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**Class 9
Physics**

Chapter 5

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Thursday

13,3,2025

Chapter 5

Pressure and Deformation in Solids

Q1) Write Hooke's Law, its mathematical formula and Graph?

Hooke's Law:- Within elastic limits the extensions (or compression) x is directly proportional to restoring force F_{res} i.e.

Mathematical formula:-

$$F_{res} \propto -x$$

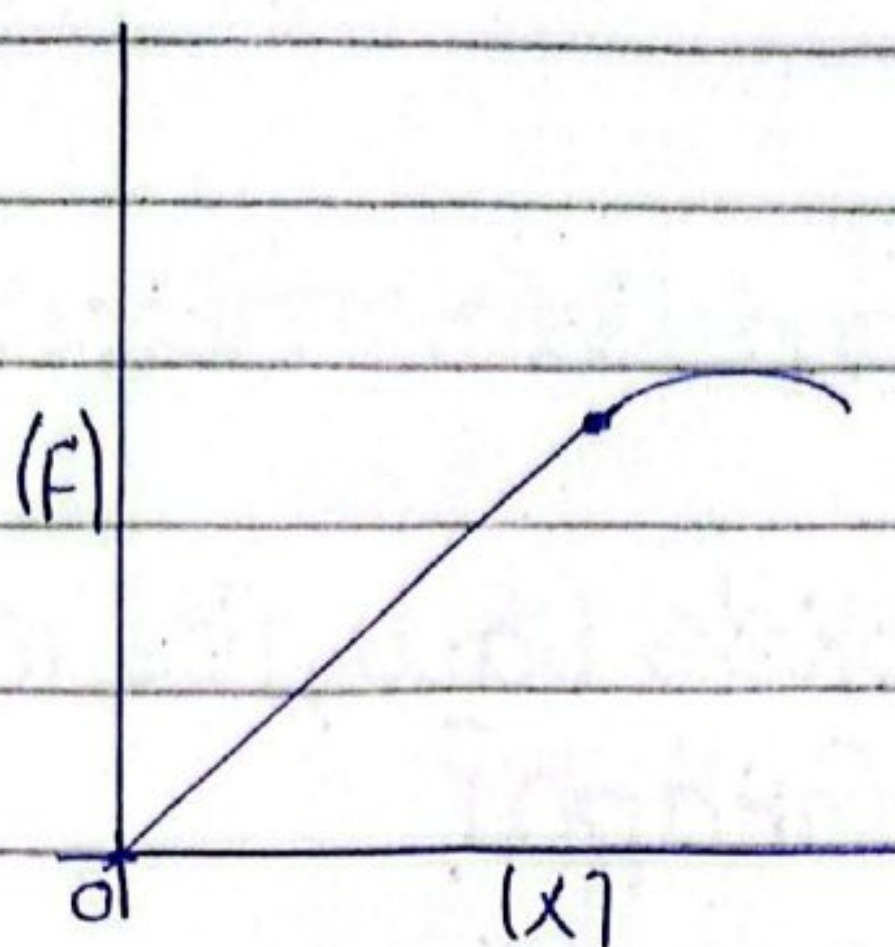
$$k = \frac{-F_{res}}{x}$$

F_{res} = Restoring force of spring (N) -

x = Displacement from equilibrium position (m) -

k = Spring constant (N/m) - Its value depends upon stiffness and strength of spring -

-ve = Sign shown is that restoring force is opposite in direction of displacement -



Hooke's law

2) On what factor's does the value of K depends on?

The value of K depends on properties, stiffness, elasticity and physical dimensions like, length, thickness, cross sectional area -

3) What are limitations of Hooke's law?

Ans) It is only applicable up to proportional limit -

2) Only accurate for ^{elastic} solids where the force applied is small -

The graph b/w F and x must be linear -

4) What physical quantity we obtain from Slope of line F/x ?

It gives the value of spring constant -

(Strain types ::) Unit less, formula =

$$\text{Strain} = \frac{\text{change in length}}{\text{Original length}}$$

-) Tensile Strain:- It is change in length -
-) Volumetric Strain:- Change in volume -
-) Shear Strain :: Change in shape -

