DPP – 1

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/82

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Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/20

Q 1. A barometer tube reads 76 cm of mercury. If the tube is gradually inclined at an angle of 60° with vertical, keeping the open end immersed in the mercury reservoir, the length of the mercury column will be:
(a) 152 cm (b) 76 cm (c) 38 cm (d) $38\sqrt{3}$

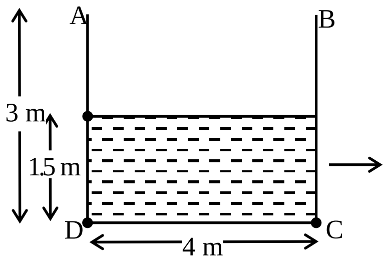
Q 2. Equal mass of three liquids are kept in three identical cylindrical vessels A, B and C. The densities are ρ_A, ρ_B, ρ_C with $\rho_A < \rho_B < \rho_C$. The force on the base will be -
(a) maximum in vessel A
(b) maximum in vessel B
(c) maximum in vessel C
(d) equal in all the vessels

Q 3. A satellite revolves round the earth. Air pressure inside the satellite is maintained at 76 cm of mercury. What will be the height of mercury column in a barometer tube 90 cm long placed in the satellite?
(a) 76 cm (b) 90 cm (c) zero (d) None

Q 4. The pressure in a liquid at two points in the same horizontal plane are equal. Consider an elevator accelerating upward and a car accelerating on a horizontal road. The above statement is correct in -
(a) the car only (b) the elevator only
(c) both of them (d) neither of them

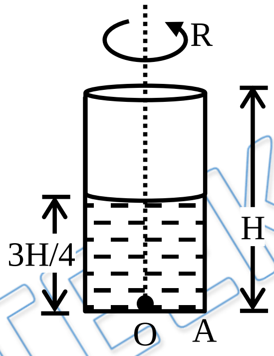
Q 5. A beaker containing a liquid is kept inside a big closed jar. If the air inside the jar is continuously pumped out, the pressure in the liquid near the bottom of the liquid will -
(a) increase
(b) decrease
(c) remain constant
(d) first decrease and then increase

Q 6. A container having dimensions 5m × 4m × 3m is accelerated along its breadth in horizontal. Container is filled with water up to the height of 1.5 m. Container is accelerated with 7.5 m/s^2. in accelerated container
(Take g = 10m/s^2, density of water is 10^3 kg/m^3)



(a) Gauge pressure at point C is 10^4 Pascal
(b) Gauge pressure at point D is 3×10^4 Pascal
(c) Gauge pressure at the middle of the base is 1.5×10^4 Pascal
(d) Remaining volume of liquid inside the container is $20m^3$

Q 7. A liquid of density r filled in the vessel as shown is rotated with constant angular velocity 'w' about the axis passing through the middle. The radius of cylinder is R. Then –

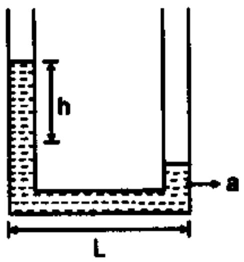


(a) The minimum value of 'w' for which the liquid comes out is $\sqrt{\frac{gH}{R^2}}$

(b) The value of 'w' for which the base of container is just exposed is $\sqrt{\frac{2gH}{R^2}}$

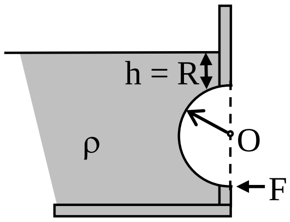
(c) Volume of liquid remaining in the container in option(b) is $\frac{\pi R^2 H}{2}$
(d) Gauge pressure at point A in the container in option(b) is rgH

Q 8. When at rest, a liquid stands at the same level in the U tubes. But as indicated a height difference h occurs when the system is given an acceleration a towards the right. Here, h is equal to:



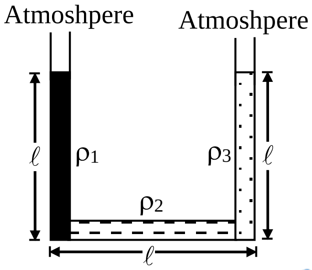
(a) $\frac{aL}{2g}$ (b) $\frac{gL}{2a}$ (c) $\frac{gL}{a}$ (d) $\frac{aL}{g}$

Q 9. The figure shows a semi-cylindrical massless gate pivoted at the point O holding a stationary liquid of density r. A horizontal force F is applied at its lowest position to keep it stationary. The magnitude of the force is –



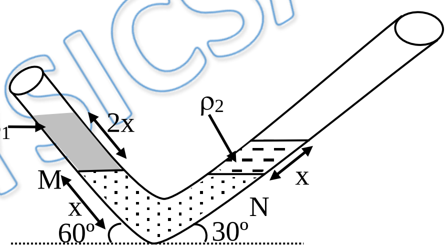
(a) $\frac{9}{2}\rho g R^2$ (b) $\frac{3}{2}\rho g R^2$
(c) rgR^2 (d) Zero

