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**Class 9
Physics**

Chapter 2

Handwritten Notes

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May 15-24

classwork

wednesday

Chapter: "2"

"Kinematics"

1. Differentiate b/w Rest and Motion. With help of Example Show that rest and motion are relative to observer?

Ans /

Rest

Motion

1. A body is said to be at Rest, if it does not change its position with respect to its surroundings. A body is said to be in motion, if it changes its position with respect to its surroundings.
2. The state of rest and motion of a body is changing continuously relative to each other. A body can be both at rest and in motion with respect to different observers at the same time.

rest and in motion at same time.

to a fixed point is called reference point

Example:-

A book lying on table
A fixed bench in Park

Example:-

A flying Bird

A boy playing football

★ **Rest and Motion are Relative term ::**

Rest and Motion are relative terms because they depend on the observer's frame of reference.

• **For Example ::** a passenger sitting in a moving bus is at rest because he is not changing his position with respect to other passenger or object in bus. But to an observer outside the bus, the

passenger and object inside the bus are in motion.

A belief
15/05/2017

May-16, 2024

Classwork

Thursday

Chapter # 02

Kinematics

Short Q/Ans

1. Differentiate b/w Circular Motion and Rotatory Motion.

Circular Motion Rotatory Motion

- | | |
|---|---|
| 1. The motion of body in a circular path is called Circular Motion. | The Spinning Motion of a body about its axis is called Rotatory Motion. |
| 2. Center of axis lies outside body. | Axis of Rotation lies inside body. |
| 3. It is due to centripetal force. | It involves torque. |

Example:-

Motion of Man
around Earth

Example:-

Blades of a
fan -

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16/05/24

May 17, 24

classwork

Friday

Unit # 02

Kinematics

2. What are different types of Motion? Define each types of Motion with example of daily life.

Ans/ Motion is categorized into 3 different types translatory, Rotatory, Vibratory motion.

Translatory Motion :: In translatory Motion body moves along a line without any rotation. The line may be straight or curved.

For Example :: Motion of a car, flying birds.

Rectilinear Motion: Straight line of a body known as linear or curvilinear motion.

For Example:

Airplane flying straight in Air.

Curvilinear Motion: The motion of an object of an is curved or circular path is called Curvilinear Motion.

For Example:- Motion of Moon around Earth.

Random Motion: The disordered or irregular motion of an object is called Random Motion.

For Example:- Motion of bird-butterfly.

Rotatory Motion: The spinning motion of an object around its axis is called Rotatory Motion.

For Example:- Motion of Blades of fan - Earth's axis.

Vibratory Motion: The to and fro motion of an object about its mean position is known as Vibratory Motion.

For Example:- string of a guitar, see saw

@ hdu
19/05/2024

May 20, 24

classwork

Monday

Chapter 2

"Kinematics"

Q4. Define position? Differentiate b/w Distance and displacement.

Distance

- The length of path traveled b/w two position is called distance.

- Distance has no direction therefore it is a scalar quantity.

- It is always positive.

- Distance in SI measured in meter (m).

Displacement.

- The shortest distance b/w initial and final position is called displacement.

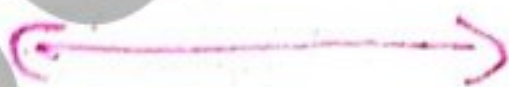
- Displacement has both magnitude and direction therefore it is vector.

- It may be positive, zero or negative.

- Displacement in SI is measured in meter (m).

Position :-

Position is distance and direction of a body from a fixed reference point.



May 21-24
Unit #2

C.W

Tuesday

"Kinematics"

Q1. In a park, children are enjoying a ride on a ferris wheel as shown.
What kind of Motion big wheel has
and what kind ride have

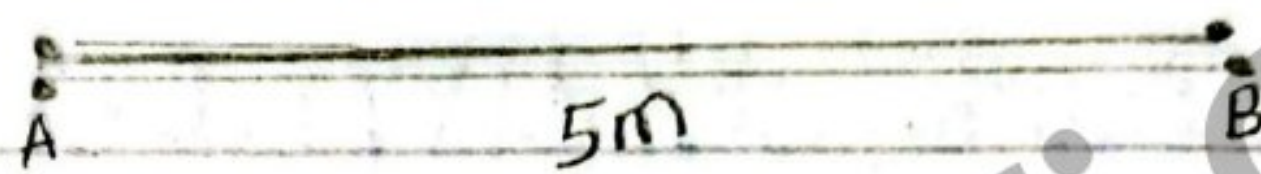
• Children are enjoying a ride on big wheel. ^{the motion of children in wheel.} is called circular motion?

Big wheel is rotating about its axis
so motion of wheel is called rotatory Motion.

Q2. A bog moves for same time give two situations in which displacement is zero but distance is not zero.

If a body starts its journey on a straight line from point A to B such that $AB = 5\text{m}$ and come back from B point to A

Then its displacement is zero because starting and ending point is zero but distance is $5\text{m} + 5\text{m} = 10$



2. A boy completes his journey along a circular path then his displacement is zero because starting and ending point is same but distance is not zero.

Q3/ a stone tied to string is writing in circle. What is direction of its body. What is direction of its body velocity at any instant.

Ans A stone is tied to string and it is moving in circular path. The instantaneous velocity of stone is acting as tangent to the circle. Thus direction of velocity is perpendicular to direction of centripetal force.

June, 2024

classwork

Tuesday

Unit # 02

"Kinematics"

Differentiate b/w speed and velocity also describe Average speed, velocity, uniform and variable speeds, uniform and variable velocities.

Speed

It is defined as rate of change of distance.

It is a scalar quantity.

It can never be negative.

Speed in SI is measured in m/s .

Velocity

It is defined as rate of change in displacement.

It is a vector quantity.

It can never be positive or negative.

Velocity in SI is measured in m/s .

Speed in Velocity.
without direction

Velocity is directed by speed.

Average Speed :- Average Speed is total distance covered in time.

Mathematically :-

$$V_{ave} = \frac{\text{total distance } S}{\text{Total time } T}$$

Can be written as $S = V_{ave} \times T$

Uniform Speed :- If an object covers equal distance in equal interval.

13,6,2024

C.W

Wed

Unit# 02

"Kinematics"

4. Is it possible to accelerate an object without speeding it up or down

Yes, an object can be accelerated without speeding up or slowing down. We know that acceleration is referred as rate of change of velocity and velocity is speed in particular direction and is a vector quantity, so if velocity can either changes its speed or direction there is some acceleration.

Hence an object in uniform circular motion is accelerating but its speed neither increase nor decreases.

Can a car moving towards right have direction of acceleration towards left?

If a car is moving towards right then direction of velocity and acceleration is same i.e. towards right - we apply brakes on car then its speed decreases and deceleration is produced in it. In this case the direction of velocity is towards right but direction of acceleration is towards left.

With help of daily life examples describe situations in which:

- 1. acceleration is in direction of motion
- 2. acceleration is against direction of motion
- 3. acceleration is zero and body is in motion

a) If a car is moving towards on a straight line with increasing speed then acceleration is in direction of motion.

b) When we apply brakes then speed of car decreases, in this case acceleration is against direction of motion.

c) If a car is moving with uniform speed then its velocity does not change with time. So acceleration is zero but car is in motion.

3 Which controls in car produce acceleration and deceleration?

If the speed of car is increasing then it is called acceleration. We use accelerator to increase speed of car which produce acceleration

If speed of car is decreasing it is called deceleration. We use brakes to decrease speed of car which produces deceleration in car.

If two stones of 10 kg and 1 kg are dropped from a 1 km tower. Which will hit ground with greater velocity? Which will hit ground first? (Neglect Air resistance)

If two stones of 1 kg and 10 kg dropped from height of 1 km tower then heavier stone hit ground with greater velocity. Because force which earth attract body towards center is equal to the weight of objects. So stone having mass 10 kg will hit ground with greater velocity. If we neglect air resistance then both stone will reach ground at same time.

• A 100g ball is just released (from rest) and another is thrown downward with velocity of 10 m/s . Which will have greater acceleration? (Neglect air resistance)

Both dropped ball will experience same acceleration due to gravity neglecting air resistance. In absence of other external forces. All objects near earth surface experience same acceleration due to gravity i.e. $g = 9.8\text{ m/s}^2$. This value is same all objects regardless of their mass or initial velocity when air resistance is not considered.

