22) **Planck's work was connected with**

(a) Wave nature of matter (b) Photoelectric effect

(c) Structure of atom (d) Quantum nature of radiation

(23) **If the wavelength of incident radiation in a photoelectric experiment is decreased then**

(a) The photoelectric current will decrease (b) The photoelectric current will increase

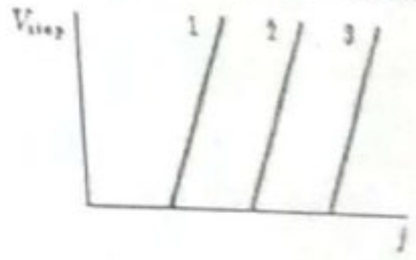
(c) The stopping potential will decrease (d) The stopping potential will increase

(24) **In a photoelectric effect experiment at a frequency above cut off, the number of electrons ejected is proportional to**

(a) The frequency of the incident light (b) Their potential energy

(c) The number of photons that hit the cathode (d) Their kinetic energy

(25) **The diagram shows the graphs of the stopping potential as a function of the frequency of the incident light for photoelectric experiments performed on three different materials. Rank the materials according to the values of their work functions, from least to greatest**



(a) 1, 2, 3 (b) 2, 1, 3

(c) 1, 3, 2 (d) 3, 2, 1

(26) **According to special theory of relativity, time is not absolute quantity. This result applies to _____ timing processes**

(a) Physical (b) Chemical

(c) Biological (d) All

(27) **In Compton scattering from stationary electrons the largest change in wavelength occurs when the photon is scattered through**

(a) 90^0 (b) 180^0

(c) 45^0 (d) 0^0

(28) **Moving with the same velocity, which of the following has the longest de-Broglie wavelength?**

(a) α-particle (b) β-particle

(c) Proton (d) Neutron

(29) **Which of the following is NOT evidence for the wave nature of matter?**

(a) The diffraction pattern obtained when electrons pass through a slit

(b) Interference of light

(c) The photoelectric effect

(d) The validity of the Heisenberg uncertainty principle.

(30) **The velocity of a particle of mass m of de-Broglie wavelength λ is _____**

(a) $\frac{2h}{m\lambda}$ (b) $\frac{m\lambda c^2}{h}$

(c) $2m\lambda c^2$ (d) $h/m\lambda$

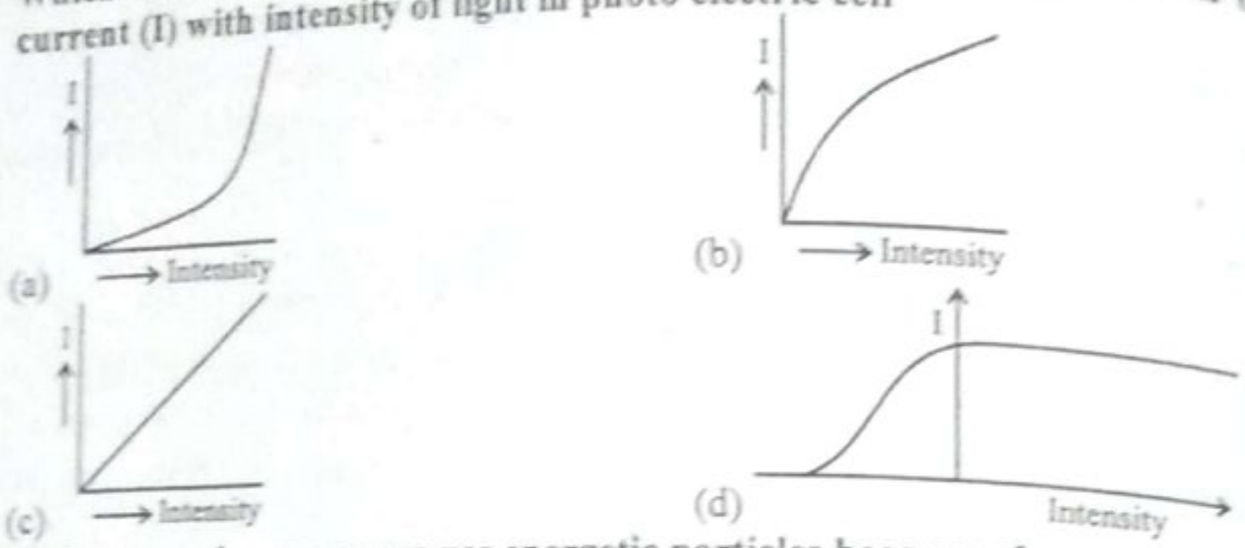
(31) **In Davisson-Germer experiment, the diffracted electron beam from crystal shows**

(a) Particle property. (b) Wave property.

(c) Light property. (d) Quantum property.

Scanned by CamScanner

(32) **Which one of the following graphs in the figure shows the variation of photoelectric current (I) with intensity of light in photo electric cell**



(33) **In electron microscope, we use energetic particles because of** _____
(a) Penetrating power is high. (b) Kinetic energy is large.
(c) Wavelength is very short. (d) All the above reasons.

(34) **The resolution of 50 KV electron microscope is**
(a) 0.2 to 0.5 μm (b) 0.5 μm to 1 nm
(c) 0.5 to 1 μm (b) 0.2 nm

(35) **A three dimensional image is obtained by** _____
(a) Electron microscope. (b) Scanning electron microscope.
(c) Magnetic imaging. (d) None of the above.

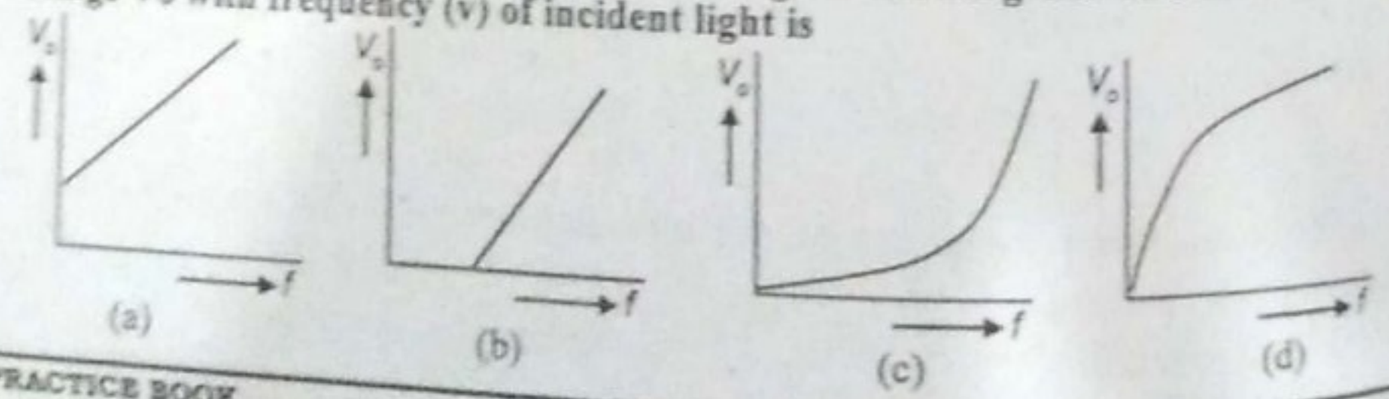
(36) **Mass of a photon of frequency f is given by**
(a) $m = \frac{hf}{c}$ (b) $m = \frac{hf}{c^2}$
(c) $m = \frac{h}{\lambda}$ (d) $m = \frac{hf^2}{c}$

(37) **Of the following which is the best evidence for the wave nature of matter?**
(a) The relationship between momentum and energy for an electron.
(b) The reflection of electrons by crystals
(c) The spectral radiancy of cavity radiation
(d) The Compton effect

(38) **The energy radiated per second per unit area of black body is directly proportional to fourth power of Kelvin's temperature is** _____
(a) Karl-wein's law. (b) Rayleigh Jeans law.
(c) Stephens law. (d) Planck's Law

(39) **Compton effect proves the** _____
(a) Photon theory of light. (b) Dual nature of light.
(c) Wave nature of light. (d) Uncertain nature of light.

(40) **For a photoelectric cell, the graph in the figure showing the variation of the cut off voltage Vo with frequency (v) of incident light is**



(41) **The wavelength of matter waves is independent of:**
(a) Mass (b) Velocity
(c) Momentum (d) Charge

(42) **In a photoelectric effect experiment the stopping potential is:**
(a) The electric potential that causes the electronic current to vanish
(b) The photon energy
(c) The kinetic energy of the most energetic electrons ejected
(d) The energy required to remove an electron from the sample

(43) **An observer sitting in an aeroplane and moving with very high speed observes a metre rod placed on the ground. The rod appears to him**
(a) Less than 100 cm (b) More than 100 cm
(c) 100 cm (d) 200 cm

(44) **A body of mass 200 g moves at the speed of 5 m/hr. So de-Broglie wavelength related to it is of the order ($h=6.26 \times 10^{-34}$ Js)**
(a) 10^{-10}m (b) 10^{-30} m
(c) 10^{-20} m (d) 10^{-40} m

(45) **Ratio of momentum of photons having wavelength 4000 angstrom and 8000 angstrom is**
(a) 2 : 1 (b) 1 : 2
(c) 20 : 1 (d) 1 : 20

(46) **If the K.E of a free electron doubles then its de-Broglie wavelength changes by a factor**
(a) $\frac{1}{2}$ (b) $\frac{1}{\sqrt{2}}$
(c) 2 (d) $\sqrt{2}$

(47) **The maximum energy of the electrons released in a photo cell is independent of**
(a) frequency of incident light (b) intensity of incident light
(c) nature of cathode rays (d) none of these

(48) **Light of frequency 1.5 times the threshold frequency is incident on a photo sensitive material. If the**
frequency is halved and intensity is doubled the photo electric current becomes
(a) four times (b) double
(c) half (d) zero

(49) **On decreasing the intensity of incident light**
(a) the photoelectric current will increase
(b) the number of photoelectrons emitted will increase
(c) the number of emitted electrons will decrease
(d) all of the above

(50) **The reverse process of photo electric effect is**
(a) annihilation of matter (b) pair production
(c) production of x-rays (d) nuclear fission

Scanned by CamScanner

ANSWER KEY

1	d	11	c	21	b	31	b	41	d
2	d	12	b	22	d	32	c	42	a
3	d	13	c	23	d	33	c	43	a
4	b	14	c	24	c	34	b	44	b
5	c	15	b	25	a	35	b	45	a
6	d	16	c	26	d	36	b	46	b
7	b	17	d	27	b	37	b	47	b
8	c	18	c	28	b	38	c	48	d
9	b	19	c	29	c	39	a	49	c
10	a	20	c	30	d	40	b	50	c

EXPLANATORY NOTES

(1) $K.E_e = E_i - \varphi = 6.2eV - 4.2eV$

$K.E_e = 2eV = 2\left(1.6\times10^{-19}\right)J$

$= 3.2\times10^{-19}J$

(2) Photocell is a device use to convert sunlight into electric energy.

(3) $E \propto f \rightarrow \frac{E_A}{E_B} = \frac{f_A}{f_B} = \frac{2f_B}{f_B}$

$\frac{E_A}{E_B} = 2$

(4) Length contraction can only occur when move parallel to meter rod

(5) $\lambda = \frac{h}{p} = \frac{6.6\times10^{-34}}{3.3\times10^{-23}}$

$\lambda = 2\times10^{-11}m = 2\times10^{-2}\times10^{-9}m$

$= 0.02nm$

(6) Energy of γ rays is the largest $\therefore E = hf$

(7) $m = \frac{mo}{\sqrt{1-\frac{v^2}{c^2}}}$ Here, $m = 2m_o$

$2m_o = \frac{m_o}{\sqrt{1-\frac{v^2}{c^2}}} \rightarrow 1-\frac{v^2}{c^2} = \frac{1}{4}$

$= v = \frac{\sqrt{3}}{2}c$

(8) Special theory of relativity says speed of light remain "c"

(9) Photocell is a device based on photoelectric effect

(10) Photoelectric current $\propto$ Intensity of light

(11) Stopping potential depend upon work function and frequency of incident light.

(12) $\Delta E.\Delta t \approx h$ (uncertainty principle)

(13) As, $K.E_e = eV = hf$

$e/h = f/V$ = slope of f & V

(14) $m = \frac{m_o}{\sqrt{1-v^2/c^2}}$ *if* $v = c$

$m = \infty$

(15) $\lambda_{max} \propto \frac{1}{T}$

(16) Mass variation = $m = \frac{m_o}{\sqrt{1-v^2/c^2}}$

(17) Einstein's concept.

(18) $\lambda = \frac{h}{\sqrt{2meV}} \rightarrow \lambda \propto \frac{1}{\sqrt{V}}$

(19) $\Delta\lambda = \frac{h}{m_o c}(1-\cos\theta)$

$\theta = 180° \Rightarrow \cos\theta = -1$

$\Delta\lambda_{max} = 2\frac{h}{m_o c}$

(20) Davison and Germer experiment confirm that electron diffracts like wave.

(21) $\lambda = \frac{h}{p} \rightarrow \lambda \propto \frac{1}{p}$

(22) Plank's work is related with quantum nature of light and he gave the idea of quanta

(23) As,

$V_o \propto f_o$

Hence $V_o \propto \frac{1}{\lambda_o}$

(24) Photoelectric current $\propto$ intensity of light

Scanned by CamScanner

(25) As,

$\varphi \propto f_o$

So,

$f_3 > f_2 > f_1$

Hence,

$\varphi_3 > \varphi_2 > \varphi_1$

(26) Time is not absolute quantity so it will involve equally in all processes

(27) $\Delta\lambda = \frac{h}{m_o c}(1-\cos\theta)$

$1-\cos\theta = \max$

When

$\cos\theta = -1$

$\theta = 180°$

(28) As,

$\lambda = \frac{h}{mv}$

$v = const$

$\lambda \propto \frac{1}{m}$

(29) Photo electric effect shows particle nature of light

(30) $\lambda = \frac{h}{mv} \rightarrow v = \frac{h}{m\lambda}$

(31) Diffraction is a property of waves.

(32) Photoelectric current is proportional to intensity of light.

(33) $\lambda \propto \frac{1}{E}$

(34) 50KV electron microscope can produce $0.5 \rightarrow 1nm$ resolution (Book statement)

(35) 3D image can produce by scanning electron microscope

(36) $E = hf = mc^2 \rightarrow m = \frac{hf}{c^2}$

(37) Reflection is the property of wave.

(38) Stephen's law $E = \sigma T^4$

(39) Compton's effect prove photon or particle nature of light

(40) $V_o \propto f$ (After threshold frequency)

(41) According to $\lambda = \frac{h}{mv}$, wavelength is independent of charge.

(42) At stopping potential the current becomes zero.

(43) According to length contraction $\ell = \ell_o\sqrt{1-\frac{v^2}{c^2}}$, $\ell < \ell_o$ less than 100 cm

(44) $m = 200\,g = 0.2\,kg,\ v = 5\frac{m}{hr} = \frac{5}{3600}\frac{m}{s}$

$p = \frac{h}{\lambda} = mv$

$\therefore \lambda = \frac{h}{mv} = \frac{6.626\times10^{-34}\times3600}{0.2\times5}$

$= 23.85\times10^{-31}$

$= 2.385\times10^{-30}$

$= 10^{-30}\,m$

(45)

$P = \frac{h}{\lambda} \quad \therefore P \propto \frac{1}{\lambda}$

$\therefore \frac{P_1}{P_2} = \frac{\lambda_2}{\lambda_1} = \frac{8000}{4000} = \frac{2}{1}$

$\therefore \frac{P_1}{P_2} = 2:1$

(46) $\lambda = \frac{h}{\sqrt{2mE}}$

$\lambda \propto \frac{1}{\sqrt{E}}$

(47) Energy of electron does not depend upon intensity of light

(48) When the frequency of light is less than threshold frequency then no photo electron w emitted hence photo electric current will be zero

(49) No of emitted electrons $\propto$ intensity of incident light.

(50) In photoelectric effect photons produce electrons. But in X-ray production electrons p photons.

Scanned by CamScanner

19 Chapter DAWN OF MODERN PHYSICS

SELF ASSESMENT TEST

(1) **The photoelectric effect is described as the ejection of electrons from the surface of a metal when:**
(a) it is heated to a high temperature
(b) electrons of suitable velocity impinge on it
(c) light of suitable wavelength falls on it
(d) it is placed in a strong magnetic field

(2) **When monochromatic light falls on photosensitive material, the number of photoelectrons emitted per second is n and their maximum kinetic energy is K_{max}. If the intensity of the incident light is doubled, then.**
(a) both n and K_{max} are doubled (b) both n and K_{max} are halved
(c) N is doubled but K_{max} remains the same (d) K_{max} is doubled but n remains the same

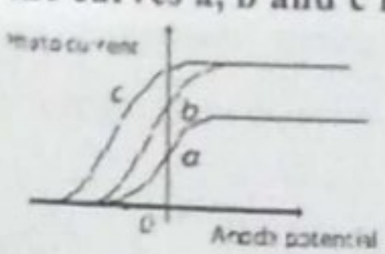
(3) **An electron and a proton are accelerated through the same potential. If their masses are m_e, and m_p respectively, then the ratio of their de-Broglie wavelength is**
(a) 1 (b) $\frac{m_p}{m_e}$
(c) $\frac{m_e}{m_p}$ (d) $\sqrt{\frac{m_p}{m_e}}$

(4) **The curve drawn between velocity and frequency of photon in vacuum will be a:**
(a) straight line parallel to velocity axis
(b) hyperbola
(c) straight line passing through origin and making an angle of 45° with frequency axis
(d) straight line parallel to frequency axis

(5) **The speed of photon:**
(a) May be greater than speed of light (b) Must be equal to speed of light
(c) May be less than speed of light (d) Must be less than speed of light

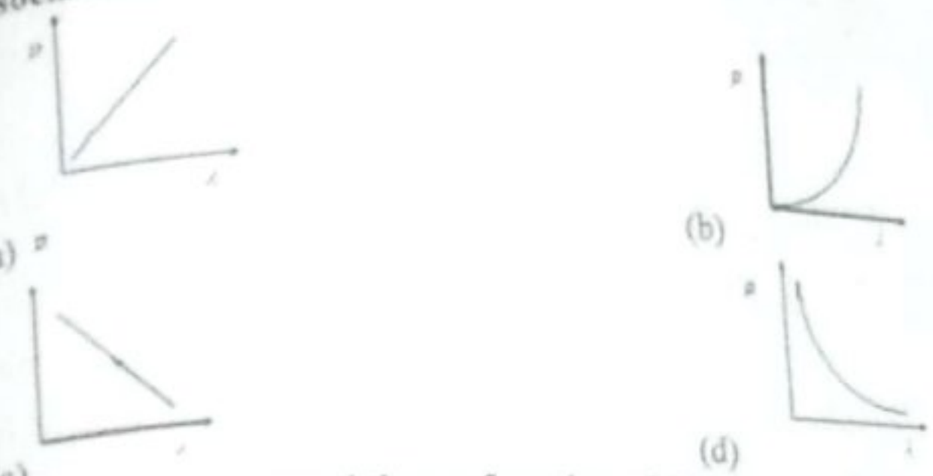
(6) **A radio station emits 10 kW power of 90.8 MHz. Find the number of photon emitted per second**
(a) 1.6×10^{28} (b) 1.6×10^{29}
(c) 1.6×10^{30} (d) 1.6×10^{32}

(7) **The figure shows the variation of photocurrent with anode potential for a photo-sensitive surface for three different radiations. Let I_a, I_b and I_c be the intensities and f_a, f_b and f_c be the frequencies for the curves a, b and c respectively**

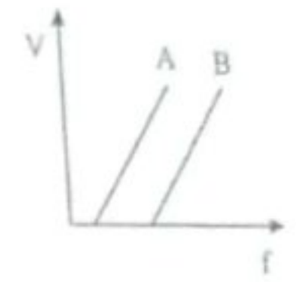


(a) $f_a=f_b$ and $I_a \neq I_b$ (b) $f_a=f_c$ and $I_a=I_c$
(c) $f_a=f_b$ and $I_a=I_b$ (d) $f_a=f_b$ and $I_a=I_b$

(8) **Which of the following figure represents the variation of particle momentum and the associated de-Broglie wavelength?**

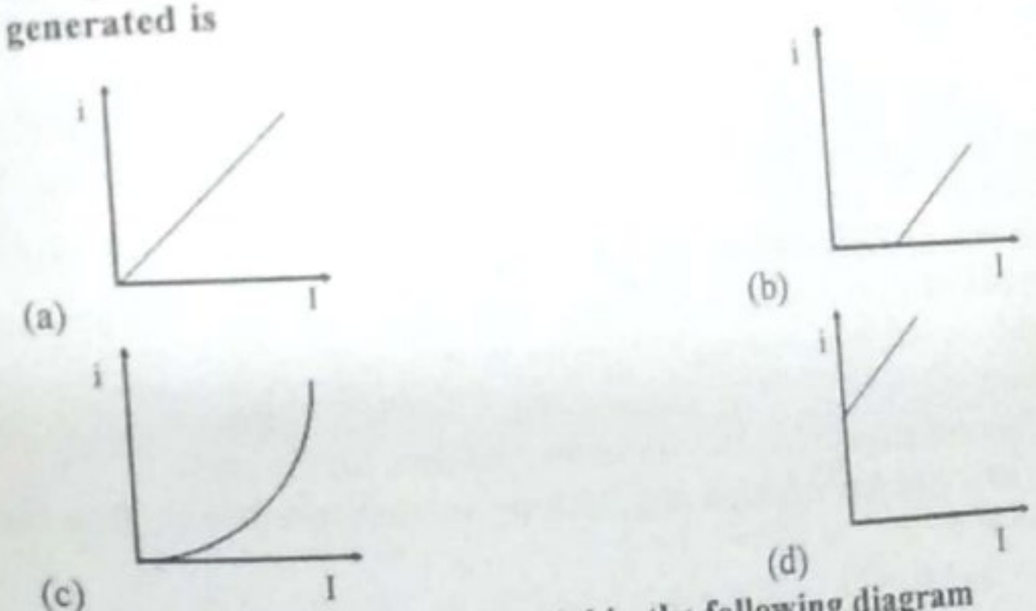


(9) **The stopping potential as a function of the frequency of the incident radiation is plotted for two different photoelectric surfaces A and B. The graphs show that work function of A is**

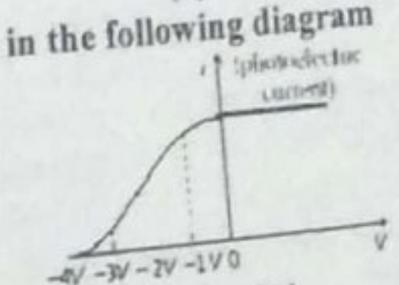


(a) greater than that of B
(b) smaller than that of B
(c) equal to that of B
(d) no inference can be drawn about their work functions from the given graphs

(10) **The graph between intensity of light falling on a metallic plate (I) with the current (i) generated is**



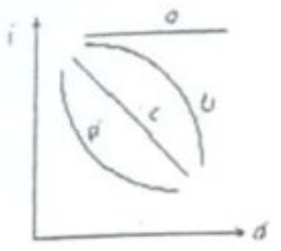
(11) **The value of stopping potential in the following diagram**



(a) -2V (b) -3V
(c) - 4V (d) -1V

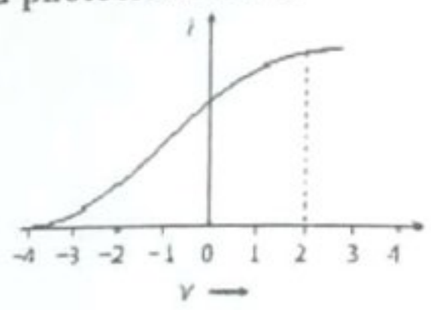
Scanned by CamScanner

(12) A point source of light is used in an experiment on photoelectric effect. Which of the following curves best represents the variation of photo current (i) with distance of the source from the emitter



(a) a
(b) d
(c) b
(d) c

(13) Figure represents the graph of photo current I versus applied voltage (V). The maximum energy of the emitted photoelectrons is



(a) 2eV
(b) 0 eV
(c) 4 eV
(d) 4 J

(14) Wave is associated with matter
(a) when it is stationary
(b) when it is in motion with the velocity of light only
(c) when it is in motion with any velocity
(d) none of these

(15) A proton, an electron and a uranium nucleus all have the same wavelength. The one with the most energy
(a) is the electron
(b) is the proton
(c) is the uranium nucleus
(d) depends upon the wavelength and the properties of the particle.