Q 10. Three liquids having densities ρ_1, ρ_2 and ρ_3 are filled in a U-tube. Length of each liquid column is equal to l . $\rho_1 > \rho_2 > \rho_3$ and liquids remain at rest (relative to the tube) in the position shown in figure. It is possible that–



(a) U-tube is accelerating leftwards
(b) U-tube is accelerating upwards with acceleration g
(c) U-tube is moving with a constant velocity
(d) None of these

Q 11. liquids of density ρ_1 and ρ_2 stand in the bent tube as shown. Density of lowermost liquid is ρ . Point M and N are at same horizontal level and system is in equilibrium. Then –

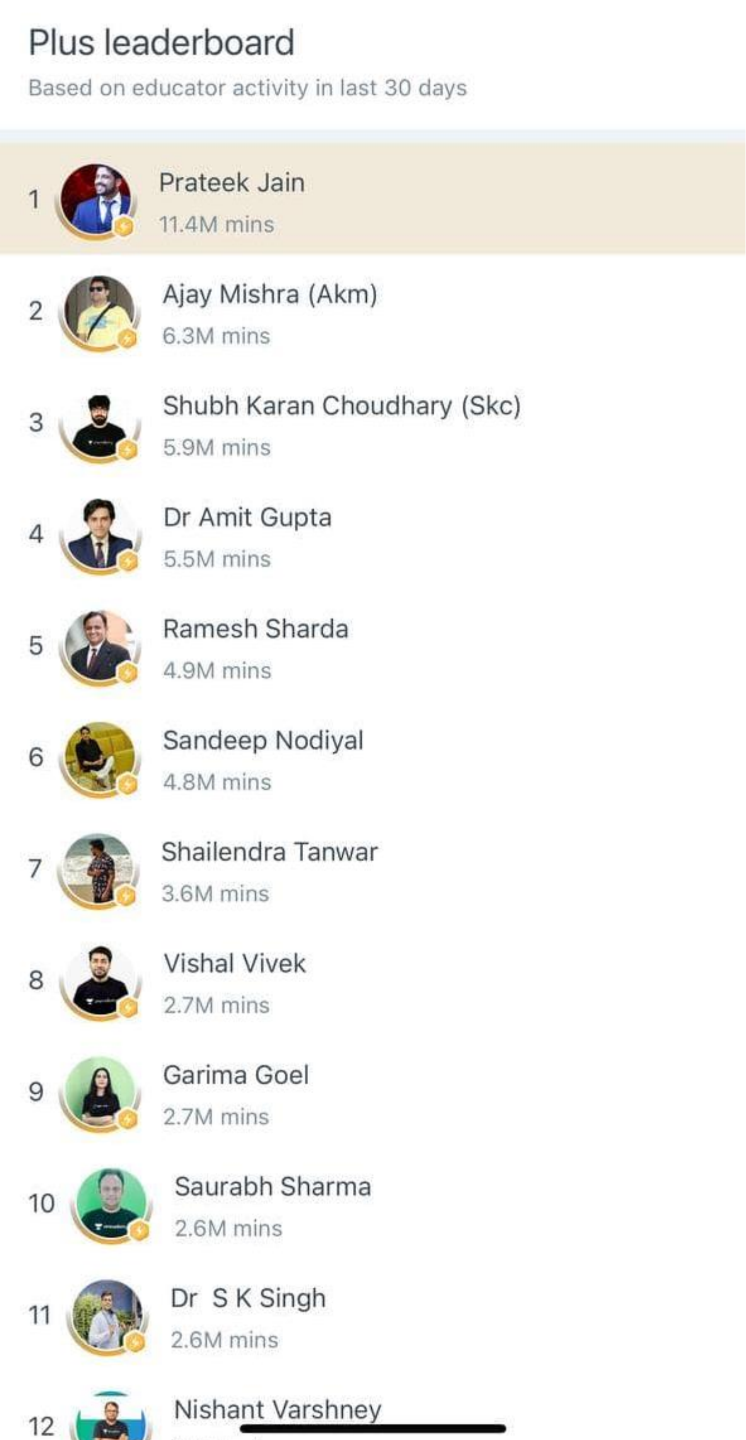


(a) $P_M = P_N$ (b) $\rho_2 = 2\sqrt{3}\,\rho_1$
(c) $\rho_1 = 2\sqrt{3}\,\rho_2$ (d) None of these

Q 12. A cubical open vessel of diameter 5 m is filled with a liquid. The vessel is accelerated horizontally in such a way that the height of the liquid becomes 5 m and the pressure at the mid point of the vessel becomes equal the atmospheric pressure. Then the acceleration of the vessel will be
(a) g (b)3g (c) 2g (d) 3g/2

Answer Key

Q.1 a	Q.2 d	Q.3 b	Q.4 b	Q.5 b
Q.6 b, c	Q.7 a, b, c, d	Q.8 d	Q.9 d	Q.10 d
Q.11 a, b	Q.12 c			



