PHYSICS

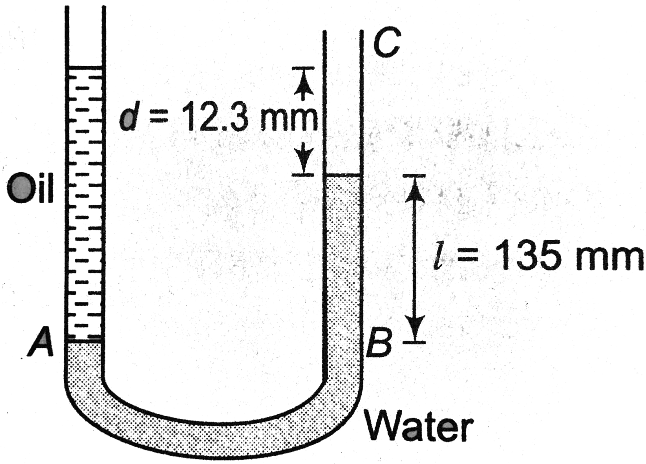
BOOKS - DC PANDEY PHYSICS (HINGLISH)

FLUID MECHANICS

Example

1. Relative density of an oil is 0.8.Find the absolute density of oil in CGS and SI units.

2. For the arrangement shown in the figure, what is the density of oil?



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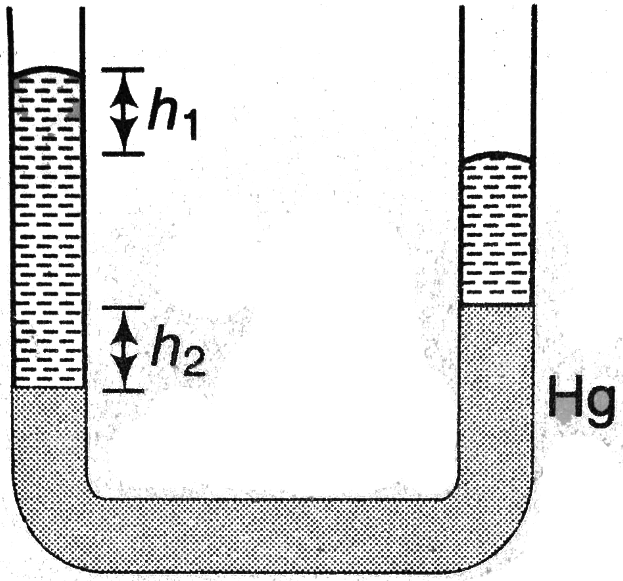
3. A U-tube of uniform cross-sectional area and open to the atmosphere is partially filled with mercury. Water is then poured into both arms. If the equilibrium configuration of the tube is as shown in figure with $h_2 = 1.0 cm$, determine the value of h_1



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4. A U-shaped tube open to the air at both ends contains some mercury. A quantity of water is carefully poured into the left arm of the U-shaped tube until the vertical height of the water column is $15.0 cm$.

(a) What is the gauge pressure at the water mercury interface ?

(b) Calculate the vertical distance h from the top of the mercury in the right hand arm of the tube to the top of the water in the left-hand arm.

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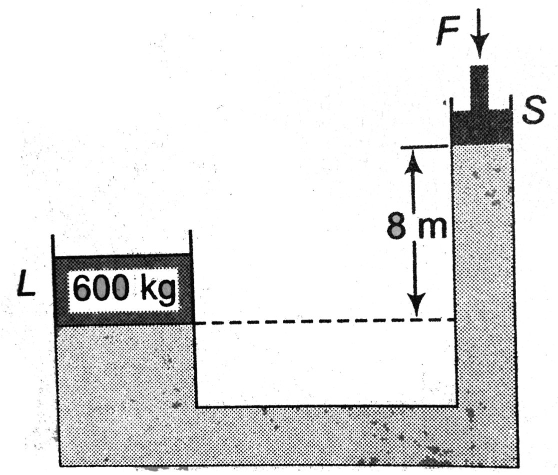
5. For the system shown in figure, the cylinder on the left, at L, has a mass of 600 kg and a cross-sectional area of $800cm^2$. The piston on the right, at S, has cross-sectional area $25cm^2$ and negligible weight. If the apparatus is filled with oil $(\rho = 0.78g/cm^3)$, what is the force F required to hold the system is equilibrium?