What are freely falling bodies
What is gravitational acceleration. Write down sign conventions for gravitational acceleration? Write down three equations of motion of free falling bodies.

Free falling Bodies:-

Free falling bodies are objects that are falling under influence of gravity without any other forces acting upon them, such as air resistance.

Gravitational Acceleration:-

Gravitational Acceleration often denoted by " g " is the acceleration experienced by an object due to gravity. All freely falling objects have same acceleration due to

gravity (g) and is independent of their masses.

Acceleration due to gravity is directed downward, towards center of earth. On earth's gravitational acceleration is 9.8 m/s^2 .

Sign Convention for Gravitation Acceleration:

- When an object move with gravity (object move toward earth), acceleration due to gravity is term as positive ($+g$).

When an object moves against gravity (like an object thrown upward) acceleration due to gravity is taken as negative ($-g$).

Equation of Motion of freefalling bodies.

1. $U_f = U_i + gt$

2. $S = U_i t + \frac{1}{2} g t^2$

3. $2gs = U_f^2 - U_i^2$

S = distance

g = gravitational acceleration

t = time

U_f = final Velocity

U_i = initial Velocity

15-8-24

Thurs

Chapter # 02

"Kinematics"

1. Draw speed time graphs for zero acceleration, uniform acceleration and uniform deceleration. Also show that area under speed time graph represents distance covered by speed.

Ans/ Body moving with constant speed "zero acceleration"

No change in speed as time is passing. It means body is moving with uniform speed. Since there is no slope. Acceleration is zero.

Uniform acceleration :: "Increasing speed linearly"

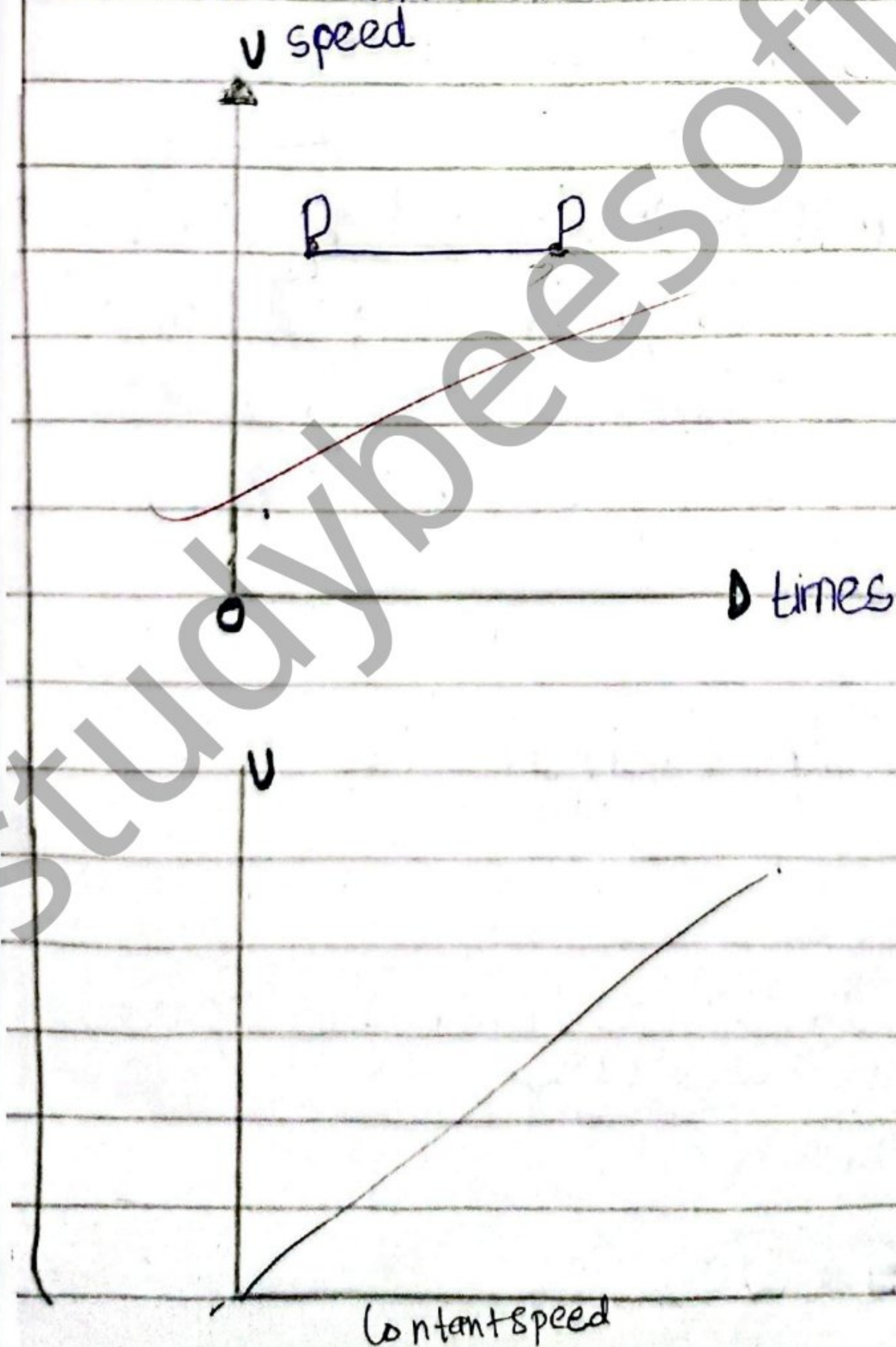
Speed is increasing linearly with time the slope is Uniform

Therefore acceleration is uniform

Uniform deceleration :: "decreasing speed linearly"

Speed is decreasing linearly with time

The slope is uniform Therefore deceleration is uniform.



Area under speed time graph is distance Travelled ::

If motion of the body represented by speed time graph is symmetrical shape. The area can be calculated using appropriate formula for Geometrical shapes.

For Example :: Consider figure as shown in which the speed time graph of object in motion is represented by rectangle. The Area of rectangle is ::