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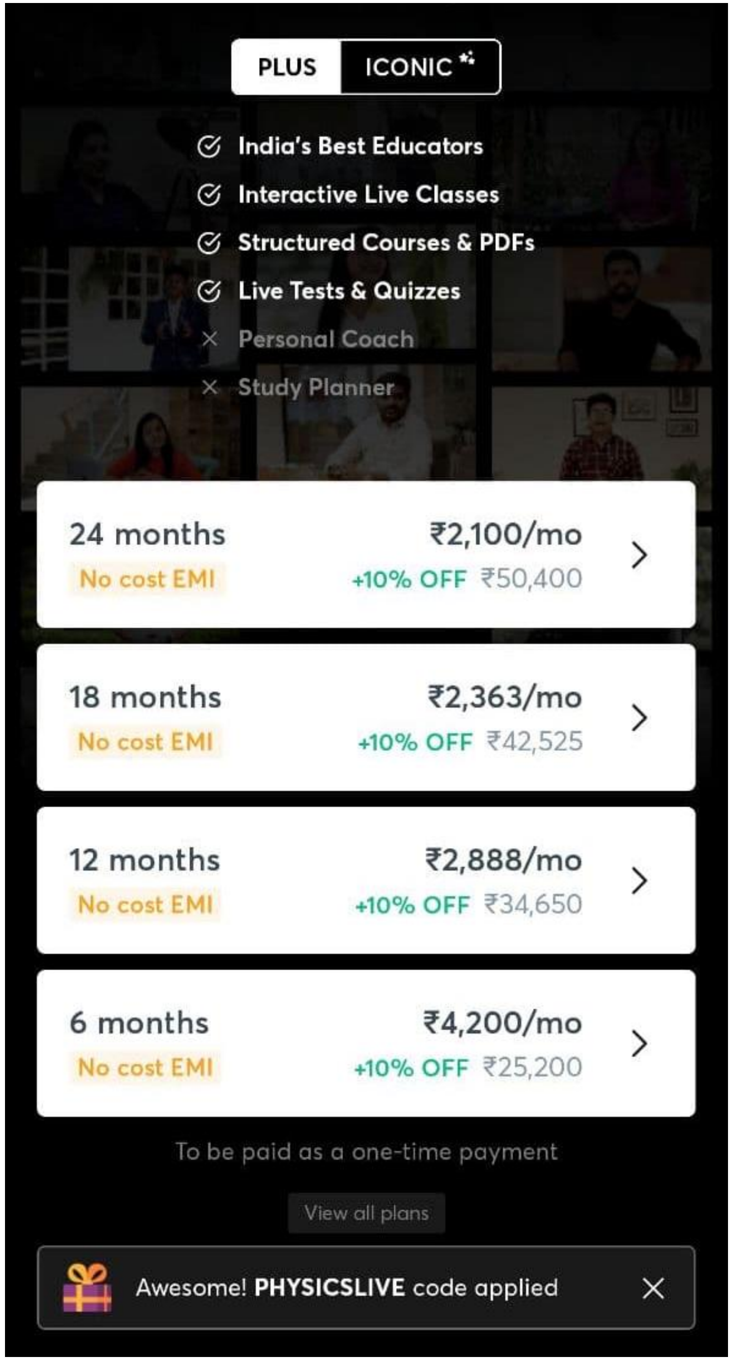
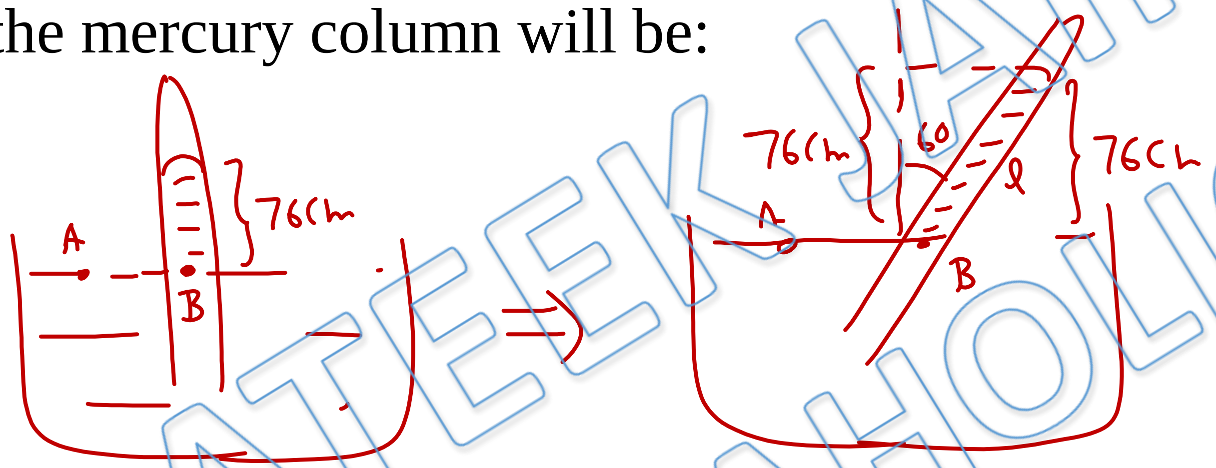