(16) At frequencies of the incident radiation above the threshold frequency, the photoelectric current in a photoelectric cell increases with increase in.
(a) intensity of incident radiation
(b) wavelength incident radiation
(c) frequency of incident radiation
(d) speed of incident radiation

(17) If the de-Broglie wavelengths for a proton and for a α–particle are equal, then the ratio of their velocities will be
(a) 1:2
(b) 1:4
(c) 2:1
(d) 4 : 1

(18) Dual nature of radiation is shown by
(a) photoelectric effect alone
(b) refraction and diffraction
(c) photoelectric effect and diffraction
(d) diffraction and reflection

(19) In Compton scattering, the change in wave length is max. if_____
(a) angle of scattering is 90°
(b) angle of scattering is 60°
(c) angle of scattering is180°
(d) angle of scattering is zero

(20) Violet light can cause photoelectric emission from a metal but blue light cannot. If sodium light is incident on the metal, then.
(a) the photoelectric current decreases
(b) the number of photoelectrons ejected per second increases
(c) the velocity of photoelectrons increases
(d) no photoelectric emission occurs.

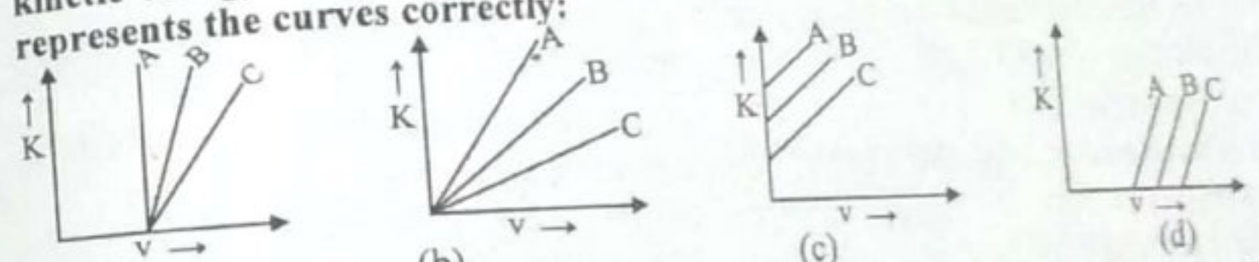
(21) A photon is _____
(a) a unit of energy
(b) a positively charged particle
(c) a quantum of electromagnetic radiation
(d) a unit of wavelength

(22) If an electron and a photon propagate in the form of waves having the same wavelength, it implies that they have the same
(a) velocity
(b) energy
(c) angular momentum
(d) Momentum

(23) Particle nature and wave nature of electromagnetic waves and electrons can be shown by
(a) electron has small mass, deflected by the metal sheet
(b) x-ray is diffracted, reflected by thick metal sheet
(c) light is refracted and diffracted
(d) photo electricity and electron microscopy

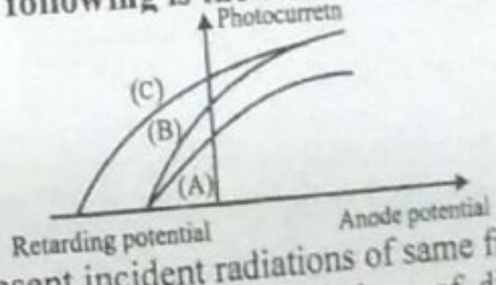
(24) The kinetic energy of electron and proton is 10^{-32}J. Then the relation between their de-Broglie wavelengths is
(a) $\lambda_p=\lambda_e$
(b) $\lambda_p>\lambda_e$
(c) $\lambda_p<\lambda_e$
(d) $\lambda_p=2\lambda_e$

(25) For three different metals A, B, C photo-emission is observed one by one and maximum kinetic energy (K) versus frequency (v) of incident light graphs are plotted. Which fig. represents the curves correctly:



(26) The threshold wavelength for a metal whose work function is W_o is λ_o. What is the threshold wavelength for a metal whose work function is $W_o/2$?
(a) $\frac{\lambda_o}{4}$
(b) $\frac{\lambda_o}{2}$
(c) $2\lambda_o$
(d) $4\lambda_o$

(27) The figure shows a plot of photo current versus anode potential for a photosensitive surface. Which one of the following is the correct statement?



(a) curves (a) and (b) represent incident radiations of same frequency but of different intensity
(b) curves (b) and (c) represent incident radiations of different frequencies and different intensities
(c) curves (b) and (c) represent incident radiations of same frequency and same intensity
(d) curves (a) and (b) represent incident radiations of different frequencies and different intensities

Scanned by CamScanner

(28) If n number of photon are striking on a metal surface, then total momentum exerted is _____
(a) nh/λ (b) 2nhλ
(c) zero (d) n f×t

(29) An electron and proton have the same de-Broglie wavelength. Then the kinetic energy of the electron is
(a) zero (b) equal to the kinetic energy of the proton
(c) greater than the kinetic energy of the proton (d) infinity.

(30) The velocity of a particle of mass m of de-Broglie wavelength λ is _____
(a) $\frac{2h}{m\lambda}$ (b) $\frac{m\lambda c^2}{h}$
(c) $2m\lambda c^2$ (d) h/mλ

(31) The de-Broglie wavelength
(a) does not depend on impulse (b) inversely proportional to impulse
(c) is proportional to impulse (d) is proportional to mass

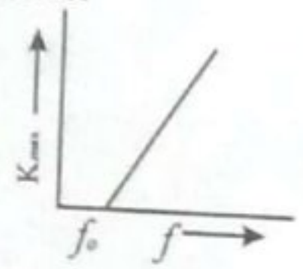
(32) The wavelength of the matter wave is independent of
(a) charge. (b) mass
(c) velocity (d) momentum.

(33) The momentum of a photon is 3.3×10^{-29}kg m/sec. Its frequency will be
(a) 7.5×10^{12}Hz (b) 6×10^{3}Hz
(c) 3×10^{3}Hz (d) 1.5×10^{13}Hz.

(34) Of the following moving with same momentum, the one which has largest wavelength is:
(a) an electron (b) a proton
(c) an α-particle (d) all have same de-Broglie wavelength

(35) The momentum of a photon is 2×10^{-16}gm-cm/sec. Its energy is
(a) 6×10^{-8}erg. (b) 6×10^{-6}erg
(c) 2.0×10^{-26}erg (d) 0.61×10^{-26}erg

(36) The maximum kinetic energy K_{max} of photoelectrons emitted in a photoelectric cells is measured using lights of various frequencies f. The graph in Fig shows how K_{max} varies with f. The slope of the graph is equal to.



(a) the charge of an electron
(b) the charge to mass ratio of an electron
(c) the work function of the emitter in the cell
(d) Planck's constant

(37) If the momentum of a photon is p, then its frequency is
(a) ph/c
(b) pc/h
(c) mh/c
(d) mc/h Where m is the rest mass of the photon

(38) An AIR station is broadcasting the waves of wavelength 300 metres. If the radiating power of the transmitter is 10 kW, then the number of photons radiated per second is
(a) 1.5×10^{29} (b) 1.5×10^{33}
(c) 1.5×10^{31} (d) 1.5×10^{35}

(39) If a photon has velocity c and frequency n, then which of following represents its wavelength
(a) hc/E (b) hf/c²
(c) hf/c. (d) hf.

(40) An electron is at rest. Its wavelength is
(a) 1 (b) it has not wave character
(c) hc/m (d) hc × m_o

(41) If E_1, E_2, E_3 are the respective kinetic energies of an electron, an alpha-particle and a proton, each having the same de-Broglie wavelength then
(a) $E_1 > E_3 > E_2$ (b) $E_2 > E_1 > E_3$
(c) $E_1 > E_2 > E_3$ (d) $E_1 = E_2 = E_3$

(42) A proton and an α particle are accelerated through the same kinetic energy. The ratio of their de-Broglie wavelength $(\lambda_p / \lambda_\alpha)$.
(a) 1:1 (b) $\sqrt{2}$:1
(c) 2:1 (d) 4:1

(43) The magnitude of de-Broglie wavelength (λ) of electrons (e) proton (p) neutron n and α particles, all have the same energy 1 MeV, in increasing order will follow the sequence.
(a) $\lambda_e, \lambda_p, \lambda_n, \lambda_\alpha$ (b) $\lambda_e, \lambda_p, \lambda_\alpha, \lambda_n$
(c) $\lambda_\alpha, \lambda_n, \lambda_p, \lambda_e$ (d) $\lambda_\alpha, \lambda_p, \lambda_n, \lambda_e$

(44) The length of meter rod moving with velocity equal to 3×10^8 ms^{-1} appears to an observer at rest as
(a) 1 m (b) $\frac{1}{2}$m
(c) $\frac{1}{4}$m (d) Zero

(45) To decrease uncertainty in the measurement of position and momentum of a particle

	Position	Momentum
(a)	Decrease λ	Increase λ
(b)	Increase λ	Decrease λ
(c)	Decrease λ	Decrease λ
(d)	Increase λ	Increase λ

(46) Einstein's photoelectric equation states that $E_k = hf - \varphi$. In this equation E_k is
(a) maximum kinetic energy of the emitted electrons
(b) minimum kinetic energy of the emitted electrons
(c) mean kinetic energy of the emitted electrons
(d) kinetic energy of all the emitted electrons

Scanned by CamScanner

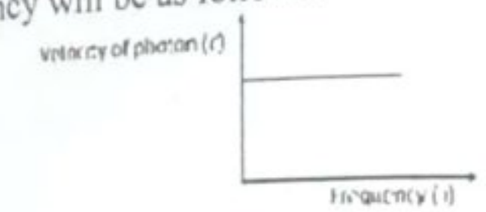
EXPLANATORY NOTES

(1) Basic definition.

(2) Intensity determine the number of emitted electrons on the other hand frequency determine the energy and there is no relation between intensity and energy.

(3) $\lambda = \frac{h}{\sqrt{2mVe}} \Rightarrow \frac{\lambda_e}{\lambda_p} = \sqrt{\frac{m_p}{m_e}}$ $\because V = \text{same}$

(4) Velocity of photon (i.e. light) does not depend upon frequency. Hence the graph between velocity of photon and frequency will be as follows.



(5) EM wave consists of tiny bundles of energy and these bundles have speed equal to speed of light.

(6) $P = \frac{E}{t} = \frac{nhf}{t} \Rightarrow \frac{n}{t} = \frac{p}{hf}$

$$\frac{n}{t} = \frac{10\times10^{3}}{(6.63\times10^{-34})(90.8\times10^{6})}$$

$\boxed{n = 1.6\times10^{29} \text{ photons per second}}$

(7) The stopping potential for curves a and b is same $f_a = f_b$

Saturation current is proportional to intensity $I_a < I_b$

(8) De-Broglie wavelength $\lambda = \frac{h}{p} \Rightarrow \lambda \propto \frac{1}{p}$ i.e. graph will be a rectangular hyperbola

(9) From the given graph it is clear that if we extend the given graph for A and B, intercept of the line A on V axis will be smaller as compared to line B means work function of A is smaller than that of B.

(10) Photo current (i) directly proportional to light intensity (I) falling on a photosensitive plate. $i \propto I$.

(11) Stopping potential is that negative potential for which photo electric current is zero.

(12) $I \propto \frac{1}{d^2}$ and photo current $i \propto I \propto \frac{1}{d^2}$

(13) From the graph stopping potential $|Vs| = V_0$ Also $K.E_{max} = (|V_0|)e = (4V)e = 4eV$

(14) According to de-Broglie hypothesis $\lambda = \frac{h}{mv}$

(15) $\lambda = \frac{h}{mv} = \frac{h}{\sqrt{2mE}} \Rightarrow E = \frac{h^2}{2m\lambda^2}$ $\because \lambda$ is same for all, so $E \propto \frac{1}{m}$. Hence energy will be maximum for particle with lesser mass.

(16) Intensity determine the No. of emitted electrons.

(17) $\lambda = \frac{h}{m_1v_1} = \frac{h}{m_2v_2}$; $\therefore \frac{v_1}{v_2} = \frac{m_2}{m_1} = \frac{4}{1}$

(18) $\left.\begin{matrix}\text{Photoelectric effect} \rightarrow \text{Particle nature}\\ \text{Diffraction} \rightarrow \text{Wave nature}\end{matrix}\right\}$ Dual nature

(19) $\Delta\lambda = \frac{h}{m_oc}(1-\cos\theta)$

When $\theta = 180°$

$\Delta\lambda = \frac{h}{m_oc}(1-\cos180°)$

$\Delta\lambda = \frac{h}{m_oc}(1-(-1))$

$\boxed{\Delta\lambda = \frac{2h}{m_oc}}$

(20) Sodium (yellow) light have less energy as compared to that of blue and violet light.

(21) Photon is energy packet of energy which are integral part of all electromagnetic radiations which cannot be subdivided according to Einstein.

(22) If an electron and a photon propagate in the form of waves having the same wavelength, it implies that they have same momentum. This is according to de-Broglie equation, $p \propto 1/\lambda$.

(23) In photoelectric effect particle nature of electron is shown. While in electron microscope, beam of electron is considered as electron wave.

(24) By using $\lambda = \frac{h}{\sqrt{2mE}}$ $\because E = 10^{-32}\,J = \text{constant}$ Hence $\lambda \propto \frac{1}{\sqrt{m}}$ Since $m_p > m_e$ so $\lambda_p < \lambda_e$

(25) Kinetic energy of photo electrons depends upon the frequency of incident light and for three different metals we have three different stopping potentials.

(26) $E = hf_o \Rightarrow W = hf_o = \frac{hc}{\lambda_o} \Rightarrow W_o \propto \frac{1}{\lambda_o}$

(27) Stopping potential $\propto$ frequency of incident photon

Photoelectric current $\propto$ intensity of incident photon

(28) As $p = \frac{h}{\lambda}$ for 1 photon

$\therefore p = \frac{nh}{\lambda}$ for n photon

(29) $\lambda = \frac{h}{\sqrt{2mE}} \Rightarrow E \propto \frac{1}{\sqrt{m}}$ $(\lambda = \text{constant})$ $\because m_e < m_p$ so $E_e > E_p$

(30) As $\lambda = \frac{h}{mv}$

So $\boxed{v = \frac{h}{m\lambda}}$

(31) The De-Broglie wavelength is $\lambda = \frac{h}{|p|} = \frac{h}{|I|} \Rightarrow \lambda \propto \frac{1}{|I|}$

(32) From de-Broglie wavelength $\lambda = \frac{h}{mv}$

(33) $p = \frac{hv}{c} \Rightarrow v = \frac{pc}{h} = \frac{3.3\times10^{-29}\times3\times10^{8}}{6.6\times10^{-34}} = 1.5\times10^{13}\,Hz$

Scanned by CamScanner

(34) As $\lambda = \frac{h}{p} = \frac{h}{\text{constant}} = \text{constant}$

(35) $p = \frac{E}{c} \Rightarrow E = p \times c = 2\times10^{-16} \times \left(3\times10^{10}\right) = 6\times10^{-6}\, erg$

(36) $\text{Slope} = \frac{\Delta y}{\Delta x} = \frac{K.E_{max}}{f} = h \qquad \because E = hf$

(37) $p = \frac{E}{c} = \frac{hv}{c} \Rightarrow v = \frac{pc}{h}$

(38) $P = \frac{W}{t} = \frac{nhc}{\lambda t} \Rightarrow \left(\frac{n}{t}\right) = \frac{P\lambda}{hc} = \frac{10\times10^{3}\times300}{6.6\times10^{-34}\times3\times10^{8}} \doteq 1.5\times10^{31}$

(39) $E = \frac{hc}{\lambda} \Rightarrow \lambda = \frac{hc}{E}$.

(40) An electron in rest possesses only particle nature.

(41) $\lambda = \frac{h}{\sqrt{2mE}} \propto \frac{1}{\sqrt{mE}} \qquad \therefore \qquad E \propto \frac{1}{m} \Rightarrow E_1 > E_3 > E_2$

(42) $\lambda = \frac{h}{\sqrt{2m_p E_k}} \propto \frac{1}{\sqrt{m}} \qquad \therefore \qquad \frac{\lambda_p}{\lambda_\alpha} = \sqrt{\frac{m_\alpha}{m_p}} = \sqrt{\frac{4m_p}{m_p}} = \frac{2}{1}$

(43) $\lambda = \frac{h}{\sqrt{2mE_k}} \propto \frac{1}{\sqrt{m}}$ for same kinetic energy

(44) $l = l_0\sqrt{1-\frac{v^2}{c^2}}$ Here relative motion $v = 3\times10^8\ ms^{-1}$

$l = l_0\sqrt{1-\frac{c^2}{c^2}} = 0$

(45) To reduce uncertainty in position we need photon of shorter wavelength and to reduce uncertainty in momentum we need photon of longer wavelength

(46) According to Einstein's photoelectric equation

$E_K = hf - \phi$

Where E_k = K.E of emitted electron.

(47) According to Einstein's photoelectric equation

$E_K = hf - \phi$

$hf = \phi + E_k = 3.5 + 1.2 = 4.7\ eV$

(48) $\Delta\lambda = \frac{h}{m_0 c}(1-\cos\theta)$

(49) $m = \frac{m_0}{\sqrt{1-\frac{v^2}{c^2}}} \qquad ;c = \infty$

$m = \frac{m_0}{\sqrt{1-\frac{v^2}{\infty}}} \Rightarrow \boxed{m = m_0}$

(50) Minimum energy for pair production is called threshold energy.

$E = hf = 1.02\text{MeV}$

$\frac{hc}{\lambda} = 1.02\text{MeV}$

$\lambda = \frac{6.63\times10^{-34}\times3\times10^{8}}{1.02\times10^{6}\times1.6\times10^{-19}} \Rightarrow \lambda = 1.2\times10^{-12}\text{m}$

$\boxed{\lambda = 1.2\text{pm}}$

(51) $eV_s = hf - \phi_0$

$V_s = \frac{hf}{e} - \phi_0$

$V_s = \frac{hc}{e\lambda} - \phi_0$

$V_1 = \frac{hc}{e\lambda_1} - \phi_0$

$V_2 = \frac{hc}{e\lambda_2} - \phi_0$

$V_1 - V_2 = \frac{hc}{e}\left(\frac{1}{\lambda_1} - \frac{1}{\lambda_2}\right)$

$\frac{h}{e}$

(52) $\lambda = \frac{h}{mv}$

$\lambda = \frac{6.63\times10^{-34}}{1\times1} = 6.63\times10^{-34}\ m$

(53) $E = hf = 6.6\times10^{-34}\times10^{15} = 6.6\times10^{-19}\ J$

(54) $K.E_{max} = E - \phi_o = (3.4-2)eV = 1.4eV$

(55) $hf = \phi + K.E_{max} = \phi + eV_o \Rightarrow eV_o = hf - \phi$

From equation, the stopping potential "V_o" depends on frequency of incident light "f" and nature of material "ϕ".

(56) In photocell cesium, coated oxidized silver cathode emits electrons for infrared light.

(57) Quantum effects are important only when observing atomic size objects.

(58) $P = \frac{h}{\lambda} = \frac{hf}{c}$

(59) $P = \frac{h}{\lambda} = \frac{6.63\times10^{-34}}{0.1\times10^{-10}} = 6.63\times10^{-34}\times10^{11} = 6.63\times10^{-23}\ Ns$

(60) de-Broglie purposed that particle (electron) shows wave nature (stationary waves).