Strain are independent and is always place at (x) axis -

19, 3, 2025

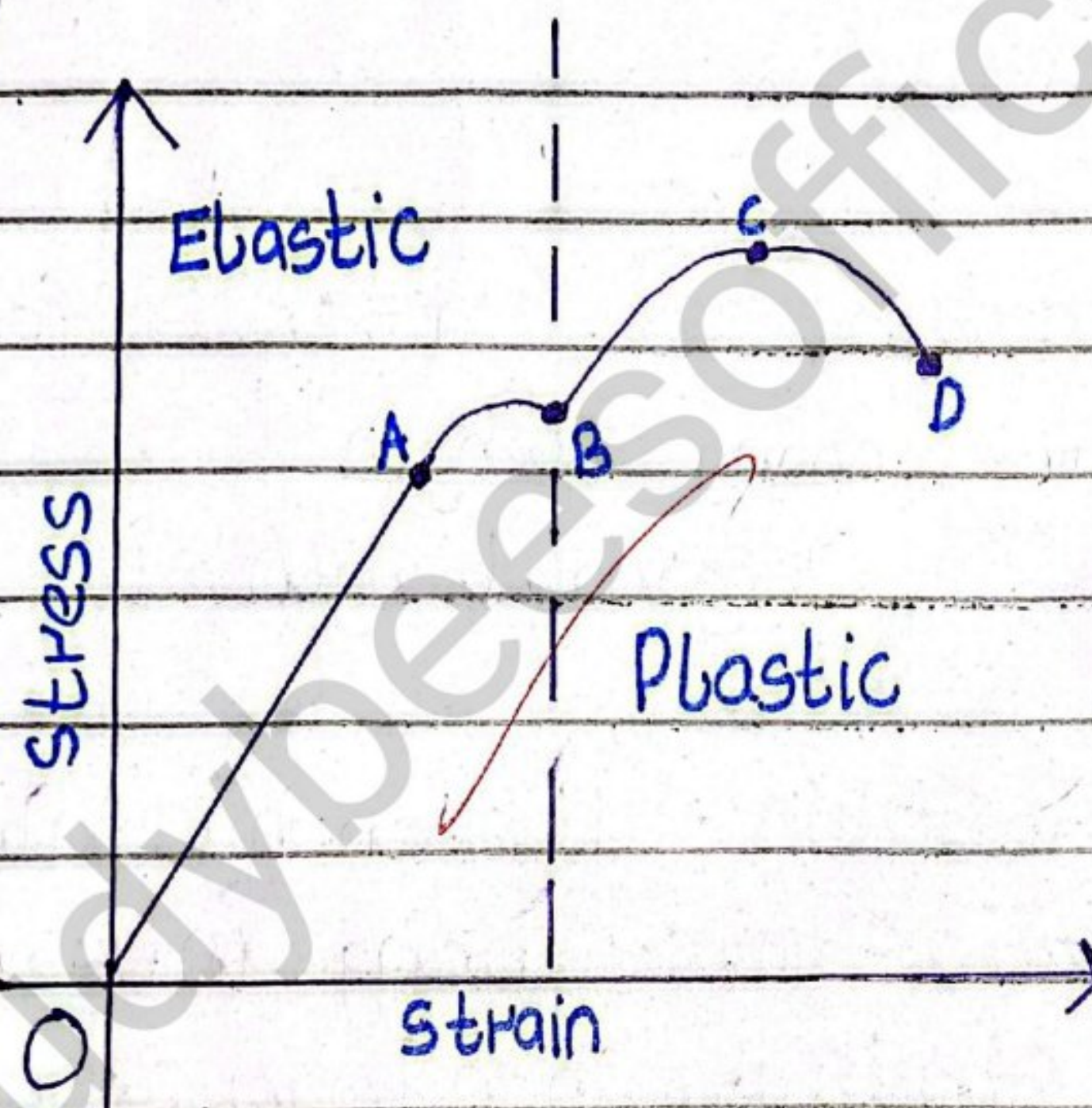
Wednesday

Chapter 5

Pressure and Deformation in Solids -

1. Explain Stress and Strain with graph?

Ans/



★ Stress and Strain Curves:

Stress and strain curves are measured by stress tester, One such machine Rockwell hardness tester -

(i) **Point A:** It is the limit of proportionality, the limit upto hooke's law is obeyed -

(ii) **Point B :-** It is the elastic limit, The limit upto body shows elastic limit also known as yield strength -

(iii) **Point C :-** It is the Ultimate stress that a body can bear before fracture (breaking) -

(iv) **Point D :-** It is the point where body breaks down -

Q Define Pressure and its unit?

It is defined as force per unit area -

It is represented by ' P ' - Its unit is Pascal and mathematical formula

is $P = \frac{F}{A}$ - One pascal is $= \frac{1N}{1m^2}$ -

Pressure is a scalar quantity -

15, 4, 2025

C.W

Chapter # 5

(N.P)

❖ High Response Questions.

