EXERCISE – V

JEE QUESTIONS

1. A

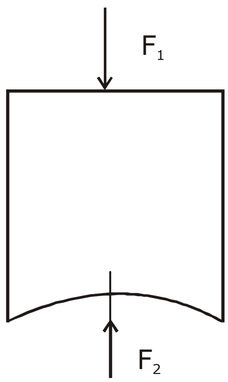
From $A_1V_1 = A_2V_2$

$$L^2\sqrt{2gy} = \pi R^2\sqrt{2g(4y)}$$

$$L^2 = \pi R^2$$

$$R = \frac{L}{\sqrt{2\pi}}$$

2. D



F_2 - F_1 = Buoyancy force

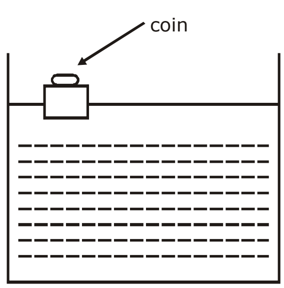
F_2 = F_1 + Buoyancy force

F_2 = (Pressure) (Area of Projection) $+ V\rho g$

$F_2 = \rho gh(\pi R^2) + v\rho g$

$= \rho g\,(v+\pi R^2 h)$

3. D



Initially,

$W_{coin} + W_{block} = V_d\rho_l g$

$$V_d = \frac{W_{coin}}{\rho_l g} + \frac{W_{block}}{\rho_l g}$$

Finally

$$\frac{W_{coin}}{\rho_{coin} g} + \frac{W_{block}}{\rho_l g} = V_{d'}$$

$$\rho_{coin} > \rho_l$$

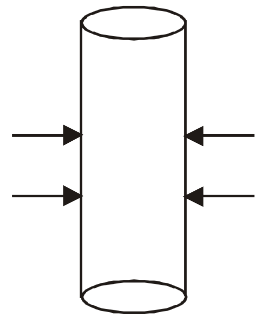
$$\Rightarrow V_d' < V_d$$

$\Rightarrow$ l decreases and h decreases

4.

(a)

In portion A



$F_a = 0$

If radius of cylinder is r.

Then

Net Buoyancy = Weight of cylinder

$$\pi r^2 h_A\rho_A g + \pi r^2 h_B\rho_B g = \pi r^2(h + h_A + h_B)\rho_c g$$

h = 0.25 cm.

Net upward force = extra Buoyancy force.

$= \pi r^2 h\rho_B g$

$$a = \frac{F}{m} = \frac{\pi r^2 h\rho_B g}{\pi r^2(h + h_A + h_B)\rho_C}$$

$$\therefore a = \frac{g}{6}$$

5. From $A_1V_1 = A_2V_2$

$\pi(4)^2\,(0.25) = \pi(1)^2\,V_2$

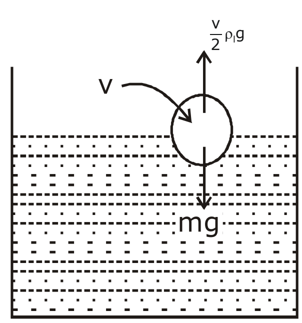
V_2 = 4m/sec

Range = V_2 (Time of flight)

$$= 4\sqrt{\frac{2\times 1.25}{100}}$$

= 2 m

6.

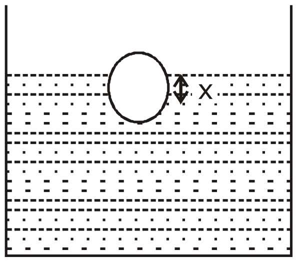


at equilibrium position

$$\Rightarrow \frac{4}{3}\pi R^3\rho_s g = \frac{1}{2}\left(\frac{4}{3}\pi R^3\right)\rho g$$

$$\rho_s = \frac{\rho}{2}$$

After slightly displaced from its M.P.



F_{net} = Extra Buoyancy force

$F_{net} = \pi R^2 x\rho g$

$$\text{Now } f = \frac{1}{2\pi}\sqrt{\frac{K}{m}}$$

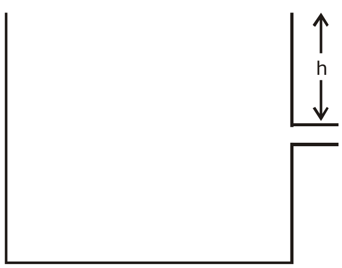
$K = \pi R^2 \rho g$

$$m = \frac{4}{3}\pi R^3 \rho_s g = \left(\frac{4}{3}\pi R^3\right)\left(\frac{\rho}{2}g\right)$$

$$f = \frac{1}{2\pi}\sqrt{\frac{3g}{2R}}$$

7.