Written Solution
Physics DPP

DPP-1 Fluid- Barometer, Manometer, Gauge pressure, Free surface of liquid

By Physicsaholics Team

Q1) A barometer tube reads 76 cm of mercury. If the tube is gradually inclined at an angle of 60° with vertical, keeping the open end immersed in the mercury reservoir, the length of the mercury column will be:



(a) 152 cm (b) 76 cm (c) 38 cm (d) $38\sqrt{3}$

$P_A = P_B$

$\Rightarrow P_0 = \rho g h$ → 76cm

$l \cos 60 = 76\text{cm}$

$l = 152\text{cm}$

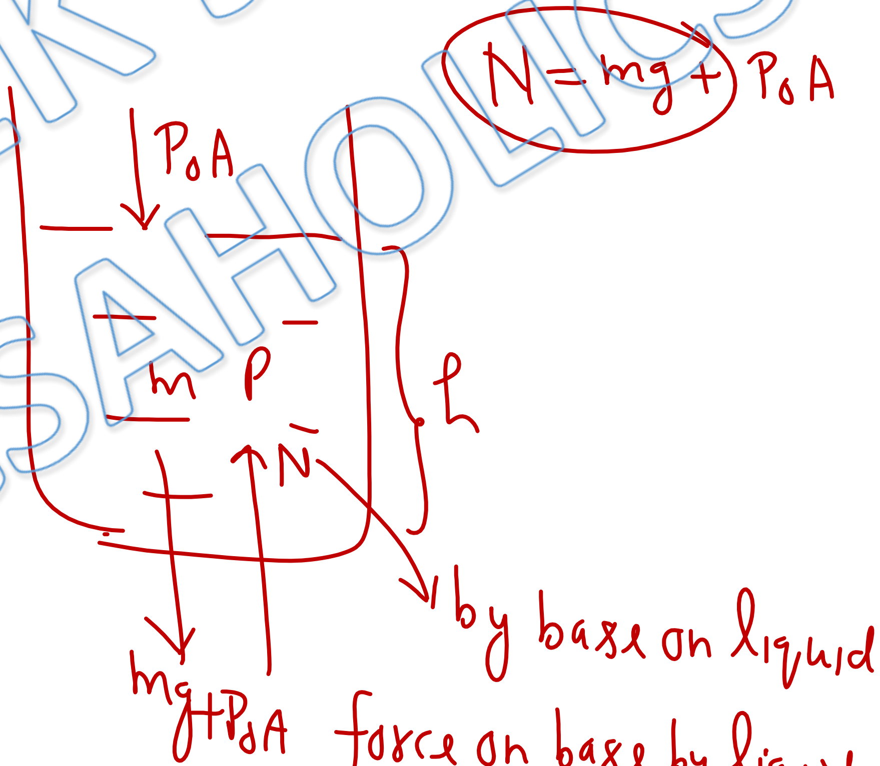
Q2) Equal mass of three liquids are kept in three identical cylindrical vessels A, B and C. The densities are ρ_A, ρ_B, ρ_C with $\rho_A < \rho_B < \rho_C$. The force on the base will be -

(a) maximum in vessel A

(b) maximum in vessel B

(c) maximum in vessel C

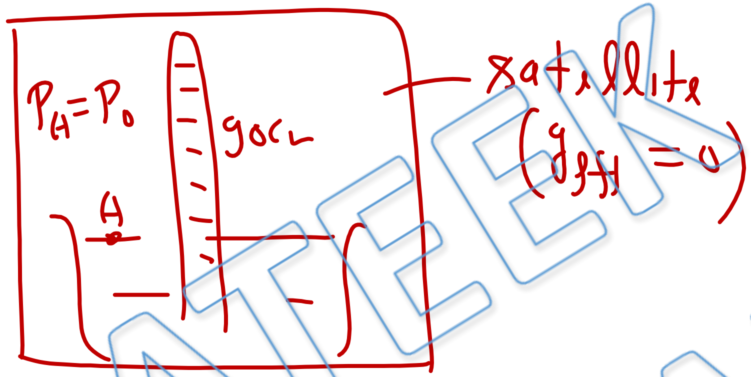
(d) equal in all the vessels

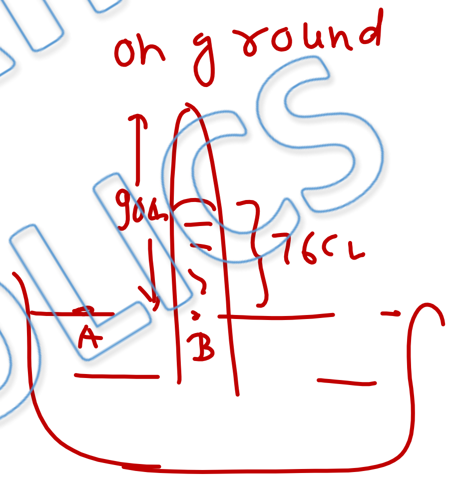


force on base by liquid $= mg + P_0A \rightarrow$ same in all cases

Q3) A satellite revolves round the earth. Air pressure inside the satellite is maintained at 76 cm of mercury. What will be the height of mercury column in a barometer tube 90 cm long placed in the satellite?