$$A = \text{width} \times \text{length}$$

$$A = v \times t$$

The distance by average speed is given by equation

$$S = v \times t$$

Thus the area under speed time graph represents distance traveled

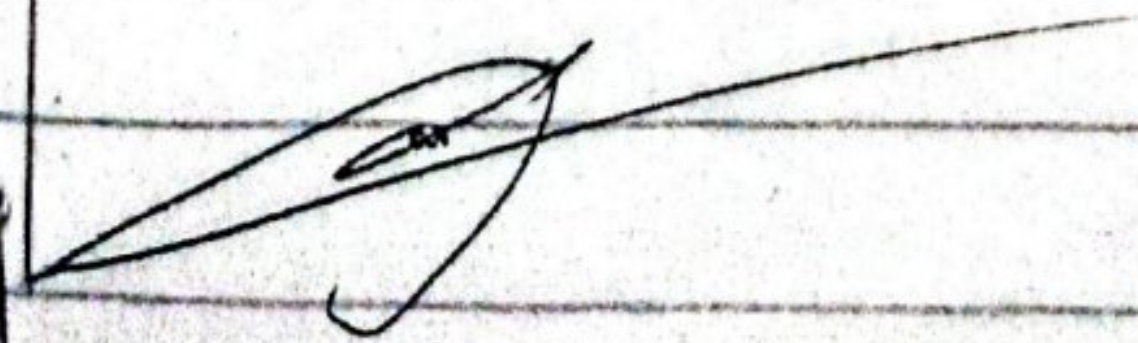
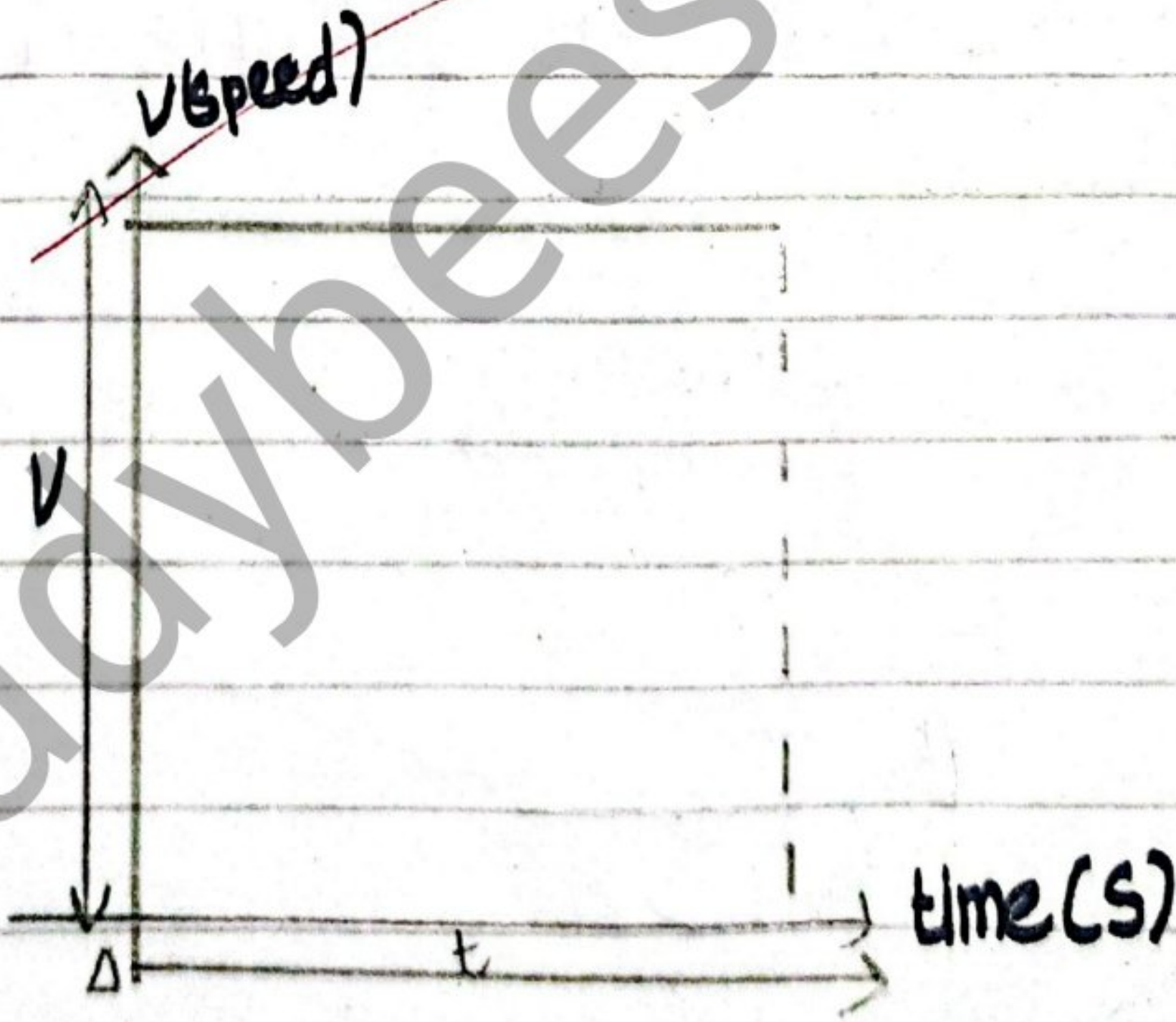
$$U = \frac{\Delta S}{t}$$

