WS-11 Foundation 9th class ①

fluid mechanics

Ttasle

①

$h = 76$ cm

$= \cancel{76} \times 10^{-2}$ m

Normal pressure $= 76$ cm of Hg

In SI system $P = \rho g h$

$= 1.36 \times 10^{3} \times 10 \times 76 \times 10^{-2}$ m

$= 103.36 \times 10^{2}$ N/m²

$= 103360$ N/m² → A.

②

$\rho_{liquid} = 12$ kg/m³ ; $P = 600$ Pa

pressure at a depth $p = \cancel{P_{atm}} + \rho g h$

$600 = \cancel{0} + 12 \times 10 \times h$

$h = \frac{\cancel{600}^{5}}{\cancel{12 \times 10}} = 5$ m → D

③

Pressure at ground floor $P_G = 120000$ Pa.

pressure at a height $P_h = 30000$ Pa

$P = P_a + \rho g h$

⇒ ~~30000 120,000 = 30~~ Pressure difference $= \rho g h$

⇒ $(120{,}000 - 30{,}000) = 10^{3} \times 10 \times h$

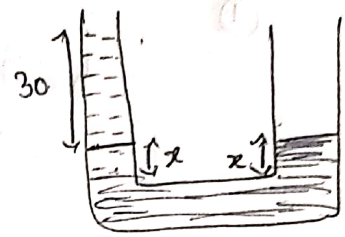
⇒ $9\cancel{0}{,}000 = 10^{4}$ h

$h = 9$ m → C.

(4)

$a_L = 3a_r$. $h_L = 30cm$

Mercury rises in right limb until the Pressure's are equal in both limb's.



$$P_w = P_{Hg}$$

$$\Rightarrow \cancel{P_a} + \rho_w g h_w = \cancel{P_a} + \rho_{Hg} g h_{Hg}$$

h_w = height of water = $30 + 3x$

h_{Hg} = height of Hg = $4x$.

$\therefore \rho_w \cancel{g} h_w = \rho_{Hg} \cancel{g} h_{Hg}$

$\Rightarrow \cancel{10^3} \times (30+3x) = 13.6 \times \cancel{10^3} (4x)$

$\Rightarrow 30 + 3x = 13.6 \times 4x$

By solving it we get

$x = 0.58 cm \rightarrow A$

Volume = constant

$A \times l$ = constant

$A \propto \frac{1}{l}$

$\Rightarrow \frac{A_L}{A_r} = \frac{L_r}{L_L}$

$\Rightarrow 3 = \frac{L_r}{L_L}$

$\Rightarrow L_r = 3L_L$

(5)

Given Area = $1.5 m^2$: $h = 1m$.

Pressure exerted by the water = $\rho g h = 10^3 \times 10 \times 1 = 10^4$

Force exerted = $P \times A$

$= 10^4 \times 1.5 = 1.5 \times 10^4 N. \rightarrow B$

(6) Area of tube $a_1 = 1\,cm^2$

Area of top of vessel $a_2 = 100\,cm^2$

height of vessel $h_2 = 1\,cm$

height of water in tube = 99 cm

But from bottom of vessel = 100 cm = 100×10^{-2} m

weight of water in the system

= weight of water in (tube of Area $1\,cm^2$ + vessel of area $100\,cm^2$]

$\Rightarrow \rho g V_1 + \rho g V_2$

$\Rightarrow 10^3 \times 10 \times [V_1 + V_2] = 10^4 [a_1 h_1 + a_2 h_2]$

$= 10^4 [99 \times 1 \times 10^{-6} + 100 \times 10^{-6}]$

$\Rightarrow 1.99\,N \rightarrow B, C.$

Force exerted by water against the bottom of the vessel $F_{base} = P_{base} \times Area$.

