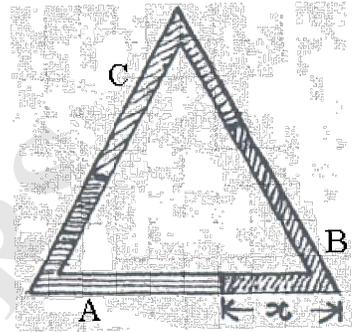


[SINGLE CORRECT CHOICE TYPE]

- Q.1 A narrow closed tube of uniform cross-section in the form of an equilateral triangle of side L contains equal volumes of three liquids A, B and C which do not mix. The densities of the liquids are in arithmetic progression. The tube is in the vertical plane with one side horizontal as shown in figure. A possible value of x is [3]

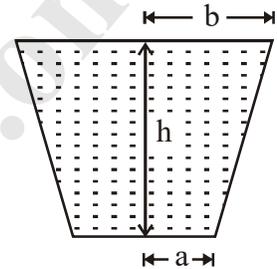


- (A) $\frac{L}{3}$ (B) $\frac{L}{4}$
 (C) $\frac{2L}{5}$ (D) $\frac{L}{6}$

- Q.2 The stem of a hydrometer is uniform in cross-section and has graduations spaced uniformly from 0, 1, 2, upto 10. When floating in pure water, the hydrometer reads zero and in a liquid of relative density 1.50, it reads 10. The relative density of a liquid in which it reads 5 is [3]

- (A) 1.15 (B) 1.20 (C) 1.25 (D) 1.30

- Q.3 A bucket full of liquid of height h, density ρ and radii a and b ($b > a$) is shown in figure. The net downward thrust on the curved surface of the bucket due to the liquid alone is [3]



- (A) $2\pi\rho g(b-a)h(2a+b)$ (B) $\pi\rho g(b-a)h(2a+b)$
 (C) $\pi\rho g(b-a)h(2a+b)/2$ (D) $\pi\rho gh\left(\frac{b^2}{3} + \frac{ab}{3} - \frac{2a^2}{3}\right)$

- Q.4 A block of ice (of uniform density ρ) in the form of a cube of edge of length L floats in water (of density ρ_0). The work that should be performed by an external agent to submerge the ice block completely in water is [3]

- (A) $L^4\left(\rho_0 - \frac{\rho}{2}\right) g$ (B) $L^4(\rho_0 - \rho) g/2$ (C) $L^4(\rho_0 - \rho)^2 g/\rho_0$ (D) $L^4(\rho_0 - \rho)^2 g/(2\rho_0)$

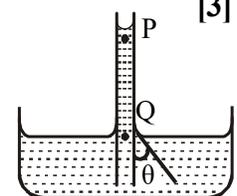
- Q.5 A hose can deliver $8.0 \times 10^{-3} m^3$ of water per second from a hole of area $4.0 cm^2$. If the jet is placed horizontally against a vertical wall and if the water that hits the wall drops down vertically, the force on the wall due to the water jet is [3]

- (A) $2 \times 10^4 N$ (B) $200 N$ (C) $160 N$ (D) $100 N$

- Q.6 Two soap bubbles are blown. In the first bubble, excess pressure is 4 times of that of second soap bubble. The ratio of radii of first to that of second soap bubble is [3]

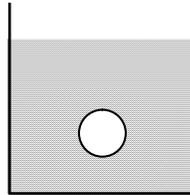
- (A) 1 : 4 (B) 1 : 2 (C) 2 : 1 (D) 4 : 1

- Q.7 Liquid reaches an equilibrium as shown, in a capillary tube of internal radius r. If the surface tension of the liquid is T, the angle of contact θ and density of liquid ρ , then the pressure difference between P and Q is [3]



- (A) $\left(\frac{2T}{r}\right)\cos\theta$ (B) $\frac{T}{r\cos\theta}$
 (C) $\frac{2T}{r\cos\theta}$ (D) $\left(\frac{4T}{r}\right)\cos\theta$