$$U \times t = S$$

$$A = l \times w$$

$$A = U \times t$$

$$S = U \times t$$



8-20-24

classwork

Unit #02

"Kinematics",

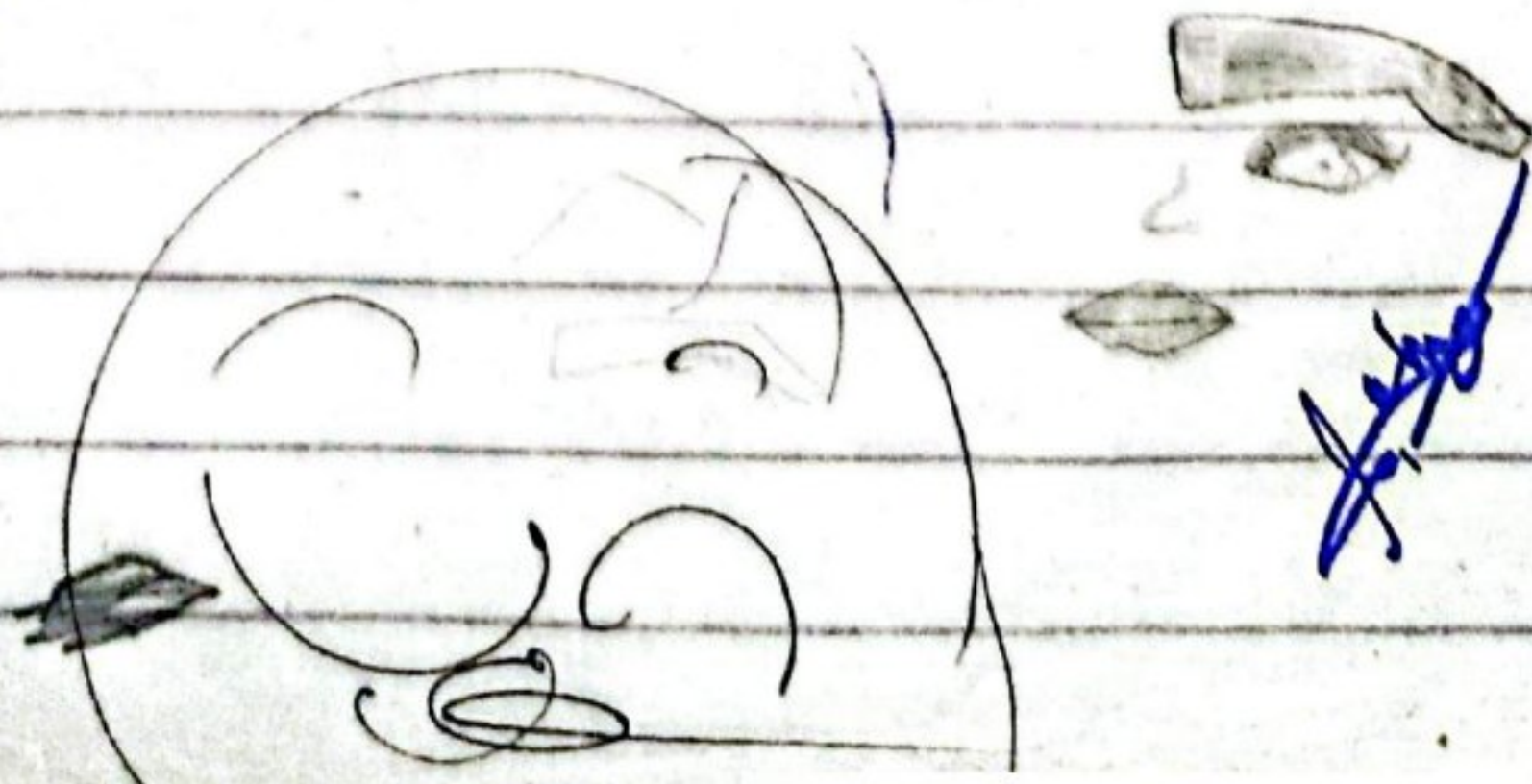
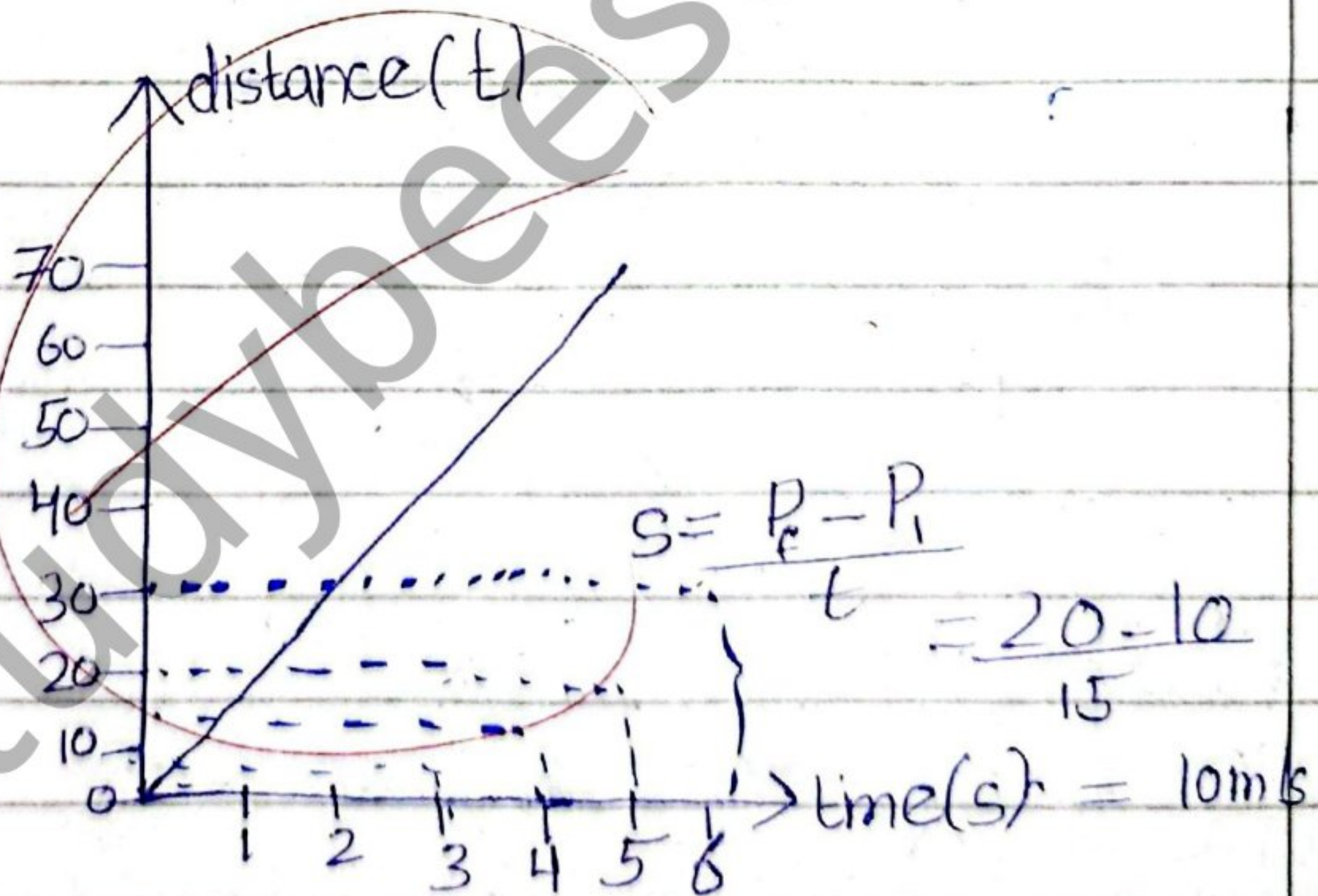
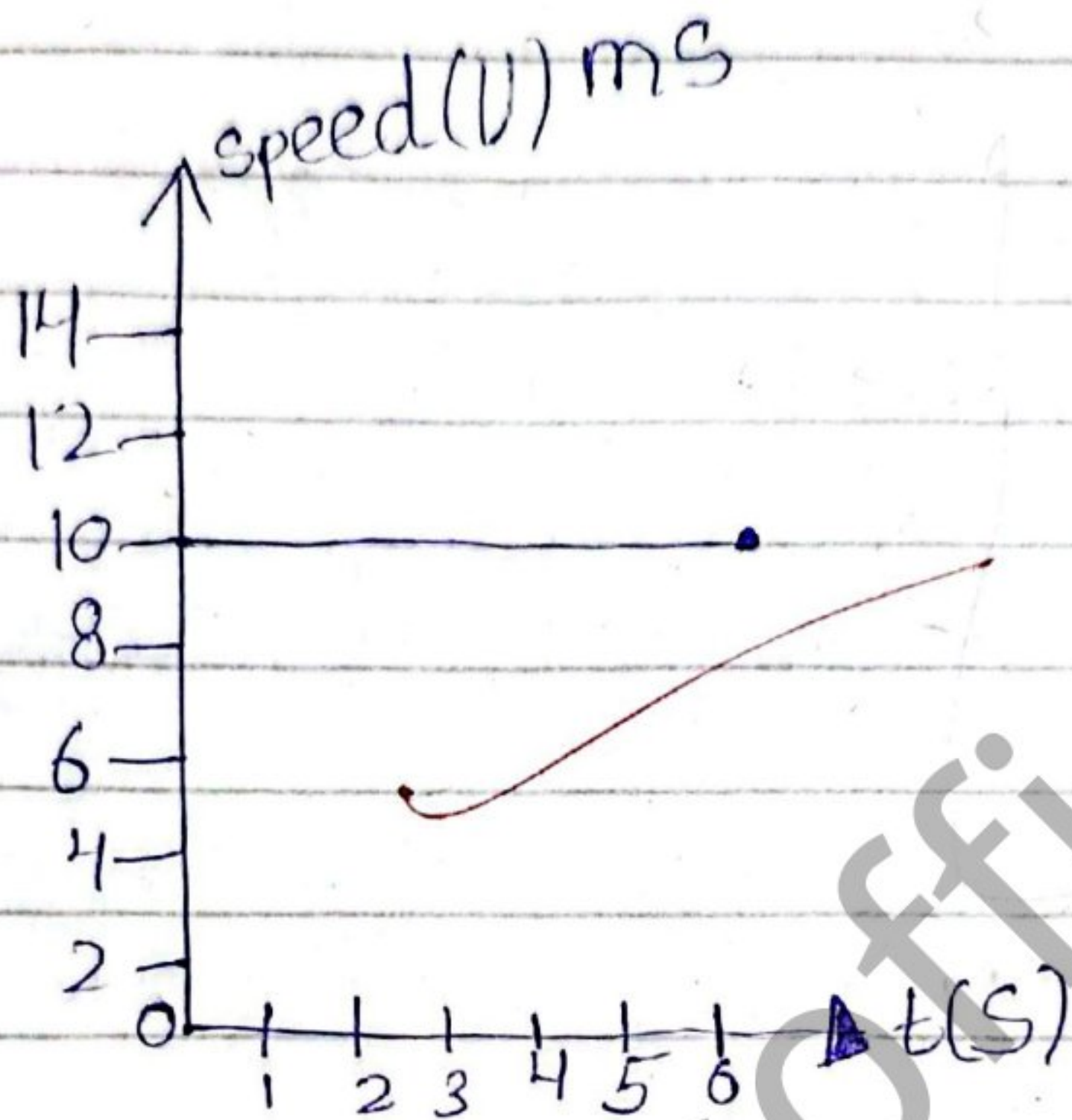
7. Examine distance time graph

Ans/ The distance-time graph shows a straight line which means the motorcyclist covers equal distance in equal interval of time (uniform speed).