Scanned by CamScanner

20 Chapter ATOMIC SPECTRA

PRACTICE EXERCISE

(1) An atom with one electron has an ionization energy of 25 eV. How much energy will be released when the electron makes the transition from an excited energy level, where $E = -16$ eV, to the ground state
(a) 9 eV (b) 11 eV
(c) 16 eV (d) 25 eV

(2) Photon of highest frequency will be absorbed when transition takes place from _____
(a) 1st to 5th orbit (b) 2nd to 5th orbit
(c) 3rd to 5th orbit (d) 4th to 5th orbit

(3) Electrons held in the atom due to
(a) Weak nuclear forces (b) Gravitational forces
(c) Nuclear forces (d) Coulomb's forces

(4) If electron and proton have the same wavelength then they have same
(a) Energy (b) Velocity
(c) Momentum (d) All of above

(5) Excited atoms return to their ground state in _____
(a) 10^{-10}s (b) 10^{-8}s
(c) 10^{-6}s (d) 10^{-9}s

(6) The most energetic photon in a continuous X-ray spectrum has an energy approximately equal to:
(a) The energy of all the electrons in a target atom
(b) The rest energy, mc^2, of an electron
(c) The kinetic energy of an incident-beam electron
(d) The kinetic energy of a K-electron in the target atom

(7) Hydrogen atom does not emit X-rays because _____
(a) Its energy levels are too close to each other
(b) Its energy levels are too far apart
(c) It is too small in size
(d) It has a single electron

(8) $\frac{K^2me^4}{h^2}$ has the dimensions of
(a) Length (b) Pressure
(c) Work (d) Time

(9) When electron jumps from n^{th} to the p^{th} orbit in an hydrogen atom then the wavelength of the emitted radiation is given by
(a) $\frac{1}{\lambda} = R_H\left[\frac{1}{p^2} - \frac{1}{n^2}\right]$ (b) $\frac{1}{\lambda} = \frac{1}{R_H}\left[\frac{1}{p^2} - \frac{1}{n^2}\right]$
(c) $\frac{1}{\lambda} = R_H\left[\frac{1}{n^2} - \frac{1}{p^2}\right]$ (d) $\frac{1}{\lambda} = \frac{1}{R_H}\left[\frac{1}{4^2} - \frac{1}{n^2}\right]$

(10) In excited state the total energy is E, what is K.E with proper sign
(a) 2E (b) -E/2
(c) 2/E (d) -E

(11) Ground state energy of the 4th orbit in a H-atom is _____
(a) –13.60 eV (b) –3.40eV
(c) –0.85eV (d) –1.51eV

(12) X – Rays can not produce
(a) Photo Electric Effect (b) Compton's Effect
(c) Pair Production (d) All of these

(13) An atom X is excited to an energy E_2 from the ground state E_1 by collision with an atom which of the following statements is correct (I) the electron in X lose energy just after collision (II) the excited atom X emits a photon given by $hf=E_2-E_1$ (III) the colliding atom must have lost energy to excite X
(a) All are correct (b) II and III
(c) I and III (d) III only

(14) The electric P.E of an electron in an orbit at a distance r_n from the positive charge _____
(a) Ke^2/r_n (b) Ke^2/r_n^2
(c) $-Ke^2/r_n$ (d) $-Ke^2/r_n^2$

(15) Radiation with wavelength longer than red lights _____
(a) Ultraviolet rays (b) X-rays
(c) Infra red radiation (d) Visible radiation

(16) Bracket series is obtained when all transition of electron terminate on _____
(a) 4th orbit (b) 5th orbit
(c) 3rd orbit (d) 2nd orbit

(17) In an electronic transition, atom cannot emit _____
(a) γ-rays (b) Infrared radiation
(c) Visible light (d) Ultraviolet rays

(18) Reverse process of photoelectric effect is _____-
(a) Pair production (b) Compton effect
(c) Annihilation of matter (d) X- rays production

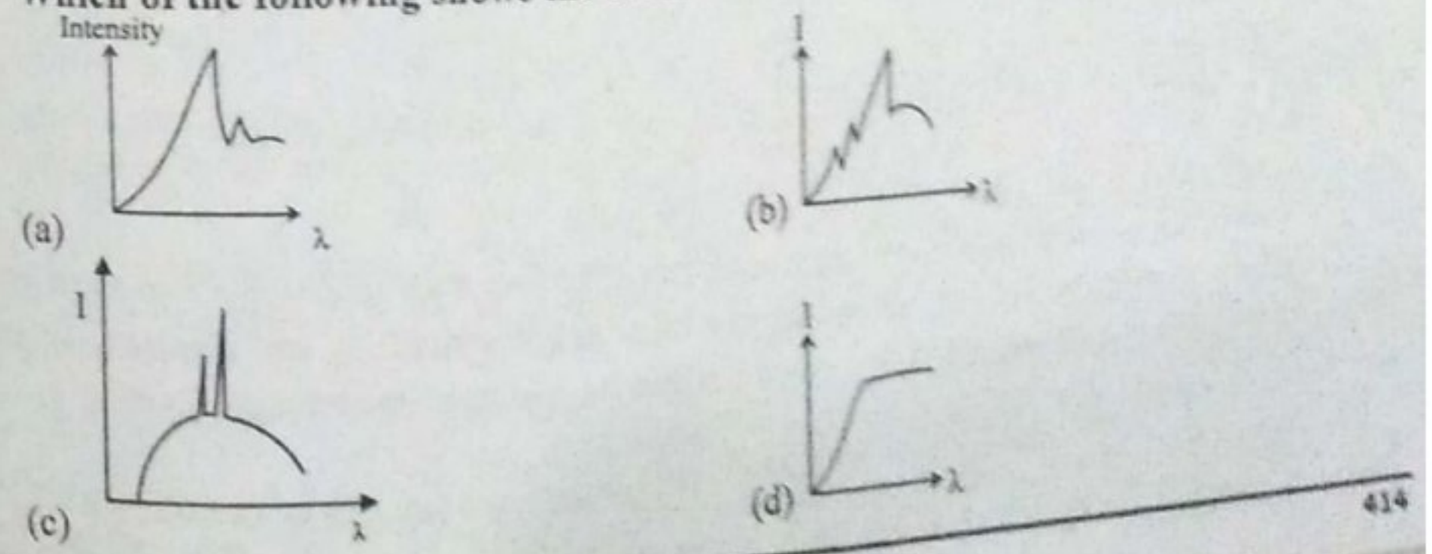
(19) X rays are similar in nature to _____
(a) Cathode rays (b) Positive rays
(c) γ- rays (d) α- rays

(20) The penetrating power of X- rays depends on their _____
(a) Applied voltage (b) Filament current
(c) Source (d) All of the above

(21) A Balmer line is emitted when the electron in a hydrogen atom jumps from
(a) A higher orbit to the first orbit (b) A higher orbit to the second orbit
(c) The first orbit to a higher orbit (d) The second orbit to a higher orbit

(22) A laser beam can be sharply focused because it is:
(a) Circularly polarized (b) Intense
(c) Highly directional (d) Highly coherent

(23) Which of the following shows the best relation between wavelength and intensity?



Scanned by CamScanner

(24) **Which of the following is true?**
(a) Lyman series is a continuous spectrum
(b) Paschen series is a line spectrum in the infra red
(c) Ballmer series is a line spectrum in the ultraviolet
(d) The spectral series formula can be derived from the Rutherford model of the hydrogen atom

(25) **In an X-ray tube, electrons each of charge e are accelerated through V potential difference allowed to hit a metal target. The wavelength of the X-rays emitted is_____**
(a) hc/eV (b) he/Vc
(c) eV/h (d) impossible to predict

(26) **The minimum wavelength of X-rays can further be reduced by_____**
(a) Reducing the pressure or cooling the target.
(b) Increasing the temperature of the filament.
(c) Using a target element of higher atomic number.
(d) Increasing the potential difference between the cathode and the target.

(27) **The characteristic X-rays spectrum is due to _____**
(a) The illumination of the target metal by ultra-violet radiation.
(b) The bombardment of the target by protons.
(c) The bombardment of target by electrons.
(d) The absorption of γ radiation by the target metal.

(28) **LASER action can't be achieved without**
(a) Population inversion (b) Induced emission
(c) Spontaneous emission (d) All of them

(29) **Maximum frequency in the spectrum from X-ray tube is directly proportional to the _____**
(a) Number of incident electron i.e. filament current.
(b) The kinetic energy of the incident electron i.e. the potential difference through which they are accelerated.
(c) The soft target which can easily emit electrons.
(d) All of above are correct.

(30) **X-rays are diffracted by a crystal but not by a diffraction grating because _____**
(a) The ions in a crystal are well arranged.
(b) The lines in a diffraction grating cannot reflect X-rays.
(c) The penetration power of X-rays is high in a diffraction grating.
(d) The wavelengths of X-rays are of the same order of magnitude as the separation between atoms in a crystal.

(31) **UV radiation can be produced by**
(a) Heating the filament. (b) Electron excitation in the gas.
(c) Ionization of atoms. (d) All the above.

(32) **The ratio of life time of metastable excited state to the normal state is**
(a) $1:10^5$ (b) $1:10^4$
(c) $10^5:1$ (d) $1:10^6$

(33) **Protons are accelerated form rest by a potential difference 4 kV and strike a metal target. If a proton produces one photon on impact of minimum wavelength λ_1 and similarly an electron accelerated to 4 kV strikes the target and produces a minimum wavelength λ_2 then**
(a) $\lambda_1 < \lambda_2$ (b) $\lambda_1 > \lambda_2$
(c) $\lambda_1 = \lambda_2$ (d) no such relation can be established

(34) **Electron cannot exist in the nucleus; it is confirmed by observing that**
(a) It does emit γ-radiation.
(b) Its size as compare to proton and neutron is very small.
(c) No antiparticle of electron is present.
(d) The velocity of electron must by very high according to uncertainty principle.

(35) **X-rays and γ-rays both are electromagnetic waves. Which of the following statements is correct?**
(a) The wavelength of X-rays is less than that of γ-rays
(b) The wavelength of X-rays is greater than that of γ-rays
(c) The frequency of γ-rays is less than that of X-rays.
(d) The frequency and wavelength of X-rays are more than those of γ-rays.

(36) **In laser production, the state in which more atoms are in the upper state than in the lower one is called _____**
(a) Metal stable state. (b) Normal state.
(c) Inverted population. (d) All the above.

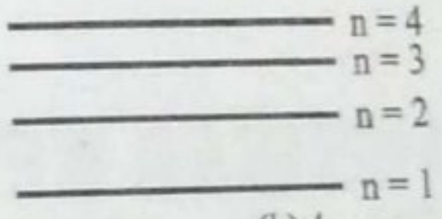
(37) **The stay of electron in metastable state for an atom in laser light is_____**
(a) 10^{-4}sec. (b) 10^{-5}sec.
(c) 10^{-3}sec. (d) 10^{-8}sec.

(38) **In He-Ne laser, the lasing action is produced by_____**
(a) Ne only. (b) He-Ne both.
(c) Electrons of He. (d) Electrons of Ne.

(39) **Who discovered X-ray?**
(a) Roentgen (b) Marie curie
(c) Rutherford (d) All

(40) **The velocity of laser light is _____**
(a) Less than ordinary light. (b) More than ordinary light.
(c) Equal to ordinary light. (d) Different for different colours or frequency

(41) **Four lowest energy levels of H atom are shown in the figure. The number of possible emission lines would be**



(a) 3 (b) 4
(c) 5 (d) 6

(42) **K_β - characteristic X-rays are produced due to the transition of electrons**
(a) From L- shell (b) From M-shell to L-shell
(c) From M-shell to K-shell (d) From N-shell to K-shell

(43) **What is the ratio of the circumference of the first Bohr orbit for the electron in the hydrogen atom to the de-Broglie wavelength of electrons having the same velocity as the electron in the first Bohr orbit of the hydrogen atom?**
(a) 1:1 (b) 1:2 (c) 1:4 (d) 2:1

(44) **If photons of energy 12.75 eV are passing through hydrogen gas in ground state then number of lines in emission spectrum will be**
(a) 6 (b) 4 (c) 3 (d) 2

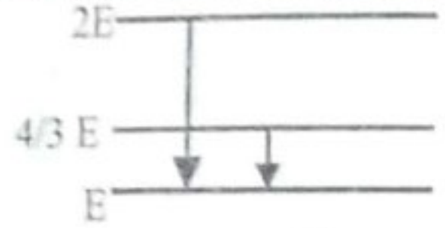
(45) **An x-ray tube operating at 30 kV, will emit x-ray of minimum wavelength**
(a) 2840 Å (b) 0.413 Å (c) 2.14 Å (d) 1.78 Å

Scanned by CamScanner

(46) The prominent lines of the Balmer series lie in
(a) visible (b) infrared
(c) ultraviolet (d) red

(47) In the state $n=\infty$ of hydrogen atom, total energy of electron is:
(a) 5.2 eV (b) 9.8 eV
(c) zero (d) 10.5 eV

(48) The following fig indicates the energy levels of a certain atom. When the system moves from 2 E level to E a photon of wavelength λ is emitted. The wavelength of photon produced during its transition from level 4E/3 to level E is.



(a) $\frac{\lambda}{3}$ (b) $\frac{3\lambda}{4}$
(c) $\frac{4\lambda}{3}$ (d) 3λ

(49) The ratio of the energies of the hydrogen atom in the first and the second excited states is
(a) 1 : 4 (b) 4 : 1
(c) 4 : 9 (d) 9 : 4

(50) With increasing quantum number the energy difference between adjacent levels in atoms
(a) decreases
(b) increases
(c) decreases for low Z and increase for high Z atoms
(d) remains constant

ANSWER KEY

1	a	11	c	21	b	31	b	41	d
2	a	12	c	22	c	32	c	42	c
3	d	13	d	23	c	33	c	43	a
4	c	14	c	24	b	34	d	44	a
5	b	15	c	25	a	35	b	45	b
6	c	16	a	26	d	36	c	46	a
7	a	17	a	27	c	37	c	47	c
8	c	18	d	28	a	38	a	48	d
9	a	19	c	29	b	39	a	49	d
10	d	20	a	30	d	40	c	50	a

EXPLANATORY NOTES

(1) $E=-16-(-25)=9$ eV

(2) Frequency will be max of absorbed radiation when energy gap is max.

(3) Electrons around nucleus revolve due to coulomb's electrostatic force.

(4) $\lambda=\frac{h}{p}$ If $\lambda_e=\lambda_p$ So,

$p_e=P_p$

(5) Electron stay in excited state for 10^{-8}s.

(6) $K.E_e=\frac{1}{2}mv_{max}^2=$ Energy of photon$=hf$

(7) For production of X-Rays high atomic no metal used but energy gap for hydrogen is too close.

(8) $E=\frac{2\pi^2K^2me^4}{h^2}$

Hence,

$\frac{K^2me^4}{h^2}$ has unit of energy of work.

(9) As Rydberg equation is

$\frac{1}{\lambda}=R_H\left(\frac{1}{p^2}-\frac{1}{n^2}\right)$

(10)

$T.E=\frac{-Ke^2}{2r_n}$

$K.E=\frac{Ke^2}{2r_n}$

$P.E=-\frac{Ke^2}{r_n}$

K.E=T.E(opposite sign)$=-E$

(11) $E_n=-\frac{E_o}{n^2}$

(12) X-ray cannot produce pair production, because for pair production high energy photon gamma ray photons are required.

(13) Energy emitted $=E_o-E_2=-ve$, colliding atom lost energy to excite X-Atom.

Scanned by CamScanner

(14) $P.E=\frac{-ke^2}{r_n}$

(15) Infrared light has $\lambda > \lambda_{vis}$

(16) For bracket series electron must jump into 4th shell.

(17) γ-rays emit from nucleus only.

(18) In photoelectric affect photons emit electrons from metal surface and in X-Ray production electrons produce photons.

(19) Both X-Rays & γ-rays are electromagnetic.

(20) Penetration power depend upon energy of X-rays and energy depend upon accelerating voltage.

(21) Balmer series emit when electron jump from any higher orbit to 2nd shell.

(22) A laser beam can be sharply focused because it is highly directional

(23) In characteristic X-ray the light of longer wavelength has high intensity in respective series.

(24) Paschen series is a line spectrum in infrared region.

(25) $K.E_e = eV = hf = \frac{hc}{\lambda}$

$\lambda = \frac{hc}{eV}$

(26) $\lambda_{min} \propto \frac{1}{V}$

(27) X-Rays produce when e⁻s are bombarded on target metal.

(28) Laser action is basically due to population inversion.

(29) $\lambda \propto \frac{1}{V}$

$f \propto V$

(30) Diffraction only happen when size of wavelength is of the order of separation between the grating So, X-rays are shorter in wavelength. So, are unable to reflect through grating but can diffract through crystals.

(31) UV radiation can be produced by electronic excitation in the gases

(32) $\frac{\text{Life time of meta stable state}}{\text{Life time of normal exuted state}} = \frac{10^{-3}}{10^{-8}} = 10^5 : 1$

(33) $\lambda = \frac{hc}{eV}$

Charge on e⁻ and proton is same and voltage is also same. So,

$\lambda_1 = \lambda_2$

(34) According to De-Broglie and uncertainty principle, speed of electron must not be greater than speed of light to exist inside nucleus.

(35) $E_\gamma > E_x \rightarrow f_\gamma > f_x$

$\lambda_\gamma < \lambda_x$

(36) In metastable state more, electrons lie in upper state than ground state known as population inversion.

(37) Electron stay in Meta stable state = 10^{-3}s.

(38) Lasing Medium in He–Ne laser is Ne only.

(39) Roentgen was the scientist who discover X-rays.

(40) Laser is electromagnetic light and ordinary light is also electromagnetic so, both have same speed.

(41) No. of possible spectral lines $= \frac{n(n-1)}{2} = \frac{4(4-1)}{2} = 2(3) = 6$

(42) K_β will emit when electron jump from M shell to K shell

(43) As $K.E = +\frac{Ke^2}{2r_n}$

$T.E = \frac{-ke^2}{2r_n}$

So $K.E = -E$

(44)

$E_{photon} + E_1 = E_n$

$12.75eV + (-13.6eV) = \frac{-13.6eV}{n^2}$

$0.85eV = \frac{-13.6eV}{n^2}$

$n = 4$

Hence;

no. of transitions $= \frac{n(n-1)}{2}$

$= \frac{4(4-1)}{2}$

$= 6$

Scanned by CamScanner

(45)

$$\lambda_{min} = \frac{1240\text{nm}}{V}$$

$$= \frac{1240}{30\times10^{3}}$$

$$= \frac{413}{10^{4}}$$

$$= 4.13\times10^{-2}\times10^{-9}$$

$$= 4.13\times10^{-11}$$

$$= 0.413\times10^{-10}\text{m}$$

$$= 0.413\,\text{Å}$$

(46) Energy difference of Balmer series lies in visible spectrum.

(47) $n = \infty$

As, $E_n = \frac{E_0}{n^2} = 0$

(48) As,

$$\Delta E = \frac{hc}{\lambda} \rightarrow 2E - E = \frac{hc}{\lambda}$$

$$\boxed{\Delta E \propto \frac{1}{\lambda}}$$

$$\frac{4}{3}E - E = \frac{1}{3}E$$

As, $\Delta E' \rightarrow \frac{\Delta E}{3}$

So, $\lambda' \rightarrow 3\lambda$ $\quad \therefore E \propto \frac{1}{\lambda}$

(49)

$$E_n = \frac{-E_0}{n^2}$$

$$E_n \propto \frac{1}{n^2}$$

$$\frac{E_1}{E_2} = \left(\frac{n_2}{n_1}\right)^2 = \left(\frac{3}{2}\right)^2 = \frac{9}{4}$$

(50) $E_n \propto \frac{1}{n^2}$

20 Chapter ATOMIC SPECTRA

SELF ASSESMENT TEST

(1) The potential difference applied to an X-ray tube is increased. As a result, in the emitted radiations,

(a) the intensity increases
(b) the minimum wavelength increases
(c) the intensity decreases
(d) the minimum wavelength decreases

(2) In the nth orbit, the energy of an electron $E_n = -13.6/n^2$ eV for hydrogen atom. The energy required to take the electron from first orbit to second orbit will be

(a) 10.2 eV
(b) 12.1 eV
(c) 13.6 eV
(d) 3.4 eV

(3) In an X-ray tube, electrons accelerated through a very high potential difference strike a metal target. If the potential difference is increased, the speed of the emitted X-rays.

(a) increases
(b) decreases
(c) first increases then decreases
(d) is always equal to 3×10^{8} ms^{-1}

(4) The Lyman series of hydrogen spectrum lies in the region

(a) visible
(b) infrared
(c) of x–rays
(d) ultraviolet

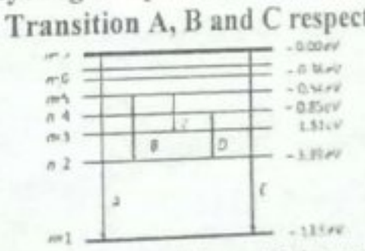
(5) The minimum wavelength of X-rays produced in an X-ray tube is λ when the operating voltage is V. What is the minimum wavelength of the X-rays when the operating voltage is V/2?

(a) $\frac{\lambda}{2}$
(b) λ
(c) 2λ
(d) 4λ

(6) The most energetic photon in a continuous x-ray spectrum has an energy approximately equal to:

(a) the energy of all the electrons in a target atom
(b) the rest energy, mc^2, of an electron
(c) the kinetic energy of an incident-beam electron
(d) the kinetic energy of a k-electron in the target atom

(7) The energy levels of the hydrogen spectrum is shown in figure. There are some transitions A, B, C, D and E. Transition A, B and C respectively represent



(a) series limit of Lyman series, third spectral line of Balmer series and second spectral line of Paschen series
(b) ionization potential of hydrogen, second spectral line of Balmer series and third spectral line of Paschen series
(c) first member of Lyman series, third spectral line of Balmer series and the second spectral line of Paschen series
(d) series limit of Lyman series, second spectral line of Balmer series and third spectral line of Paschen series

Scanned by CamScanner

(8) In Bohr model of hydrogen atom, let PE represent potential energy and TE the total energy. In going to a higher level:
(a) PE decreases, TE increases (b) PE increases, TE decreases
(c) PE decreases, TE decreases (d) PE increases, TE increases

(9) In the continuous part of the spectrum of X-rays the limiting frequency is.
(a) inversely proportional to the potential through which electrons have been accelerated
(b) is directly proportional to the accelerating potential
(c) not dependent upon the accelerating potential
(d) is dependent upon the nature of the target material

(10) The energy required to remove an electron in a hydrogen atom from n=10 state is
(a) 1.36 eV (b) 0.0136 eV
(c) 13.6 eV (d) 0.136 eV

(11) Ionization potential of hydrogen atom is 13.6 V. Hydrogen atoms in the ground state are excited by monochromatic radiation of photon energy 12.1 eV. The spectral lines emitted by hydrogen atoms according to Bohr's theory will be
(a) four (b) two
(c) Three (d) one

(12) When the accelerating voltage applied on the electrons, in an X-ray tube, is increased beyond a critical value.
(a) the spectrum of white radiation is unaffected
(b) only the intensities of various wavelength are increased
(c) only the wavelength of characteristic radiation is affected
(d) the intensities of characteristic lines relative to the white spectrum are increased but here is no change in their wavelength.