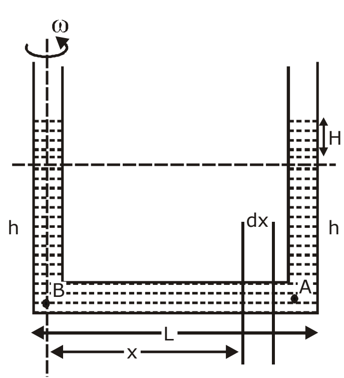
From $A_1V_1 = A_2V_2$ .....(1)



$$P_o + \rho gh + \frac{1}{2}\rho v_1^2 = P_o + 0 + \frac{1}{2}\rho v_2^2 \text{.......(2)}$$

After solving eqn (1) & (2)
you will get the answer.

8.



$$P_B = \rho gh + P_o$$

$$P_A = P_o + (H+h)\rho g \quad \text{....(1)}$$

In small element having mass dm.

$AdP = (dm)\omega^2 x$

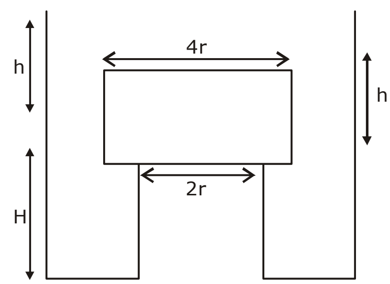
$AdP = A\rho.dx\omega^2 x$

$$\int_{P_B}^{P_A} dP = \rho\omega^2 \int_0^L x\,dx$$

$$(P_A - P_B) = \frac{\rho\omega^2 L^2}{2}$$

$$H\rho g = \frac{\rho\omega^2 L^2}{2} \Rightarrow H = \frac{\omega^2 L^2}{2g}$$

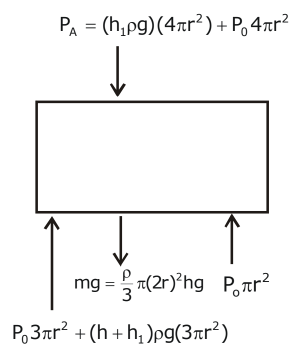
9.



Area of Base of the cylinder = $\pi(2r)^2 = 4\pi r^2$

Area of Hole = $\pi(r)^2$

Net force is just balanced when height is h_1 then



at balancing coudition

$$P_0(4\pi r^2) + (h_1\rho g)(4\pi r^2) + \frac{\rho}{3}\pi(4r^2)hg$$

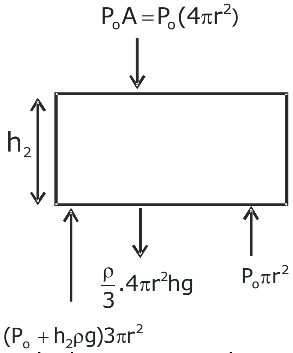
$$= P_o\pi r^2 + P_o 3\pi r^2 + (h+h_1)\rho g(3\pi r^2)$$

$$4h_1\rho g + \frac{4}{3}\rho hg = 3h\rho g + 3h_1\rho g$$

$$h_1\rho g = \frac{5}{3}h\rho g$$

$$h_1 = \frac{5h}{3}$$

10.



At balancing condition

$$\frac{\rho}{3}.4\pi r^2hg = h_2\rho g3\pi r^2$$

$$h_2 = \frac{4h}{9}$$

11. Cylinder will not move up and remains at its original position

Because at $h_2 > \frac{4h}{9}$, cylinder bend to move upward and $h_2 < \frac{4h}{9}$ it remains at rest.

12. From $A_1V_1 = A_2V_2$

13. B

air from end 1 flows towards end 2. Volume of the soap bubble at end 1 decreases

14. Buoyant force is resultant of pressure force of liquid.

15. $P_1^{1-\gamma}T_1^{\gamma} = P_2^{1-\gamma}T_2^{\gamma}$

$P_1 = P_o + \rho_l gh$

$T_1 = T_o$

$P_2 = P_o + \rho_l g(H - y)$

16. Buoyancy force $= \rho_l Vg$

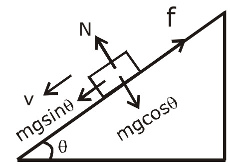
$$= \rho_l g\left[\frac{nRT_2}{P_2}\right]$$

$$T_2 = T_o\left[\frac{P_o + \rho_l g(H - Y)}{P + \rho_l gH}\right]^{2/5}$$

$P_2 = P_o + \rho_l g(H - Y)$

17. 6

18.



For (P)

Force exerted by x on Y.

$= R = \sqrt{N^2 + f^2} = mg$

W.D. by friction is +ve so mechanical energy of the system is decreasing

For (Q)

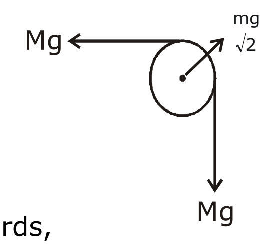
x is balancing weight of Y and Z.

P.E. is increasing because height is increasing.

For (R)

P.E. is decreasing

Total Mechanical energy is decreasing.



For (S)

As mass move downwards,

Fluid move upward so potential energy of x is increase.

Mechanical energy is constant because Fluid is non-viscous.

For (T)

V = constant so F_x = Mg

In this due to viscous force

Mechanical energy is not conserved.

19. A,B,D