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$v = \frac{s_f - s_i}{t}$$

So velocity time graphs of motorcyclist is a line parallel to time axis which indicate ^{that} the uniform velocity as it has same velocity at all points



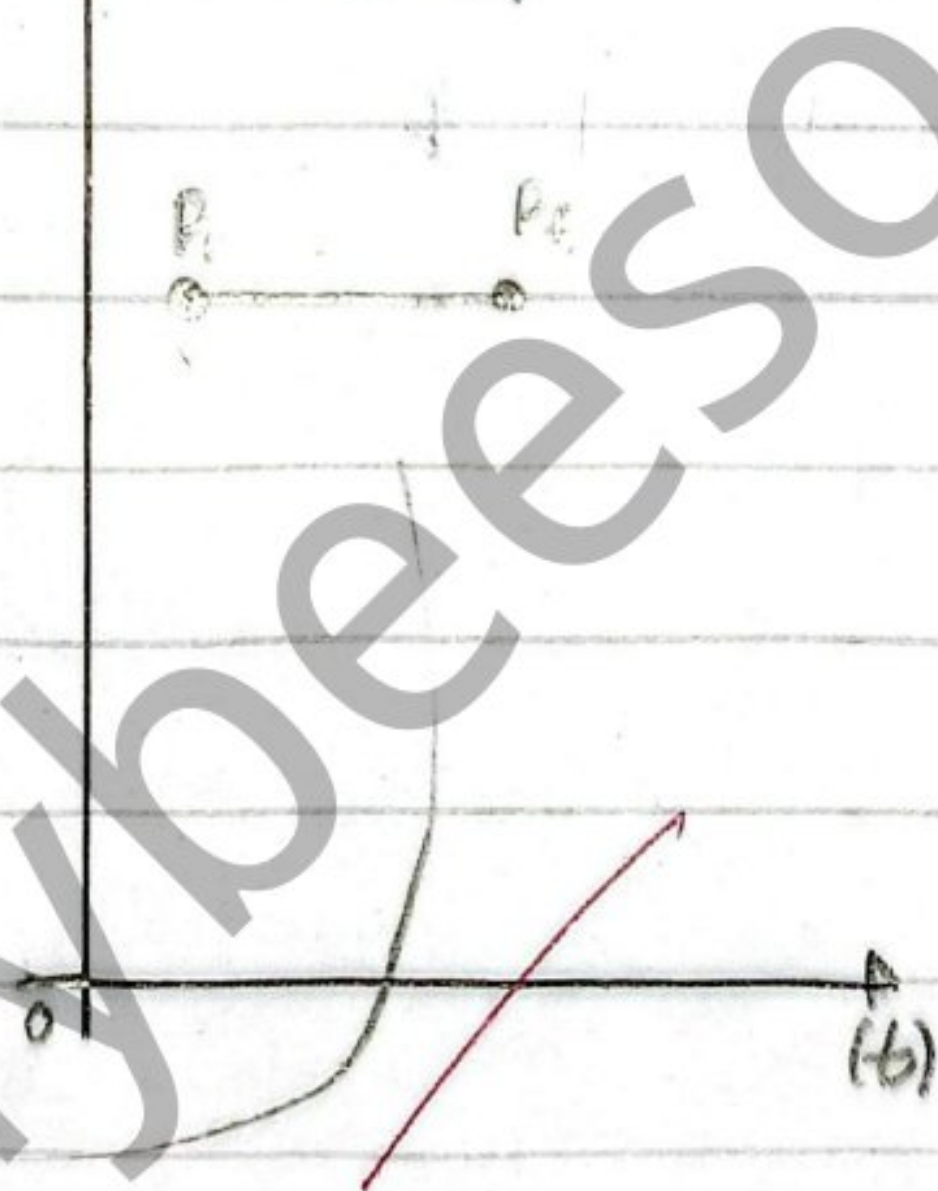
Aug-20-24
Unit#2

C.W

"Kinematic"

7 Draw distance decreasing speed.

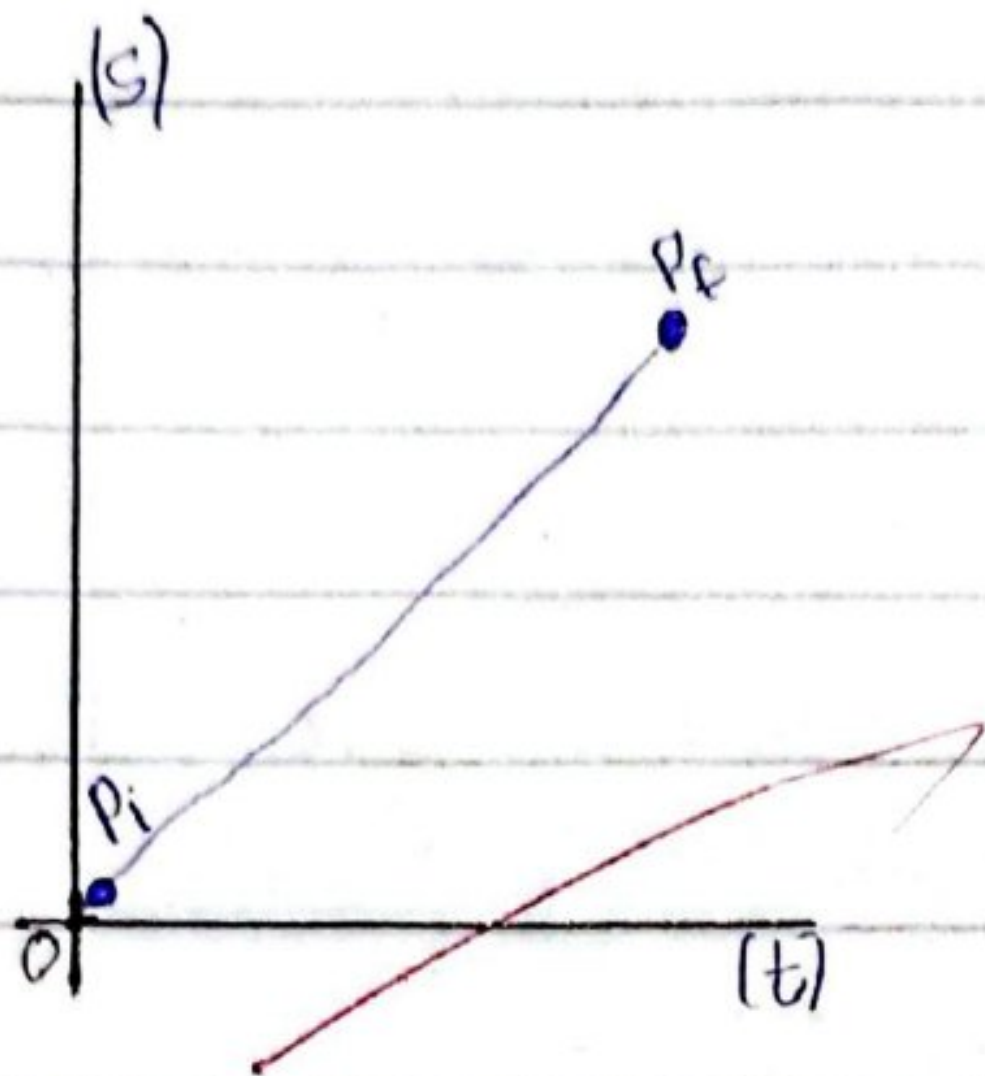
Distance (S)