(13) The radiations emitted from hydrogen filled discharge tube show_____
(a) band spectrum (b) line spectrum
(c) continuous spectrum (d) none

(14) The angular momentum of electron in nth orbit is given by
(a) $h/2\pi n$ (b) $n^2h/2\pi$
(c) $nh/2\pi$ (d) nh

(15) Radiation with wavelength longer than red light _____
(a) ultraviolet rays (b) x-rays
(c) infrared radiation (d) visible radiation

(16) Bracket series is obtained when all transitions of electron terminate on _____
(a) 4^{th} orbit (b) 5^{th} orbit
(c) 3^{rd} orbit (d) 2^{nd} orbit

(17) In an electronic transition, atom cannot emit _____
(a) γ-rays (b) infrared radiation
(c) visible light (d) ultraviolet rays

(18) Reverse process of photoelectric effect is _____.
(a) pair production (b) compton effect
(c) annihilation of matter (d) x- rays production

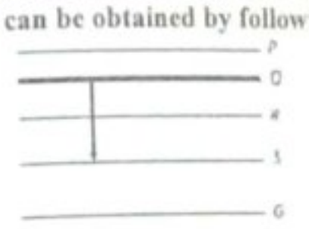
(19) The energy in monochromatic X-rays of wavelength $1\,\mathring{A}$ is roughly equal to.
(a) 2×10^{-15} J (b) 2×10^{-16} J
(c) 2×10^{-17} J (d) 2×10^{-18} J

(20) The ratio of the energies of the hydrogen atom in its first to second excited state is
(a) 9/ 4 (b) 1/4
(c) 4/9 (d) 4

(21) The following diagram indicates the energy levels of a certain atom when the system moves from 2E level to E, a photon of wavelength λ is emitted. The wavelength of photon produced during its transition from 4E/3 level to E is

(a) 4λ/3 (b) 3λ
(c) 3λ/4 (d) λ/3

(22) Figure shows the energy levels P, Q, R, S and G of an atom where G is the ground state. A red line in the emission spectrum of the atom can be obtained by an energy level change from Q to S. A blue line can be obtained by following energy level change



(a) R to S (b) Q to R
(c) R to G (d) P to Q

(23) In spectrum of hydrogen atom, Paschen series is
(a) $\frac{1}{\lambda}=R\left(\frac{1}{2^2}-\frac{1}{n^2}\right)$ (b) $\frac{1}{\lambda}=R\left(\frac{1}{1^2}-\frac{1}{n^2}\right)$
(c) $\frac{1}{\lambda}=R\left(\frac{1}{3^2}-\frac{1}{n^2}\right)$ (d) $\frac{1}{\lambda}=R\left(\frac{1}{4^2}-\frac{1}{n^2}\right)$

(24) Radiation emitted from TV picture tube is_____
(a) γ-rays. (b) x-rays.
(c) far infrared. (d) infrared.

(25) When a hydrogen atom is raised from the ground state to an excited state
(a) P.E. increases and K.E. decreases
(b) P.E. decreases and K.E. increases
(c) both kinetic energy and potential energy increase
(d) both K.E. and P.E. decrease

(26) Which of the following statements about the Bohr model of the hydrogen atom is false
(a) acceleration of electron in n = 2 orbit is less than that in n = 1 orbit
(b) angular momentum of electron in n = 2 orbit is more than that in n = 1 orbit
(c) kinetic energy of electron in n = 2 orbit is less than that in n = 1 orbit.
(d) potential energy of electron in n = 2 orbit is less than that in n = 1 orbit

(27) If an electron jumps from 1st orbital to 3rd orbital, then it will
(a) no gain of energy (b) release energy
(c) absorb energy (d) none of these

(28) The minimum wavelength of X-rays emitted from an X-ray tube operating at a voltage of 10^4 volts is roughly equal to.
(a) $1.24\,\mathring{A}$ (b) $1.5\,\mathring{A}$
(c) $2\,\mathring{A}$ (d) $2.5\,\mathring{A}$

Scanned by CamScanner

(29) A hydrogen atom is in first excited state. To ionize the atom, the minimum energy required is:
(a) –13.6 ev (b) slightly less than 13.6 ev
(c) –3.4 eV (d) –1.5 eV

(30) To explain his theory, Bohr used
(a) conservation of energy (b) conservation of quantum frequency
(c) conservation of linear momentum (d) conservation of angular momentum

(31) The difference in angular momentum associated with the electron in the two successive orbits of hydrogen atom is
(a) $\frac{h}{\pi}$ (b) $\frac{h}{2\pi}$
(c) $\frac{h}{2}$ (d) $(n-1)\frac{h}{2\pi}$

(32) What is the velocity of a particle of mass m & de-Broglie wavelength λ?
(a) $\frac{h}{m\lambda}$ (b) $\frac{2h}{m\lambda}$
(c) $\frac{mh}{\lambda}$ (d) $\left(\frac{2hc}{m\lambda}\right)^{\frac{1}{2}}$

(33) In Bohr's model, if the atomic radius of the first orbit is r, then the radius of the fourth orbit is
(a) r/16 (b) 4r
(c) 16r (d) r

(34) The continuous X-rays spectrum produced by an X-ray machine at constant voltage has
(a) A minimum frequency (b) A single wavelength
(c) A maximum wavelength (d) A minimum wavelength

(35) X-rays and γ-rays both are electromagnetic waves. Which of the following statements is correct?
(a) the wavelength of X-rays is less than that of γ-rays
(b) the wavelength of X-rays is greater than that of γ-rays
(c) the frequency of γ-rays is less than that of X-rays.
(d) the frequency and wavelength of X-rays are more than those of γ-rays.

(36) In an X-rays tube, the intensity of the emitted X-rays beam is increased by
(a) increasing the target potential (b) decreasing the filament current.
(c) increasing the filament current (d) decreasing the target potential.

(37) X-rays of frequency f are used to irradiate sodium and copper surface in two separate experiments and the stopping potential determined. Then.
(a) the stopping potential is more for copper than for sodium.
(b) the stopping potential is more for sodium than for copper
(c) the stopping potential is same for sodium and copper
(d) the stopping potential for both will vary as 1/K

(38) For production of characteristic K_β X-rays, the electron transition is
(a) n=3 to n=1 (b) n=3 to n=2
(c) n=4 to n=2 (d) n=2 to n=1

(39) Reflecting mirrors in laser is used to _____
(a) further stimulation (b) lasing more
(c) for producing more energetic lasers (d) all the above

(40) The total energy of an electron in the first excited state of hydrogen atom is about -3.4 eV. Its kinetic energy in this state is:
(a) 3.4 eV (b) 6.8 eV
(c) –3.4 eV (d) –6.8 eV

(41) The wavelength of X-rays decreases, when
(a) Temperature of target is increased
(b) Intensity of electron beam is increased
(c) K.E. of electrons striking the target is increased
(d) K.E. of electrons striking the target is decreased

(42) Laser are classified into:
(a) solid laser (b) liquid laser
(c) gas laser (d) solid, liquid and gas laser

(43) The wavelength of last spectral line in Lyman series in of Rydberg constant is
(a) R (b) R^2
(c) $\frac{1}{R}$ (d) $\frac{1}{R^2}$

(44) The Rydberg constant 'R' in per meter is
(a) 1.0274×10^7 (b) 1.04274×10^7
(c) 1.0674×10^7 (d) 1.0974×10^7

(45) The target in an X-rays unit is given a
(a) zero potential (b) low negative
(c) high positive potential (d) high negative potential

(46) What is the effect of electric and magnetic fields on X – rays?
(a) x – rays deflected
(b) x – rays are not deflected
(c) x – rays are sometimes deflected and sometimes not
(d) nothing can be said

(47) Red light emitted in Helium – Neon Laser is of wavelength
(a) 500nm (b) 632.8nm
(c) 750nm (d) 550nm

(48) In the x-ray tube before striking the target we accelerate the electrons through a potential difference of V volt. For which of the following value of V, we will have x-rays of largest wavelength?
(a) 10 kV (b) 20 kV
(c) 30 kV (d) 40 kV

(49) The electromagnetic waves that has highest wavelength is
(a) x-rays (b) ultraviolet rays
(c) infra-red rays (d) microwaves

(50) The speed of an electron having a wavelength in vacuum is order of 1Å will be
(a) 7.25×10^6 m/s (b) 6.26×10^6 m/s
(c) 5.25×10^6 m/s (d) 4.24×10^6 m/s

Scanned by CamScanner

(51) **Mosley's law relates the frequencies of line X-rays with the following characteristics of the target element**
(a) its density (b) its atomic weight
(c) its atomic number (d) inter planer spacing of the atomic planes

(52) **The shortest wavelength of X-rays emitted from an X-ray tube depends upon**
(a) current in the tube (b) voltage applied to tube
(c) nature of gas in tube (d) atomic number of target material

(53) **X-rays are not used for radar purpose because**
(a) they are not reflected by target (b) they are not electromagnetic wave
(c) they are completely absorbed by air (d) they sometimes damage the target

(54) **What determines the hardness of the X-rays obtained from the Coolidge tube**
(a) current in the filament
(b) pressure of air in the tube
(c) nature of target
(d) potential difference between cathode and target

(55) **The orbital velocity of electron in the ground state is v. If the electron is excited to energy state $-0.54eV$, its orbital velocity will be**
(a) v (b) $\frac{v}{3}$
(c) $\frac{v}{5}$ (d) $\frac{v}{7}$

(56) **When a hydrogen atom is raised from the ground state to an excited state,**
(a) both kinetic energy (K.E) and potential energy (P.E) increases
(b) both K.E and PE decreases
(c) P.E increases, K.E decreases, T.E increases
(d) P.E decreases, K.E increases, T.E decreases

(57) **Consider a photon of continuous X-rays coming from a Coolidge tube. Its energy comes from**
(a) K.E of the striking electron (b) K.E of free electron of the target
(c) K.E of the ions of target (d) an atomic transition in the target

(58) **When an electron strikes the target in a Coolidge tube, its entire K.E**
(a) is converted into photon (b) may be converted into photon
(c) may be converted into heat (d) both B and C

(59) **Which of the following is correct option?**
(a) $E_\alpha > E_\beta > E_\gamma$ (b) $E_\beta > E_\alpha > E_\gamma$
(c) $E_\gamma > E_\beta > E_\alpha$ (d) $E_\alpha = E_\beta = E_\gamma$

(60) **Which is an example of continuous spectra?**
(a) black body radiation (b) molecular spectra
(c) atomic spectra (d) none of these

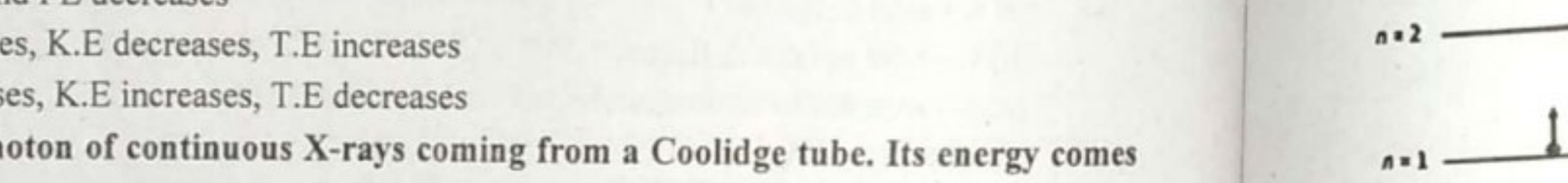
ANSWER KEY

1	d	11	c	21	b	31	b	41	c	51	c
2	a	12	d	22	c	32	a	42	d	52	b
3	d	13	b	23	c	33	c	43	c	53	a
4	d	14	c	24	b	34	d	44	d	54	d
5	c	15	c	25	a	35	b	45	c	55	c
6	c	16	a	26	d	36	c	46	b	56	c
7	a	17	a	27	c	37	b	47	b	57	a
8	d	18	d	28	a	38	a	48	a	58	d
9	b	19	a	29	c	39	a	49	d	59	c
10	d	20	a	30	d	40	a	50	a	60	a

EXPLANATORY NOTES

(1) As $eV = \frac{hc}{\lambda_{min}}$ or $\lambda_{min} \propto \frac{1}{V}$ when V ↑ λ_{min} ↓

(2) $E_{1\to 2} = -3.4 - (13.6) = +10.2\,eV$



(3) Speed of X-ray is independent of potential difference and is always equal to $3\times10^8\ ms^{-1}$.

(4) Lyman series lies in the UV region

(5) As $\frac{hc}{\lambda_{min}} = eV \Rightarrow \lambda_{min} \propto \frac{1}{V}$; $\lambda'_{min} \propto \frac{1}{V/2}$

$\lambda'_{min} \propto 2\lambda_{min}$

(6) Energy of photon = K.E of electron

(7) Transition A ($n = \infty$ to $n = 1$) : Series limit of Lyman series Transition B ($n = 5$ to $n = 2$) : Third spectral line of Balmer series Transition C ($n = 5$ to $n = 3$) : Second spectral line of Paschen series.

(8) $P.E = \frac{-ke^2}{r_n}$

when r increase $P.E$ becomes less negative i.e increases

$TE = \frac{-ke^2}{2r_n}$

when r increases TE becomes less negative i.e increases

Scanned by CamScanner

(9) $K.E = Ve$

$hf_{max} = Ve \Rightarrow f_{max} = \frac{Ve}{h}$

$\Rightarrow f_{max} \propto V$

(10)

$$\text{Energy required} = \frac{13.6}{n^2} = \frac{13.6}{10^2} = 0.136\,eV$$

(11) Final energy of electron $= -13.6 + 12.1 = -1.51$ eV. Which is corresponds to third level i.e. n = 3. Hence number of spectral lines emitted $= \frac{n(n-1)}{2} = \frac{3(3-1)}{2} = 3$

(12) Due to high penetration of electron in target material only possibility of emission of more X-rays photons is increased rather than energy.

(13) Gas or vapor state of elements shows line spectrum

(14) According to Bohr's second postulate $L_o = mvr = \frac{nh}{2\pi}$

(15) According to electromagnetic spectrum IR have longer wavelength or less energy than red light.

(16) For bracket series

$\frac{1}{\lambda} = R_H\left[\frac{1}{4^2} - \frac{1}{n^2}\right]$

Lower orbit = 4th orbit

$n = 5, 6, 7, \ldots\ldots \infty$

(17) γ – rays production is nuclear phenomenon so, it cannot produce by electronic transition

(18) In X-rays production incident electrons cause photons to be emitted and in photoelectric effect photons make the emission of electrons.

(19) $E = \frac{hc}{\lambda} = \frac{(6.63\times10^{-34})(3\times10^{8})}{10^{-10}}$

$= 20\times10^{-16}\,J$

$= 2\times10^{-15}\,J$

(20) First excited state i.e. second orbit (n = 2) Second excited state i.e. third orbit (n = 3)

$\because E = -\frac{13.6}{n^2} \Rightarrow \frac{E_2}{E_3} = \left(\frac{3}{2}\right)^2 = \frac{9}{4}$

(21)

$-E = \frac{hc}{\lambda} \Rightarrow E = \frac{hc}{\lambda}$ $\quad \frac{4E}{3} - E = \frac{hc}{\lambda'} \Rightarrow \frac{E}{3} = \frac{hc}{\lambda'}$ $\quad \therefore \frac{\lambda'}{\lambda} = 3 \Rightarrow \lambda' = 3\lambda$

(22) If E is the energy radiated in transition then $E_{R\to G} > E_{Q\to S} > E_{Q\to R} > E_{P\to Q}$ For getting blue line energy radiated should be maximum $\left(E \propto \frac{1}{\lambda}\right)$

(23) For paschen series

$\frac{1}{\lambda} = R\left(\frac{1}{3^2} - \frac{1}{n^2}\right)$

$n = 4, 5, 6 \ldots \infty$

(24) X-rays emit from T.V picture.

(25) $P.E \propto -\frac{1}{r}$ and $K.E \propto \frac{1}{r}$ As r increases so K.E decreases but P.E increases.

(26) As n increases P.E. also increases

(27) When an electron jumps from the orbit of lower energy (n=1) to the orbit of higher energy (n=3), energy is absorbed

(28) $\lambda_{min} = \frac{12400}{10^4}\,\text{Å} = 1.24\,\text{Å}$

(29) For 1st excited state n = 2 so $\Rightarrow E = -\frac{E_o}{n^2} = -\frac{13.6eV}{(2)^2} = -3.4eV$

Ionization energy $= 0 - (-3.4) = 3.4$eV

(30) Bohr postulated that the angular momentum of the electron is conserved.

(31) $L = \frac{nh}{2\pi} \Rightarrow L_2 - L_1 = (n+1)\frac{h}{2\pi} - \frac{nh}{2\pi} = \frac{h}{2\pi}$

(32) From De-Broglie equation

$\lambda = \frac{h}{mv}$ or $v = \frac{h}{m\lambda}$

(33) $r_n \propto n^2 \Rightarrow \frac{r_4}{r_1} = \left(\frac{4}{1}\right)^2 = \frac{16}{1} \Rightarrow r_4 = 16r_1 \Rightarrow r_4 = 16r_o$

(34) Continuous spectrum of X-rays consists of radiations of all possible wavelength range having a definite short wavelength limit

(35) As $E = \frac{hc}{\lambda}$ or $\lambda = \frac{hc}{E}$

As $E_{x-rays} < E_{r-rays}$

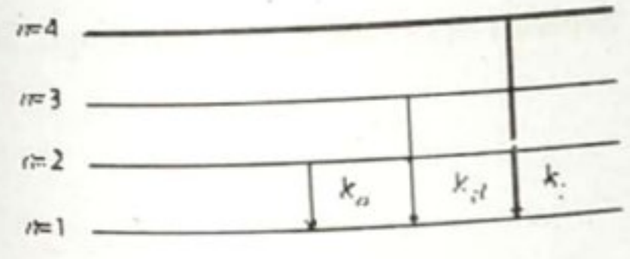
So $\lambda_{xrays} > \lambda_{r-rays}$

(36) By changing the filament current with the help of rheostat, thermionic emission intensity of X-rays can be changed

(37) Work function $\propto \frac{1}{\text{K.E}}$

Threshold frequency for sodium is less than copper so electrons from sodium will have more K.E, therefore, more stopping potential is required for electrons of sodium to stop.

(38)



(39) To achieve intense laser, we use reflecting mirrors in assembly.

Scanned by CamScanner

(40) As

$$E_n = \frac{-ke^2}{2rn} = -3.4eV$$

$$K.E = -T.E$$

$$= -(-3.4) = 3.4eV$$

(41)

$$\lambda_{min} = \frac{hc}{eV(\text{energy})}$$; when KE (or eV) increases, λ decreases

(42) There are three types of laser.

(43) $\frac{1}{\lambda} = R\left(\frac{1}{1^2} - \frac{1}{\infty^2}\right) \Rightarrow \lambda = \frac{1}{R}$

(44) $R = 1.09 \times 10^7 m^{-1}$

(45) High positive potential requires at anode (Target metal)

(46) Electric or magnetic field can deflect charges only

(47) Emitted wavelength in He – Ne laser is 632.8nm

(48) $\lambda_{min} \propto \frac{1}{V}$

(49)

Radio	micro	IR	visible	U.V	X-rays	γ – Rays

λ decreases →

(50) $\lambda = \frac{h}{mv}$

$$\Rightarrow v = \frac{h}{m\lambda}$$

$$v = \frac{6.63 \times 10^{-34}}{9.4 \times 10^{-31} \times 10^{-10}}$$

$$v = 7.28 \times 10^6 ms^{-1}$$

(51) According to Mosley's law.

$\sqrt{f} \propto Z$

(52) $\lambda_{min} = \frac{hc}{Ve}$

(53) X-rays are not used for radar purpose because they are not reflected by target.

(54) $\lambda_{min} = \frac{hc}{Ve}$

From relation wavelength of continuous X-rays depends upon accelerating voltage. So energy (hardness) depends upon accelerating voltage.

(55) $E_n = -\frac{13.6}{n^2}$ or $n^2 = -\frac{13.6}{-0.54}$

Or $n^2 = 25.2$ or $n = 5(nearly)$

$$v_n = \frac{2\pi ke^2}{nh} \Rightarrow v_n \propto \frac{1}{n} \Rightarrow v_n = \frac{v}{5}$$

(56) When electron is raised from the ground state to an excited state

(i) K.E decreases $\because v_n \propto \frac{1}{n}$

(ii) P.E increases

(iii) T.E increases $\because T.E = -K.E$

(57) Continuous X-rays produces due to deceleration of electron. So its energy comes from striking electron.

(58) When an electron strikes the target in a Coolidge tube, its entire K.E into photon and heat.

(59) For characteristics X-rays

$\lambda_\alpha > \lambda_\beta > \lambda_\gamma$

$f_\alpha < f_\beta < f_\gamma$

$E_\alpha < E_\beta < E_\gamma$

(60) Black body radiation is example of continuous spectra, molecular spectra is example of band spectra and atomic spectra is example of line spectra.