$P_{base} = P_{atm} + \rho_w g h_w = 10^5 + 10^3 \times 10 \times 100 \times 10^{-2}$

$= 1.1 \times 10^5\,N/m^2$

Area of base $a_2 = 100\,cm^2 = 100 \times 10^{-4}\,m^2 = 10^{-2}\,m^2$

F_{base} = Pressure × Area $= 1.1 \times 10^5 \times 10^{-2}$

$= 1100\,N$

(7)

we know

pressure difference $= \rho g h$

$\Rightarrow (40000 - 10000) = 10^3 \times 10 \times h$

$\Rightarrow 30{,}090 = 10^4 h$

$\Rightarrow h = 3m$ — A.

(8)

height of water $h_w = 10cm$

density of ~~water~~ kerosene $d_k = 0.8 \times 10^3$ kg/cc.

density of water $d_w = 10^3$ kg/kg.

kerosene rises until ~~water~~ pressure in two limbs are equal.

$P_w = P_k$

$\Rightarrow d_w g h_w = d_k g h_k$

$\Rightarrow \cancel{10^3} \times 10 = 0.8 \times \cancel{10^3} \times h_k$

$\Rightarrow h_k = \frac{10}{0.8} = \frac{100}{8} = 12.5$ cm $\rightarrow$ B

(9)

Given . Pressure at a depth ~~d~~ $P = 4$ atmo

Atmospheric Pressure $P_{at} = 1$ atm

we know variation of pressure with depth $P = P_a + \rho g h$

$\Rightarrow 4at = 1 atm + \rho g h$

$\Rightarrow 3 atm = 10^3 \times 10 \times h$

$= 3 \times 10^4 = 10^4 h \Rightarrow h = 30$ m $\rightarrow$ A

1 atm $= 10^5$ (or) 1.05×10^5 pascals

(10)

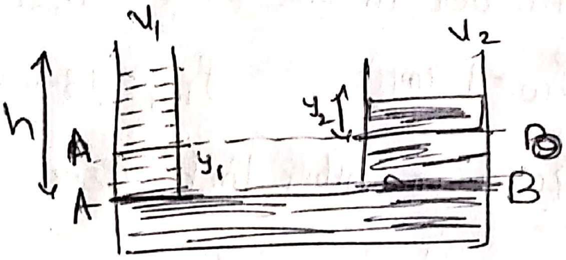
let D_1 and D_2 are the diameters of two vessels

$$S = \text{Relative density of } Hg = \frac{d_{Hg}}{d_w}.$$

$$r_2 = n r_1$$

If the level in the narrow tube goes down by y_1

Then in wider tube goes up to y_2.



$$V_1 = V_2$$

$$\Rightarrow A_1 y_1 = A_2 y_2 \Rightarrow \cancel{\pi} r_1^2 = \cancel{\pi} r_2^2 y_2$$

$$\Rightarrow r_1^2 y_1 = (n r_1)^2 y_2$$

$$\Rightarrow y_1 = n^2 y_2.$$

$$P_A = P_B$$

$$\Rightarrow \rho_w g h = \rho_m g [y_1 + y_2]$$

$$\Rightarrow h = \frac{\rho_m}{\rho_w} [n^2 y_2 + y_2)$$

$$\Rightarrow h = S\, y_2 (n^2 + 1] \Rightarrow y_2 = \frac{h}{S(n^2+1)}$$

(11)

$h_w = 10m$ $h_g = 20m$

$d_w = 10^3 kg/m^3$

$P = P_{atm} + \rho g h_w = 1 atm + 10^3 \times 10 \times 10 = 10^5 + 10^5$

$= 2 \times 10^5$ Pascal

$= 2 atm.$

(12)

level of water in one limb $h_1 = 27.2 cm.$

$\rho_w = 1 gm/cc$; $\rho_{Hg} = 13.6$ units.