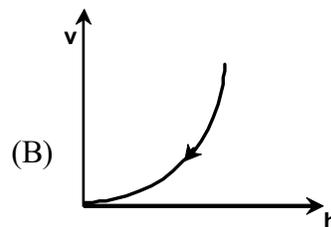
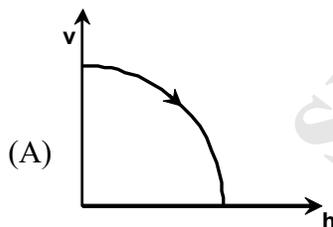
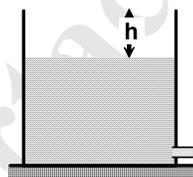
- Q.8 A long capillary tube with both ends open is filled with water and set in a vertical position. The radius of the capillary is 0.1 cm and surface tension of water is 70 dynes/cm. The length of the water column remaining in the capillary tube will be approximately [3]
 (A) 1.5 cm (B) 2.8 cm (C) 3.6 cm (D) 5.8 cm
- Q.9 Water rises to height of 2 cm in a capillary tube. The angle of contact is zero. The tube is now depressed further so that its length above the surface of water is only 1 cm. The apparent angle of contact now is [3]
 (A) 0° (B) 30° (C) 60° (D) 90°
- Q.10 A smooth spherical ball of radius 1 cm and density $4 \times 10^3 \text{ kg/m}^3$ is dropped gently in a large container containing viscous liquid of density $2 \times 10^3 \text{ kg/m}^3$, $\eta = 0.1 \text{ N-s/m}^2$. The distance moved by the ball in $t = 0.1 \text{ sec}$ after it attains terminal velocity is [3]

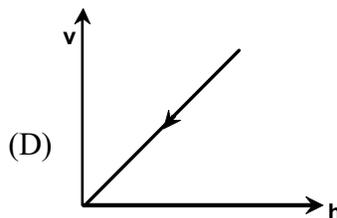
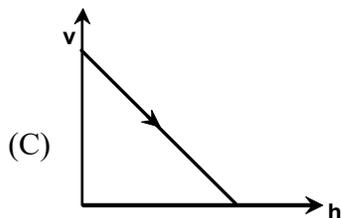


- (A) $\frac{4}{5} \text{ m up}$ (B) $\frac{4}{9} \text{ m up}$ (C) $\frac{2}{3} \text{ m down}$ (D) $\frac{4}{9} \text{ m down}$

- Q.11 For a stream line flow of water following statements are given below [3]
 (a) Two streamlines do not intersect each other.
 (b) Streamlines must be straight.
 (c) Streamlines flow is more likely for liquids with low density and high viscosity.
 (d) Streamlines flow is more likely for liquids with high density and low viscosity.
 (A) (a) and (b) are true. (B) (a), (b) and (c) are true.
 (C) (a) and (c) are true. (D) All are true.

- Q.12 A rectangular tank is filled completely with water. A hole at its bottom is unplugged. The graph between the velocity of efflux (through a small hole) vs depth of water h from the top of tank. [3]

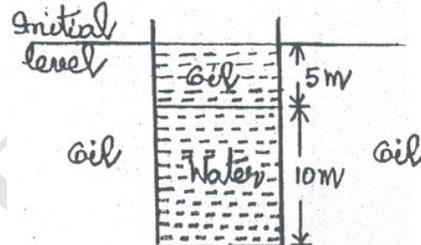




[PARAGRAPH TYPE]

Pargraph for Q.No.13 to 15

A vessel of uniform cross-section open at the top with an orifice at its bottom contains oil (relative density 0.8) on top of water. It is immersed vertically in a large open tank of oil as shown in figure. Water flows out of the vessel.