Scanned by CamScanner

21 Chapter NUCLEAR PHYSICS

PRACTICE EXERCISE

(1) The reaction $^{218}_{85}At \rightarrow ^{214}_{83}Bi$ is an example of what type of radioactive decay?
(a) Alpha (b) β^-
(c) β^+ (d) Electron capture

(2) The radioactive element has the half life of 1600 years, after 6400 years what amount will remain undecay
(a) 1/16 (b) 1/8
(c) 1/2 (d) 1/4

(3) The binding energy per nucleon is maximum for
(a) $_{26}Fe^{56}$ (b) $_{92}U^{235}$
(c) $_{56}Ba^{141}$ (d) $_{2}He^{4}$

(4) In typical nuclear fission reaction the energy released is approx:
(a) 8MeV (b) 931MeV
(c) 200MeV (d) 931eV

(5) Which of the following undergo fission reaction easily by slow moving neutrons?
(a) U-235, Pu-239 (b) Pu-239, Th-234
(c) U-238, Rn-232 (d) Th-234, U-238

(6) Neutron and proton are commonly known as _____
(a) Nucleon (b) Meson
(c) Boson (d) Quartz

(7) Half life of radium is 1590 years. In how many years shall the earth loss all its radium due to radioactive decay?
(a) 1590×10^{6} years (b) 1590×10^{12} years
(c) 1590×10^{24} years (d) Never

(8) Which one of the following radiation possesses maximum penetrating power?
(a) α-rays (b) β-rays
(c) γ-rays (d) All have equal penetrating power

(9) Radioactivity is a _____
(I) Spontaneous activity (II) Chemical property
(III) Self disintegration property
Which of above statements is/are correct?
(a) I & II (b) II & III
(c) III & I (d) I, II & III

(10) Quenching gas used in G.M counter is
(a) Bromine (b) Helium
(c) Neon (d) All of these

(11) Transuranic elements have atomic number _____
(a) Greater than 72 (b) Greater than 82
(c) Greater than 92 (d) Greater than 102

(12) Nuclear forces exist between _____
(a) Proton-proton (b) Proton-neutron
(c) Neutron-neutron (d) All of the above

(13) Tungsten-176 has a half-life of 2.5 hours. After how many hours will the disintegration rate of a tungsten-176 sample drop to $\frac{1}{16}$ its initial value?
(a) 5 (b) 8.3
(c) 10 (d) 13

(14) What are the values of a and z in the following nuclear reaction?
$_{2}He^{4} + _{z}N^{14} \longrightarrow _{8}O^{a} + _{1}H^{1}$
(a) 17, 7 (b) 7, 17
(c) 13, 6 (d) 6, 13

(15) In which sequence the radioactive radiations are emitted in the following nuclear reaction.
$_{z}X^{A} \longrightarrow _{z+1}Y^{A} \longrightarrow _{z-1}Z^{A-4} \longrightarrow _{z-1}Y^{A-4}$
(a) α,β,γ (b) β,α,γ
(c) γ,α, β (d) γ, β, α

(16) What is the missing nuclei in the following reaction?
$_{3}Li^{6} + ? \longrightarrow _{4}Be^{9} + _{1}H^{1}$
(a) $_{2}He^{4}$ (b) $_{1}H^{1}$
(c) $_{0}n^{1}$ (d) $_{1}H^{3}$

(17) Number of electrons in the nucleus of $_{92}U^{235}$ are
(a) 235 (b) 92
(c) 91 (d) None of these

(18) Electrons are
(a) Hardons (b) Leptons
(c) Baryons (d) Photons

(19) When an animal dies each gram of carbon in its body emits about 16β particles each minute. Each gram of carbon from same animal remains is found to emit 4β particles per minute. How old is the animal (Half life of radioactive carbon is 6000 years)
(a) 3000 years (b) 6000 years
(c) 12000 years (d) 18000 years

(20) Which of the following nuclides has equal number of neutrons and protons
(a) $_{1}H^{1}$ (b) $_{4}Be^{9}$
(c) $_{2}He^{4}$ (d) $_{3}Li^{7}$

(21) The uranium atom $_{92}U^{238}$ emits an α particle to become thorium, which then emits a β-particles to become protactinium. What is the proton number of protactinium
(a) 89 (b) 91
(c) 95 (d) 85

(22) Nuclide $_{90}X^{225}$ decays to nuclide Y with the emission of two α particles and one β-particle. What is the composition of Y?
(a) $_{89}Y^{221}$ (b) $_{85}Y^{217}$
(c) $_{87}Y^{217}$ (d) $_{86}Y^{216}$

(23) α Particle is bombarded on $_{7}N^{14}$ as a result $_{8}O^{17}$ is formed. The particle emitted is
(a) Neutron (b) Proton
(c) Electron (d) Positron

(24) Which of the following is a fusion reaction
(a) $_{0}n^{1} + _{7}N^{14} \longrightarrow _{6}C^{14} + _{1}H^{1}$ (b) $_{1}H^{3} \longrightarrow _{2}He + _{1}B^{9}$
(c) $_{1}H^{2} + _{1}H^{2} \longrightarrow _{2}He^{4}$ (d) None of these

(25) Curie is a unit of
(a) Energy of β-rays (b) Half life
(c) Radioactivity (d) Intensity of γ-rays

(26) The unit of radioactivity 'curie' is equal to _____
(a) 3.74×10^{9} disintegration per sec (b) 3.70×10^{10} disintegration per sec
(c) 3.55×10^{10} disintegration per sec (d) 3.60×10^{10} disintegration per sec

Scanned by CamScanner

(27) **In liquid metal fast breeder reactor, the type of uranium used is _____**
(a) $_{92}U^{235}$ (b) $_{92}U^{238}$
(c) $_{92}U^{234}$ (d) $_{92}U^{239}$

(28) **Radioactive materials can be identified by measuring their _____**
(a) Hardness (b) Mass
(c) Half life (d) Total life

(29) **If one or more of the neutrons emitted during fission can be used to build up further fission then the reaction is self sustained and is known as ___**
(a) Fission reaction (b) Fusion reaction
(c) Chain reaction (d) Chemical reaction

(30) **During an encounter with an atom, α-particle knocks out_____**
(a) Protons (b) Electrons
(c) Neutrons (d) Nothing

(31) **The path of β-particle is _____**
(a) Rectilinear (b) Curved
(c) Zigzag or erratic (d) Elliptical

(32) **Which of the following radiations are suitable for the treatment of an infection in the interior of the body?**
(a) α-rays (b) β-rays
(c) γ-rays (d) X-rays

(33) **Various types of cancer are treated by _____**
(a) Cobalt-60 (b) Strontium-90
(c) Carbon-14 (d) Nickel-63

(34) **Charge on α-particles is _____**
(a) +1 (b) +2
(c) –2 (d) -1

(35) **β-particle ionizes an atom _____**
(a) Through direct collision (b) Through electrostatic attraction
(c) Through electrostatic repulsion (d) All of above

(36) **T.V sets and microwave ovens emits _____**
(a) X-rays (b) α-rays
(c) β-rays (d) γ-rays

(37) **Strontium-90 is used as _____**
(a) β-particle source (b) α-particle source
(c) γ-rays source (d) Neutron source

(38) **The penetration power of β-particle as compared to α-particle is _____**
(a) 10 times more (b) 100 times more
(c) 100 times less (d) 10 times less

(39) **Geiger counter is suitable for _____**
(a) Fast counting (b) Extremely fast counting
(c) Slow counting (d) All situations

(40) **An α-particle can produce fluorescence in _____**
(a) ZnS (b) Barium platinocyanide
(c) Sodium iodide (d) All of above

(41) **The half life of a certain element is 3.5 days at S.T.P .If the temperature is doubled and pressure is reduced to half then half life of the same element will be**
(a) 1.75 days (b) 7 days
(c) 3.5 days (d) 14 days

(42) **In nuclear fission reactor, fuel rods the quantity of $^{235}_{92}U$ is**
(a) 0.7% (b) 93%
(c) 99-100% (d) 2-4%

(43) **The energy spectrum of a black body exhibits maximum around a wavelength λ_0. The temperature of the black body is now changed such that the energy is maximum around a wavelength $\frac{3\lambda_0}{4}$. The power radiated by the black body will now increase by a factor of**
(a) $\frac{256}{81}$ (b) $\frac{64}{27}$ (c) $\frac{16}{9}$ (d) $\frac{4}{3}$

(44) **α, β and γ-rays from a radioactive source are passed through 0.5 mm thick aluminium sheet. The transmitted radiations consist of:**
(a) α, β and γ-rays (b) β and γ rays
(c) γ-rays only (d) α-rays only

(45) **A radioactive nucleus decays according to following series**
$X \xrightarrow{\alpha} X_1 \xrightarrow{\beta} X_2 \xrightarrow{\alpha} X_3 \xrightarrow{\gamma} X_4$
If the atomic number and atomic weight of the parent element X are 72 and 180 respectively, then the atomic number and atomic mass of X_4 are respectively
(a) 70, 172 (b) 69, 171
(c) 69, 172 (d) 68, 172

(46) **When boron $^{10}_{5}B$ is bombarded by neutrons, α-particles are emitted. The resulting nucleolus has the mass number**
(a) 11 (b) 7
(c) 6 (d) 15

(47) **A radioactive decay rate of radioactive elements is found to be 10^3 disintegration per sec at a certain time. If the half life of the element is 1 second, the decay rate after one second is _____ and after 3 second is_____**
(a) 500, 125 (b) 10^3, 10^3
(c) 125, 500 (d) 100, 10

(48) **The phenomenon of radioactivity is associated with**
(a) fission of nuclei
(b) emission of spectral lines
(c) disintegration of neutrons
(d) spontaneous disintegration of nucleolus of atoms

(49) **$_{92}U^{238}$ nucleus emits two α-particles and two β-particles and transforms into a thorium nucleus. Which of the following is the mass number and atomic number of the thorium nucleus so produced?**
(a) 230, 94 (b) 234, 90
(c) 230, 88 (d) 234, 88

(50) **Which of the following is the percentage of the original quantity of a radioactive material left after five half–lives approximately?**
(a) 3% (b) 10%
(c) 5% (d) 20%

Scanned by CamScanner

ANSWER KEY

1	a	11	c	21	b	31	c	41	c
2	a	12	d	22	c	32	c	42	d
3	a	13	c	23	b	33	a	43	d
4	c	14	a	24	c	34	b	44	b
5	a	15	b	25	c	35	c	45	c
6	a	16	a	26	b	36	a	46	b
7	d	17	d	27	b	37	a	47	a
8	c	18	b	28	c	38	b	48	d
9	c	19	c	29	c	39	a	49	a
10	a	20	c	30	b	40	d	50	a

EXPLANATORY NOTES

(1) Mass reduced by 4 charge reduced by 2.
Hence α -particle eliminate.

(2) Number of half-lives $= \frac{t}{T_{\frac{1}{2}}} = \frac{6400}{1600}$

$n = 4$

Remaining amount $= \frac{1}{2^4} = \frac{1}{16}$

(3) Max binding energy is of iron. $\left(Fe^{56}\right) = 8.8\text{MeV}$

(4) Fission of uranium produce 200 MeV.

(5) U-235 is favorable for slow nuclear fission reaction.

(6) Neutron and proton are subatomic particles.

(7) Infinite time require for a radioactive substance to destroy completely.

(8) Penetration order
$\gamma > \beta > \alpha$

(9) Radioactivity is a spontaneous disintegration of nucleus.

(10) Bromine has low ionization potential.

(11) Definition of Transuranic element

(12) Forces present between subatomic particles are nuclear forces.

(13) Remaining amount $= \frac{1}{2^n} = \frac{1}{16} = \frac{1}{2^4}$

Number of Half-lives $= nT_{\frac{1}{2}}$

So, total time $= 4(2.5hr) \Rightarrow t = 10$ hours

(14) $4+14=A+1 \Rightarrow A=17$

$2+Z=8+1 \Rightarrow Z=7$

(15) $X_Z^A \xrightarrow{\beta} Y_{Z+1}^A \xrightarrow{\alpha} Z_{Z-1}^{A-4} \xrightarrow{\gamma} Y_{Z-1}^{A-4}$

(16) ${}_3Li^6 + {}_2?^4 \rightarrow {}_4Be^9 + {}_1H^1$

Missing is ${}_2He^4$

$6 + A = 10$

$A = 10 - 6 = 4$

$3 + Z = 5$

$Z = 2$ So, ${}_2He^4$

(17) There is no electron inside the nucleus.

(18) Electrons does not experience strong nuclear force. So they are leptons.

(19) Activity reduce $16\beta \rightarrow 4\beta$

So n = 2

$t = nT\frac{1}{2} = 2(6000)$

$= 12000\,years$

(20) ${}_2He^4$

Protons = 2

Neutrons = 4-2=2

(21) When 1α & 1β emit 1

Mass reduce = 4

Charge reduce = 1

So,

Charge = 92-1= 91

(22) When 2α & 1β emit

Mass reduces $= -4 \times 2 = -8$

Charge reduce $= -2 \times 2 + 1 = -3$

${}_{87}Y^{217}$

(23) ${}_7N^{14} + {}_2\alpha^4 \rightarrow {}_8O^{17} + {}_1H^1$

Proton will emit.

Scanned by CamScanner

(24) In fusion two nuclei merge to form single nucleus.

(25) Units of radioactivity is curie.

(26) Curie = 3.7×10^{10} disintegrating/sec

(27) In fast reactor U^{238} used

(28) Radioactive elements are identified by their half lives

$$T_{1/2}=\frac{0.693}{\lambda}$$

(29) Fission chain reaction proceeds its own.

(30) α has high ionization power so, it will knockout e^- from atom.

(31) Path of β when it emit from nucleus in absence of any external forces is zig-zag and eratic.

(32) $\lambda=\frac{h}{mv}\Rightarrow v=\frac{h}{m\lambda}$ r. radiation is used for infection in interior body.

(33) Cobalt 60 used for treatment of cancer.

(34) $_2He^4$ has charge +2.

(35) β - particle repel electrons to ionize atoms.

(36) T.V sets emit X-rays

(37) Strontium –90 is a source of β -particles.

(38) Penetration of β =100 times of penetration of α.

(39) GM counter is fast counting device.

(40) α,β,γ produce fluorescent on all elements mentioned.

(41) Half-life is independent of temperature and pressure

(42) Enriched fuel rods contain (2-4) % of $^{235}_{92}u$.

(43) $\because \lambda_{max}\times T=\text{constant}$

$$\frac{T_2}{T_1}=\frac{\lambda_1}{\lambda_2}=\frac{\lambda_0}{\frac{3}{4}\lambda_0}=\frac{4}{3}$$

Since,

$E\propto T^4$

$$=\left(\frac{4}{3}\right)^4$$

$$=\frac{256}{81}$$

(44) Beta particle and gama ray are more penetrating than alpha particle

(45) $^{180}_{72}X\xrightarrow{\alpha}{}^{176}_{70}X_1\xrightarrow{\beta}{}^{176}_{71}X_2\xrightarrow{\alpha}{}^{172}_{69}X_3\xrightarrow{\gamma}{}^{172}_{69}X_4$

(46) $^{10}_5B+^1_0n\rightarrow{}^7_3X+^4_2He$

Resultaut nucleus has mass number "7".

(47) After 1 sec, 1 half life will pass so, remaining activity $=\frac{10^3}{2^1}=500$

a) After 3 sec, 3 half-lives will pass so, Remaining activity $=\frac{10^3}{2^3}=\frac{1000}{8}=125$

(48) Radioactivity is the spontaneous disintegration of nucleus.

(49) $^{238}_{92}U\rightarrow{}^{230}_{90}Th+2^4_2He+2^0_{-1}\beta$

Hence Thorium has mass number = 230

Charge number = 90

(50) After 5 half-lives remaining amount $=\frac{1}{2^5}=\frac{1}{32}$

Percentage of remaining amount $=\frac{1}{32}\times100\approx3\%$

Scanned by CamScanner

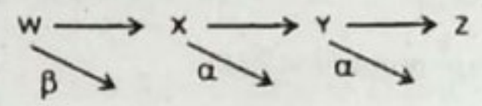
21 Chapter NUCLEAR PHYSICS

SELF ASSESMENT TEST

(1) $^{90}_{38}Sr$ decays to $^{90}_{39}Y$ by
(a) emission of α-particles (b) emission of β-particles
(c) emission of 1α and 2β particles (d) absorption of electrons

(2) **A radioactive substance is at t=0, the number of atoms is 8×10^4. Its half-life period is 3 years. The number of atoms 1×10^4 will remain after interval**
(a) 19 years (b) 24 years
(c) 9 years (d) 6 years

(3) **A radioactive isotope W decay to X which decay to Y and Y decays to Z as represented by the figure below.**



What is the change in the atomic number from W to Z?
(a) increases by 3 (b) decreases by 3
(c) increases by 5 (d) decreases by 5

(4) **Which can pass through 20 cm thickness of the steel**
(a) alpha rays (b) beta rays
(c) gamma rays (d) UV rays

(5) **In the nuclear decay**

$$^{A}_{Z}X \longrightarrow ^{A}_{Z+1}Y \longrightarrow ^{A-4}_{Z-1}B^{*} \longrightarrow ^{A-4}_{Z-1}B$$

The particle emitted in the sequence are
(a) α,β,γ (b) β,α,γ
(c) γ,β,α (d) β,γ,α

(6) **A nucleus of atomic mass A and atomic number Z emits 'β' particles. The atomic mass and atomic number of the resulting nucleus are**
(a) A, Z + 1 (b) A + 1, Z
(c) A−4, Z−2 (d) A, Z

(7) **The radioactivity of a certain radioactive element drops to 1/64 of its initial value in 30 seconds. Its half-life is**
(a) 4 seconds (b) 3 seconds
(c) 5 seconds (d) 2 seconds

(8) **The percentage of radioactive nucleus that remains undecayed after 5 half lives is nearly:**
(a) 3% (b) 5 %
(c) 10% (d) 20%

(9) **Which of the following is in the increasing order for penetrating power?**
(a) γ, β, α (b) γ, α, β
(c) β, α, γ (d) α, β, γ

(10) **The decay constant of radium is 4.28×10^{-4} per year. Its half-life will be**
(a) 1240 years (b) 2000 years
(c) 1620 years (d) 63 years

(11) **In Geiger-Muller counter, the electrons which are emitted from cathode give rise to**
(a) false counts (b) spurious counts
(c) initial counts (d) both "a" and "c"

(12) **Which of the following is not a mode of radioactive decay?**
(a) alpha decay (b) electron capture
(c) fusion (d) positron emission

(13) **Nuclear forces exist between _____**
(a) proton-proton (b) proton-neutron
(c) neutron-neutron (d) all of the above

(14) **Mass defect per nucleon is _____**
(a) binding energy of nucleus (b) packing fraction
(c) average energy of nucleus (d) all of above are one and same thing

(15) **Tick the correct statement**
(a) moderators slow down the neutrons (b) moderators bring the neutrons to rest
(c) moderators absorb the neutrons (d) moderators reflect the neutrons

(16) **The bombardment of nitrogen with α-particles will produce _____**
(a) neutron (b) proton
(c) electron (d) positron

(17) **Diameter of an atom is approximately_____**
(a) 10^{-12}m (b) 10^{-11}m
(c) 10^{-10}m (d) 10^{-14}m

(18) **Which of the following isotopes is normally fissionable?**
(a) $^{238}_{92}U$ (b) $^{239}_{93}Np$
(c) $^{235}_{92}U$ (d) $^{4}_{2}He$

(19) **Fission chain reaction in a nuclear reactor can be controlled by introducing _____**
(a) iron rods (b) graphite rods
(c) cadmium rods (d) platinum rods

(20) **Which one of the following radiations possesses maximum velocity?**
(a) α-rays (b) β-rays
(c) γ-rays (d) all of above have same speed

(21) **Nuclei having the same mass number but different atomic number are__**
(a) isotopes (b) isobars
(c) isotones (d) isomers

(22) **A mass spectrograph (spectrometer) sorts out _____**
(a) molecules (b) atoms
(c) elements (d) isotopes

(23) **Sum of the masses of constituent nucleons as compared to the mass of the resultant nucleus is _____**
(a) smaller (b) greater
(c) same (d) sometimes smaller some times greater

(24) **An α-particle is emitted from $_{88}Ra^{226}$. What is the mass and atomic number of the daughter nucleus?**

	Mass number	Atomic number
(a)	224	86
(b)	220	80
(c)	222	86
(d)	226	87

(25) **A sample contains 16 gm of a radioactive material, the half life of which is two days. After 32 days, the amount of radioactive material left in the sample is**
(a) 14gm (b) less than 1 mg
(c) 12gm (d) 1gm

Scanned by CamScanner

(26) **Half-life of a radioactive substance is T. The time taken for all the nuclei to disintegrate will be**
(a) 2T (b) uncertain
(c) 4T (d) T^2

(27) **The correct order of ionizing capacity of α , β and γ–rays is**
(a) α>γ>β (b) α<β<γ
(c) α>β>γ (d) α>β>γ

(28) **If one or more of the neutrons emitted during fission can be used to build up further fission then the reaction is self sustained and is known as ___**
(a) fission reaction (b) fusion reaction
(c) chain reaction (d) chemical reaction

(29) **The decay constant of a radioactive element is 0.01 per second. Its half-life period is**
(a) 0.693 sec (b) 69.3 sec
(c) 6.93 sec (d) 693 sec

(30) **A radioactive nucleus $_{92}X^{235}$ decays to $_{91}Y^{231}$. Which of the following particles are emitted**
(a) two deuterons and one positron (b) one alpha and one electron
(c) one alpha and one proton (d) one proton and four neutrons

(31) **The half-life period of a radioactive substance is 5 min. The amount of substance decayed in 20 min will be**
(a) 75% (b) 25%
(c) 93.75% (d) 6.25%

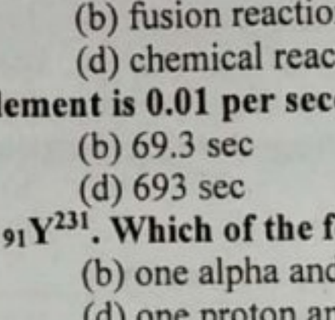
(32) **Which of the following is a correct statement**
(a) gamma rays are high energy neutrons
(b) beta rays are same as cathode rays
(c) alpha particles are singly ionized helium atoms
(d) protons and neutrons have exactly the same mass

(33) **A nucleus $_nX^m$ emits one α and one β-particles. The resulting nucleus is**
(a) $_{n-4}Z^{m-4}$ (b) $_{n-2}Y^{m-4}$
(c) $_nX^{m-4}$ (d) $_{n-1}Z^{m-4}$

(34) **The activity of a radioactive sample is 1.6 curie and its half life is 2.5 days. Its activity after 10 days will be:**
(a) 0.8 curie (b) 0.4 Curie
(c) 0.1 curie (d) 0.16 Curie

(35) **A nucleus with Z = 92 emits the following in a sequence:**
α,β−,β−,α,α,α,α,α,β−,β−,α,β+,β+,α. The Z of the resulting nucleus is
(a) 74 (b) 78
(c) 76 (d) 82

(36) **The count rate of 10g of radioactive material was measured at different times and this has been shown in the figure. The half-life of material and the total counts (approximately) in the first half life period, respectively are**



(a) 3h, 235 (b) 4h, 9000
(c) 3h, 50 (d) 3h, 14000

(37) **Fission of nuclei is possible because the binding energy per nucleon in them**
(a) increases with mass number at high mass numbers
(b) increases with mass number at low mass numbers
(c) decreases with mass number at low mass numbers
(d) decreases with mass number at high mass numbers

(38) **Average distance covered by α-particle in air before its ionizing power ceases, is called its _____**
(a) trajectory (b) range
(c) firing level (d) limit

(39) **In the given nuclear reaction A, B, C, D, E represents**

$$_{92}U^{238} \xrightarrow{\alpha} {}_BTh^A \xrightarrow{\beta} {}_DPa^C \xrightarrow{E} {}_{92}U^{234}$$

(a) A = 234, B = 90, C = 234, D = 93, E = α
(b) A = 238, B = 93, C = 234, D = 91, E = β
(c) A = 234, B = 90, C = 238, D = 94, E = α
(d) A = 234, B = 90, C = 234, D = 91, E = β

(40) **γ-rays are electromagnetic waves like**
(a) light waves (b) heat waves
(c) micro waves (d) x-rays

(41) **Charge on β-particle is**
(a) ±1 (b) –1
(c) +2 (d) –2

(42) **Steel rods coated with boron are used in nuclear reactors, because:**
(a) boron can absorb neutron
(b) it adds strength to the structure of nuclear plant
(c) boron speeds up neutrons
(d) boron can slow down neutrons

(43) **Enriched uranium is better as a fuel for a nuclear reactor because it has greater proportion of**
(a) ^{233}U (b) ^{235}U
(c) ^{238}U (d) ^{239}U

(44) **Which of the following is an example of nuclear fusion?**
(a) formation of water from hydrogen and oxygen
(b) formation of helium from hydrogen
(c) formation of barium and krypton from uranium
(d) formation of nitrogen by the bombardment of α-particles on Berillium $_4Be^9$

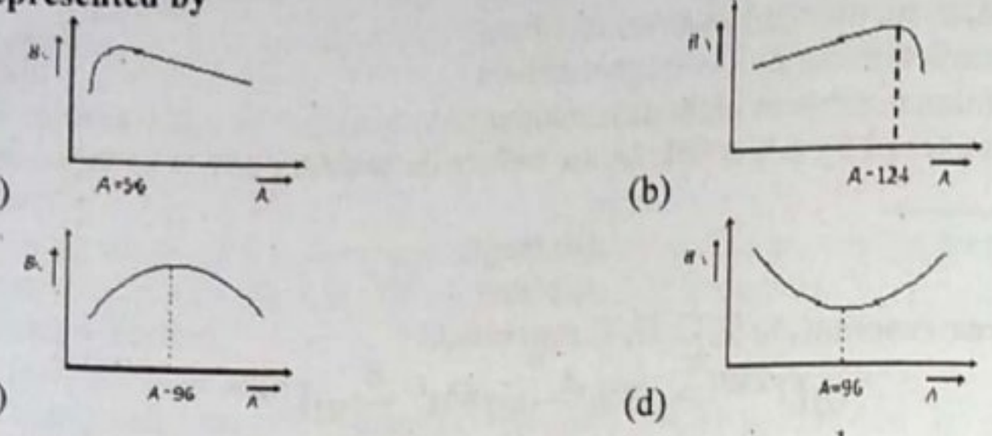
(45) **The half-life of the isotope $^{24}_{11}Na$ is 15 hours. How much times does it take for $\frac{7}{8}$ th of a sample of this isotope to decay?**
(a) 75 h (b) 65 h
(c) 55 h (d) 45 h

(46) **What fraction of a radioactive material will get disintegrated in a period of two half-lives?**
(a) whole (b) half
(c) one-fourth (d) three-fourth

(47) **The half life of radon is**
(a) 4 days (b) 4 months
(c) 4 years (d) 4 weeks

Scanned by CamScanner

(48) The dependence of binding energy per nucleon, B_N on the mass number, A, is represented by



(49) The half-life of a radioactive element which has only $\frac{1}{32}$ of its original mass left after a lapse of 60 days is:

(a) 12 days (b) 32 days
(c) 60 days (d) 64 days

(50) In the following nuclear reaction, how many α and β particles are emitted? ${}_{92}X^{235} \rightarrow {}_{82}Y^{207}$

(a) 3 α -particles and 2 β -particles (b) 7 α -particles and 4 β -particles
(c) 6 α -particles and 2 β -particles (d) 4 α -particles and 2 β -particles

(51) The nuclei of which one of the following pairs of nuclei are isotones?