The liquid in other limb rises until pressures are same

$P_A^1 = P_C$

$\Rightarrow \rho_w g h_1 = \rho_{Hg} g h_2$

$\Rightarrow 1 \times 27.2 = 13.6 h_2 \Rightarrow h_2 = 2 cm.$

Difference in levels $= 27.2 - 2 = 25.2 cm$

(13)

Because the vessels base areas are different so Force exerted by water on the base of vessel is not same.

(14)

As the depth of a point in a liquid increases Pressure also changes from the relation

$P_{depth} = P_{atm} + \rho g h$

$\rho \rightarrow$ density of liquid; $h =$ depth of a point in a liquid.

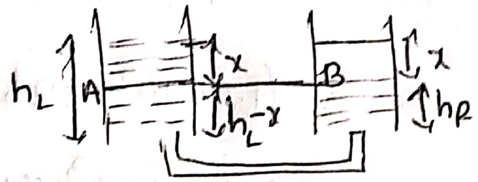
15, 16

left — Right

$d_L = 800\ kg/m^3$; $d_R = 1600\ kg/m^3$

$h_L = 30\ cm$; $h_R = 20\ cm$

when two tanks are connected then liquid flows until to both have same level



let 'x' be the rise of liquid the level in Right vessel, so same level falls in left vessel

$$P_A = P_B$$

$$\Rightarrow \rho_L g (h_L - x) = \rho_R g (h_R + x)$$

$$\Rightarrow \cancel{800}(30 - x) = \overset{2}{\cancel{1600}}(20 - x)$$

$$\Rightarrow 30 - x = 40 - 2x \Rightarrow 2x - x = 40 - 30$$

$$\Rightarrow x = 10\ cm = 0.1\ m$$

If we connect the tube at a distance of 0.1 m from top of vessel No flow takes place.

(17), (18), (19)

height of water $h_w = 10cm = 0.1\,m$

Bottom Area = $10cm^2$; Top area = $30\,cm^2 = 30\times10^{-4}\,m^2$

vol = 1 lit $= 10^{-3}\,m^3$; $d_w = 10^3\,kg/m^3$

$P_{atm} = 1.01\times10^5\,N/m^2$

Force at bottom = $P \times Area$

$= (1.01\times10^5 + \rho g h)\,A$

$= (1.01\times10^5 + 10^3\times10\times0.1)\times10^{-3}$

$= (10.1 + 0.1)\times10^4\times10^{-3}$

$= 10.2\times10 = 102\,N$ downward

(18). Let F be the force exerted by side of wall on the water (upward). then from equilibrium

$F + F_1 = F_2 + w$

$\Rightarrow F = F_2 + w - F_1 = 303 - 10 - 102 = 211\,N$ (upward)

(19) If air inside the Jar is completely Pumped out

$F_1 = \rho g h A_1 = 10^3\times10\times0.01\times10^{-3} = 1N$ downward

Here F_2 = Force exerted by atmosphere on water

$= P_0 A_2 = 1.01\times10^5\times3\times10^{-3} = \underline{303}\,N$ (downwards)

w = weight of water $= mg = V d g =$

$= 10^{-3}\times10^3\times10$

$= 10N$ (downwards)

(20)

Given $d_L = 12\ kg/m^3$, Pressure $= 720\ Pa$.

Pressure at a point inside of liquid

$$P = \cancel{P_a} + \rho g h$$

$$\Rightarrow \overset{6}{\cancel{720}} = \cancel{12 \times 10} \times h$$

$$\Rightarrow h = 6\,m$$

(21)

Given depth of water $h = 20\,m$

change in Pressure $= \rho g h = 10^3 \times 10 \times 20$

$= 2 \times 10^5\ N/m^2$

$= 2\ atm$

LTask

CW Q's

(2)

We know variation of Pressure with depth

$$P = P_{atm} + \underbrace{\rho g h}_{\text{Pressure due to liquid column}}$$

(5)

Atmospheric Pressure decreases with increase of height Because density of air is heavier near the surface of earth and begins to lighten as we go to higher altitudes. and eventually leads to empty space, outside of the atmosphere of the earth.