$P_A = 76$ cm of Hg.

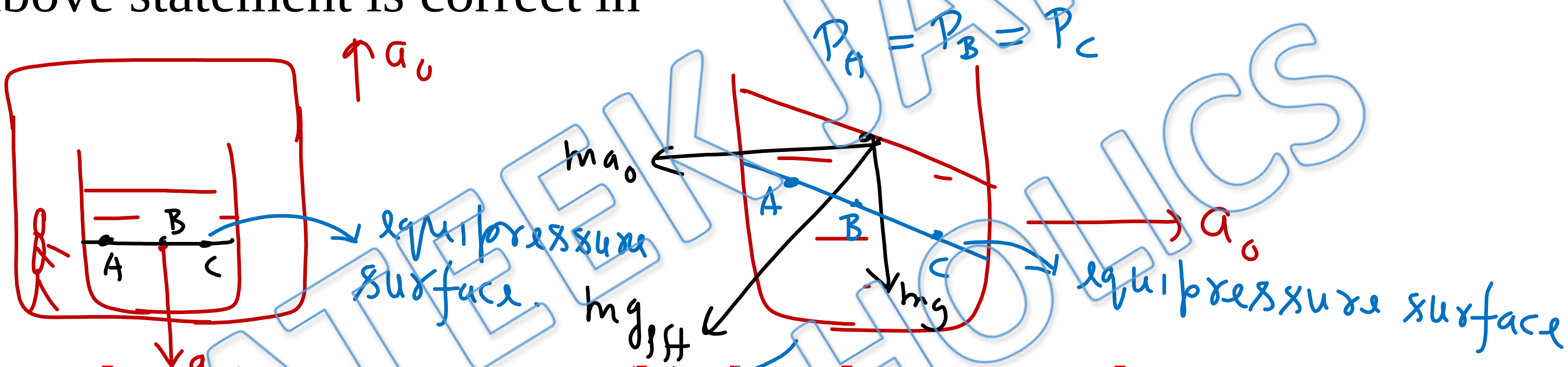




(a) 76 cm (b) 90 cm (c) zero (d) None

Pressure due to liquid column = $\rho g_{eff} h = 0$

Q4) The pressure in a liquid at two points in the same horizontal plane are equal. Consider an elevator accelerating upward and a car accelerating on a horizontal road. The above statement is correct in -



(a) the car only $g_{eff} = g + a_0$

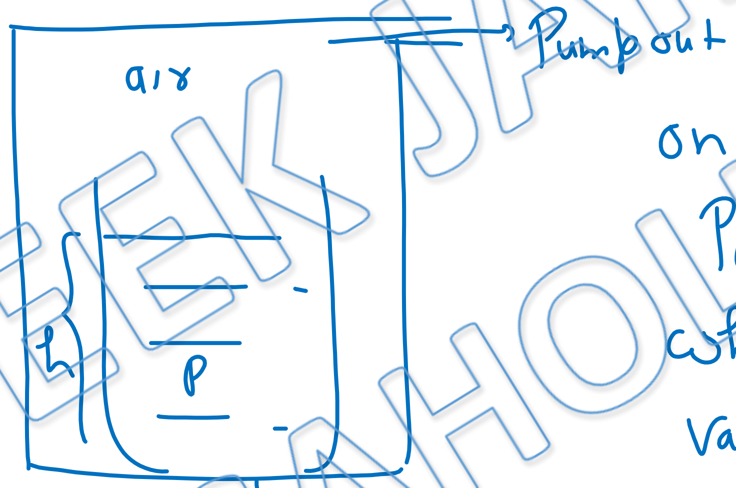
(b) the elevator only

(c) both of them

(d) neither of them

$P_A = P_B = P_C$

Q5) A beaker containing a liquid is kept inside a big closed jar. If the air inside the jar is continuously pumped out, the pressure in the liquid near the bottom of the liquid will -



(a) increase

(b) decrease

(c) remain constant

(d) first decrease and then increase

$P = P_0 + \rho g h$

On pumping out air

P_0 decreases $\Rightarrow P \downarrow$

when P becomes equal to vapour pressure of liquid

after that. liqud Converts IntoVapour

$\Rightarrow h \downarrow$

$\Rightarrow P \downarrow$

Q6) A container having dimensions 5m × 4m × 3m is accelerated along its breadth in horizontal. Container is filled with water up to the height of 1.5 m. Container is accelerated with 7.5 m/s^2. in accelerated container

