DPP

DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 4

Topic :- MECHANICAL PROPERTIES OF SOLIDS

1 **(b)**

Let the change in position of the body due to additional force is x.

So, $F = \frac{1}{2}k\,x$

$\therefore\ x = \frac{2F}{k}$

3 **(a)**

$l = \frac{FL}{AY} \therefore l \propto \frac{1}{r^2}$ [Y,L and F are constant]

i.e. for the same load, thickest wire will show minimum elongation. So graph D represent the thickest wire

4 **(a)**

$$l = \frac{L^2 dg}{2Y} = \frac{(10)^2 \times 1500 \times 10}{2 \times 5 \times 10^8} = 15 \times 10^{-4} m$$

5 **(d)**

$$\tau_x = \frac{\pi\eta r^4}{2l}\theta_x \quad \text{and} \quad \tau_y = \frac{\pi\eta(2r)^4}{2l}\theta_y$$

Since, $\tau_x = \tau_y$,

$$\therefore\ \theta_x = 16\theta_y \quad \text{or} \quad \frac{\theta_x}{\theta_y} = 16$$

6 **(a)**

$F = -5x - 16x^3 = -(5 + 16x^2)x = -kx$

$\therefore k = 5 + 16x^2$

Work done, $W = \frac{1}{2}k_2x_2^2 - \frac{1}{2}k_1x_1^2$

$$= \frac{1}{2}[5 + 16(0.2)^2](0.2)^2 - \frac{1}{2}[5 + 16(0.1)^2](0.1)^2$$

$$= 2.82 \times 4 \times 10^{-2} - 2.58 \times 10^{-2} = 8.7 \times 10^{-2} J$$

7 **(b)**

When a wire is stretched work is done against the interatomic forces. This work is stored in the wire in the form of elastic potential energy.

$$W = \frac{1}{2} \times \text{stress} \times \text{strain} \times \text{volume of wire}$$

Also, when strain in small, ratio of longitudinal stress to corresponding longitudinal strain is called Young's modulus of material of body.

$$Y = \frac{\text{longitudinal stress}}{\text{longitudinal strain}}$$

$$\therefore W = \frac{1}{2} \times \text{stress} \times \frac{\text{stress}}{\text{Y}} \times \text{volume}$$

$$= \frac{(\text{stress})^2 \times \text{volume}}{2Y}$$

8 **(b)**

According the Hooke's law modulus of elasticity E.

$$= \frac{\text{Stress}}{\text{Strain}} = \text{Constant}$$

Hence, if stress is increased, then the ratio of stress to strain remains constant.

9 **(c)**

Work done is stretching a wire,

$$U = \frac{1}{2} \times \frac{YAl^2}{L}$$

$$= \frac{1}{2} \times \frac{2 \times 10^{11} \times 3 \times 10^{-6} \times (1 \times 10^{-3})^2}{4}$$

$$= 0.075 \text{ J}$$

10 **(a)**

$$\eta = \frac{Y}{2(1+\sigma)}, \qquad \sigma = 0$$

$$\therefore \quad \eta = \frac{Y}{2} = \frac{6 \times 10^{12}}{2} = 3 \times 10^{12} \text{ Nm}^{-2}$$

11 **(a)**

$F = 2000N, L = 6m, l = 0.5cm, A = 10^{-6}m^2$

$$Y = \frac{FL}{Al} = \frac{2000 \times 6}{10^{-6} \times 0.5 \times 10^{-2}} = 2.35 \times 10^{12} N/m^2$$

12 **(a)**

Energy density $= \frac{1}{2}$ stress $\times$ strain

$$= \frac{1}{2}\text{stress} \times \frac{\text{stress}}{Y} = \frac{(\text{stress})^2}{2Y} \propto \frac{1}{D^4}$$

Now , $\frac{u_A}{u_B} = \frac{D_B^4}{D_A^4} = (2)^4 = 16$

13 **(a)**

If (A) is the area of cross-section and l is the length of rope, the mass of rope, $m = \frac{Al}{\rho}$. As the weight of the rope acts at the mid-point of the rope.

So, $Y = \frac{mg}{A} \times \frac{(I/2)}{\Delta l}$

$\Delta l = \frac{mgl}{2AY} = \frac{Al\rho gl}{2AY} = \frac{g\rho l^2}{2AY}$

Or $\Delta l = \frac{9.8 \times 1.5 \times 10^3 \times 8^2}{2 \times 5 \times 10^6} = 9.6 \times 10^2\text{m}$

14 **(a)**

Assume original length of spring $= l$

$mg = kx$

$k_1(60) = k_2(l - 60) = kl$

$\therefore \quad mg = k_1 = (7.5)$ according to question

And $mg = k_2 = (5.0)$

$\therefore \quad k_1 = \frac{kl}{60}, k_2 = \frac{kl}{l - 60}$

$\frac{k_1}{k_2} = \frac{5.0}{7.5} = \frac{l - 60}{60}$

$\Rightarrow \quad \frac{2}{3} = \frac{l - 60}{60}$

$\therefore \quad l = 100$ cm

And $kx = k_1 \times 7.5$

$kx = \left(\frac{5k}{3}\right) \times 7.5$

$\therefore \quad x = 12.5$ cm

15 **(c)**

$K = \frac{F}{l}$ and $W = \frac{1}{2}Fl = \frac{1}{2}Kl \times l = \frac{1}{2}Kl^2$

16 **(c)**

For twisting, Angle of shear $\phi \propto \frac{1}{L}$

i.e. if L is more then ϕ will be small

17 **(b)**

$2\pi\sqrt{\frac{m}{k}} = 0.6$ ...(i) and $2\pi\sqrt{\frac{m + m'}{k}} = 0.7$ ...(ii)

Dividing (ii) by (i), we get $\left(\frac{7}{6}\right)^2 = \frac{m + m'}{m} = \frac{49}{36}$

$\frac{m + m'}{m} - 1 = \frac{49}{36} - 1 \Rightarrow \frac{m'}{m} = \frac{13}{36}$

$\Rightarrow m' = \frac{13m}{36}$

Also $\frac{k}{m} = \frac{4\pi^2}{(0.6)^2}$

Desired extension $= \frac{m'g}{k} = \frac{13}{36} \times \frac{mg}{k}$

$\frac{13}{36} \times 10 \times \frac{0.36}{4\pi^2} = 3.5\ cm$

18 **(a)**

$L = \frac{P}{dg} = \frac{10^6}{3 \times 10^3 \times 10} = \frac{100}{3} = 34m$

19 **(d)**

Equal stress

$\frac{F_1}{A_1} = \frac{F_2}{A_2} \Rightarrow \frac{F_1}{F_2} = \frac{0.1}{0.2} = \frac{1}{2}$

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	B	A	A	A	D	A	B	B	C	A
Q.	11	12	13	14	15	16	17	18	19	20
A.	A	A	A	A	C	C	B	A	D	B