(a) ${}_{34}Se^{74}, {}_{31}Ga^{71}$ (b) ${}_{20}Ca^{40}, {}_{16}S^{32}$
(c) ${}_{42}Mo^{92}, {}_{40}Zr^{92}$ (d) ${}_{38}Sr^{84}, {}_{38}Sr^{86}$

(52) ${}^{222}_{86}A \rightarrow {}^{210}_{84}B$ in this reaction how many α and β emissions have occurred

(a) $6\alpha, 3\beta$ (b) $3\alpha, 4\beta$
(c) $4\alpha, 3\beta$ (d) $3\alpha, 6\beta$

(53) Which of the following cannot be emitted by radioactive substance during their decay?

(a) electrons (b) protons
(c) neutrinoes (d) helium nuclei

(54) The value of A in the following reaction is ${}^{9}_{4}Be + {}^{4}_{2}He \rightarrow {}^{A}_{6}C + {}^{1}_{0}n$

(a) 14 (b) 10
(c) 12 (d) 16

(55) A neutron decays to

(a) one P, one γ one β^+ (b) one β^+, one β^- one γ
(c) one P, one β^- one $\bar{\nu}$ (d) All of the above

(56) The radioactivity of a certain radioactive element drops to 1/64 of its initial value in 30 second. Its half-life is

(a) 2 second (b) 4 second
(c) 5 second (d) 6 second

(57) What percentage of original radioactive atoms is left after five half lives?

(a) 0.3% (b) 1%
(c) 31% (d) 3.125%

(58) One microgram of matter converted into energy will give

(a) 90 J (b) 9×10^3 J
(c) 9×10^{10} J (d) 9×10^5 J

(59) Which of the following pairs is an isobar?

(a) ${}^{1}_{1}H$ and ${}^{2}_{1}H$ (b) ${}^{2}_{1}H$ and ${}^{3}_{1}H$
(c) ${}^{12}_{6}C$ and ${}^{13}_{6}C$ (d) ${}^{30}_{15}P$ and ${}^{30}_{14}Si$

(60) In nuclear reactions, we have the conservation of.

(a) mass only (b) energy only
(c) momentum only (d) mass, energy and momentum

ANSWER KEY

1	b	11	b	21	b	31	c	41	a	51	a
2	c	12	c	22	d	32	b	42	a	52	b
3	b	13	d	23	b	33	d	43	b	53	b
4	c	14	b	24	c	34	c	44	b	54	c
5	b	15	a	25	b	35	b	45	d	55	c
6	a	16	b	26	b	36	d	46	d	56	c
7	c	17	c	27	c	37	d	47	a	57	d
8	a	18	c	28	c	38	b	48	a	58	c
9	d	19	c	29	b	39	d	49	a	59	d
10	c	20	c	30	b	40	d	50	b	60	d

Scanned by CamScanner

EXPLANATORY NOTES

(1) Charge number increases by 1, so it is β-emission

(2)

$$\text{By formula } N = N_0\left(\frac{1}{2}\right)^{t/T} \text{ or } 10^4 = 8\times10^4\left(\frac{1}{2}\right)^{t/3} \text{ or } \left(\frac{1}{8}\right) = \left(\frac{1}{2}\right)^{t/3} \text{ or}$$

$$\left(\frac{1}{2}\right)^3 = \left(\frac{1}{2}\right)^{t/3} \Rightarrow 3 = \frac{t}{3} \text{ Hence t = 9 years.}$$

(3) β Atomic number increases by 1
α Atomic number decreases by 2
α Atomic number decreases by 2
Total decreases by 3

(4) Gamma rays are highly penetrating

(5) Charge number increases by 1, so it is β-emission
Charge number decreases by 2, so it is α-emission
No change in charge number so it is γ-emission

(6)

$${}_ZX^A \xrightarrow{{}_{-1}\beta^0} {}_{Z+1}X^A$$

(7)

$$N = N_0\left(\frac{1}{2}\right)^{t/T} \Rightarrow \frac{N_0}{64} = N_0\left(\frac{1}{2}\right)^{30/T} \Rightarrow T = \frac{30}{6} = 5\,\text{sec}$$

(8) $N = \frac{N_o}{2^n} = \frac{1}{2^5} = \frac{1}{32} = 0.03 \Rightarrow 3\%$

(9) Order of penetration $\gamma > \beta > \alpha$

(10)

$$T = \frac{0.6931\times1}{\lambda} = \frac{0.6931\times1}{4.28\times10^{-4}}\,year = 1620\,years$$

(11) Book line

(12) In fusion two lighter nuclei combines, it is not the radioactive decay.

(13) All micro particles within the nucleus have nuclear force interaction among them.

(14) $\frac{\Delta m}{A}$ = packing fraction

(15) Moderators slow down the fast-moving neutrons by collision

(16) ${}^{14}_{7}N + {}^{9}_{2}He \rightarrow {}^{17}_{8}O + {}^{1}_{1}H$

(17) $d = 10^{-10}\,m$

(18) ${}^{235}_{92}U$ is normally fissionable element

(19) Cadmium and boron are usually used to absorb neutrons

(20) $v_\gamma > v_\beta > v_\alpha$ γ – rays are EM and have speed $3\times10^8 ms^{-1}$.

(21) Definition Isotopes

(22) Device used to find number of isotopes.

(23) Mass of constituents > Mass of nucleus

(24) In α decay,
Atomic number is decreased by '2'
Mass number is decreased by '4'

(25) Remaining amount $= 16\times\left(\frac{1}{2}\right)^{32/2} = 16\times\left(\frac{1}{2}\right)^{16} = \left(\frac{1}{2}\right)^{12} < 1mg$

(26) Uncertain, because it is infinite. No radioactive element can be disintegrated fully.

(27) Ionizing property depends upon the charge and mass.

(28) Controlled chain reaction

(29) $r_{1/2} = \frac{0.6931}{0.01} = 69.31\,\text{seconds}$

(30) ${}_{92}X^{235} \xrightarrow{\alpha} {}_{90}X^{231} \xrightarrow{-1e^0} {}_{91}Y^{231}$

(31) Number of half-lives in 20 min $n = \frac{20}{5} = 4$ Fraction of material remains after four half-lives $= \frac{1}{16}$ Hence fraction that decays $= 1 - \frac{1}{16} = \frac{15}{16} = 93.75\%$

(32) Both the beta-rays and the cathode rays are made up of electrons. gamma-rays are EM waves, alpha-particles are doubly ionized helium atoms and protons and neutrons have approximately the same mass

(33) ${}_nX^m \xrightarrow{\alpha} {}_{n-2}X^{m-4} \xrightarrow{-\beta} {}_{n-1}X^{m-4}$

(34) $A_o = 1.6$

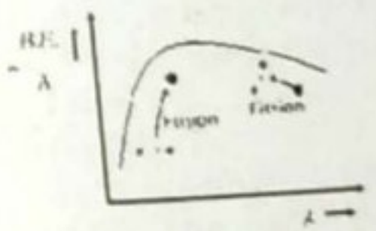
$$n = \frac{10}{2.5} = 4$$

$$A = A_o\left(\frac{1}{2}\right)^n \Rightarrow A = 1.6\left(\frac{1}{2}\right)^4 = \frac{16}{10}\times\frac{1}{16} = \frac{1}{10} = 0.1$$

(35) $Z_{\text{Resulting nucleus}} = 92 - 8\times2 + 4\times1 - 2\times1 = 78$

(36) Read time for 50 count rates, it gives half-life period of 3 hrs, one small square gives 600 counts (10 × 60). The number of small squares between graph and time axis are approx 24
Hence count rate = 24×600=14400

(37)



(39)

$${}_{92}U^{238} \xrightarrow{\alpha} {}_{90}Th^{234} \xrightarrow{\beta} {}_{91}Pa^{234} \xrightarrow{E(\gamma,\beta^-)} {}_{92}U^{234}$$

(40) γ – rays and x – rays
Both are electromagnetic waves

(41) Beta particles have ± charge

(42) Boron is normally used to absorb neutrons

(43) ${}^{235}_{92}U$ is suitable for fission and rarer in nature

(44) ${}^{2}_{1}H + {}^{2}_{1}H \rightarrow {}^{4}_{2}He + 24\,MeV$

(45) From $= \frac{7}{8} \Rightarrow n = 3$

$$n = \frac{t}{T_{1/2}} \Rightarrow t = nT_{1/2} = 3\times15 = 45\,\text{hour}$$

Scanned by CamScanner

(46) Decayed $= N_o\left(1-\frac{1}{2^n}\right)$

(47) Half-life of radon is 3.8 days $\approx$ 4 days

(48) B.E. per nucleon is maximum for Fe-56. Binding energy per nucleon first increases then decreases.

(49) from $\frac{1}{32}=\frac{1}{2^5}$

$n=5,\ T_{1/2}=\frac{t}{n}=\frac{60}{5}\Rightarrow T_{1/2}=12$

(50) 'A' decreases by 28

So, No. of $\alpha-$particles $=\frac{28}{4}=7$

No. of $\beta-$particles $=14-10=4$

So, 7 alpha and 4 beta particles are emitted.

(51) Same number of neutrons in $_{34}Se^{74}$ and $_{31}Ga^{71}$.

(52) Atomic mass decreases by 12 shows the 3α emissions. For 3α missions atomic number should decrease by 6 but in this case atomic number decreases by 2 which means emission of 4β.

(53) Proton are not emitted

(54) By using law of conservation of mass

$9+4=A+1$

$A=12$

(55) $^1_0n\rightarrow{}^1_1H+{}^0_{-1}e+\bar{\nu}$

(56) $\frac{A}{A_0}=\frac{1}{2^{t/T}}$

$\frac{1}{64}=\frac{1}{2^{30/T}}$ *or* $\frac{1}{2^6}=\frac{1}{2^{30/T}}$

Or $\frac{30}{T}=6$ *or* $T=\frac{30}{6}s=5s.$

(57) Percentage fractional undecay $=\frac{1}{2^n}\times100=\frac{1}{2^5}\times100=\frac{1}{32}\times100=3.125\%$

(58) $E=\Delta mc^2=10^{-6}\times\left(3\times10^8\right)^2=9\times10^{10}J$

(59) For isobar atomic mass A is same.

(60) In nuclear reactions, all laws are applicable.

POST-ASSESSMENT TEST

Note:- Physics paper of ECAT contains 30 questions.

(1) Two pendulums begin to swing simultaneously. The first pendulum makes 9 full oscillations while the other makes 7 oscillations. The ratio of lengths of the two pendulums is
(a) 7/9 (b) 81/49
(c) 9/7 (d) 49/81

(2) A scooter of mass 120 kg is moving with a uniform velocity of 108 km/h. The force required to stop the vehicle in 10 s is
(a) 720 N (b) 360 N
(c) 180 N (d) 60N

(3) A ball of mass 0.25 kg attached to the ends of a string of length 1.96 m is rotating in a horizontal circle. The string will break, if tension is more than 25 N. What is the maximum velocity with which the ball can be rotated?
(a) 3m/s (b) 9m/s
(c) 14m/s (d) 5m/s

(4) Light roofs are blown of during wind storm. It is because of
(a) less weight of roof (b) more height of roof
(c) difference in pressure (d) all are correct

(5) An aeroplane flying 490m above ground level at 100ms^{-1} releases a block. How far on ground will it strike.
(a) 0.1 Km (b) 1 Km
(c) 2 Km (d) none

(6) In wave motion the least distance between two points which are out of phase is
(a) λ (b) $\lambda/2$
(c) $3\lambda/2$ (d) $\lambda/4$

(7) A particle performing SHM when its displacement is 3 cm, its acceleration is 12cm s^{-2}. It is vibrating with period
(a) 4π sec (b) 2π sec
(c) π sec (d) 4π sec

(8) If the amplitude of a wave at a distance r from a point source is A, the amplitude at a distance 2 r will be
(a) A/2 (b) A^2
(c) 2A (d) A

(9) In a noiseless transformer, an alternating current of 2 A is flowing in the primary coil. The number of turns on the primary and secondary coils are 100 and 20 respectively. The value of the current in the secondary coil is
(a) 0.08A (b) 10 A
(c) 0.4A (d) 5A

(10) Satellite is launched from earth into orbit. What happened to the mass of satellite and weight of satellite?

	Mass	Weight
(a)	increases	increases
(b)	remain same	decreases
(c)	decreases	increases
(d)	increases	decreases

(11) A spherical body is moving through fluid (say water). If the temperature of fluid increases the terminal velocity of the fluid
(a) decreases (b) increases
(c) does not change (d) increases or decreases depend upon the.

Scanned by CamScanner

(12) **The width of the depletion region of a junction is reduced under forward bias because**
(a) more charge carriers are available
(b) number of minority charge carriers are reduced
(c) majority carriers on both sides of junction are driven towards it
(d) doping level is increased

(13) **In a Young's double slit experiment if the monochromatic source is replaced by a source of white light,**
(a) fringes will be alternately white and black
(b) central fringe is white and other are coloured
(c) central fringe is dark and others are coloured
(d) central fringe is coloured and all other are white

(14) **In a two input logic gate both inputs are at 0 and the output is 1 the gate would be**
(a) NAND (b) NOR
(c) XNOR (d) any of given gates in a, b and c

(15) **The equation of motion for a body executing SHM is given by $y=1.5\sin(10\pi t+5)$. Then the frequency is given by**
(a) 1.5 Hz (b) 5πHz
(c) 5 Hz (d) π Hz

(16) **In a potentiometer of one metre length, an unknown emf voltage source is balanced at 60 cm length of potentiometer wire, while a 3 V battery is balanced at 45 cm length. Then the emf of the unknown voltage source is**
(A) 3 V (b) 2.25 V
(c) 4.5 V (d) 4 V

(17) **Four molecules have speeds of 2 kms^{-1}, 3 kms^{-1}, 4 kms^{-1} and 5 kms^{-1}. The rms speed of these molecules in kms^{-1} is**
(a) $\frac{\sqrt{54}}{4}$ (b) 3.5
(c) $\frac{\sqrt{54}}{2}$ (d) $3\sqrt{3}$

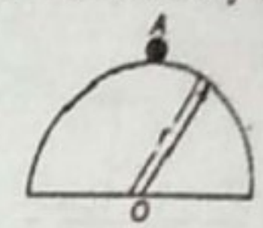
(18) **The atomic number and mass number of a nucleus is Z and A. there new value after emission of two alpha and two beta radiation is**
(a) Z-2,A-4 (b) Z-2,A-8
(c) Z-4,A-4 (d) Z-4,A-8

(19) **The particle which are lighter than protons are called**
(a) photons (b) mesons
(c) hadrons (d) baryons

(20) **Each of the two point charges are doubled and their distance is halved. Force of interaction becomes n times, where n is**
(a) 1/16 (b) 16
(c) 4 (d) 1

(21) **A wire of length 50 cm and cross-sectional area 1 mm^2 is made of a material of Young's modulus 2×10^{10} N/m^2. How much work is done in stretching the wire through 1mm?**
(a) $8\times10^{-1}J2$ (b) $2\times10^{-4}J$
(c) $4\times10^{-2}J$ (d) $\times10^{-2}J$

(22) **A mass m slides from rest down the surface of a frictionless hemispherical bowl of radius r from the highest point A. The velocity of mass when it**



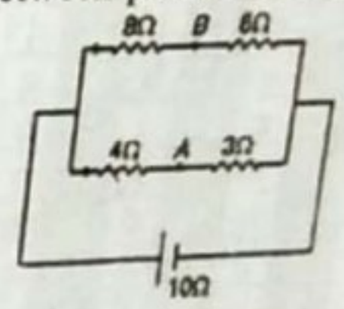
(a) mgr (b) gr
(c) $\sqrt{mgr}$ (d) $\sqrt{2gr}$

(23) **If R is the range of projectile then its K.E be maximum after covering a horizontal distance**
(a) $\frac{R}{4}$ (b) $\frac{R}{2}$
(c) 3R/4 (d) R

(24) **Which of the following is true for γ-rays?**

	Charge	Rest mass
(a)	positive	$m c^2$
(b)	neutral	Zero
(c)	neutral	$m c^2$
(d)	negative	Zero

(25) **The potential difference between points A and B is.**



(a) 20/7 (b) zero
(c) 40/7 (d) 10/7

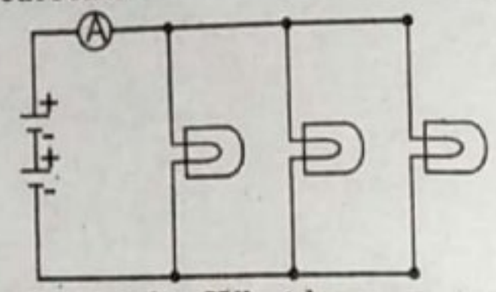
(26) **With rise in temperature the resistance of semiconductor.**
(a) increases (b) decreases
(c) remains same (d) becomes infinite

(27) **When two resistances are connected in series they have**
(a) same resistance value (b) same voltage across them
(c) only one current path (d) different resistance value

(28) **A bomb is fired from a cannon with a velocity of of 1000 m/s making an angle of 30° with the horizontal. The time taken by the bomb to reach the highest point, will be**
(a) 51 sec (b) 25.5 sec
(c) 61 sec (d) 21 sec

Scanned by CamScanner

(29) **Three similar light bulbs are connected to a constant voltage DC supply as shown in the diagram. Each bulb operates at normal brightness and an ammeter of negligible resistance registers a steady current.**



The filament of one of the bulbs breaks. What happens to the ammeter reading and the brightness of the remaining bulbs?

(a) ammeter reading increases, bulb brightness increases
(b) ammeter reading increases, bulb brightness remains unchanged
(c) ammeter reading remains unchanged, bulb brightness remains unchanged
(d) ammeter reading decreases, bulb brightness remains unchanged

(30) **The path difference between two identical sinusoidal waves is $\lambda/6$ their phase difference is**

(a) 30^0 (b) 60^0
(c) 180^0 (d) 15^0

ANSWER KEY

1	d	11	b	21	d
2	b	12	c	22	d
3	c	13	b	23	d
4	c	14	d	24	b
5	a	15	c	25	b
6	b	16	d	26	b
7	c	17	c	27	c
8	a	18	b	28	a
9	b	19	b	29	d
10	b	20	b	30	b

EXPLANATORY NOTES

(1) $f=\frac{1}{2\pi}\sqrt{\frac{g}{l}} \Rightarrow f \propto \frac{1}{\sqrt{\ell}}$

$\Rightarrow \frac{l_1}{l_2}=\frac{f_2^2}{f_1^2}$

(2) $F=\frac{mv}{t}$

(3) $F=\frac{mv^2}{r} \Rightarrow v=\sqrt{\frac{F\times r}{m}}$

(4) $P \propto \frac{1}{v}$ (Application of Bernoulli's equation)

(5) $S=Vx\times\sqrt{\frac{2h}{g}}=100\times\sqrt{\frac{2\times490}{9.8}}=1000m=1km$

(6) $\phi=\frac{2\pi x}{\lambda}$ here $\phi=\pi \Rightarrow x=\frac{\lambda}{2}$

(7) $a=-\omega^2 x$

$a=\left(\frac{2\pi}{T}\right)^2 x$

$a=\left(\frac{4\pi^2}{T^2}\right)x$

$T^2=\frac{4\pi^2 x}{a}$

(8) $I \propto \frac{1}{r^2}$ but $I \propto A^2 \Rightarrow A \propto \frac{1}{r}$

(9) $\frac{V_s}{V_p}=\frac{N_s}{N_p}=\frac{I_p}{I_s}$

$\frac{V_p I_p}{V_s}=I_s$

$10A=I_s$

(10) *As* $w=mg$

$w \propto g$, $m=constant$

(11) $v_t=\frac{2\rho g r^2}{9\eta} \Rightarrow$ if temperature ↑; viscosity ↓; v_t ↑

(12) In forward biasing majority charge carriers move towards junction.
(13) If white light is used in YDSE then central fringe will be white.
(14) Truth table of all logic gates.

Scanned by CamScanner

(15)

$x = x_o \sin 2\pi ft$

$\Rightarrow 2\pi ft = 10\pi t$

$f = \dfrac{10\pi t}{2\pi t} = 5Hz$

(16) $\dfrac{\varepsilon_1}{\varepsilon_2} = \dfrac{l_1}{l_2}$

(17) $v_{rms} = \sqrt{\dfrac{(v_1)^2 + (v_2)^2 + (v_3)^2 + (v_4)^2}{total\ number\ of\ particles}}$

$= \sqrt{\dfrac{4+9+16+25}{4}} = \sqrt{\dfrac{54}{4}} = \dfrac{\sqrt{54}}{2}$

(18) $A' = A - 4 - 4 = A - 8$

$Z' = Z - 4 + 2 = Z - 2$

(19) $m < m_p\,(Mesons)$

$m \geq m_p\,(Baryons)$

(20) $F \propto q_1 q_2$

Also $F \propto \dfrac{1}{r^2}$

(21) $Energy = \dfrac{1}{2}\dfrac{YA\Delta l^2}{l}$

(22) Loss in P.E = gain in K.E

$mgh = \dfrac{1}{2}mv^2$

$\Rightarrow v = \sqrt{2gh}$

$\Rightarrow v = \sqrt{2gr} \quad \because h = r$

(23) $v = \max$, when $X = R$

$K.E = \text{maximum}$

(24) "γ" is charge less, its rest mass is zero.