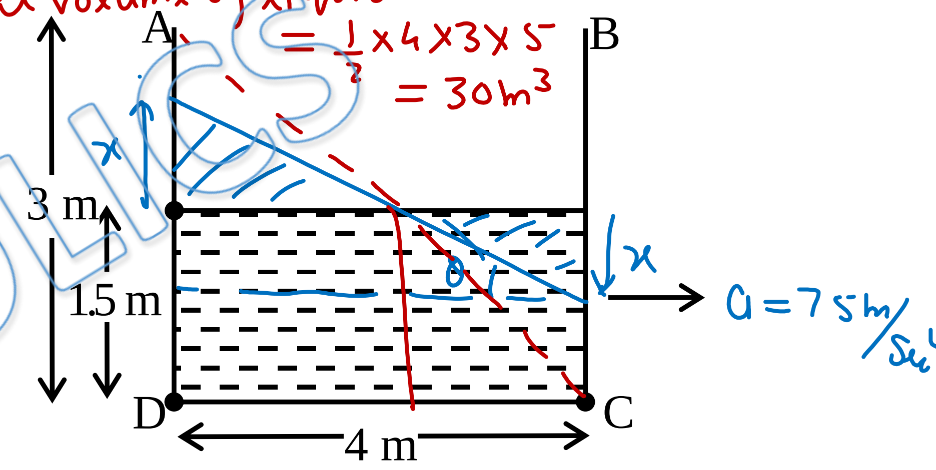
(Take g = 10m/s^2, density of water is 10^3 kg/m^3)

$\tan\theta = \frac{2x}{4} = \frac{a}{g} = \frac{7.5}{10}$

$\frac{2x}{4} = \frac{3}{4} \Rightarrow x = 1.5\,m$

Volume of liquid $= 5 \times 4 \times 1.5 = 30\,m^3$

final volume of liquid $= \frac{1}{2} \times 4 \times 3 \times 5 = 30\,m^3$

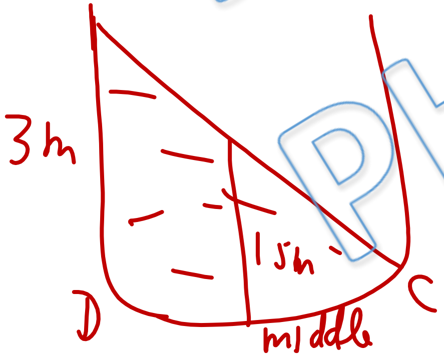


(a) Gauge pressure at point C is 10^4 Pascal

(b) Gauge pressure at point D is 3×10^4 Pascal

(c) Gauge pressure at the middle of the base is 1.5×10^4 Pascal

(d) Remaining volume of liquid inside the container is 20m^3

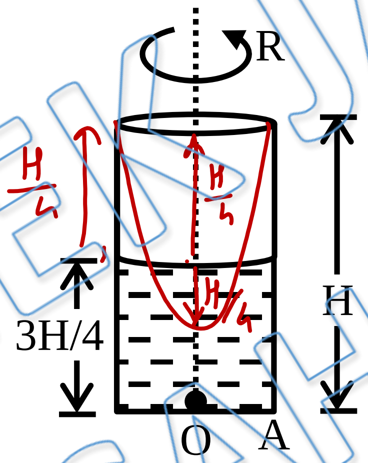


G.P. at C = 0

" " D = $\rho g h = 10^3 \times 10 \times 3 = 3\times10^4$

" " mid point of base $= 10^3 \times 10 \times 1.5 = 1.5\times10^4$

Q7) A liquid of density ρ filled in the vessel as shown is rotated with constant angular velocity 'ω' about the axis passing through the middle. The radius of cylinder is R. Then –



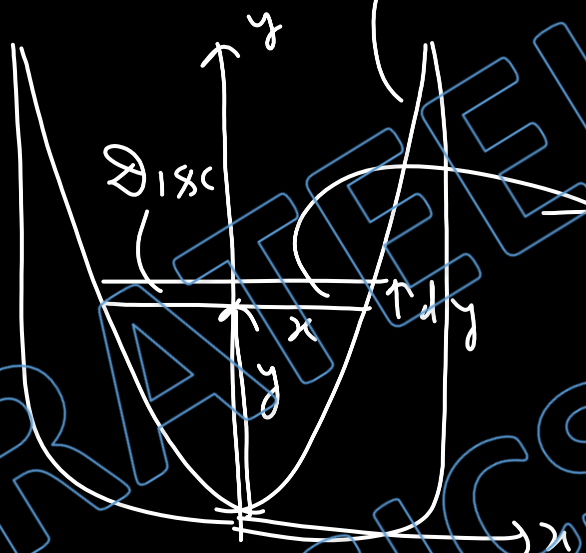
(a) The minimum value of 'ω' for which the liquid comes out is $\sqrt{\frac{gH}{R^2}}$

(b) The value of 'ω' for which the base of container is just exposed is $\sqrt{\frac{2gH}{R^2}}$

(c) Volume of liquid remaining in the container in option(b) is $\frac{\pi R^2 H}{2}$