★ Body at Zero Rest:-

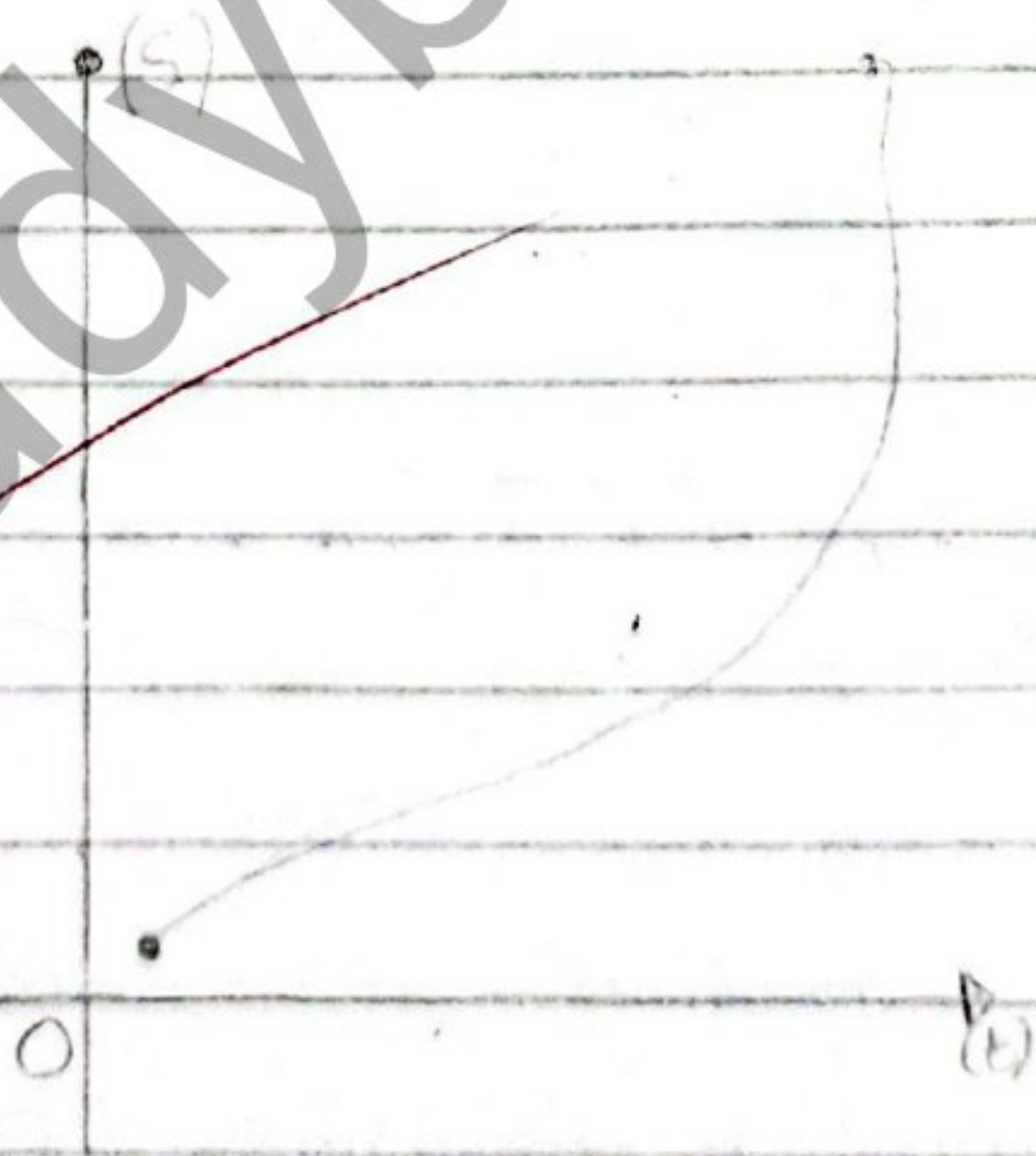
Time is passing and no speed change in distance is seen - It means body is at rest - Since there's no slope so speed is zero.

C.W



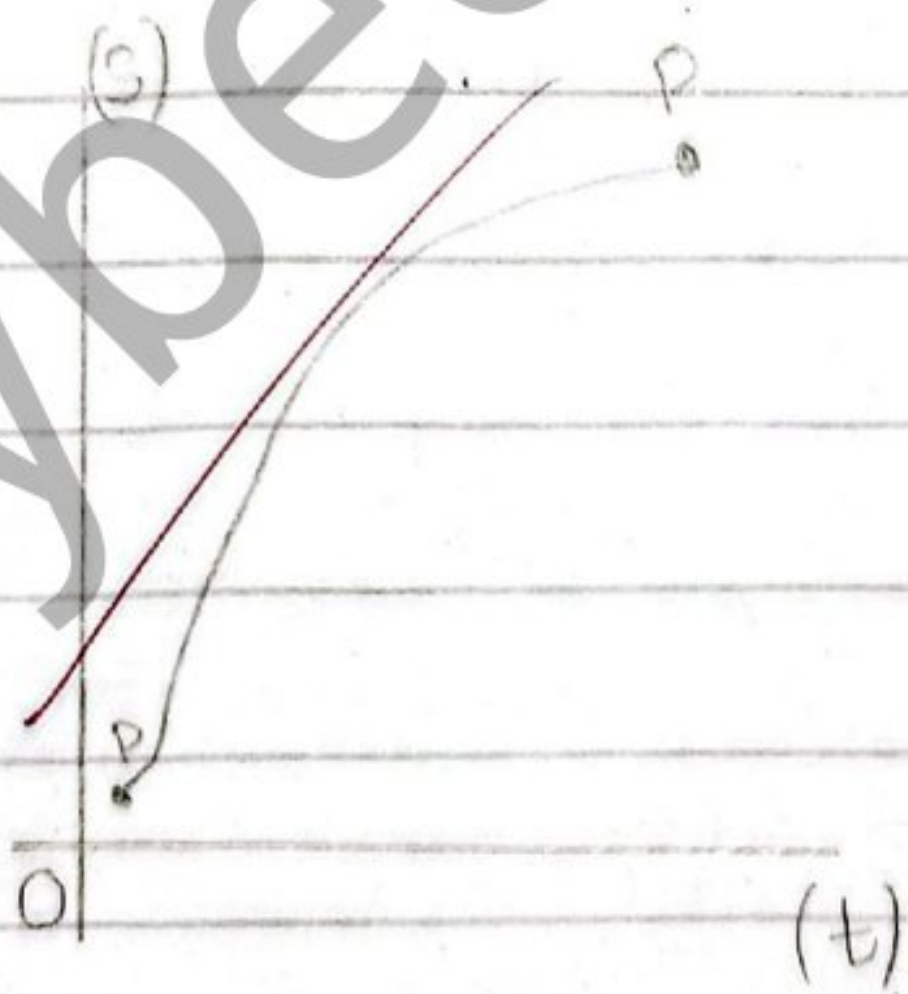
Body moving with constant speed:-

The distance is increasing linearly with time.
The slope is constant therefore object is moving with uniform speed.



Body moving with variable speed:-

The distance is changing non linearly with time (curving up) - Slope is increasing therefore object is increasing its speed.



The distance is changing linearly with time (curving down) - Slope is changing object is decreasing its speed -

8-19-24

Monday

Numerical Problems

Convert following

1) 160 km/hr into m/s

$$= \frac{160 \times 1000 \text{ m}}{3600 \text{ sec}}$$

$$= 44.44 \text{ m/s}$$

2) 36 m/s into km/h

$$\frac{36 \text{ km}}{1000} \times \frac{1 \text{ h}}{3600}$$

$$3600$$

$$3 \times 3600 \times \text{km}$$

$$1000 \times \text{h}$$

$$= 129.6 \frac{\text{km}}{\text{h}}$$

c 15 km/h^2 into m/s^2

$$= \frac{15 \times 1000 \text{ m}}{(3600)^2}$$

$$\frac{15 \times 1000 \text{ m}}{12960000 \text{ s}^2}$$

$$= 0.001 \text{ m/s}^2$$

d 1 m/s^2 into km/h^2

$$\frac{1 \text{ km}}{1000}$$

$$\frac{(1 \text{ h})^2}{(3600)^2}$$

$$\frac{1 \text{ km}}{1000}$$

$$\frac{1h^2}{12960000}$$

$$\frac{1 \times 12960000 \text{ km}}{1000 h^2}$$

$$= 12960 \frac{\text{km}}{h^2}$$

In 20 s.s a

Given data

$$U_i(\text{cycl}) = 5 \frac{\text{km}}{h} = \frac{5 \times 1000 \text{ m/s}}{3600} = 1.38 \text{ m/s}$$

$$U_f(\text{cycl}) = 7 \frac{\text{km}}{h} = \frac{7 \times 1000 \text{ m/s}}{3600} = 1.94$$

$$U_i(\text{car}) = 0 \text{ m/s}$$

$$U_e(\text{car}) = \frac{20 \text{ km}}{h} = \frac{20 \times 1000 \text{ m}}{3600 \text{ sec}}$$

$$U_f(\text{car}) = 5.5 \text{ m/s}$$

$$t = 10$$

to find

$$a(\text{cyc}) = ?$$

$$a(\text{car}) = ?$$

Sol:

$$a(\text{cyc}) = \frac{\Delta v}{T}$$

$$a(\text{cyc}) = \frac{v_f(\text{car}) - v_f(\text{cyc})}{T}$$

$$a(\text{cyc}) = \frac{1.94 \text{ m/s} - 1.38 \text{ m/s}}{10 \text{ s}}$$

$$a(\text{cyc}) = 0.056 \text{ m/s}^2$$

$$a(\text{car}) = \frac{v_f(\text{car}) - v_f(\text{cyc})}{t}$$

$$a(\text{car}) = \frac{5.55 \text{ m/s} - 0}{10 \text{ s}}$$
$$= 0.55 \text{ m/s}^2$$

A Ball thrown..... what speed with which Ball is thrown up?

