## ANSWERS FOR SHORT QUESTIONS (3 MARKS)

**73.** The ultimate stress should not exceed elastic limit of steel ($30 \times 10^7$ N/m$^2$)

$$U = \frac{F}{A} = \frac{Mg}{\pi r^2} = \frac{10^5 \times 9.8}{\pi r^2} = 30 \times 10^7$$

$\therefore r = 3.2$ cm

So to lift a bad of $10^4$ kg, crane is designed to withstand $10^5$ kg. To impart flexibility the rope is made of large number of thin wires braided.

**74.** (a) Wire with larger plastic region is more ductile material A.

(b) Young's modulus is $\frac{\text{Stress}}{\text{Strain}}$

$\therefore Y_A > Y_B$

(c) For given strain, larger stress is required for A than that for B.

$\therefore$ A is stronger than B.

(d) Material with smaller plastic region is more brittle, therefore B is more brittle than A.

**76.** (i) In case (a) Pressure head, $h = +20$ cm of Hg

Absolute Pressure = $P + h = 76 + 20 = 96$ cm of Hg.

Gauge Pressure = $h = 20$ cm of Hg.

In case (b) Pressure Head $h = -18$ cm of Hg

Absolute Pressure = $76 - 18 = 58$ cm of Hg

Gauge Pressure = $h = -18$ cm of Hg

**77.** as

$$h_1 p_1 g = h_2 p_2 g$$

$$h_1 \times 13.6 \times g = 13.6 \times 1 \times g$$

$$h_1 = 1 \text{ cm}$$

Therefore as 13.6 cm of $H_2O$ is poured in right limb it will displace Hg level by 1 cm in the left limb, so that difference of levels in the two limbs will become 19 cm.

**79.** $$v = \frac{2}{9}\left[\frac{g(\sigma-\rho)r^2}{\eta}\right]$$

$\Rightarrow$ $$\frac{v}{r^2} = \frac{2g}{9\eta}(\sigma-\rho) \quad \text{...(1)}$$

Similarly, $$\frac{v'}{R^2} = \frac{2g}{9\eta}(\sigma-\rho) \quad \text{...(2)}$$

Divididng 1 by 2,

$$\frac{v}{v'} = \frac{r^2}{R^2} \Rightarrow v' = v\left(\frac{R}{r}\right)^2$$

If N drops coalesce, then

Volume of one big drop = Volume of N droplets

$$\frac{4}{3}\pi R^3 = N\left(\frac{4}{3}\pi r^3\right)$$

$$R = N^{1/3}r$$

$\therefore$ Terminal velocity of bigger drop

$$=\left(\frac{R}{r}\right)^2 \times v \text{ from equation (1)}$$

$$=N^{2/3}\, v \text{ from equation (2)}$$

**80.** Let $P_1$ & $P_2$ be the pressures inside the two bubbles, then

$$P_1 - P = \frac{4T}{r_1} \Rightarrow P_1 = P + \frac{4T}{r_1}$$

$$P_2 - P = \frac{4T}{r_2} \Rightarrow P_2 = P + \frac{4T}{r_2}$$

When bubbles coalesce

$$P_1V_1 + P_2V_2 = PV \quad \text{...(1)}$$

$\therefore$ The pressure inside the new bubble

$$P = P + \frac{4T}{r}$$

Substituting for P, $P_1$ & $P_2$ in equation (1)

$$\left(P+\frac{4T}{r_1}\right)\frac{4}{3}\pi r_1^3+\left(P+\frac{4T}{r_2}\right)\frac{4}{3}\pi r_2^3=\left(P+\frac{4T}{r}\right)\frac{4}{3}\pi r^3$$

or $$\frac{4}{3}\pi P(r_1^3+r_2^3-r^3)+\frac{16\pi T}{3}[r_1^2+r_2^2-r^2]=0$$

Given change in volume,

$$V=\frac{4}{3}\pi r_1^3+\frac{4}{3}\pi r_2^3-\frac{4}{3}\pi r^3 \quad ...(3)$$

Change in Area

$$4\pi r_1^2+4\pi r_2^2-4\pi r^2 \quad ...(4)$$

Using equation (3) and (4) in (2), we get

$$PV+\frac{4T}{3}A = 3\,PV+4TA=0$$