(d) Gauge pressure at point A in the container in option(b) is ρgH

Ans. a,b,c,d



$$y = \frac{\omega^2 x^2}{2g} = \frac{2gH}{R^2} \times \frac{x^2}{2g} = \frac{Hx^2}{R^2}$$

$$dV = \pi x^2 dy = \pi \frac{R^2 y}{H} dy$$

$$V = \frac{\pi R^2}{H} \int_0^H y\, dy$$

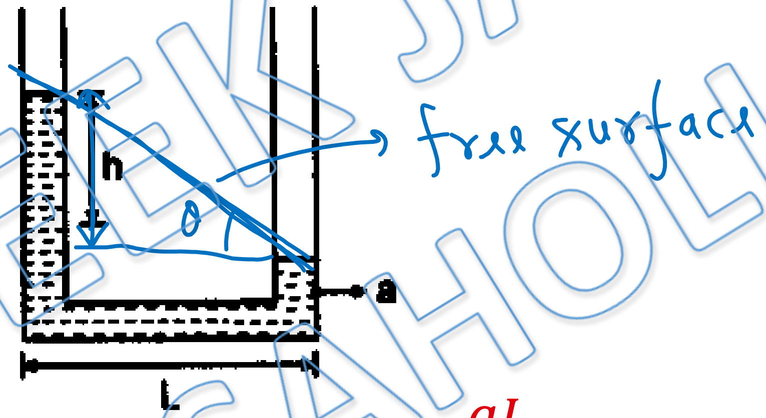
$$= \frac{\pi R^2}{H} \times \frac{H^2}{2} = \frac{\pi R^2 H}{2}$$

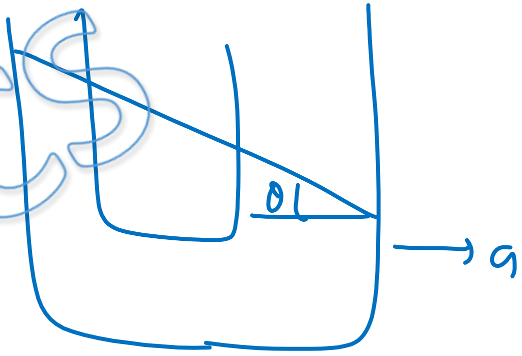
$$\text{Volume of liquid} = \underbrace{\pi R^2 H}_{\text{total volume of container}} - \underbrace{\frac{\pi R^2 H}{2}}_{\text{Volume of empty space}} = \pi R^2 H$$

Q8) When at rest, a liquid stands at the same level in the U tubes . But as indicated a height difference h occurs when the system is given an acceleration a towards the right. Here, h is equal to:

$\tan\theta = \frac{a}{g} = \frac{h}{L}$

$h = \frac{aL}{g}$





(a) $\frac{aL}{2g}$ (b) $\frac{gL}{2a}$ (c) $\frac{gL}{a}$ (d) $\frac{aL}{g}$ ✓

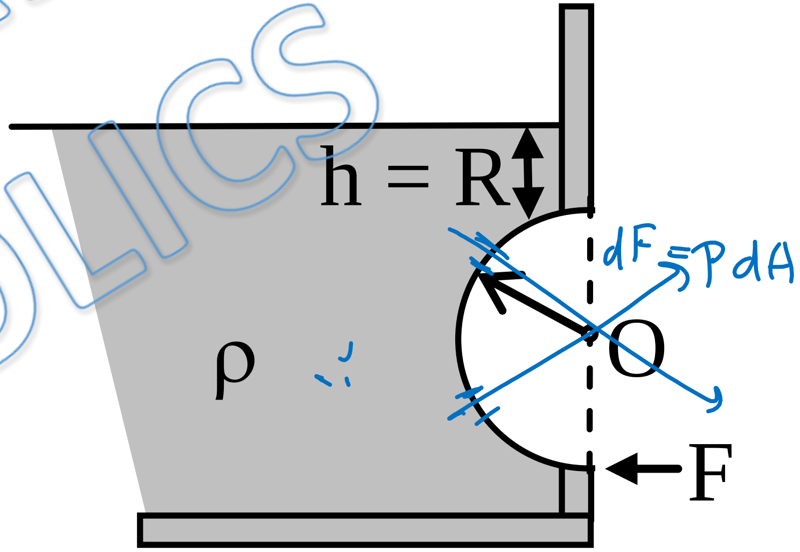
Q9) The figure shows a semi-cylindrical massless gate pivoted at the point O holding a stationary liquid of density ρ. A horizontal force F is applied at its lowest position to keep it stationary. The magnitude of the force is –

torque of dF about Axis = 0

net torque by liquid about axis = 0

required Antitorque = 0

⇒ F = 0



(a) $\frac{9}{2}\rho g R^2$

(b) $\frac{3}{2}\rho g R^2$

(c) $\rho g R^2$

(d) Zero ✓

Q10) Three liquids having densities ρ_1, ρ_2 and ρ_3 are filled in a U-tube. Length of each liquid column is equal to l. $\rho_1 > \rho_2 > \rho_3$ and liquids remain at rest (relative to the tube) in the position shown in figure. It is possible that–