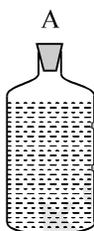


- Q.13 The initial speed of water for the values given in the figure is nearly [3]
 (A) 10.0 m/s (B) 8.0 m/s (C) 6.3 m/s (D) 5.0 m/s
- Q.14 When the liquid stops, the height of the oil-water interface in the vessel is [3]
 (A) 8.0 m (B) 6.0 m (C) zero (D) none of these
- Q.15 If the ratio of the crosssectional area of the vessel to that of the orifice is 50, the time in which the flow of the liquid stops is nearly [3]
 (A) 30 s (B) 32 s (C) 15 s (D) 16 s

[MATRIX TYPE]

- Q.16 A bottle is filled with water, above which a little air at atmospheric pressure is present. Plugs are blocking the three small holes (A, B & C). [8]

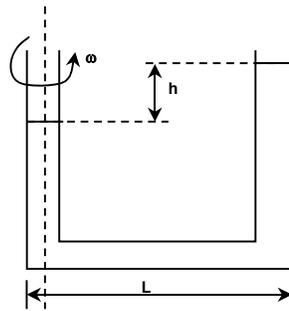
- Column I**
- (A) A & C are opened
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 (C) Only C is opened
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- Column II**
- (P) Air comes into the bottle from upper most open hole
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[SUBJECTIVE TYPE]

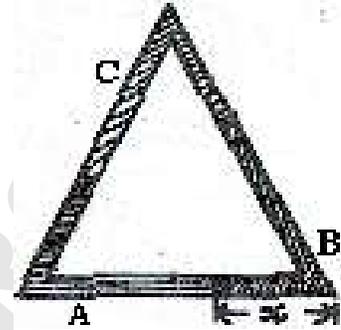
- Q.17 A large number of liquid drops each of radius r coalesce to form a single drop of radius R . The energy released in the process is converted into the kinetic energy of the big drop so formed. Find the speed of the big drop if surface tension of liquid is T and density of liquid is ρ . [5]
- Q.18 A U tube of uniform corss-section and of length L contains a liquid. It is mounted on a horizontal turn table rotating with an angular speed ω about one of the arms. Find the difference in height between the liquid column in the vertical arms. [3]



- Q.19 A water droplet of radius r starts falling from rest from a height h and acquires the terminal speed just before reaching the ground. If g (acceleration due to gravity) is assumed to be constant find the work done by air drag. The co-efficient of viscosity of air is η and ρ_a , ρ_w are densities of air and water respectively. **[5]**
- Q.20 A uniform cylinder floats with its axis vertical with $\left(\frac{1}{n}\right)^{\text{th}}$ part of its length in the upper liquid and $\left(\frac{n-3}{n}\right)^{\text{th}}$ part of its length in the lower liquid, in a mixture of two liquids, which are immiscible. If the specific gravities of the two liquids are ρ_1 , ρ_2 ($\rho_2 > \rho_1$), the specific gravity of the material of the cylinder is **[5]**
- Q.21 A plastic circular disc of radius R is placed on a thin oil film of thickness t and viscosity η , spread over a flat horizontal surface. Find the power required to spin the disc about its central vertical axis with a constant angular velocity ω . **[5]**

[SINGLE CORRECT CHOICE TYPE]

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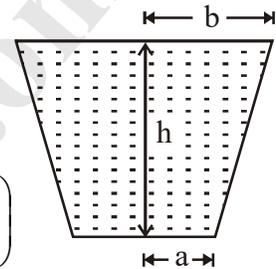


- (A*) $\frac{L}{3}$ (B) $\frac{L}{4}$
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- Q.2 The stem of a hydrometer is uniform in cross-section and has graduations spaced uniformly from 0, 1, 2, upto 10. When floating in pure water, the hydrometer reads zero and in a liquid of relative density 1.50, it reads 10. The relative density of a liquid in which it reads 5 is [3]

