# DPP

DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

**Solutions**

SUBJECT : PHYSICS
DPP NO. : 9

## Topic :- MECHANICAL PROPERTIES OF SOLIDS

2 **(d)**

Young's modulus $Y = \frac{FL}{Al}$

or $F = \frac{YAl}{L}$

or $F \propto A$ or $F \propto r^2$ or $F \propto d^2$

$\therefore \quad \frac{F_1}{F_2} = \frac{d_1^2}{d_2^2}$

Given, $d_1 = d,\ d_2 = 2d, F_1 = 200\text{N}$

$\therefore \quad \frac{200}{F_2} = \frac{(d)^2}{(2d)^2} = \frac{1}{4}$

or $\quad F_2 = 4 \times 200 = 800\text{N}$

3 **(b)**

$F =$ force developed

$= YA \propto (\Delta\theta)$

$= 10^{11} \times 10^{-4} \times 10^{-5} \times 100 = 10^4\text{N}$

4 **(c)**

For cylinder A,

$\tau = \frac{\pi\eta r^4}{2l}\ \theta'$

For cylinder $B$, $\tau = \frac{\pi\eta(2r)^4(\theta - \theta')}{2l}$

$\frac{\pi\eta r^4\theta'}{2l} = \frac{\pi\eta(2r)^4(\theta - \theta')}{2l}$

$\theta' = \frac{16}{17}\theta$

6 **(d)**

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

$\frac{l_1}{l_2} = \left(\frac{r_2}{r_1}\right)^2 = (2)^2 = 4$

7 **(a)**

Thermal stress $= Y\alpha\Delta\theta$

$= 1.2 \times 10^{11} \times 1.1 \times 10^{-5} \times (20 - 10) = 1.32 \times 10^{7} N/m^2$

8 **(b)**

Bulk modulus $K = \frac{\Delta p}{\Delta V} V$

$$\Delta p = \frac{K \Delta V}{V}$$

$$\Delta p = \frac{2100 \times 10^6 \times 0.008}{200} = 84 \text{ kPa}$$

10 **(d)**

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

Given, $F/A =$ stress $= 3.18 \times 10^8 Nm^{-2}$

$l = 1m, Y = 2 \times 10^{11} Nm^{-2}$

$$\Delta l = \frac{lF/A}{Y} = \frac{1 \times 3.18 \times 10^8}{2 \times 10^{11}} = 1.59 \times 10^{-3} m = 1.59 mm$$

11 **(c)**

Isothermal elasticity $K_i = P = 1atm = 1.013 \times 10^5 \ N/m^2$

12 **(a)**

Young's modulus, $Y = \frac{mgL}{Al}$

$$\Rightarrow \frac{l}{L} = \frac{mg}{AY}$$

$$\therefore \frac{l}{L} = \frac{1 \times 10}{3 \times 10^{-6} \times 10^{11}}$$

$= 0.3 \times 10^{-4}$

13 **(b)**

$$\eta = \frac{Y}{2(1+\sigma)} \text{ or } \eta = \frac{2.4\,\eta}{2(1+\sigma)}$$

Or $1 + \sigma = 1.2$ or $\sigma = 0.2$

14 **(c)**

From figure the increase in length $\Delta l = (PR + RQ) - PQ$

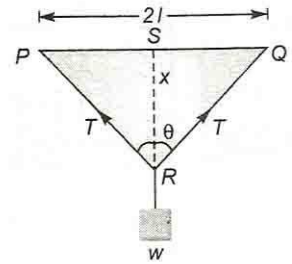
$= 2PR - PQ$

$= 2(l^2 + x^2)^{1/2} - 2l = 2l\left(1 + \frac{x^2}{l^2}\right)^{1/2} - 2l$

$= 2l\left[1 + \frac{1}{2}\frac{x^2}{l^2}\right] - 2l$

$= x^2/l$ ( By Binomial theorem)

$\therefore$ Strain $= \Delta l/2l = x^2/2l^2$




15 **(c)**

Work done on the wire to strain it will be stored as energy which is converted to heat. Therefore, the temperature increases.

16 **(a)**

Because dimension of invar does not vary with temperature

17 **(c)**

Bulk modulus, $B = -\frac{P}{\left(\frac{\Delta V}{V}\right)}$

- ve sign shows that with an increase in pressure, a decrease in volume occurs

Compressibility, $k = \frac{1}{B} = -\frac{\Delta V}{PV}$

Decrease in volume, $\Delta V = PVk$

$= 4 \times 10^7 \times 1 \times 6 \times 10^{-10} = 24 \times 10^{-3}$ litre

$= 24 \times 10^{-3} \times 10^3 cm^3 = 24\ cc$

18 **(a)**

Shearing modulus of cube

$$\eta = \frac{FL}{Al}$$

$$= \frac{8 \times 10^3 \times 40 \times 10^{-3}}{(40 \times 10^{-3})^2 \times (0.1 \times 10^{-3})} = 2 \times 10^9 \text{Nm}^{-2}$$

19 **(d)**

$$Y = \frac{F}{A} \times \frac{L}{l} \text{ or force constant} = \frac{F}{l} = \frac{YA}{L}$$

20 **(b)**

$K = Yr_0 = 20 \times 10^{10} \times 3 \times 10^{-10} = 60\ N/m$

$= 6 \times 10^{-9} N/Å$

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