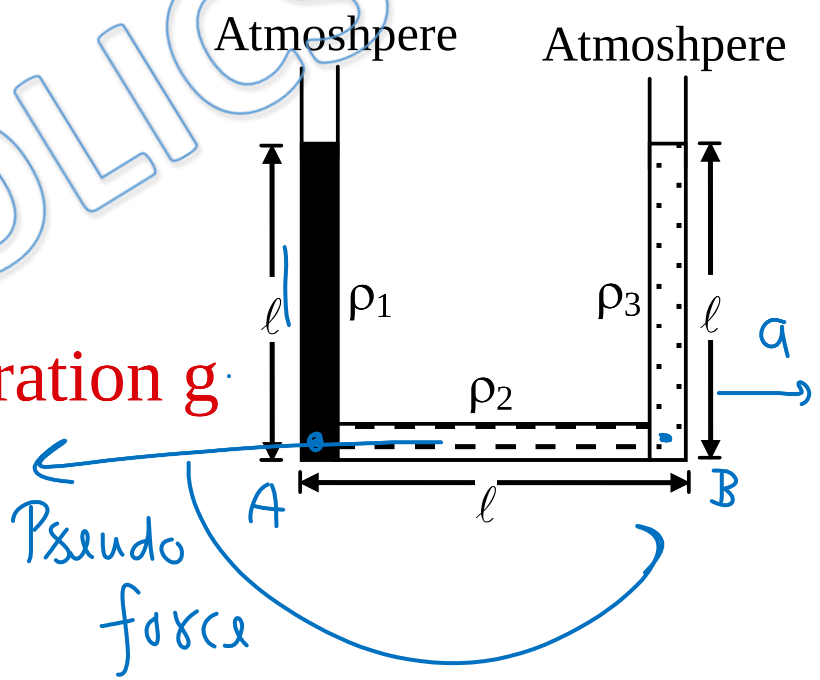
$P_A > P_B$ in given picture

(a) U-tube is accelerating leftwards

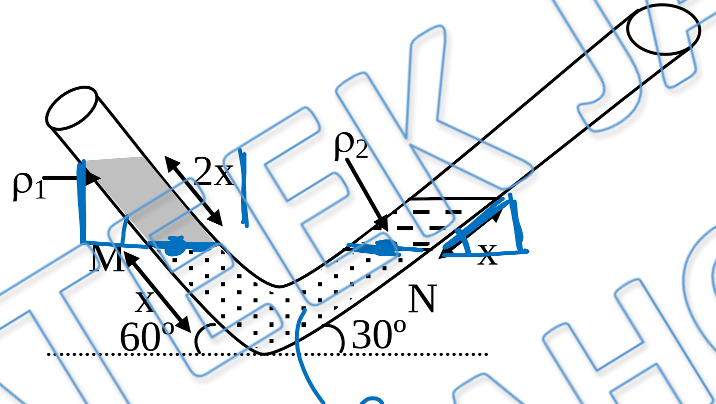
(b) U-tube is accelerating upwards with acceleration g

(c) U-tube is moving with a constant velocity

(d) None of these



Q11) liquids of density ρ_1 and ρ_2 stand in the bent tube as shown. Density of lowermost liquid is ρ . Point M and N are at same horizontal level and system is in equilibrium.Then –



(a) $P_M = P_N$ (same liquid, same level ⇒ same pressure)

(b) $\rho_2 = 2\sqrt{3}\,\rho_1$

(c) $\rho_1 = 2\sqrt{3}\,\rho_2$

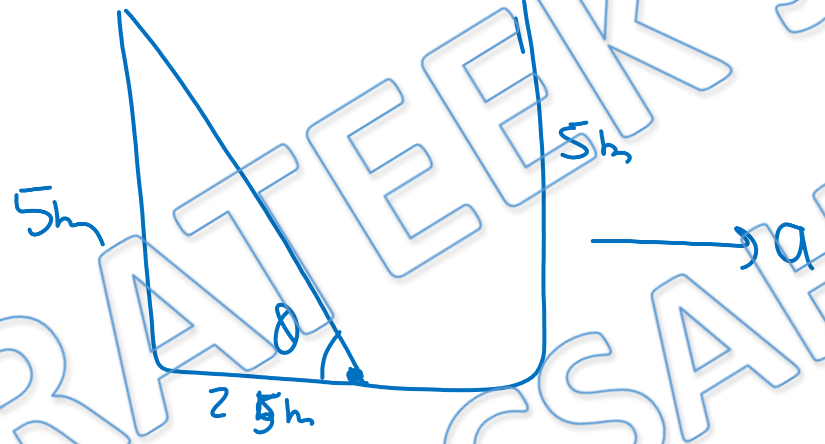
(d) None of these

$P_M = P_N$

$\Rightarrow P_0 + \rho_1 \times g \times 2x \sin 60 = P_0 + \rho_2 \times g \times x \sin 30$

$\rho_1 g \times \frac{2x\sqrt{3}}{2} = \rho_2 g \times \frac{x}{2}$

Q12) A cubical open vessel of diameter 5 m is filled with a liquid. The vessel is accelerated horizontally in such a way that the height of the liquid becomes 5 m and the pressure at the mid point of the vessel becomes equal the atmospheric pressure. Then the acceleration of the vessel will be



(a) g (b) 3g (c) 2g (d) 3g/2

$\tan\theta = \frac{5}{2.5} = \frac{a}{g}$

$a = 2g$

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