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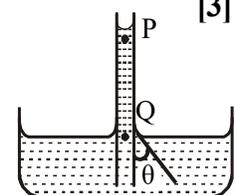
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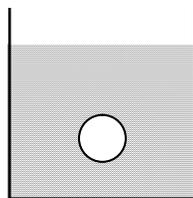
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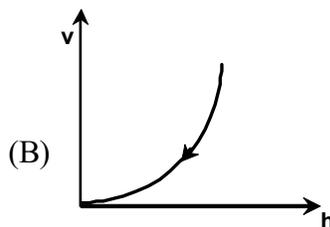
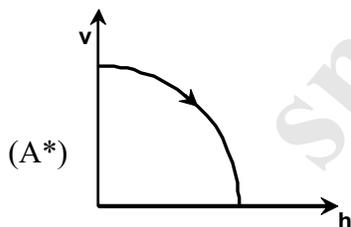
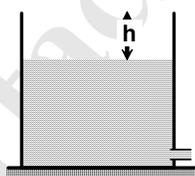
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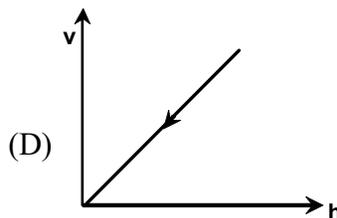
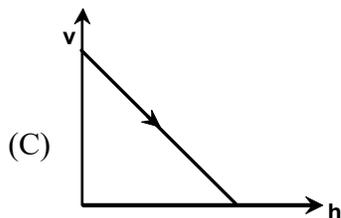


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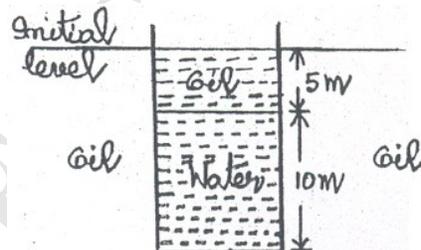




[PARAGRAPH TYPE]

Paragraph for Q.No.13 to 15

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[MATRIX TYPE]

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- Column I**
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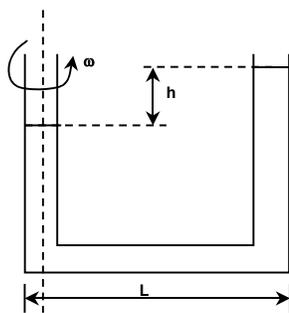
[Ans. (A) P, S, (B) P, Q, (C) R, (D) P,Q,S]

[SUBJECTIVE TYPE]

- Q.17 A large number of liquid drops each of radius r coalesce to form a single drop of radius R . The energy released in the process is converted into the kinetic energy of the big drop so formed. Find the speed of the big drop if surface tension of liquid is T and density of liquid is ρ . [5]

[Ans $\sqrt{\frac{6T}{\rho} \left(\frac{1}{r} - \frac{1}{R} \right)}$]

- Q.18 A U tube of uniform cross-section and of length L contains a liquid. It is mounted on a horizontal turn table rotating with an angular speed ω about one of the arms. Find the difference in height between the liquid column in the vertical arms. [3]



[Ans. $\frac{\omega^2 L^2}{2g}$]

- Q.19 A water droplet of radius r starts falling from rest from a height h and acquires the terminal speed just before reaching the ground. If g (acceleration due to gravity) is assumed to be constant find the work done by air drag. The co-efficient of viscosity of air is η and ρ_a , ρ_w are densities of air and water respectively. [5]

[Ans. $\frac{4}{3} \pi r^3 \rho_w g \left[\frac{2r^4 g}{81 \eta^2} (\rho_w - \rho_{air})^2 - h \left(1 - \frac{\rho_{air}}{\rho_w} \right) \right]$]

- Q.20 A uniform cylinder floats with its axis vertical with $\left(\frac{1}{n}\right)^{th}$ part of its length in the upper liquid and $\left(\frac{n-3}{n}\right)^{th}$ part of its length in the lower liquid, in a mixture of two liquids, which are immiscible. If the specific gravities of the two liquids are ρ_1 , ρ_2 ($\rho_2 > \rho_1$), the specific gravity of the material of the cylinder is [5]

Ans. $\left[\rho_2 + \frac{\rho_1 - 3\rho_2}{n} \right]$

- Q.21 A plastic circular disc of radius R is placed on a thin oil film of thickness t and viscosity η , spread over a flat horizontal surface. Find the power required to spin the disc about its central vertical axis with a constant angular velocity ω . [5]

[Ans. $P = \frac{\pi \eta \omega^2 R^4}{2t}$]