PRACTICE TEST XI CLASS PHYSICS PROPERTIES OF MATTER SOLUTION 13 NOV 2019

1. (b) Pressure at bottom of the lake = $P_0 + h\rho g$

Pressure at half the depth of a lake $= P_0 + \frac{h}{2}\rho g$

According to given condition

$$P_0 + \frac{1}{2}h\rho g = \frac{2}{3}(P_0 + h\rho g) \Rightarrow \frac{1}{3}P_0 = \frac{1}{6}h\rho g$$

$$\Rightarrow h = \frac{2P_0}{\rho g} = \frac{2\times 10^5}{10^3\times 10} = 20m.$$

2. (c) Apparent weight $= V(\rho - \sigma)g = \frac{m}{\rho}(\rho - \sigma)g$

where $m =$ mass of the body,

$\rho =$ density of the body

$\sigma =$ density of water

If two bodies are in equilibrium then their apparent weight must be equal.

$$\therefore \frac{m_1}{\rho_1}(\rho_1 - \sigma) = \frac{m_2}{\rho_2}(\rho_2 - \sigma)$$

$$\Rightarrow \frac{36}{9}(9-1) = \frac{48}{\rho_2}(\rho_2 - 1)$$

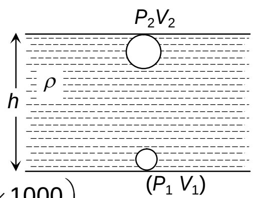
By solving we get $\rho_2 = 3$.

3. (b) According to Boyle's law, pressure and volume are inversely proportional to each other *i.e.* $P \propto \frac{1}{V}$

$$\Rightarrow P_1V_1 = P_2V_2$$

$$\Rightarrow (P_0 + h\rho_w g)V_1 = P_0V_2$$

$$\Rightarrow V_2 = \left(1 + \frac{h\rho_w g}{P_0}\right)V_1$$



$$\Rightarrow V_2 = \left(1 + \frac{47.6\times 10^2 \times 1\times 1000}{70\times 13.6\times 1000}\right)V_1$$

$$\Rightarrow V_2 = (1+5)50\,cm^3 = 300\,cm^3.$$

[As $P_2 = P_0 = 70\,cm$ of $Hg = 70\times 13.6\times 1000$]

4. (b) Force acting on the base

$$F = P\times A = hdgA = 0.4\times 900\times 10\times 2\times 10^{-3} = 7.2N$$

5. (c) As the both points are at the surface of liquid and these points are in the open atmosphere. So both point possess similar pressure and equal to 1 *atm.* Hence the pressure difference will be zero.

6. (b) Difference of pressure between sea level and the top of hill

$$\Delta P = (h_1 - h_2)\times \rho_{Hg}\times g = (75-50)\times 10^{-2}\times \rho_{Hg}\times g \quad \ldots(i)$$

and pressure difference due to h meter of air

$$\Delta P = h\times \rho_{air}\times g \quad \ldots(ii)$$

By equating (i) and (ii) we get

$$h\times \rho_{air}\times g = (75-50)\times 10^{-2}\times \rho_{Hg}\times g$$

$$\therefore h = 25\times 10^{-2}\left(\frac{\rho_{Hg}}{\rho_{air}}\right) = 25\times 10^{-2}\times 10^4 = 2500\,m$$

$\therefore$ Height of the hill = 2.5 *km.*

7. (c) Volume of ice $=\dfrac{M}{\rho}$, volume of water $=\dfrac{M}{\sigma}$.

$\therefore$ Change in volume $=\dfrac{M}{\rho}-\dfrac{M}{\sigma}=M\left(\dfrac{1}{\rho}-\dfrac{1}{\sigma}\right)$

8. (b) If two liquid of equal masses and different densities are mixed together then density of mixture

$\rho=\dfrac{2\rho_1\rho_2}{\rho_1+\rho_2}=\dfrac{2\times1\times2}{1+2}=\dfrac{4}{3}$

9. (d) Let $M_0=$ mass of body in vacuum.

Apparent weight of the body in air = Apparent weight of standard weights in air

$\Rightarrow$ Actual weight – upthrust due to displaced air

= Actual weight – upthrust due to displaced air

$$\Rightarrow M_0g-\left(\frac{M_0}{d_1}\right)dg=Mg-\left(\frac{M}{d_2}\right)dg \Rightarrow M_0=\frac{M\left[1-\dfrac{d}{d_2}\right]}{\left[1-\dfrac{d}{d_1}\right]}$$

10. (c) $P=h\rho g$ *i.e.* pressure does not depend upon the area of bottom surface.