★ N:P 1:-

Given Data:-

$$k = 8000 \text{ N/m}$$

$$F = 500 \text{ N}$$

Find:-

$$X = ?$$

Sol:- $F = kx$ ✓

$$x = \frac{F}{k}$$

$$x = \frac{500 \text{ N}}{8000 \text{ N/m}}$$

$$x = 0.0625$$

* NP#02

Given Data:

$$d_1 = 15 \text{ cm} = 0.15 \text{ m}$$

$$d_2 = 30 \text{ cm} = 0.30 \text{ m}$$

$$F_1 = 250 \text{ N}$$

$$0.15 \text{ m} = r_1 = d_1 = 0.15 = 0.075$$

$$0.30 = r_2 = \frac{d_2^2}{2} = 0.015$$

To Find = ?

$$F_2 = ?$$

$$\text{Sol: } F_2 = \left(\frac{A_2}{A_1} \right) F_1$$

$$F_2 = \frac{A_2^2}{A_1^2} \times F_1$$

$$F_2 = \frac{(0.15)^2}{0.075} \times 250$$

$$F_2 = 1000 \text{ N}$$

NP# 03

Given Data:-

$$m_2 = 1000 \text{ kg}$$

$$F_2 = m_2 g = 1000 \text{ kg} \times 9.8 \text{ m/s}^2 \\ = 9800 \text{ N}$$

$$F_1 = 50 \text{ N}$$

$$r_1 = 20 \text{ cm} = 0.2 \text{ m}$$

To Find
 $r_2 = ?$

Sol:-

$$F_2 = \frac{F_1}{r_1^2} \times r_2^2$$

$$\frac{F_2}{F_1} = \frac{r_2^2}{r_1^2}$$

$$\frac{F_2}{F_1} \times r_1^2 = r_2^2$$

$$\frac{F_2}{F_1} \times r_1^2 = r_2$$

$$(0.2)^2 = r^2 = 2.8m$$

Q. b. d. f. s. e.

15/04/25

N.P.#4

Given Data:-

$$\rho = 1000 \text{ kg/m}^3 \quad g = 9.8 \text{ m/s}^2, \quad h_2 = 70$$

$$= 0.70$$

To find:-

$$P = ?$$

Sol:-

$$P = \rho gh$$

$$P = 1000 \times 9.8 \times 70$$

$$= 68600 \text{ Pa}$$

$$= 6.86 \text{ KPA}$$

4, 12, 2025

C.W

Chapter # 05

★ Hydraulic lift:

(i) **Working Principle:** It is a machine that works on the Pascal's Principle.

(ii) **Construction:** It consists of 2 cylinders A_1 and A_2 filled with piston.

(iii) **Working:** The object that is to be lifted is placed over a piston of larger area A_1 . The force F_1 is applied on piston of smaller area A_2 . The pressure produced by force is transmitted equally to the piston of Area (A_1). The force F_2 that acts on larger piston is much greater than the force F_1 on smaller piston.

The pressure of piston of smaller area A_1 is given as:

$$P_1 = \frac{F_1}{A_1} \rightarrow (1)$$

Similarly, the pressure on piston lifting vehicle is P_2 , which is written as:

$$P_2 = \frac{F_2}{A_2} \rightarrow (2)$$

By Pasche Principle
 $P_2 = P_1$

Putting eq. 1 in eq. 2

$$F_2 = \frac{A_2}{A_1} F_1$$

$$\frac{F_2}{A_2} = \frac{F_1}{A_1}$$

Force Multiplier: Since the ratio of $A_2:A_1$ is greater than 1, hence F_2 acts on larger piston is greater than F_1 acting on small piston, The hydraulic system working on this way is force

multiplier - $\frac{A_2}{A_1} > 1$

NP# 05

Given Data:

$$A = 20\text{cm}^2 = 0.0002\text{m}^2$$

$$p = 4500\text{Pa}$$

To Find:

$$F = ?$$

Sol:-

$$p = \frac{F}{A}$$

$$F = p \times A$$

$$F = 4500 \times 0.0002$$

$$F = 9\text{N}$$

Ans
16/04/25

= 95hp

chp#5

Elasticity: Property of matter due to which material returns to its original position -

Solid > Liquid > Gas $\rightarrow$ Elasticity

Solid < Liquid < Gas $\rightarrow$ intermolecular spaces -

Inelastic Material: - not return -
Glass, Clay -

Elastic limit:

Most material are elastic upto a certain limit known as elastic limit -

Hooke's law:

It is only applicable upto proportionality limit -

$$\vec{F} \propto \vec{x}$$

"within elastic limit's extension x is directly proportional to restoring force -

$F_{\text{restoring}}$ = The force that push or pull body ~~to~~ towards mean position -

$$\vec{F} \propto \vec{x}$$

$$F = -kx$$

Q) what negative sign tells

negative sign indicates opposite direction - Both Force and displacement are opposite in direction -

At Mean Position :-

$$x = 0$$

$$F = -kx$$

$$F = -k(0)$$

$$F = 0$$

Spring Constant ::

Ratio b/w restoring force and displacement -

Q) what will happen if we double the force what

Gradient of F/x is spring constant -

will be effect on k ?

Value of k does not depend on Force and ~~dist~~ displacement -

$$k = \frac{\Delta F}{\Delta x}$$

$$k = \frac{F}{x}$$



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