Ans/ Given Data:

$$U_f = 0$$

$$t = 2 \text{ sec}$$

$$g = -9.8 \text{ m/s}^2$$

To prove

$$U_i = ?$$

Solution:

we know that

$$a = \frac{U_f - U_i}{t}$$

$$g = \frac{U_f - U_i}{t}$$

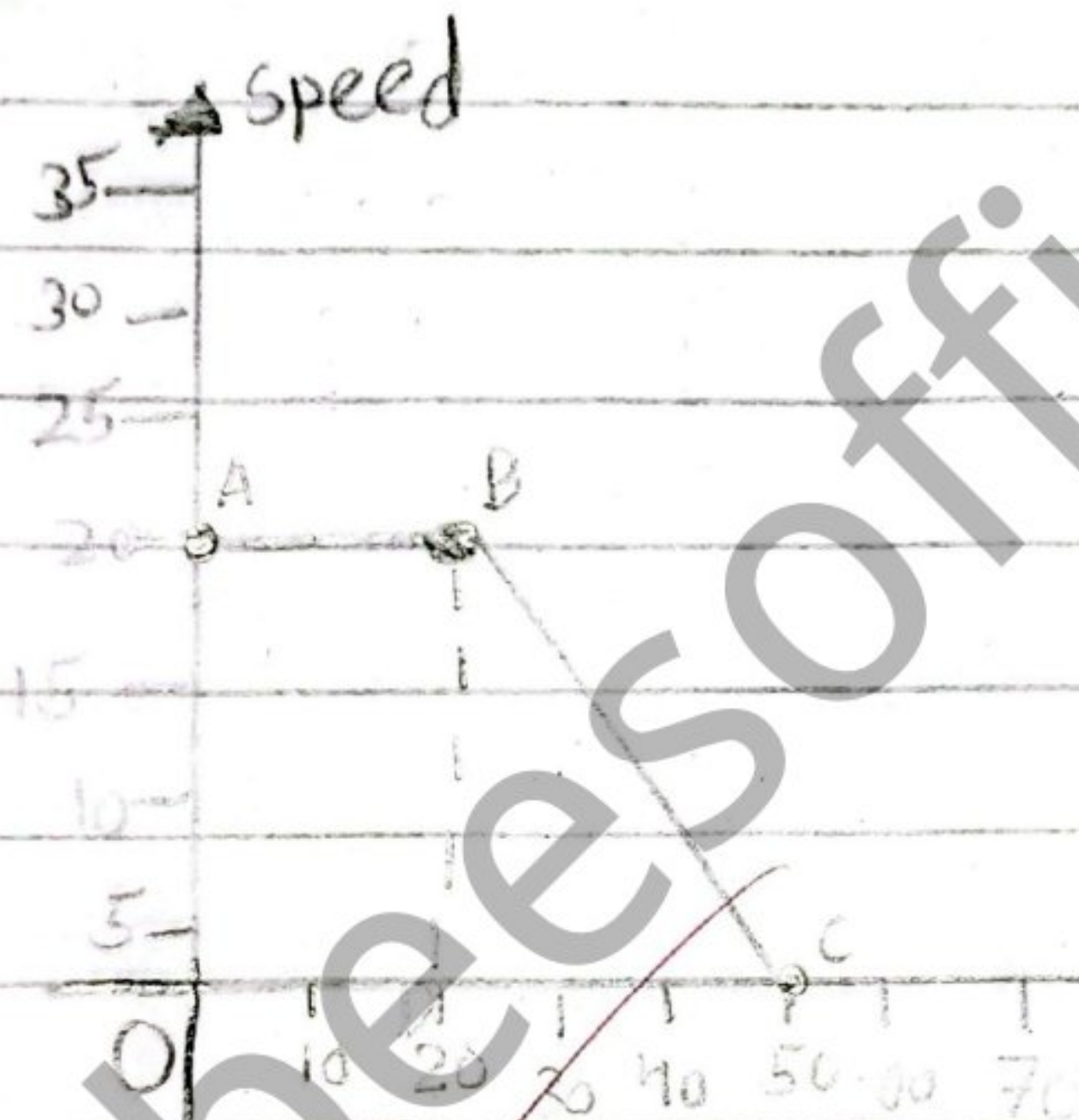
$$g \times t = -9.8 \text{ m/s}^2 \times 2 \text{ s} = 0 - U_i$$

$$19.6 \text{ m/s} = -U_i$$

$$U_i = 19.6 \text{ m/s}$$

4. A car Plot graph and calculate distance using graph.

Sol



Total distance = Area under graph
 $\text{length} \times \text{width} + \frac{1}{2} (\text{Base}) (\text{Altitude})$

$$(OA) \times (OD) + \frac{1}{2} (DC) (BP)$$

$$= 20 \text{ m/s} \times 20 \text{ s} + \frac{1}{2} (30 \text{ s}) (20 \text{ m/s})$$

$$400 \text{ m} + \frac{1}{2} (600 \text{ m}) \Rightarrow 400 + 300$$

$$= 700m$$

A girl What is her acceleration

Given Data

$$U_i = \frac{50 \text{ km}}{h} = \frac{5 \times 1000m}{3600s} = 13.8 \text{ m/s}$$

$$U_f = 0$$

$$t = 60s$$

To find

$$\text{acceleration} = \vec{a} = ?$$

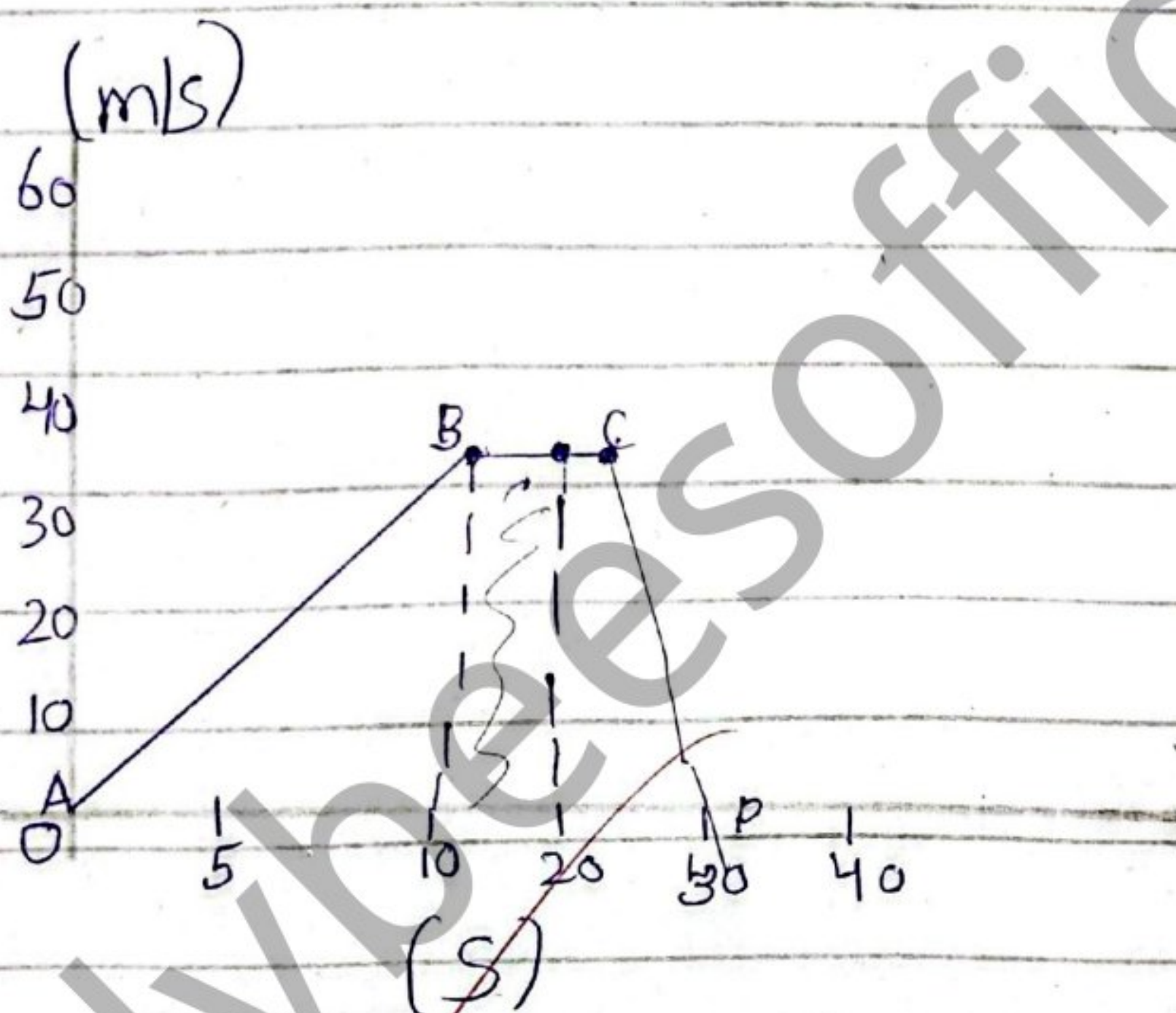
$$\text{Sol:- } \vec{a} = \vec{U}_f - \vec{U}_i$$

