DPP

DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 6

Topic :- MECHANICAL PROPERTIES OF SOLIDS

1 **(d)**

$$\frac{Y_A}{Y_B} = \frac{\tan\theta_A}{\tan\theta_B} = \frac{\tan 60}{\tan 30} = \frac{\sqrt{3}}{1/\sqrt{3}} = 3 \Rightarrow Y_A = 3Y_B$$

2 **(b)**

$$Y = \frac{Fl}{A\Delta l}$$

$Y, F \; and \; l$ are constants.

$$\therefore \frac{\Delta l_2}{\Delta_1} = \frac{a_1}{a_2} = \frac{4}{8} = \frac{1}{2}$$

Or $\Delta l_2 = \frac{\Delta l_1}{2} = \frac{0.1}{2}\text{mm} = 0.5 \text{ mm}$

3 **(d)**

Energy stored per unit volume is given by

$$W = \frac{Y \times (\text{strain})^2}{2}$$

$$= \frac{10^{11}}{2} \times \left(\frac{\text{change in length}}{\text{original length}}\right)^2$$

where Y is Young's modulus

$$= \frac{10^{11}}{2}\left(\frac{\propto L\Delta\theta}{L}\right)^2$$

$$= \frac{10^{11}}{2}(12 \times 10^{-6} \times 20)^2 = 2880 \text{ Jm}^{-3}$$

4 **(b)**

In ductile materials, yield point exist while in Brittle material, failure would occur without yielding

5 **(b)**

Initial elastic potential energy

$$U_1 = \frac{1}{2} F\Delta l = \frac{1}{2} = \frac{1}{2} \times (100 \times 1000) \times (1.59 \times 10^{-3}) = 79.5 \text{ J}$$

Let Δl_1, be the elongation in the rod when stretching force is increased by, 200N, Since, $\Delta l = \frac{F}{\pi r^2} \times \frac{l}{Y}; so, \Delta l \propto F$

$\therefore \qquad \frac{\Delta l_1}{\Delta l} = \frac{F_1}{F} = \frac{100 + 200}{100} = 3$

Or $\qquad \Delta l_1 = 3\Delta l = 3 \times 1.59 \times 10^{-3}\text{m} = 4.77 \times 10^{-3}$ m

Final elastic potential energy is

$U_1 = \frac{1}{2}F_1\Delta l_1 = \frac{1}{2} \times (300 \times 10^3) \times (4.77 \times 10^{-3}) = 715.5$ J

Increase in elastic potential energy

= 715.5-79.5 = 636.0 J

6 **(c)**

Elastic potential energy(U) is given by

$U = \frac{1}{2}F \times l$

$= \frac{1}{2} \times \frac{F}{A} \times \frac{l}{L} \times AL \quad$ ...(i)

where, L is length of wire, A is area of cross-section of wire, F is stretching force and l is increase in length.

Eq. (i) may be written as

$U = \frac{1}{2} \times$ stress × strain × volume of the wire

$\therefore$ Elastic potential energy per unit volume of the wire

$u = \frac{U}{AL} = \frac{1}{2} \times$ stress × srain

$= \frac{1}{2} \times$ (Young's modulus × strain) × strain

$= \frac{1}{2} \times (Y) \times (\text{strain})^2$

Hence,

$u = \frac{1}{2} \times 1.1 \times 10^{11} \times \left(\frac{0.1}{100}\right)^2$

$= 5.5 \times 10^4 \text{Jm}^{-3}$

7 **(b)**

$T_1 = K(l - l_1)$

$T_2 = K(l - l_2)$

So, $\frac{T_1}{T_2} = \frac{l - l_1}{(l - l_2)}$

$\therefore \ T_1 l - T_1 l_2 = T_2 l - T_2 l_1$

$(T_1 - T_2)l = T_1 l_2 - T_2 l_1$

$l = \frac{T_1 l_2 - T_2 l_1}{(T_1 - T_2)}$

$l = (5a - 4b)$ ....(i)

$k = \frac{1}{b - a}$ ....(ii)

So, length of wire when tension is 9 N

$9 = kl'$ $\qquad$ ($l' =$ change in length)

$9 = \frac{1}{(b-a)} \times l' \Rightarrow l' = 9b - 9a$

Hence, final length = $l + l'$

= $5a - 4a + 9a - 9a$

$l_0 = 5b - 4a$

8 **(c)**

$$W = \frac{YAl^2}{2L} = \frac{2 \times 10^{10} \times 10^{-6} \times (10^{-3})^2}{2 \times 50 \times 10^{-2}} = 2 \times 10^{-2} J$$

9 **(c)**

Energy $U = \frac{1}{2} \times \frac{4Al^2}{L}$

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

= 0.075 J

10 **(a)**

$$F = YA\frac{\Delta L}{L} = 2 \times 10^{11} \times (10^{-4}) \times 0.1 = 2 \times 10^6 \text{ N}$$

11 **(d)**

Energy stored per unit volume

$$= \frac{1}{2} Y \, (\text{strain})^2 = \frac{1}{2} \times 1.5 \times 10^{12} \times (2 \times 10^{-4})^2$$

= 3×10^4 Jm^{-3}

12 **(a)**

$Y = 3K(1 - 2\sigma)$ and $Y = 2\eta(1 + \sigma)$

Eliminating σ we get $Y = \frac{9\eta K}{\eta + 3K}$

13 **(b)**

Work done = $\frac{1}{2} F \times \Delta l = \frac{1}{2} Mgl$

14 **(a)**

In the figure OA, stress $\propto$ strain *i.e*. Hooke's law hold good

15 **(d)**

$Y = 2\eta(1 + \sigma)$

$\Longrightarrow \; 2.4\eta = 2\eta(1 + \sigma)$

$\Longrightarrow \; 1.2 = 1 + \sigma$

$\Longrightarrow \; \sigma = 0.2$

16 **(d)**

There will be both shear stress and normal stress

17 **(b)**

Young's modulus $Y = \frac{\text{Stress}}{\text{Strain}} = \frac{\frac{F}{A}}{\text{Strain}}$

or $Y \frac{mg}{A \times \text{strain}}$

or $m = \frac{Y \times A \times \text{strain}}{g}$

$$= \frac{2 \times 10^{11} \times 10^{-3} \times 10^{-6}}{10} = 60\text{kg}$$

18 **(c)**

Breaking Force $\propto$ Area of cross section of wire (πr^2) If radius of wire is double then breaking force will become four times

19 **(a)**

Extensions $\Delta l = \left(\frac{L}{YA}\right) \cdot W$

ie, graph is a straight line passing through origin (as shown in question also), the slope of which is $\frac{L}{YA}$

Slope $= \left(\frac{L}{YA}\right)$

$Y = \left(\frac{L}{A}\right)\left(\frac{1}{\text{slope}}\right)$

$= \left(\frac{1.0}{10^{-6}}\right) \frac{(80 - 20)}{(4 - 1) \times 10^{-4}}$

$= 2.0 \times 10^{11} \text{Nm}^{-2}$

20 **(b)**

$Y = \frac{F}{\pi R^2} \times \frac{l}{\Delta l}$

F, l *and* Δl are constants.

$\therefore \; R^2 \propto \frac{1}{Y}$

$\frac{R_S^2}{R_B^2} = \frac{Y_B}{Y_S} = \frac{10^{11}}{2 \times 10^{11}} = \frac{1}{2}$

Or $\frac{R_S}{R_B} = \frac{1}{\sqrt{2}}$ or $R_S = \frac{R_B}{\sqrt{2}}$

PE

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