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(9)

Pressure is a scalar quantity because it is the ratio of the component of the force normal to the area and it is independent on the size of the area chosen.

(10)

According to Pascal's law, pressure is same if the point's are same depth from surface of liquid and is independent on base area.

(11)

we know $P = P_0 + \rho g h$

ρ, g = constant $P \propto h$.

$\therefore$ c → correct option

(12)

Here pressure at a depth $P = \rho g h$ depends on depth (h), density (ρ) and acceleration due to gravity (g) only. so P = same in all directions at a given point.

Jee mains level

(1)

Given $h = 10m$ $P = \rho g h = 10^3 \times 10 \times 10$

$= 10^5$ Pa

$= 0.5\times10^4 + 10.$

(2)

Given $h_{Hg} = 50cm$

$d_{Hg} = 13.6$ gm/cc ; $g = 1000$ cm/s^2

$P = \rho g h = 13.6 \times 50 \times 1000$

$\Rightarrow 680 \times 10^3 = 6.8 \times 10^5$ dy/cm^2 $\to$ A

(3)

$h_{w} = 27.2$ cm.

Mercury rises in other limb until Pressure is same at certain level

$P_{Hg} = P_w$

$\Rightarrow \rho_{Hg}\, g\, h_{Hg} = \rho_w\, g\, h_w$

$\Rightarrow \cancel{13.6} \times h_{Hg} = 1 \times \cancel{27.2}^{2}$ cm

$h_{Hg} = 2cm.$

difference in levels $= h_w \sim H_{Hg}$

$= 27.2 - 2$

$= 25.2$ cm

(4)

Barometer reading $P = 70$ cm of Hg. $= 70\times10^{-2}\times g\times13600$

$P_w = \rho_w g h_w$

$\Rightarrow P_{Hg} = P_w$

$\Rightarrow \cancel{7}\cancel{0}\times10^{-2}\times\cancel{g}\times 136\cancel{0}\cancel{0} = \cancel{10^3}\times\cancel{g}\times h_w$

$\Rightarrow 7\times136\times10^{-2} = h_w$

$\Rightarrow$ 9.52 m $= h_w \rightarrow$ A

(5)

$P_w =$ atmospheric Pressure

$= 76$ cm of Hg

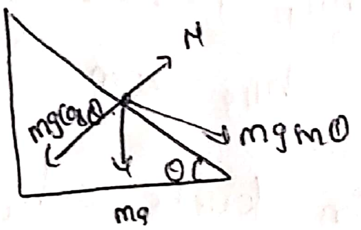
$\Rightarrow \rho_w g h_w = 76 \times d_{Hg}\times g$

$\Rightarrow 10^3 \times h_w = 76\times13600$

$\Rightarrow h_w = \frac{76\times13600}{10^3} = 13.6\times76 = 1033$ cm or

$= 10.33$ m $\rightarrow$ C

(6)



$N = mg\cos\theta$

Here Pressure is exerted due to Normal Reaction force

$\therefore$ Force on small area $= P\Delta A$

$\Rightarrow \rho g h \cos\theta\, \Delta A$

$\Rightarrow \rho g h (\Delta A) \cos\theta$

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(10)

$d_A = 1.6\ gm/cm^3$

$h_A = 26.6\ cm$; $h_B = 50\ cm$

$$P_B = P_A$$

$$\Rightarrow \rho_B\, g\, h_B = \rho_A\, g\, h_A$$

$$\Rightarrow \rho_B \times 50 = 1.6 \times 26.6$$

$$\Rightarrow \rho_B = \frac{1.6 \times 26.6}{50} = 0.85\ g/cm^3.$$

(11)