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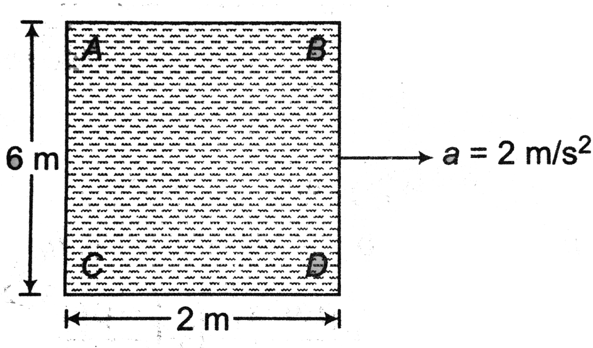
6. A closed container shown in figure is filled with water $(\rho = 10^3 kg / M^3)$



This is accelerated in horizonal direction with an acceleration, $a = 2m / s^2$.Find (a)$p_C - p_D$ and (b) $p_A - p_D$.

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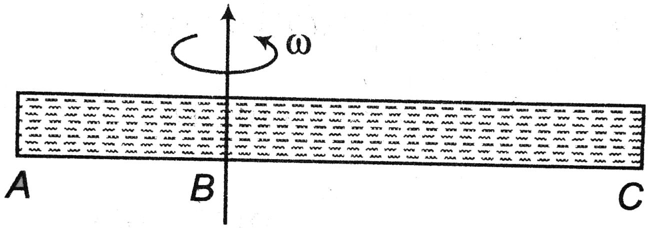
7. A closed tube is filled with



$AB = 2m$

$BC = 4cm$

water $(\rho = 10^3 kg/m^3)$. It rotating about an axis shown in figure with an angular velocity $\omega = 2rad/s$. Find, $p_A - p_C$.

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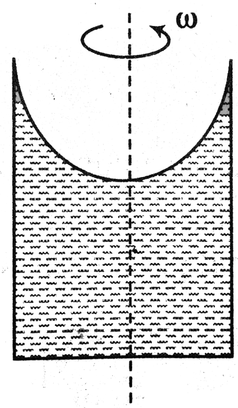
8. A liquid of density ρ is in a bucket that spins with angular velocity $'\omega'$ as shown in figure. Prove that the free surface of the liquid has a parabolic shape. Find equation of this.



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9. Density of ice is $900kg/m^3$. A piece of ice is floating in water of density $1000kg/m^3$. Find the fraction of volume of the picec of ice outside the water.

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10. A metallic sphere floats in an immiscible mixture of water $\left(\rho_w = 10^3 kg/m^3\right)$ and a liquid $\left(\rho_L = 13.5 \times 10^3 kg/m^3\right)$ such that its $\frac{4}{5}th$ volume is in water and $\frac{1}{5}th$ volume in the liquid. Find the density of metal.

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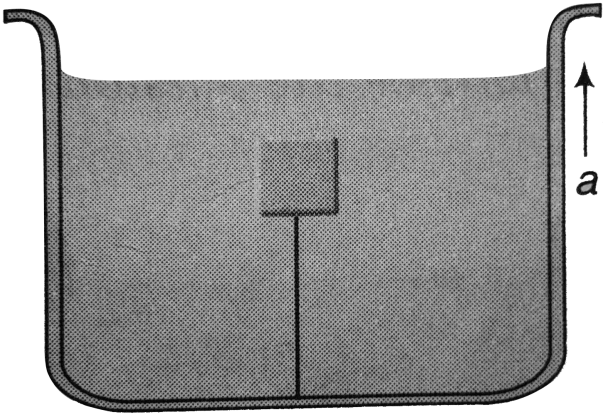
11. A block of mass 1 kg and density $0.8 g/cm^3$ is held stationary with the help of a string as shown in figure. The tank is accelerating vertically upwards with an acceleration a $= 1.0 m/s^2$. Find



(a) the tension in the string,

(b) if the string is now cut find the acceleration of block.

(Take $g = 10m/s^2$ and density of water $= 10^3 kg/m^3$).

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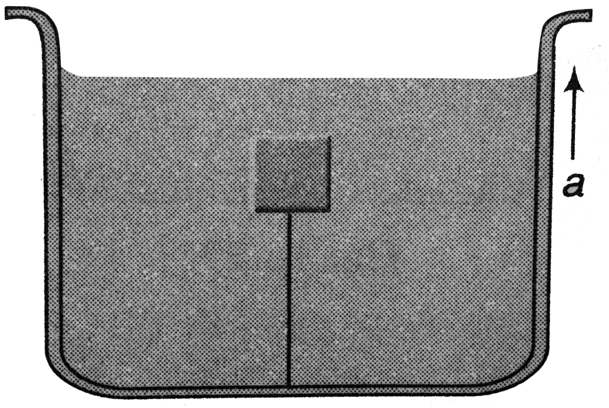
12. The tension in a string holding a solid block below the surface of a liquid (of density greater than that of solid) as shown in figure is T_0 when the system is at rest. What will be the tension in the string if the system has an upward acceleration a?