(25) $V_B = \dfrac{8}{14} \times 10 = \dfrac{80}{14} = \dfrac{40}{7}$

$V_A = \dfrac{4}{7} \times 10 = \dfrac{40}{7}$

$\Delta V = V_B - V_A = 0$

(26) $R \propto \dfrac{1}{T}$

(27) Current remains same in series combination.

(28)

$T = \dfrac{2v_i \sin\theta}{g}$

for maximum height

$T = \dfrac{V_i \sin\theta}{g}$

(29) Parallel combination of resistances $\rightarrow R_e = \dfrac{R}{n}$; $n \downarrow$; $R_e \uparrow$; $I \downarrow$

(30) $\phi = \dfrac{2\pi x}{\lambda}$

Here $x = \dfrac{\lambda}{6}$

$\phi = \dfrac{2\pi}{\lambda}\dfrac{\lambda}{6} = \dfrac{\pi}{3} = 60^o$

Scanned by CamScanner

(46) Decayed $= N_o\left(1-\frac{1}{2^n}\right)$

(47) Half-life of radon is 3.8 days $\approx$ 4 days

(48) B.E. per nucleon is maximum for Fe-56. Binding energy per nucleon first increases then decreases.

(49) from $\frac{1}{32}=\frac{1}{2^5}$

$n=5, T_{1/2}=\frac{t}{n}=\frac{60}{5}\Rightarrow T_{1/2}=12$

(50) 'A' decreases by 28

So, No. of $\alpha-$particles $=\frac{28}{4}=7$

No. of $\beta-$particles $=14-10=4$

So, 7 alpha and 4 beta particles are emitted.

(51) Same number of neutrons in ${}_{34}Se^{74}$ and ${}_{31}Ga^{71}$.

(52) Atomic mass decreases by 12 shows the 3α emissions. For 3α missions atomic number should decrease by 6 but in this case atomic number decreases by 2 which means emission of 4β.

(53) Proton are not emitted

(54) By using law of conservation of mass

$9+4=A+1$

$A=12$

(55) ${}^1_0n\rightarrow{}^1_1H+{}^0_{-1}e+\bar{v}$

(56) $\frac{A}{A_0}=\frac{1}{2^{t/T}}$

$\frac{1}{64}=\frac{1}{2^{30/T}}$ or $\frac{1}{2^6}=\frac{1}{2^{30/T}}$

Or $\frac{30}{T}=6$ or $T=\frac{30}{6}s=5s.$

(57) Percentage fractional undecay $=\frac{1}{2^n}\times100=\frac{1}{2^5}\times100=\frac{1}{32}\times100=3.125\%$

(58) $E=\Delta mc^2=10^{-6}\times\left(3\times10^8\right)^2=9\times10^{10}J$

(59) For isobar atomic mass A is same.

(60) In nuclear reactions, all laws are applicable.

POST-ASSESSMENT TEST

Note:- Physics paper of ECAT contains 30 questions.

(1) Two pendulums begin to swing simultaneously. The first pendulum makes 9 full oscillations while the other makes 7 oscillations. The ratio of lengths of the two pendulums is
(a) 7/9 (b) 81/49
(c) 9/7 (d) 49/81

(2) A scooter of mass 120 kg is moving with a uniform velocity of 108 km/h. The force required to stop the vehicle in 10 s is
(a) 720 N (b) 360 N
(c) 180 N (d) 60N

(3) A ball of mass 0.25 kg attached to the ends of a string of length 1.96 m is rotating in a horizontal circle. The string will break, if tension is more than 25 N. What is the maximum velocity with which the ball can be rotated?
(a) 3m/s (b) 9m/s
(c) 14m/s (d) 5m/s

(4) Light roofs are blown of during wind storm. It is because of
(a) less weight of roof (b) more height of roof
(c) difference in pressure (d) all are correct

(5) An aeroplane flying 490m above ground level at 100ms^{-1} releases a block. How far on ground will it strike.
(a) 0.1 Km (b) 1 Km
(c) 2 Km (d) none

(6) In wave motion the least distance between two points which are out of phase is
(a) λ (b) $\lambda/2$
(c) $3\lambda/2$ (d) $\lambda/4$

(7) A particle performing SHM when its displacement is 3 cm, its acceleration is 12cm s^{-2}. It is vibrating with period
(a) 4π sec (b) 2π sec
(c) π sec (d) 4π sec

(8) If the amplitude of a wave at a distance r from a point source is A, the amplitude at a distance 2 r will be
(a) A/2 (b) A^2
(c) 2A (d) A

(9) In a noiseless transformer, an alternating current of 2 A is flowing in the primary coil. The number of turns on the primary and secondary coils are 100 and 20 respectively. The value of the current in the secondary coil is
(a) 0.08A (b) 10 A
(c) 0.4A (d) 5A

(10) Satellite is launched from earth into orbit. What happened to the mass of satellite and weight of satellite?

Mass	Weight
(a) increases	increases
(b) remain same	decreases
(c) decreases	increases
(d) increases	decreases

(11) A spherical body is moving through fluid (say water). If the temperature of fluid increases the terminal velocity of the fluid
(a) decreases (b) increases
(c) does not change (d) increases or decreases depend upon the.

Scanned by CamScanner

(12) **The width of the depletion region of a junction is reduced under forward bias because**
(a) more charge carriers are available
(b) number of minority charge carriers are reduced
(c) majority carriers on both sides of junction are driven towards it
(d) doping level is increased

(13) **In a Young's double slit experiment if the monochromatic source is replaced by a source of white light,**
(a) fringes will be alternately white and black
(b) central fringe is white and other are coloured
(c) central fringe is dark and others are coloured
(d) central fringe is coloured and all other are white

(14) **In a two input logic gate both inputs are at 0 and the output is 1 the gate would be**
(a) NAND (b) NOR
(c) XNOR (d) any of given gates in a, b and c

(15) **The equation of motion for a body executing SHM is given by $y=1.5\sin(10\pi t+5)$. Then the frequency is given by**
(a) 1.5 Hz (b) 5πHz
(c) 5 Hz (d) π Hz

(16) **In a potentiometer of one metre length, an unknown emf voltage source is balanced at 60 cm length of potentiometer wire, while a 3 V battery is balanced at 45 cm length. Then the emf of the unknown voltage source is**
(A) 3 V (b) 2.25 V
(c) 4.5 V (d) 4 V

(17) **Four molecules have speeds of 2 kms^{-1}, 3 kms^{-1}, 4 kms^{-1} and 5 kms^{-1}. The rms speed of these molecules in kms^{-1} is**
(a) $\frac{\sqrt{54}}{4}$ (b) 3.5
(c) $\frac{\sqrt{54}}{2}$ (d) $3\sqrt{3}$

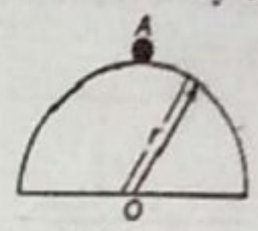
(18) **The atomic number and mass number of a nucleus is Z and A. there new value after emission of two alpha and two beta radiation is**
(a) Z-2,A-4 (b) Z-2,A-8
(c) Z-4,A-4 (d) Z-4,A-8

(19) **The particle which are lighter than protons are called**
(a) photons (b) mesons
(c) hadrons (d) baryons

(20) **Each of the two point charges are doubled and their distance is halved. Force of interaction becomes n times, where n is**
(a) 1/16 (b) 16
(c) 4 (d) 1

(21) **A wire of length 50 cm and cross-sectional area 1 mm^2 is made of a material of Young's modulus 2×10^{10} N/m^2. How much work is done in stretching the wire through 1mm?**
(a) 8×10^{-1}J2 (b) 2×10^{-4}J
(c) 4×10^{-2}J (d) $\times10^{-2}$J

(22) **A mass m slides from rest down the surface of a frictionless hemispherical bowl of radius r from the highest point A. The velocity of mass when it**



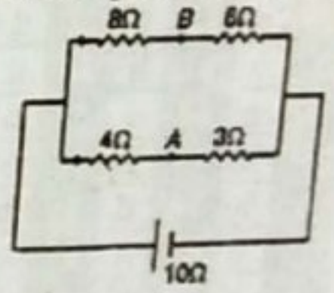
(a) mgr (b) gr
(c) $\sqrt{mgr}$ (d) $\sqrt{2gr}$

(23) **If R is the range of projectile then its K.E be maximum after covering a horizontal distance**
(a) $\frac{R}{4}$ (b) $\frac{R}{2}$
(c) 3R/4 (d) R

(24) **Which of the following is true for γ-rays?**

	Charge	Rest mass
(a)	positive	$m c^2$
(b)	neutral	Zero
(c)	neutral	$m c^2$
(d)	negative	Zero

(25) **The potential difference between points A and B is.**



(a) 20/7 (b) zero
(c) 40/7 (d) 10/7

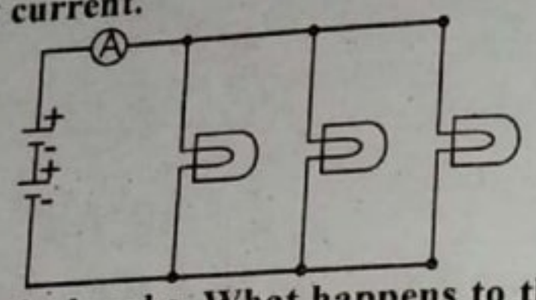
(26) **With rise in temperature the resistance of semiconductor.**
(a) increases (b) decreases
(c) remains same (d) becomes infinite

(27) **When two resistances are connected in series they have**
(a) same resistance value (b) same voltage across them
(c) only one current path (d) different resistance value

(28) **A bomb is fired from a cannon with a velocity of of 1000 m/s making an angle of 30° with the horizontal. The time taken by the bomb to reach the highest point, will be**
(a) 51 sec (b) 25.5 sec
(c) 61 sec (d) 21 sec

Scanned by CamScanner

(29) Three similar light bulbs are connected to a constant voltage DC supply as shown in the diagram. Each bulb operates at normal brightness and an ammeter of negligible resistance registers a steady current.



The filament of one of the bulbs breaks. What happens to the ammeter reading and the brightness of the remaining bulbs?

(a) ammeter reading increases, bulb brightness increases
(b) ammeter reading increases, bulb brightness remains unchanged
(c) ammeter reading remains unchanged, bulb brightness remains unchanged
(d) ammeter reading decreases, bulb brightness remains unchanged

(30) The path difference between two identical sinusoidal waves is $\lambda/6$ their phase difference is

(a) 30^0 (b) 60^0
(c) 180^0 (d) 15^0

ANSWER KEY

1	d	11	b	21	d
2	b	12	c	22	d
3	c	13	b	23	d
4	c	14	d	24	b
5	a	15	c	25	b
6	b	16	d	26	b
7	c	17	c	27	c
8	a	18	b	28	a
9	b	19	b	29	d
10	b	20	b	30	b

EXPLANATORY NOTES

(1) $f = \frac{1}{2\pi}\sqrt{\frac{g}{l}} \Rightarrow f \propto \frac{1}{\sqrt{\ell}}$

$\Rightarrow \frac{l_1}{l_2} = \frac{f_2^2}{f_1^2}$

(2) $F = \frac{mv}{t}$

(3) $F = \frac{mv^2}{r} \Rightarrow v = \sqrt{\frac{F \times r}{m}}$

(4) $P \propto \frac{1}{v}$ (Application of Bernoulli's equation)

(5) $S = Vx \times \sqrt{\frac{2h}{g}} = 100 \times \sqrt{\frac{2 \times 490}{9.8}} = 1000m = 1km$

(6) $\phi = \frac{2\pi x}{\lambda}$ *here* $\phi = \pi \Rightarrow x = \frac{\lambda}{2}$

(7) $a = -\omega^2 x$

$a = \left(\frac{2\pi}{T}\right)^2 x$

$a = \left(\frac{4\pi^2}{T^2}\right) x$

$T^2 = \frac{4\pi^2 x}{a}$

(8) $I \propto \frac{1}{r^2}$ but $I \propto A^2 \Rightarrow A \propto \frac{1}{r}$

(9) $\frac{V_s}{V_p} = \frac{N_s}{N_p} = \frac{I_p}{I_s}$

$\frac{V_p I_p}{V_s} = I_s$

$10A = I_s$

(10) *As* $w = mg$

$w \propto g$, $m = constant$

(11) $v_t = \frac{2\rho g r^2}{9\eta} \Rightarrow$ if temperature ↑; viscosity ↓; v_t ↑

(12) In forward biasing majority charge carriers move towards junction.
(13) If white light is used in YDSE then central fringe will be white.
(14) Truth table of all logic gates.

Scanned by CamScanner

(15)

$x = x_o \sin 2\pi ft$

$\Rightarrow 2\pi ft = 10\pi t$

$f = \frac{10\pi t}{2\pi t} = 5Hz$

(16) $\frac{\varepsilon_1}{\varepsilon_2} = \frac{l_1}{l_2}$

(17) $v_{rms} = \sqrt{\frac{(v_1)^2 + (v_2)^2 + (v_3)^2 + (v_4)^2}{total\ number\ of\ particles}}$

$= \sqrt{\frac{4+9+16+25}{4}} = \sqrt{\frac{54}{4}} = \frac{\sqrt{54}}{2}$

(18) $A' = A - 4 - 4 = A - 8$

$Z' = Z - 4 + 2 = Z - 2$

(19) $m < m_p\,(Mesons)$

$m \geq m_p\,(Baryons)$

(20) $F \propto q_1 q_2$

Also $F \propto \frac{1}{r^2}$

(21) $Energy = \frac{1}{2}\frac{YA\Delta l^2}{l}$

(22) Loss in P.E = gain in K.E

$mgh = \frac{1}{2}mv^2$

$\Rightarrow v = \sqrt{2gh}$

$\Rightarrow v = \sqrt{2gr} \quad \because h = r$

(23) $v = \max$, when $X = R$

$K.E = \text{maximum}$

(24) "γ" is charge less, its rest mass is zero.

(25) $V_B = \frac{8}{14} \times 10 = \frac{80}{14} = \frac{40}{7}$

$V_A = \frac{4}{7} \times 10 = \frac{40}{7}$

$\Delta V = V_B - V_A = 0$

(26) $R \propto \frac{1}{T}$

(27) Current remains same in series combination.

(28)

$T = \frac{2v_i \sin\theta}{g}$

for maximum height

$T = \frac{V_i \sin\theta}{g}$

(29) Parallel combination of resistances $\rightarrow R_e = \frac{R}{n}$; n ↓; R_e ↑; I ↓

(30) $\phi = \frac{2\pi x}{\lambda}$

Here $x = \frac{\lambda}{6}$

$\phi = \frac{2\pi}{\lambda}\frac{\lambda}{6} = \frac{\pi}{3} = 60^o$

Scanned by CamScanner

POST-ASSESSMENT TEST

Note:- Physics paper of GIKI contains 30 questions.

(1) A rock is dropped off a cliff and strikes the ground with an impact velocity of 30 m/s. How high was the cliff?
(a) 10 m (b) 20 m
(c) 145 m (d) 45 m

(2) A ball is released from the top of a tower of height h metre. It takes T second to reach the ground. What is the position of the ball in T/ 3s ?
(a) h/9 m from the ground (b) 7h/9 m from the ground
(c) 8h/9 m from the ground (d) 17h/18 m from the ground

(3) If earth shrinks to half the present radius the duration of day and night will be
(a) 24 hours (b) 12 hours
(c) 6 hours (d) 3 hours

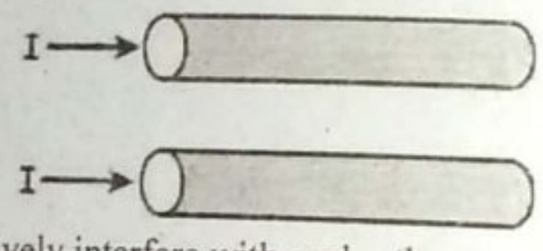
(4) Light roofs are blown of during wind storm. It is because of
(a) less weight of roof (b) more height of roof
(c) difference in pressure (d) all are correct

(5) The maximum velocity of SHM is a_0 the period of oscillation is
(a) $2\pi x_0/a_0$ (b) $2\pi a_0/x_0$
(c) $2\pi a_0 x_0$ (d) $2\pi/a_0 x_0$

(6) In wave motion the least distance between two points which are out of phase is
(a) λ (b) $\lambda/2$
(c) $3\lambda/2$ (d) $\lambda/4$

(7) A particle performing SHM when its displacement is 3 cm, its acceleration is 12cm s^{-2}. It is vibrating with period
(a) 4π Sec (b) 2π Sec
(c) π Sec (d) 4π Sec

(8) In the diagram above, two wires are aligned side by side. They are both hooked into different circuits in which the current is switched on to allow current to flow in each circuit. Which of the following statements is correct?



(a) The two currents destructively interfere with each other
(b) The two currents constructively interfere with each other
(c) The two wires attract and move closer
(d) The two wires repel and move away

(9) Two particles A and B of equal masses are suspended from two massless springs of spring constants k_1 and k_2 respectively. If the maximum velocities, during oscillations are equal, the ratio of amplitudes of A and B is
(a) $\sqrt{k_1/k_2}$ (b) k_1/k_2
(c) $\sqrt{k_2/k_1}$ (d) k_2/k_1

(10) A heater coil is cut into two equal part s and only one part is now used in the heater. The heat generated will be
(a) doubled (b) four times
(c) one-fourth (d) halved

(11) A spherical body is moving through fluid (say water). If the temperature of fluid increases the terminal velocity of spherical body
(a) decreases (b) increases
(c) does not change (d) increases or decreases depend upon the.

(12) The width of the depletion region of a junction is reduced under forward bias because
(a) more charge carriers are available
(b) number of minority charge carriers are reduced
(c) majority carriers on both sides of junction are driven towards it
(d) doping level is increased

(13) In a Young's double slit experiment if the monochromatic source is replaced by a source of white light,
(a) Fringes will be alternately white and black
(b) Central fringe is white and other are coloured
(c) Central fringe is dark and others are coloured
(d) Central fringe is coloured and all other are white

(14) In a two input logic gate both inputs are at 0 and the output is 1 the gate would be
(a) NAND (b) NOR
(c) XNOR (d) any of given gates in a, b and c

(15) A uniform electric field and a uniform magnetic field are acting along the same direction in a certain region. If an electron is projected along the direction of the fields with a certain velocity, then
(a) its velocity will decrease
(b) its velocity will increase
(c) it will turn towards right of direction of motion
(d) it will turn towards left of direction of motion

(16) A parallel plate capacitor is made by stacking in equally spaced plated connected alternatively. If the capacitance between any two adjacent plates is C, then the resultant capacitance is
(a) (n-1)C (b) (n+1)C
(c) C (d) nC

(17) Four molecules have speeds of 2 kms^{-1}, 3 kms^{-1}, 4 kms^{-1} and 5 kms^{-1}. The rms speed of these molecules in kms^{-1} is
(a) $\frac{\sqrt{54}}{4}$ (b) 3.5
(c) $\frac{\sqrt{54}}{2}$ (d) $3\sqrt{3}$

(18) A boy playing on the roof of a 10 m high building throws a ball with a speed of 10 m/s at an angle of 30° with the horizontal. How far from the throwing point will the ball be at the height of 10 m from the ground?
(a) 5.20 m (b) 4.33 m
(c) 2.60 m (d) 8.66 m

(19) A rope stretched between two fixed points can support transverse standing waves. What is the ratio of the sixth harmonic frequency to the third harmonic frequency?
(a) $\frac{1}{2}$ (b) 2
(c) $\frac{1}{\sqrt{2}}$ (d) $2\sqrt{2}$

Scanned by CamScanner

(20) What is the particle emitted during the reaction
$_4{}^9Be + _2{}^4He \rightarrow _6{}^{12}C + ?$
(a) proton (b) neutron
(c) deuterium (d) beta-particle

(21) A wire of length 50 cm and cross-sectional area 1 mm^2 is made of a material of Young's modulus 2×10^{10} N/m^2. How much work is done in stretching the wire through 1mm?
(a) 8×10^{-1}J2 (b) 2×10^{-4}J
(c) 4×10^{-2}J (d) 2×10^{-2}J

(22) The resistance of hot tungsten filament is about 10 times the cold resistance. What will be the resistance of 100 W and 200 V lamp, when not in use?
(a) 40Ω (b) 20Ω
(c) 400Ω (d) 200Ω

(23) If R is the range of projectile then its K.E be maximum after covering a horizontal distance
(a) $\frac{R}{4}$ (b) $\frac{R}{2}$
(c) 3R/4 (d) R

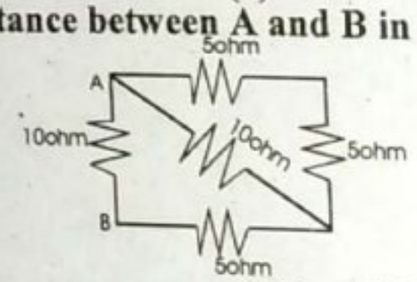
(24) An alpha particle moves through potential difference 1 volt it may gain K.E equal to
(a) 1 eV (b) 2 eV
(c) 3 eV (d) 4 eV

(25) When charges become twice and their separation also become twice then coulomb's force between them
(a) remains same (b) become half
(c) become double (d) become eight time

(26) The work function of a substance is 4.0 eV. The longest wavelength of light that can cause photoelectron emission from this substance is approximately
(a) 540 nm (b) 400 nm
(c) 310 nm (d) 220 nm

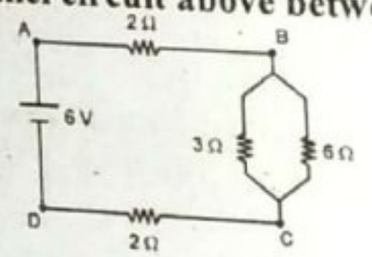
(27) If two mirrors are kept at 60° to each other, then the number of images formed by them is
(a) 5 (b) 6
(c) 7 (d) 8

(28) What is the equivalent resistance between A and B in the figure given below



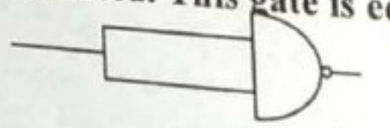
(a) $R_{eq} = 5\Omega$ (c) $R_{eq} = 15\Omega$
(b) $R_{eq} = 10\Omega$ (d) $R_{eq} = 20\Omega$

(29) What is the resistance in the parallel circuit above between points *B* and *C*?