$h_x = 8\ cm$. $h_y = 10\ cm$ $\rho_{Hg} = 13.6\ gm/cc$

$\rho_y = 3.36\ gm/cc$

From fig it is clear that $h_{Hg} = 2\ cm$

$$\therefore P_x + P_{Hg} = P_y$$

$$\Rightarrow \rho_x\, g\, h_x + \rho_{Hg}\, g\, h_{Hg} = \rho_y\, g\, h_y$$

$$\Rightarrow \rho_x\, 8 + 13.6\,(2) = 3.36\,(10)$$

$$\Rightarrow 8\rho_x + 27.2 = 33.6$$

$$\Rightarrow 8\rho_x = 33.6 - 27.2 = 6.4$$

$$\rho_x = \frac{6.4}{8} = 0.8\ gm/cc$$

(12)

$P_a = 16 \times 10^4\ Pa$. ; $h = 15\ m$.

Pressure difference $= \rho g h$

$$P_a - P_h = 10^3 \times 10 \times 15$$

$$\Rightarrow 16 \times 10^4 - P_h = 15 \times 10^4 \Rightarrow P_h = 1 \times 10^4 = 10{,}000\ Pa.$$

18, 19, 20

Given depth = 1000m ; $\rho_w = 1.03 \times 10^3$ kg/m^3; $g = 10$ m/s^2

Absolut Pressure = $P_a + \rho g h$

$= 1atm + 1.03 \times 10^3 \times 10 \times 1000$

$= 1atm + 103 \times 10^5$

$\Rightarrow 1am + 103$ atm

$= 104$ atm

Gauge pressure = $\rho g h$

$= 1.03 \times 10^3 \times 10 \times 1000$

$= 103$ atm

Force on window = $P_{abs} \times$ Area

$= 104$ atm $\times 400$ cm^2

$= 104 \times 10^5 \times 400 \times 10^{-4}$

$= 416 \times 10^3 = 4.16 \times 10^5$ N

$\simeq 4.12 \times 10^5$ N

(21)

~~$h_B = 15$ cm.~~

(25)

$P_G = 40000$ Pa, $P_h = 10000$ Pa.

Pressure difference = $P_G - P_h = h \rho g$

$\Rightarrow 40000 - 10{,}000 = h \times 10^3 \times 10$

$\Rightarrow 30000 = h \times 10^4$

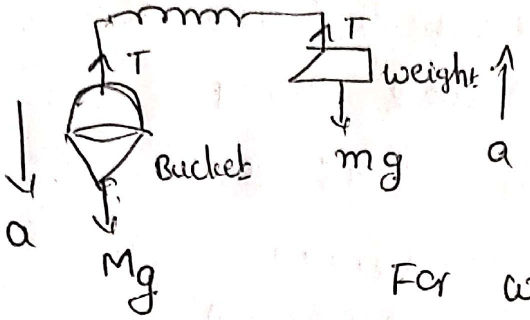
$\Rightarrow h = 3$m

(24)

let T be the tension in the rope.

For the bucket $Mg - T = Ma \rightarrow (1)$

$Mg \rightarrow$ mass (or) weight of bucket



$mg =$ weight of suspended weight $= \frac{Mg}{2}$.

For weight $T - mg = ma$

$\Rightarrow T - \frac{Mg}{2} = \frac{Ma}{2} \rightarrow (2)$

(1) + (2)

$Mg - T + T - \frac{Mg}{2} = Ma + \frac{Ma}{2}$

$\Rightarrow \frac{\cancel{M}g}{2} = \frac{3\cancel{M}a}{\cancel{2}} \Rightarrow a = \frac{g}{3}$

Thus the effective gravitational force acting on water filled in the bucket $a' = g - a = g - \frac{g}{3} = \frac{2g}{3}$

Pressure at bottom $= h\rho a' = h\rho\left(\frac{2g}{3}\right)$

$= 15 \times 10^{-2} \times 10^{3} \times \frac{2}{3} \times 10$ [h = 15 cm]

$\Rightarrow 10 \times 10 \times 10 = 10^{3}$ Pa

$= 1$ kPa