DPP

DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 3

Topic :- MECHANICAL PROPERTIES OF SOLIDS

1 **(b)**

$E = \frac{1}{2}\frac{YA/\Delta l^2}{l}$

But $m = Ald$ or $A = \frac{m}{ld}$

$\therefore \; E = \frac{Ym_{\Delta}l^2}{2l^2 d}$

E in calorie $= \frac{Ym_{\Delta}l^2}{2l^2 d}$

Now, $mS\theta = \frac{\mathrm{Ym\Delta l^2}}{2l^2 dJ}$ or $\theta = \frac{\mathrm{Y}_{\Delta}l^2}{2l^2 dJS}$

Or $\theta = \frac{12 \times 10^{11} \times 10^{-1} \times 10^{-3} \times 10^{-3}}{2 \times 2 \times 2 \times 9 \times 10^3 \times 4.2 \times 0.1 \times 10^3}$

$= \frac{12 \times 10^5}{72 \times 42 \times 10^5} = \frac{1}{252}$°C

2 **(a)**

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

$\frac{l_2}{l_1} = \frac{L_2}{L_1} \times \left(\frac{r_1}{r_2}\right)^2 = (2) \times \left(\frac{1}{2}\right)^2 = \frac{1}{2}$

$\Rightarrow l_2 = \frac{l_1}{2} = \frac{0.01m}{2} = 0.005m$

3 **(d)**

Stress $= \frac{\text{Force}}{\text{area}}$

In the present case, force applied and area of cross-section of wires are same, therefore stress has to be the same

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

Since the Young's modulus of steel wire is greater than the copper wire, therefore, strain in case of steel wire is less than that in case of copper wire

5 **(a)**

$\eta = \frac{F}{A\theta} = \frac{5 \times 10^5}{100 \times 10^{-4} \times 0.001} = 5 \times 10^{10}\mathrm{Nm^{-2}}$

6 **(a)**

$$\frac{dV}{V} = (1+2\sigma)\frac{dL}{dL}$$

If $\sigma = -\frac{1}{2}$ then $\frac{dV}{V} = 0$ $i.e.\ K = \infty$

7 **(d)**

Poisson's ratio is 0.5 so there is no change in the volume.

8 **(a)**

$$Y = \frac{FL}{Al} = \frac{1000 \times 100}{10^{-6} \times 0.1} = 10^{12} N/m^2$$

9 **(d)**

$$K = \frac{p}{-\frac{\Delta V}{V}} \Rightarrow K = \frac{h\rho g}{0.1 \times 10^{-2}}$$

$$\Rightarrow h = \frac{K \times 0.1 \times 10^{-2}}{\rho g} = \frac{9 \times 10^8 \times 10^3}{10^3 \times 10} = 90\ m$$

10 **(c)**

Increase in length $l = \frac{FL}{AY}$

or $l = \frac{FL}{\pi r^2 Y}$

Percent increase in length

$$\Delta x = \frac{l}{L} \times 100 = \frac{F}{\pi r^2 Y}$$

Here, same longitudinal force is applied.

So, $\frac{\Delta x_1}{\Delta x_2} = \left(\frac{r_2}{r_1}\right)^2 \cdot \left(\frac{Y_2}{Y_1}\right)$

$\frac{1}{\Delta x_2} = \left(\frac{1}{2}\right)^2 \cdot \left(\frac{2}{1}\right) = \frac{1}{4} \times \frac{2}{1}$

$\frac{1}{\Delta x_2} = \frac{1}{2}$

$\Delta x_2 = 1 \times 2 = 2\%$

11 **(a)**

$F = YA\alpha T$;

$$\frac{F_{Cu}}{F_{Fe}} = \frac{\alpha_{Cu}}{\alpha_{Fe}} = \frac{3}{2}$$

13 **(b)**

At point b, yielding of material starts

14 **(c)**

Restoring force is zero at mean position

$$F = -Kx + F_0 \Rightarrow 0 = -Kx + F_0 \Rightarrow x = \frac{F_0}{K}$$

$i.e.$ the particle will oscillate about $x = \frac{F_0}{K}$

$$\Rightarrow F_0 = Kx \Rightarrow ma = Kx \Rightarrow a = \frac{K}{m}n \therefore W = \sqrt{\frac{K}{m}}$$

15 **(b)**

Strain $\propto$ Stress $\propto \frac{F}{A}$

Ratio of strain $= \frac{A_2}{A_1} = \left(\frac{r_2}{r_1}\right)^2 = \left(\frac{4}{1}\right)^2 = \frac{16}{1}$

16 **(b)**

$\frac{1}{K} = \frac{\Delta V/V}{\Delta p}$ or $\frac{\Delta V}{V} = \Delta p\left[\frac{1}{K}\right]$

Or $\frac{\Delta V}{V} \times 100 = 10^5 \times 8 \times 10^{-12} \times 100 = 8 \times 10^{-5}$

17 **(a)**

$$Y = \frac{F/A}{\text{Strain}} \Rightarrow \text{strain} = \frac{F}{AY}$$

18 **(b)**

$$F = -\left(\frac{dU}{dx}\right)$$

In the region BC slope of the graph is positive

$\therefore F =$ negative *i.e.* force is attractive in nature

In the region AB slope of the graph is negative

$\therefore F =$ positive *i.e.* force is repulsive in nature

19 **(a)**

Total work done in the stretching a string

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

Hence, the work done per unit volume is $\frac{1}{2}$(stress $\times$ strain).

This work is stored as the potential energy in the string.

20 **(b)**

$$Y = \frac{FL}{Al} = \frac{4FL}{\pi l^2 l}; F = mg$$

Where L = length of the wire

$l =$ elongation of the wire

d = diameter of the wire

substituting the values, we get $Y = 2 \times 10^{11} N/m^2$

$$\Rightarrow \frac{\Delta Y}{Y} = 2\frac{\Delta d}{d} + \frac{\Delta l}{l} = 2\left(\frac{0.01}{0.4}\right) + \frac{0.05}{0.8} = \frac{9}{80}$$

$$\Rightarrow \Delta Y = \frac{9}{80} \times Y = \frac{9}{80} \times 2 \times 10^{11} = 0.2 \times 10^{11} N/m^2$$

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