11. (c) $P_1V_1=P_2V_2\Rightarrow(P_0+h\rho g)\times\dfrac{4}{3}\pi r^3=P_0\times\dfrac{4}{3}\pi(2r)^3$

Where, h = depth of lake

$\Rightarrow h\rho g=7P_0\Rightarrow h=7\times\dfrac{H\rho g}{\rho g}=7H.$

12. (c) $P_1V_1=P_2V_2\Rightarrow(P_0+h\rho g)V=P_0\times3V$

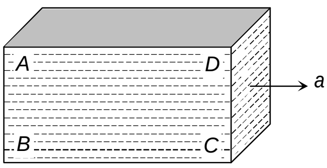
$\Rightarrow h\rho g=2P_0\Rightarrow h=\dfrac{2\times75\times13.6\times g}{\dfrac{13.6}{10}\times g}=15\ m$

13. (a) $h=\dfrac{P}{\rho g}$ $\therefore h\propto\dfrac{1}{g}$ (P and ρ are constant)

If value of g decreased by 2% then h will increase by 2%.

14. (d) $h=\dfrac{P}{\rho g}$ $\therefore h\propto\dfrac{1}{g}$. If lift moves upward with some acceleration then effective g increases. So the value of h decreases *i.e.* reading will be less than 76 *cm.*

15. (a)



Due to acceleration towards right, there will be a pseudo force in a left direction. So the pressure will be more on rear side (Points A and B) in comparison with front side (Point D and C).

Also due to height of liquid column pressure will be more at the bottom (points B and C) in comparison with top (point A and D).

So overall maximum pressure will be at point B and minimum pressure will be at point D.

16. (c) Let the total volume of ice-berg is V and its density is ρ. If this ice-berg floats in water with volume V_{in} inside it then

$V_{in}\sigma g=V\rho g \Rightarrow V_{in}=\left(\dfrac{\rho}{\sigma}\right)V$ [σ = density of water]

or $V_{out}=V-V_{in}=\left(\dfrac{\sigma-\rho}{\sigma}\right)V$

$\Rightarrow\dfrac{V_{out}}{V}=\left(\dfrac{\sigma-\rho}{\sigma}\right)=\dfrac{1000-900}{1000}=\dfrac{1}{10}$

$\therefore V_{out}=10\%$ of V

17. (a) Volume of log of wood $V=\dfrac{\text{mass}}{\text{density}}=\dfrac{120}{600}=0.2\ m^3$

Let x weight that can be put on the log of wood.

So weight of the body $= (120 + x) \times 10\ N$

Weight of displaced liquid $= V\sigma g = 0.2 \times 10^3 \times 10\ N$

The body will just sink in liquid if the weight of the body will be equal to the weight of displaced liquid.

$\therefore\ (120 + x) \times 10 = 0.2 \times 10^3 \times 10$

$\Rightarrow 120 + x = 200\ \therefore\ x = 80\ kg$

18. (c) Weight of the bowl $= mg$

$$= V\rho g = \frac{4}{3}\pi\left[\left(\frac{D}{2}\right)^3 - \left(\frac{d}{2}\right)^3\right]\rho g$$

where $D =$ Outer diameter ,
$d =$ Inner diameter
$\rho =$ Density of bowl

Weight of the liquid displaced by the bowl

$$= V\sigma g = \frac{4}{3}\pi\left(\frac{D}{2}\right)^3 \sigma\, g$$

where σ is the density of the liquid.

For the flotation $\frac{4}{3}\pi\left(\frac{D}{2}\right)^3 \sigma g = \frac{4}{3}\pi\left[\left(\frac{D}{2}\right)^3 - \left(\frac{d}{2}\right)^3\right]\rho g$

$$\Rightarrow \left(\frac{1}{2}\right)^3 \times 1.2 \times 10^3 = \left[\left(\frac{1}{2}\right)^3 - \left(\frac{d}{2}\right)^3\right] 2 \times 10^4$$

By solving we get $d = 0.98\ m$.

