Test Paper 3

1. State the law of floatation?

Ans. Law of floatation states that a body will float in a liquid, if weight of the liquid displaced by the immersed part of the body is at least equal to or greater than the weight of the body.

2. The blood pressure of humans is greater at the feet than at the brain?

Ans. The height of the blood column in the human body is more at the feet than at the brain as since pressure is directly dependent on height of the column, so pressure is more at feet than at the brain.

3. Define surface tension?

Ans. It is measured as the force acting on a unit length of a line imagined to be drawn tangentially anywhere on the free surface of the liquid at rest

4. State the angle of contact and on what values do the angle of contact depends?

Ans. Angle of contact between a liquid and a solid is defined as the angle enclosed between the tangents to the liquid surface and the solid surface inside the liquid, both the tangents being drawn at the point of contact of liquid with the solid.

It depends upon:-

1) Upon nature of liquid and solid in contact

2) The Medium which exists above the free surface of liquid.

5. Hydrostatic pressure is a scalar quantity even though pressure is force divided by area, and force is a vector. Explain?

Ans. Since due to applied force on liquid, the pressure is transmitted equally in all directions, inside the liquid. Since there is no fixed direction for the pressure due to liquid. Hence it is a scalar quantity.

6. Find the work done in blowing a soap bubble of surface tension 0.06 N/m from 2cm radius to 5cm radius?

Ans. $Given: \quad S = 0.06 Nm^{-1}$

$r_1 = 2cm = 0.02m$

$r_2 = 5cm = 0.05m$

$To\ find: \ W = ?$

$Sol^n: \quad Initial\ surface\ area\ of\ bubble = 2 \times 4\pi r_1^2 = 8 \times 3.14 \times (0.02)^2 = 100.48 \times 10^{-4} m^2$

$Final\ surface\ area\ of\ bubble = 2 \times 4\pi r_2^2 = 8 \times 3.14 \times (0.05)^2 = 628 \times 10^{-4} m^2$

$Increase\ in\ surface\ area, \Delta A = 628 \times 10^{-4} - 100.48 \times 10^{-4} = 527.52 \times 10^{-4} m^2$

$W = S \times \Delta A = 0.06 \times 527.52 \times 10^{-4} = 31.6 \times 10^{-4} J$

7. Calculate the radius of new bubble formed when two bubbles of radius r_1 and r_2 coalesce?

Ans. Consider two soap bubbles of radii r_1 and r_2 and volumes as V_1 and V_2.

$$V_1 = \frac{4}{3}\pi r_1^3 \quad and \quad V_2 = \frac{4}{3}\pi r_2^3$$

$$P_1 = \frac{4S}{r_1} \quad and \quad P_2 = \frac{4S}{r_2}$$

Let r be the radius of the new soap bubble formed when the two soap bubble coalesce under and excess of pressure inside this new soap bubble then $V = \frac{4}{3}\pi r \quad and \quad P = \frac{4S}{r}$

As the new bubble is formed under isothermal condition, so Boyle's law holds good so,

$$P_1V_1 + P_2V_2 = PV$$

$$\frac{4S}{r_1}\times\frac{4}{3}\pi r_1^3 + \frac{4S}{r_2}\times\frac{4}{3}\pi r_2^3 = \frac{4S}{r}\times\frac{4}{3}\pi r^3$$

$$r_1^2 + r_2^2 = r^2$$

$$r = \sqrt{r_1^2 + r_2^2}$$

8. A liquid drop of diameter 4 mm breaks into 1000 droplets of equal size. Calculate the resultant change in the surface energy. Surface tension of the liquid is 0.07 N/m?

Ans. $Given: \quad S = 0.07 Nm^{-1}$

$$d = 4mm = 4\times10^{-3}m$$

$$R = 2\times10^{-3}m$$

$To\ find: E = ?$

$Sol^n: \quad Let \quad r - radius\ of\ small\ drop$

$$R - radius\ of\ big\ drop$$

$$Now, \quad \frac{4}{3}\pi R^3 = 1000\times\frac{4}{3}\pi r^3$$

$$R = 10r$$

$$r = 2\times10^{-4}m$$

$$Surface\ area\ of\ big\ drop \qquad = 4\pi R^2 = 4\times3.14\times\left(2\times10^{-3}\right)^2 = 50.24\times10^{-6}m^2$$

$$Surface\ area\ of\ 1000\ small\ drops = 10004\pi r^2 = 4000\times3.14\times\left(2\times10^{-4}\right)^2 = 50.24\times10^{-5}m^2$$

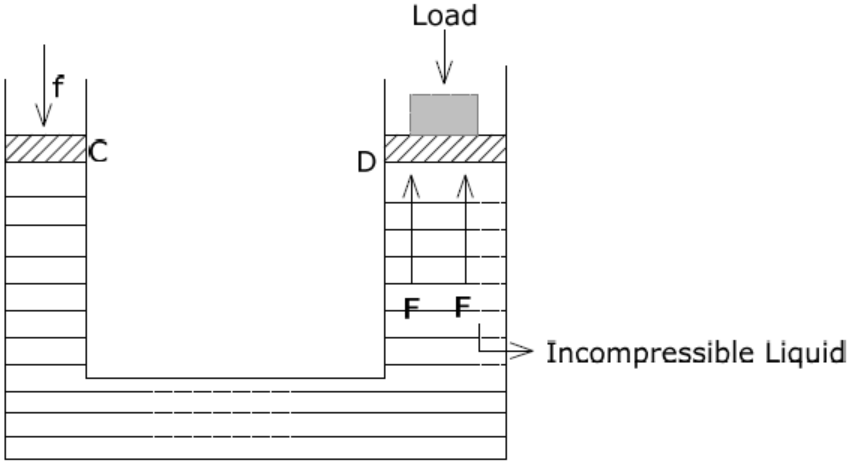
$$Increase\ in\ surface\ area, \Delta A = 50.24\times10^{-5} - 50.24\times10^{-6} = 452.16\times10^{-6}m^2$$

$$E = S\times\Delta A = 0.07\times452.16\times10^{-6} = 3165\times10^{-8}J$$

9. State the principle on which Hydraulic lift work and explain its working?

Ans. Hydraulic lift works on the principle of the Pascal's law. Acc to this law, in the absence of gravity, the pressure is same at all points inside the liquid lying at the same horizontal plane

Working of Hydraulic effect:→



Let a - Area of cross –section of piston at C

A - Area of cross – section of piston at D.

Let a downward force f be applied on the piston C. Then the pressure exerted on the liquid, $P = \frac{f}{a}$

Acc to Pascal's law, this pressure is transmitted equally to piston of cylinder D.

$\therefore$ Upward force acting on the piston of cylinder D is

$$F = PA = \frac{f}{a} A$$

$$As\ A \gg a,\ F \gg f$$

i.e. small force applied on the smaller piston will be appearing as a very large force on the large piston. As a result of which heavy load placed on larger piston is easily lifted upwards.