DPP

DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 7

Topic :- MECHANICAL PROPERTIES OF SOLIDS

1 **(c)**

$W = \frac{1}{2}\frac{YAl^2}{L} \Rightarrow 0.4 = \frac{1}{2} \times \frac{Y \times 1^{-6} \times (0.2 \times 10^{-2})^2}{1}$

$\therefore Y = 2 \times 10^{11} N/m^2$

2 **(d)**

Elastic potential energy per unit volume

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

3 **(a)**

$Y = \frac{FV}{A^2 \Delta l}$

$\Delta l \propto \frac{1}{A^2}$ or $\Delta l \propto \frac{1}{D^4}$

$\therefore \frac{\Delta l_A}{\Delta l_B} = \frac{D_B^4}{D_A^4} = \frac{1^4}{\left(\frac{1}{2}\right)^4} = 16$

$Y = \frac{F}{A} \times \frac{l}{\Delta l}$

Now, $V = Al$ or $l \frac{V}{A}$ $\therefore$ $Y = \frac{FV}{A^2 \Delta l}$

4 **(c)**

$\Delta l = \frac{4Fl}{\pi D^2 Y}$

$= \frac{4 \times 30 \times 2 \times 7}{22 \times (3 \times 10^{-3})^2 \times 1.1 \times 10^{11}}$

$= 7.7 \times 10^{-5}\text{m} = 0.077\text{mm}$

6 **(d)**

Increase in tension of wire $= YA\alpha\Delta\theta$

$= 8 \times 10^{-6} \times 2.2 \times 10^{11} \times 10^{-2} \times 10^{-4} \times 5 = 8.8\ N$

7 **(b)**

$Y_s = \frac{Fl_s}{A_s \Delta L_s}$

And $Y_C = \frac{FL_C}{A_C \Delta L_C}$

$$\therefore \quad \frac{L_C}{L_S} = \frac{\frac{Y_C A_C \Delta L_C}{F}}{\frac{Y_S A_S \Delta L_S}{F}} = \left(\frac{Y_C}{Y_S}\right)\left(\frac{A_C}{A_S}\right)\left(\frac{\Delta L_C}{\Delta L_S}\right)$$

Here, $\frac{A_C}{A_S} = 2, \frac{\Delta L_C}{\Delta L_S} = 1, \frac{Y_C}{Y_S} = \frac{1.1}{2}$

$$\therefore \quad \frac{L_C}{L_S} = \frac{1.1}{2} \times 2 \times 1 = 1.1$$

8 **(c)**

Potential energy stored in the rubber cord catapult will be converted into kinetic energy of mass

$$\frac{1}{2} mv^2 = \frac{1}{2} \frac{YAl^2}{L} \Rightarrow v = \sqrt{\frac{YAl^2}{mL}}$$

$$= \sqrt{\frac{5 \times 10^8 \times 25 \times 10^{-6} \times (5 \times 10^{-2})^2}{5 \times 10^{-3} \times 10 \times 10^{-2}}} = 250 m/s$$

9 **(a)**

Young's modulus of a material is given by

$$Y = \frac{F \times L}{A \times l}$$

For a perfectly rigid body,

$l = 0$

$\therefore Y = \infty$ (infinite)

10 **(b)**

Longitudinal strain $\alpha = \frac{l_2 - l_1}{l_1} = 10^{-3}$

$$\frac{l_2}{l_1} = 1.001$$

Poisson's ratio, $\sigma = \frac{\text{lateral strain}}{\text{longitudinal strai}} = \frac{\beta}{\alpha}$

Or $\beta = \sigma\alpha = 0.1 \times 10^{-3} = 10^{-4} = \frac{r_1 - r_2}{r_1}$

Or $\frac{r_2}{r_1} = 1 - 10^{-4} = 0.9999$

% increase in volume = $\left(\frac{V_2 - V_1}{V_1}\right) \times 100$

$= \left(\frac{\pi r_2^2 l_2 - \pi r_1^2 l_1}{\pi r_1^2 l_1}\right) \times 100 = \left(\frac{r_2^2 l_2}{r_1^2 l_1} - 1\right) \times 100$

$= [(0.9999)^2 \times 1.001 - 1] \times 100 = 0.08\%$

11 **(b)**

$$U = \frac{F^2}{2K} = \frac{T^2}{2K}$$

12 **(c)**

$$Y = \frac{Mgl}{\pi r^2 \times l} = \frac{4 \times (3.1\pi) \times 2.0}{\pi \times (2 \times 10^{-3})^2 \times 0.031 \times 10^{-3}}$$

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

13 **(d)**

10 m column of water exerts nearly 1 atmosphere pressure. So, 100 m column of water exerts nearly 10 atmospheric pressure, *ie*, 10×10^5 Pa or 10^6 Pa.

14 **(c)**

Work done $= \frac{1}{2}Fl = \frac{Mgl}{2}$

15 **(c)**

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

If spring constant is k for the first case, it is $\frac{k}{2}$ for second case.

For first case, $1 = \frac{4}{k}$ ....(i)

For second case, $x' = \frac{6}{k/2} = \frac{12}{k}$ ....(ii)

Dividing Eq. (ii) by Eq. (i), we get

$$x' = \frac{12/k}{4/k} = 3 \text{ cm}$$

16 **(a)**

$$Y = \frac{(mg + ml\omega)l}{\pi r^2 \Delta l}$$

Or $\Delta l = \frac{m(g + ml\omega^2)l}{\pi r^2 Y}$

Or $\Delta l = \frac{1(10 + 2 \times 4\pi^2 \times 4)^2}{\pi(1 \times 10^{-3})^2 \times 2 \times 10^{11}}$

Or $\Delta l = \frac{(20 + 64 \times 9.88)7}{2 \times 22 \times 10^5}$

$= \frac{4566.24}{44 \times 10^5} \times 10^3 \text{ mm} = 1 \text{ mm}$

17 **(a)**

In accordance with Hook's law

18 **(c)**

Work done $= \frac{1}{2}F \times$ extension

$= \frac{1}{2} \times \frac{YA}{L} \times 1$ $\quad \left| Y = \frac{F \times L}{A \times 1} \right.$

$= \frac{YA}{2L}$ $\quad \left| F = \frac{YA}{L} \right.$

20 **(b)**

As $\pi\theta = l\phi$; so $\phi = \frac{0.4 \times 30°}{100} = 0.12°$

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