19. (c) Specific gravity of alloy $= \frac{\text{Density of alloy}}{\text{Density of water}}$

$$= \frac{\text{Mass of alloy}}{\text{Volume of alloy} \times \text{density of water}}$$

$$= \frac{m_1 + m_2}{\left(\frac{m_1}{\rho_1} + \frac{m_2}{\rho_2}\right) \times \rho_w} = \frac{m_1 + m_2}{\frac{m_1}{\rho_1 / \rho_w} + \frac{m_2}{\rho_2 / \rho_w}} = \frac{m_1 + m_2}{\frac{m_1}{s_1} + \frac{m_2}{s_2}} \quad \left[\text{As specific gravity of substance} = \frac{\text{density of substance}}{\text{density of water}}\right]$$

20. (b) Let specific gravities of concrete and saw dust are ρ_1 and ρ_2 respectively.

According to principle of floatation weight of whole sphere $=$ upthrust on the sphere

$$\frac{4}{3}\pi(R^3 - r^3)\rho_1 g + \frac{4}{3}\pi r^3 \rho_2 g = \frac{4}{3}\pi R^3 \times 1 \times g$$

$$\Rightarrow R^3\rho_1 - r^3\rho_1 + r^3\rho_2 = R^3$$

$$\Rightarrow R^3(\rho_1 - 1) = r^3(\rho_1 - \rho_2) \Rightarrow \frac{R^3}{r^3} = \frac{\rho_1 - \rho_2}{\rho_1 - 1}$$

$$\Rightarrow \frac{R^3 - r^3}{r^3} = \frac{\rho_1 - \rho_2 - \rho_1 + 1}{\rho_1 - 1}$$

$$\Rightarrow \frac{(R^3 - r^3)\rho_1}{r^3\rho_2} = \left(\frac{1 - \rho_2}{\rho_1 - 1}\right)\frac{\rho_1}{\rho_2}$$

$$\Rightarrow \frac{\text{Mass of concrete}}{\text{Mass of saw dust}} = \left(\frac{1 - 0.3}{2.4 - 1}\right) \times \frac{2.4}{0.3} = 4$$

21. (d) Apparent weight

$= V(\rho - \sigma)g = l \times b \times h \times (5 - 1) \times g$

$= 5 \times 5 \times 5 \times 4 \times g$ *Dyne* $= 4 \times 5 \times 5 \times 5\ gf$.

22. (a) Fraction of volume immersed in the liquid $V_{in} = \left(\frac{\rho}{\sigma}\right)V$ *i.e.* it depends upon the densities of the block and liquid.

So there will be no change in it if system moves upward or downward with constant velocity or some acceleration.

23. (b) Apparent weight $= V(\rho - \sigma)g = \frac{M}{\rho}(\rho - \sigma)g$

$$= M\left(1 - \frac{\sigma}{\rho}\right)g = 2.1\left(1 - \frac{0.8}{10.5}\right)g = 1.94\, g\ N$$

= 1.94 *Kg-wt*

24. (b, c) Density of metal = ρ, Density of liquid = σ

If V is the volume of sample then according to problem

$210 = V\rho g$ ...(i)

$180 = V(\rho - 1)g$ ...(ii)

$120 = V(\rho - \sigma)g$ ...(iii)

By solving (i), (ii) and (iii) we get $\rho = 7$ and $\sigma = 3$.

25. (c) If two different bodies A and B are floating in the same liquid then $\frac{\rho_A}{\rho_B} = \frac{(f_{in})_A}{(f_{in})_B} = \frac{1/2}{2/3} = \frac{3}{4}$

26. (a)

27. (b)

28. (b)

29. (a)

30. (d) Soap helps to lower the surface tension of solution, thus soap get stick to the dust particles and grease and these are removed by action of water.

31. (a)

32. (b)

33. (b)

34. (b)

35. (c,d) At critical temperature ($T_c = 370^o C = 643\ K$), the surface tension of water is zero.

36. (a) Energy needed = Increment in surface energy

= (surface energy of n small drops) – (surface energy of one big drop)

$= n4\pi r^2 T - 4\pi R^2 T = 4\pi T(nr^2 - R^2)$

37. (d)

38. (a) When two droplets merge with each other, their surface energy decreases.

$W = T(\Delta A) =$ (negative) *i.e.* energy is released.

39. (d) $E = 4\pi R^2 T(n^{1/3} - 1)$

$= 4 \times 3.14 \times (1.4 \times 10^{-1})^2 \times 75(125^{1/3} - 1) = 74\ erg$

40. (d) $W = 8\pi T(R_2^2 - R_1^2) = 8\pi T[(2r)^2 - (r)^2] = 24\pi r^2 T$