(a) 2Ω (b) 6Ω
(c) 4Ω (d) 8Ω

(30) Two inputs of NAND gates are shorted. This gate is equivalent to



(a) OR gate (c) NOT gate
(b) AND gate (d) XOR gate

ANSWER KEY

1	d	11	b	21	d
2	c	12	c	22	a
3	c	13	b	23	d
4	c	14	d	24	b
5	a	15	a	25	a
6	b	16	a	26	c
7	c	17	c	27	a
8	c	18	d	28	a
9	c	19	b	29	a
10	a	20	b	30	c

EXPLANATORY NOTES

(1) $v = \sqrt{2gh}$

$h = \frac{v^2}{2g}$

$h = \frac{30^2}{2(10)}$

$= \frac{900}{20}$

$h = 45m$

(2) $S = v_i t + \frac{1}{2} g t^2$

$h = \frac{1}{2} g t^2$

$h' = \frac{1}{2} g \frac{T^2}{9}$

$h' = \frac{h}{9}$

$h'' = h - \frac{h}{9}$

$h'' = \frac{8h}{9}$

Scanned by CamScanner

(3) $I_1\omega_1 = I_2\omega_2$

$\because I = \frac{5}{2}MR^2$

$\because \omega = \frac{2\pi}{T}$

$\frac{r_1^2}{T_1} = \frac{r_2^2}{T_2}$

$T_2 = \left(\frac{r_2}{r_1}\right)^2 T_1$

$= \frac{T_1}{2^2} = \frac{24}{4}$

$T_2 = 6\ days$

(4) At upper part speed of air is high pressure is low. At lower side speed is low pressure is high.

(5) $v = r\omega$

$a_o = x_o\frac{2\pi}{T}$

$T = \frac{x_o 2\pi}{a_o}$

(6) $\phi = \frac{2\pi x}{\lambda}$

$\because x = \frac{\lambda}{2}$

$\phi = \pi(Out\ of\ phase)$

(7) $a = x_o\omega^2$

$a = x_o\frac{4\pi^2}{T^2}$

$T^2 = \pi^2$

$12 = 3\frac{4\pi^2}{T^2}$

$T = \pi\ \text{sec}$

(8) By right hand rule.

(9) $v_{o1} = v_{o2}$

$x_{o1}\omega_1 = x_{o2}\omega_2$

$\frac{x_{o1}}{x_{o2}} = \frac{\omega_2}{\omega_1}$

$x_{o1} : x_{o2} = \sqrt{\frac{x_2}{x_1}}$

(10) $H = I^2Rt$

$R' = \frac{R}{2};\ I' = 2I$

$H' = 4I^2\frac{R}{2}t$

$H' = 2I^2Rt$

$H' = 2H$

(11) For liquids $\because \eta \propto \frac{1}{T}$

$v_t = \frac{mg}{6\pi\eta r}$

$v_t \propto \frac{1}{\eta};\ v_t \propto T$

(12) Majority charge carrier form both sides directed towards center.

(13) For white light central fringe is white other are according to VIBGYOR order.

(14) According to Truth table, and Boolean expression. It can be any of the given.

(15) $F_b = 0$ and F_e will oppose the motion of electron. So its velocity will decrease.

(16) $C_{eq} = (n-1)C$

e.g

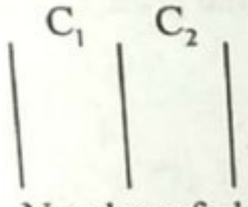
C



Number of plates 2.

Number of capacitor 1

C_1 C_2



Number of plates 3

Number of capacitor 2

(17) $v_{rms} = \sqrt{\frac{v_1^2 + v_2^2 + v_3^2}{N}}$

$v_{rms} = \frac{\sqrt{54}}{2}kms^{-1}$

(18) $R = \frac{v_1^2\sin 2\theta}{g}$

$= \frac{10^2\sin 60^o}{10}$

$R = 8.66\ m$

Scanned by CamScanner

(19) $f_n = nf_1$

$\because f_1 = \frac{v}{2l}$

$\frac{f_6}{f_3} = \frac{6}{3}$

$f_6 : f_3 = 2$

(20) ${}^{9}_{4}Be + {}^{4}_{2}He \rightarrow {}^{12}_{6}C + {}^{1}_{0}n$

(21) $W = \frac{1}{2}\frac{EA\Delta l^2}{\phi}$

$= \frac{1}{2}\frac{2\times10^{10}\times1\times10^{-6}\times1\times10^{-6}}{50\times10^{-2}}$

$W = \frac{1}{50} = 2\times10^{-2}J$

(22) $P = \frac{v^2}{R}$

$R = \frac{V^2}{P}$

$= \frac{200\times200}{100}$

$R = 400\Omega$

$R' = \frac{R}{100} = \frac{400}{10}$

$R' = 40\Omega$

(23) Velocity is maximum at point of projection and point just before hitting the ground. So K.E is maximum at point just before hitting the ground.

(24) $K.E = qV$

$K.E = 2eV$

(25) $F = \frac{kq_1q_2}{r^2}$

$f' = \frac{k(q_1q_2)4}{4r^2}$

$f' = f$

(26) $hf_o = \frac{hc}{\lambda}$

$E_o = \frac{hc}{\lambda}$

$\lambda_{max} = \frac{hc}{E_o}$

$\lambda_{max} = 310nm$

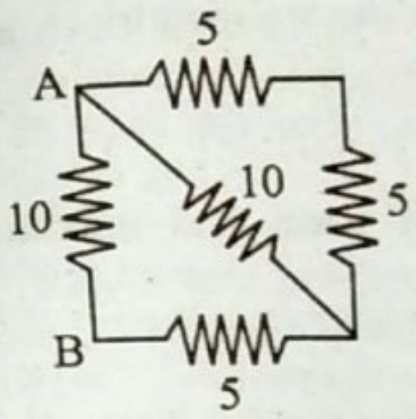
(27) $N = \frac{360}{\theta} - 1$

$= \frac{360}{60} - 1$

$= 6 - 1$

$N = 5$

(28)



By simplifying step by step.

$R_1 = 5 + 5 = 10\Omega$

$R_2 = \frac{10}{2} = 5$

$R_3 = 5 + 5 = 10$

$R_4 = \frac{10}{2}$

$R_4 = 5\Omega$

(29) $R_P = \frac{P}{S}$

$= \frac{6\times3}{6+3}$

$= \frac{18}{9}$

$R_P = 2\Omega$

(30) 1 shorted NAND = NOT Gate

Scanned by CamScanner

POST-ASSESSMENT TEST

Note:- Physics paper of PIAES contains 30 questions.

(1) The magnitudes of dot and cross products of two vectors are $6\sqrt{3}$ and 6 respectively. The angle between the vectors is
(a) 30° (b) 60°
(c) 45° (d) 120°

(2) If a bullet of mass 5g moving with velocity 100m/sec penetrates the wooden block upto 6cm. Then the average force imposed by the bullet on the block is
(a) 8300N (b) 417N
(c) 830N (d) zero

(3) The following four particles have same K.E, then which of them has maximum momentum
(a) proton (b) electron
(c) positron (d) $\propto$ – particle

(4) A body of mass M is allowed to fall freely through a height H under gravity. The ratio of its K.E gained to the linear momentum gained is
(a) 2gH (b) $\frac{gH}{2}$
(c) $\sqrt{\frac{gH}{2}}$ (d) $\sqrt{\frac{2}{gH}}$

(5) A motor-cyclist is moving inside a spherical cage of radius 5 m. The minimum speed with which he must pass the highest point without losing contact is ($g = 10\ ms^{-2}$).
(a) 5 ms^{-1} (b) $5\sqrt{2}$ ms^{-1}
(c) 10 ms^{-1} (d) $10\sqrt{2}$ ms^{-1}

(6) A tin nucleus has charge + 50e. If the proton is at a distance 10^{-12} m from the nucleus, then the potential V at this position is [charge on the proton = 1.6×10^{-19}C]
(a) 14.4×10^{4} volt (b) 7.2×10^{8} volt
(c) 7.2×10^{4} volt (d) 14.4×10^{8} volt

(7) An electron is moving with velocity of $6.6 \times 10^{5}\ ms^{-1}$. Its de-Broglie wave length is
(a) 1.1×10^{-9} m (b) 1×10^{-5} m
(c) 1×10^{-7} m (d) 1×10^{-10} m

(8) A spring of spring constant 5×10^{3} N/m is stretched initially by 5 cm from the un-stretched position. Then, the work required to stretch it further by another 5cm is
(a) 12.5 Nm (b) 18.75 Nm
(c) 25.00 Nm (d) 6.25 Nm

(9) A cylinder of height 20 m is completely filled with water,. The velocity of efflux of water (in ms^{-1}) through a small hole on the side wall of the cylinder near its bottom, is
(a) 10 (b) 20
(c) 25.5 (d) 5

(10) A lift is moving with acceleration a. A man in the lift drops a ball inside the lift. The acceleration of the ball as observed by the man in the lift and a man standing stationary on the ground are respectively
(a) g,g (b) g–a, g–a
(c) g–a, g (d) a,g

(11) Two spheres of the same material have radii 1 m and 4 m and temperatures 4000 K and 2000 K respectively. The ratio of the energy radiated per second by the first sphere to that by the second is
(a) 1:1 (b) 16:1
(c) 4:1 (d) 1:9

(12) The bending of a bimetallic strip when heated is primarily due to
(a) the good conductivity of the two metals
(b) the large coefficient of expansion of both metals
(c) the unequal expansion of the two metals
(d) the effect of gravity

(13) An automobile travelling with a speed of 60 km/h, can brake to stop within a distance of 20 m. If the car is going twice as fast, i.e., 120 km/h, the stopping distance will be
(a) 20 m (b) 40 m
(c) 60 m (d) 80 m

(14) A particle is acted upon by the force of constant magnitude which is always perpendicular to the velocity of the particle. The motion of the particle takes place in a plane, it follows that
(a) its velocity is constant (b) its acceleration is constant
(c) its kinetic energy is constant (d) it moves in a straight line

(15) In an LCR series AC circuit, the voltage across each of the components. L, C and R is 50 V. The voltage across the LC combination will be
(a) 50 V (b) $50\sqrt{2}$ V
(c) 100 V (d) 0

(16) When n-p-n transistor is used as amplifier
(a) electrons move from base to collector (b) holes moves from emitter to base
(c) electrons move from collector to base (d) holes move from base to emitter

(17) A charged oil drop is suspended in uniform field of 3×10^{4} V / m, so that it neither falls or rises. The charged on the drop will be (take the mass of the charge = 9.9×10^{-15} kg and $g = 10\ m/s^{2}$)
(a) 3.3×10^{-18} C (b) 3.2×10^{-18}C
(c) 1.6×10^{-18}C (d) 4.8×10^{-18}C

(18) A piece of copper and another germanium are cooled from room temperature to 77 K, the resistance of
(a) each of them increases
(b) each of them decreases
(c) copper decreases and germanium increases
(d) copper increases and germanium decreases

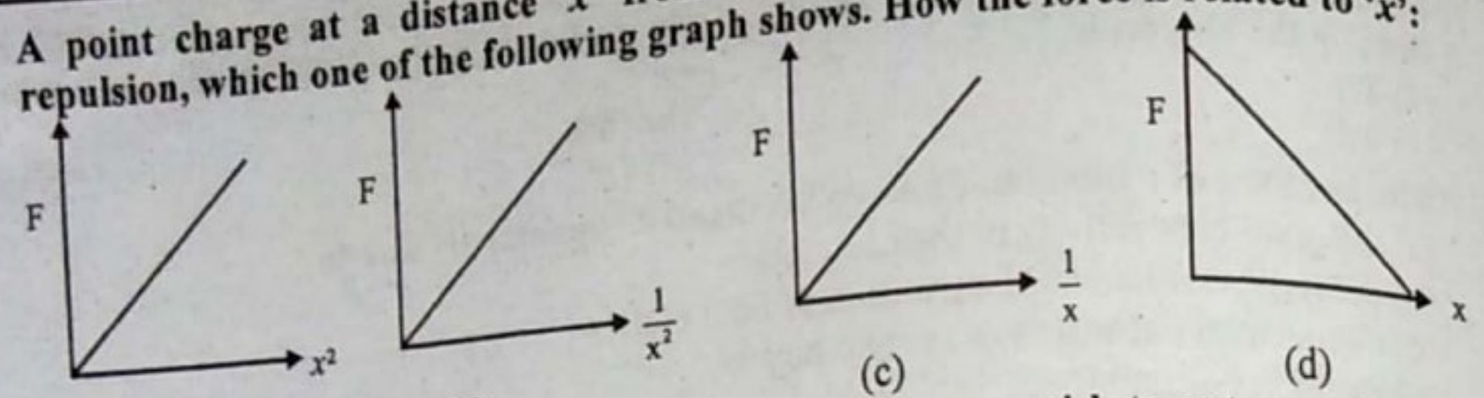
(19) When $^{235}_{92}U$ decays by alpha particle emission, the daughter nuclei formed is
(a) $^{231}_{90}Th$ (b) $^{233}_{91}Pa$
(c) $^{234}_{91}Pa$ (d) $^{239}_{94}Pu$

(20) Two charged spheres are separated by 2mm. Which of the following would produce the greatest attractive force?
(a) + 1q and +4q (b) – 1q and – 4q
(c) +2q and +2q (d) +2q and -2q

(21) When x-rays are scattered by electron, their wave length:
(a) increases (b) decreases
(c) remain unchanged (d) none of the above

Scanned by CamScanner

(22) A point charge at a distance 'x' from another point charge experiences a force of repulsion, which one of the following graph shows. How the force is related to 'x':

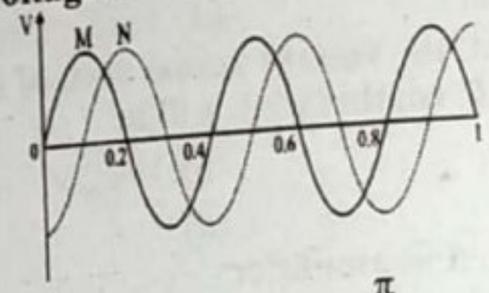


(a) (b) (c) (d)

(23) The moon rotates about its axis, in future, scientists may wish to put a satellite into an orbit around the moon such that satellite remains stationary above one point on the moon's surface. The period of rotation of the moon about its axis is 27.4 days. Calculate the radius of required orbit? $M_m = 7.35 \times 10^{22}$kg.

(a) 3.59×10^7m (b) 6.96×10^6m
(c) 4.23×10^7m (d) 8.86×10^7m

(24) Two sinusoidal voltages of the same frequency are shown in Figure. What is the phase relationship between the voltages?



(a) $\frac{\pi}{2}$ (b) $-\frac{\pi}{2}$
(c) $+\frac{\pi}{6}$ (d) $-\frac{\pi}{4}$

(25) A photocell is illuminated by a small bright source placed 1 m away. When the same source of light is placed 0.5 m away, the number of electrons emitted by photocathode would

(a) decrease by a factor of 4 (b) increase by a factor of 4
(c) decrease by a factor of 2 (d) increase by a factor of 2

ANSWER KEY

1	a	11	a	21	a
2	b	12	c	22	b
3	d	13	d	23	c
4	b	14	c	24	b
5	a	15	d	25	b
6	c	16	d		
7	a	17	a		
8	b	18	c		
9	b	19	a		
10	c	20	d		

EXPLANATORY NOTES

(1) $\frac{AB\cos\theta}{AB\sin\theta} = \frac{6\sqrt{3}}{6} \Rightarrow \theta = 30^o$

(2) $a = \frac{u^2}{2s} = \frac{(100)^2}{2\times 0.06} = \frac{1\times 10^6}{12}$

$F = ma = \frac{5\times 10^{-3}\times 1\times 10^6}{12} = \frac{5000}{12} = 417N$

(3) $\left(K.E = \frac{P^2}{2m}\right)$

(4) $v = \sqrt{gh} = 5\sqrt{2}$ $(For\ vertical\ circle)$

(5) Electric field of charges at B and D will cancel each other so, resultant field produced due to C charge only.

$E = \frac{KQ}{r^2} = 7.2\times 10^4 NC^{-1}$

(6) $V = \frac{kq}{r} = \frac{9\times 10^9\times 50\times 1.6\times 10^{-19}}{10^{-12}} = 7.2\times 10^4 V$

(7) $\lambda = \frac{h}{mv} = \frac{6.64\times 10^{-34}}{9\times 10^{-31}\times 6.6\times 10^5} = 1.1\times 10^{-9} m$

(8) $W = \frac{1}{2}k\left(x_1^2 - x_2^2\right) \Rightarrow W = 18.75J$

(9) $v_{efflux} = \sqrt{2g\left(h_1 - h_2\right)} = 20ms^{-1}$

(10) Man inside lift will observe relative change but the man on the ground will observe it as g.

(11) $\frac{E}{t} = \sigma T^4.A = \sigma T^4 \pi r^2$

$\frac{E}{t} \propto T^4 r^2 \Rightarrow \frac{\frac{E_1}{t}}{\frac{E_2}{t}} = \left(\frac{4000}{2000}\right)^4\left(\frac{1}{4}\right)^2 = 1:1$

(12) If is due to unequal expansion of two metals.

(13) As, $W = \Delta K.E$

$Fd = \frac{1}{2}mv^2 \Rightarrow d \propto v^2$

When velocity will become double, stopping distance will quadruple.

$d = 4(20) = 80m$

(14) It is a case of uniform circular motion.

(15) When voltage drop across each component will become equal then, circuit will resonate $X_C + X_L = 0$ So, voltage drop across LC will become zero.

(16) When n-p-n transistor is used as amplifier then holes move from base to emitter.

Scanned by CamScanner

(17) $qE = mg \Rightarrow q = \frac{mg}{E} = 3.3 \times 10^{-18} C$

(18) For conductors $R \propto T$

For semiconductors $R \propto \frac{1}{T}$.

(19) When α – particles emits

Mass reduces by 4

Charge reduces by 2

(20) Attractive force will produce between two opposite charges.

(21) Scattered light has more wavelength according to Compton's law.

(22) $F \propto \frac{1}{x^2}$

(23) $r = \left(\frac{GMT^2}{4\pi^2}\right)^{1/3}$

(24) There is a phase difference of $-90^o = -\frac{\pi}{2}$

(25) $I \propto \frac{1}{r^2}$

Scanned by CamScanner

KIPS EDUCATION SYSTEM » KIPS SCHOOL | KIPS COLLEGE | KIPS PREPARATIONS

ABOUT **KIPS** PREPARATIONS:

Potential at its best.

KIPS is the hallmark in all kinds of Entry & Aptitude Tests Preparation, across Pakistan. Achieving top positions and excellent results every year in entrance exams for Medical, Engineering & other Professional Universities has earned the name of trust & excellence for KIPS. We evaluate our students through original test pattern, provide them ample practice and prepare them holistically to perform at their best in MDCAT | ECAT | NUST | NUMS | PIEAS | LUMS | FAST | GIKI | ETEA | SET (AJK) | FMDC | NTS | PU | NTU and other leading professional colleges & universities.

KIPS Preparations is offering exceptional services in the following academic fields:

- **Evening Coaching** (for Matric & Inter)
- **Entry Tests Preparation**
- **Foreign Tests Preparation**
- **School of Languages**
- **Competitive Exams Preparation (CSS-PMS)**

The Largest Entry Tests Preparation Network in Pakistan

30 » Cities & Expanding

LAHORE	GUJRAT	PESHAWAR
ABBOTTABAD	ISLAMABAD	RAHIM YAR KHAN
BAHAWALPUR	JHANG	RAWALPINDI
BUREWALA	KASUR	SAHIWAL
CHISHTIAN	KHARIAN	SARGODHA
D.G. KHAN	MIRPUR (AJK)	SIALKOT
FAISALABAD	MULTAN	WAH CANTT.
GUJRANWALA		

SATELLITE CAMPUSES

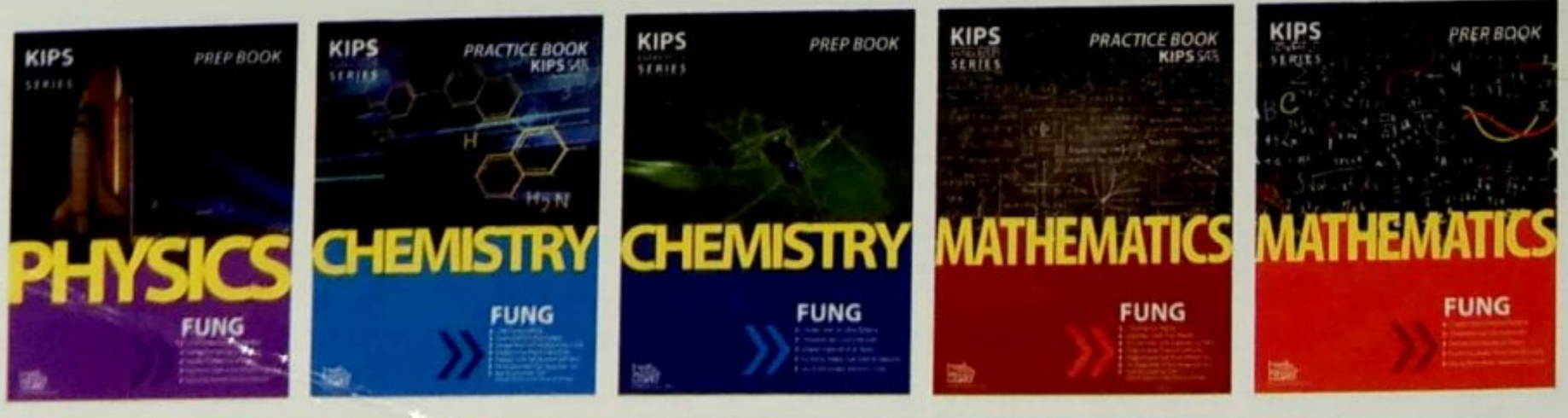
- LAYYAH
- MUZAFFARABAD
- BAHAWALNAGAR
- KOTLI
- NAROWAL
- HARIPUR
- KALLUR KOT

Head Office: 30/A, Johar Town, Lahore. 111-547-775 kips.edu.pk kips.edu.pk

KIPS ENTRY TESTS SERIES

KIPS Entry Tests Series is highly acknowledged by students seeking admission to professional institutions through entry tests. It provides a comprehensive and easy-to-remember review of each subject in a single volume. Provision of fast revision in the form of tables, flowcharts, key points & varied range of MCQs are the salient features of KIPS Entry Tests Series.

Our series comprises of Preparatory Books, Practice Books (Practice Exercises+Self Assessment Tests, Past Papers) & different Supplements for exclusive sessions on essential subjects for various Entry & Aptitude Tests like MDCAT | ECAT | NUST | NUMS | PIEAS | LUMS | FAST | GIKI | ETEA | SET (AJK) | FMDC | NTS | PU | NTU and other leading professional colleges and universities



Kitab Dost Publishers (Pvt.) Limited

27-B-1, Johar Town, Lahore - Pakistan

P: +92 42 35223022-3, 35223087 | **F:** +92 42 35223086

Scanned by CamScanner