$$a = \frac{0 - 13.8 \text{ m/s}}{60s}$$

$$a = -0.23 \text{ m/s}^2$$

6. Consider following time graph

- Which zero acceleration.
- Calculate from graph.



Given Data -

(a) At part AB speed is increasing so it is accelerating.

At part CD speed is decreasing so it shows deceleration.

At part $\overline{BC}$, speed is constant, so it shows zero acceleration.

Distance travelled = Area under graph

$S =$ Area of rectangle

$$S = l \times w$$

$$S = 50 \text{ m/s} \times 10 \text{ s}$$

$$S = 500 \text{ m}$$

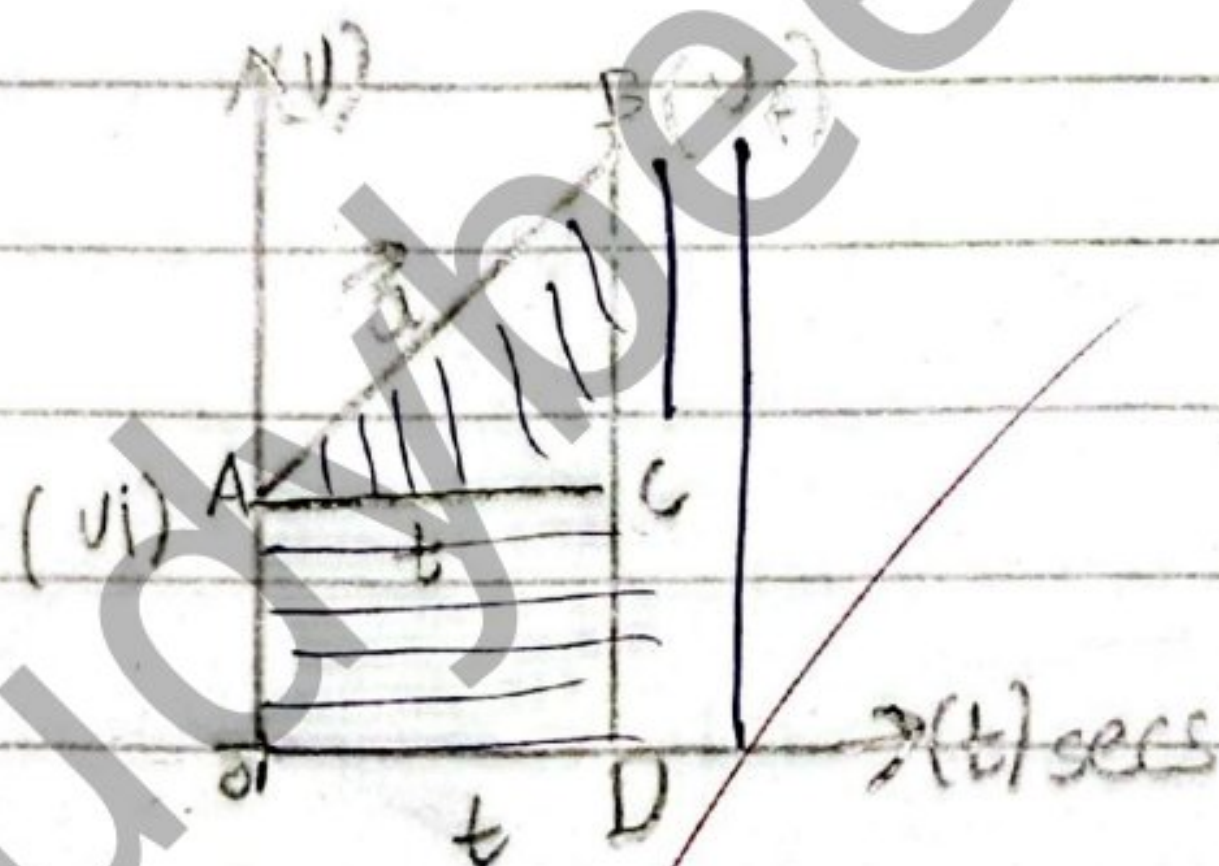
8-22-24

C.W

Topic: Equation of

Equation of Motion:

Considered a body moving with initial velocity (U_i) in a straight line having uniform acceleration (a). Its velocity becomes U_f after some time (t). Slope of line AB gives acceleration. In speed time graph distance travelled is area under graph.



$$(i) U_f = U_i + at$$

$$(ii) S = U_i t + \frac{1}{2} at^2$$

$$(iii) 2as = U_f^2 - U_i^2$$

★ First equation of motion:

(equation of motion independent to distance)

In speed-time graph for motion of body slope of line $\overline{AB}$ gives acceleration ($\vec{a}$)

$$\text{slope of line } \overline{AB} = \vec{a} = \frac{BC}{AC}$$

$$\therefore BC = BD - DC$$

$$a = \frac{BD - DC}{AC}$$

$$BD = U_f; DC = U_i; AC = t$$

$$a = \frac{U_f - U_i}{t}$$

$$at = U_f - U_i$$

Second equation of Motion:

(equation of motion Independent of final velocity)

In Speed-time graph distance travelled is Area under graph

Distance travelled is Area under graph

Distance travelled = Area under graph
 $S = \text{Area of rectangle (OACD)} + \text{Area of triangle (ABC)}$

$$S = l \times w + \frac{1}{2} (\text{Base}) (\text{Altitude})$$

$$S = (OD \times OA) + \frac{1}{2} (AC) (BC)$$

$$S = (t \times u_i) + \frac{1}{2} (t) (at)$$

$$S = u_i t + \frac{1}{2} at^2$$

8-23-24

C.W

Friday

Third equation of Motion :: (Independent to time)

In speed-time graph travelled is equal to area under graph.

Distance travelled = Area under graph

$S =$ Area of trapezium

$$S = \frac{1}{2} (OA + BD) \times OD$$

$$2S = (U_i + U_f) \times OD$$

Multiplying by 'a' on b/s

$$2as = (U_f + U_i) \times OD \times a$$

$$2as = (U_f + U_i) \times OD \times a$$

$$2as = U_f + U_i \times \frac{OD}{OD} \times \frac{BC}{OD} \therefore \vec{a} = \frac{BC}{OD}$$

$$= 2as = (V_f + V_i) (BC)$$

$$\therefore BC = BD - DC$$

$$2as = V_f + V_i (BD - DC)$$

$$2as = (V_f + V_i) (V_f - V_i)$$

$$2as = V_f^2 - V_i^2$$

Vibratory Motion

-) It is the to and fro motion of a body about its mean position.
-) It shows periodic motion.
-) It has a fixed path and predictable path.
-) eg pendulum

Circular Motion

-) It is motion in which body moves in a circular path.
-) Its center of axis lies outside the body.
-) It involves centripetal force.
- eg:- Motion of car in a circular path.

Random Motion

- It is disordered and irregular motion of a body.
- It shows no periodic motion.

- It has unpredictable path.
- eg butterfly.

Rotatory Motion

- It is a motion in which body rotates about its own axis.
- Its axis of rotation lies inside the body.
- It involves torque.
- eg:- Motion of blades of fan.



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