A. $T_0\left(1+\frac{a}{g}\right)$

B. $T_0\left(1-\frac{a}{g}\right)$

C. $T_0\left(1+\frac{g}{a}\right)$

D. $T_0\left(1-\frac{g}{a}\right)$

Answer: A

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13. Water is flowing through a horizontal tube of non-uniform cross-section. At a place, the radius of the tube is $1.0cm$ and the velocity of water is $2m/s$. What will be the velocity of water where the radius of the pipe is $2.0cm$?

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14. Calculate the rate of flow of glycerine of density. $1.25 \times 10^3 kg/m^3$ through the conical section of a pipe. If the radii of its ends are $1.0m$ and $0.04m$ and the pressure drop across its length is $10N/m^2$.

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15. Water is flowing smoothly through a closed-pipe system. At one point the speed of the water is $3.0m/s$. While at another point $1.0m$ higher the speed is $4.0m/s$. If the pressure is $20Kpa$ at the lower point, what is the pressure at the upper point? What would the pressure at the upper point be if the water were to stop flowing and the pressure at the lower point were $18kpa$?

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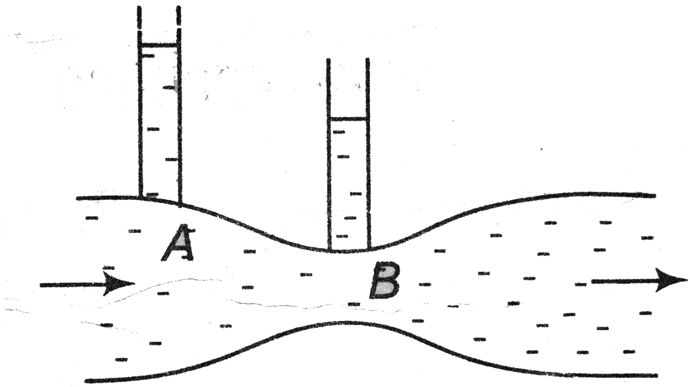
16. Water flows through a horizontal tube as shown in figure. If the difference of height of water column in the vertical tubes in $2cm$ and the areas of corss-section at A and B are $4cm^2$

respectively. Find the rate of flow of water across any section.



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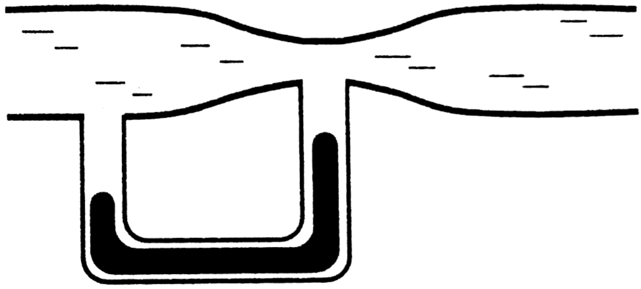
17. Water flows through the tube shown in figure. The areas of cross section of the wide and the narrow portions of the tube are $5cm^2$ and $2cm^2$ respectively. The rate of flow of water through the tube is $500cm^3s^{-1}$. Find the difference of mercury levels in the U-tube.



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18. A tank is filled with a liquid upto a height H, A small hole is made at the bottom of this tank Let t_1 be the time taken to empty first half of the tank and t_2 time taken to empty rest half of the tank then find $\frac{t_1}{t_2}$

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19. A plate of area $2m^2$ is made to move horizontally with a speed of $2m/s$ by applying a horizontal tangential force over the free surface of a liquid. If the depth of the liquid is 1m and the liquid in contact with the bed is stationary. Coefficient of viscosity of liquid is 0.01 poise. Find the tangential force needed to move the plate.

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20. Two spherical raindrops of equal size are falling vertically through air with a velocity of $1m/s$. What would be the terminal speed if these two drops were to coalesce to form a large spherical drop?

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21. With what terminal velocity will an air bubble $0.8mm$ in diameter rise in a liquid of viscosity $0.15N-s/m^2$ and specific gravity 0.9? Density of air is $1.293kg/m^3$.

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22. A spherical ball of radius $3.0 \times 10^{-4}m$ and density $10^4 kg/m^3$ falls freely under gravity through a distance h before entering a tank of water. If after entering the water the velocity of the ball does not change, find h. Viscosity of water is $9.8 \times 10^6 N-s/m^2$.

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23. A small sphere falls from rest in a viscous liquid. Due to friction, heat is produced. Find the relation between the rate of produced heat and the radius of the sphere at terminal velocity.

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24. How much work will be done in increasing the diameter of a soap bubble from $2cm$ to $5cm$? Surface tension solution is $3.0 \times 10^{-2} N/m$.

A. $3.96 \times 10^{4} J$

B. $2.58 \times 10^{4} J$

C. $1.46 \times 10^{4} J$

D. $1.88 \times 10^{4} J$

Answer: A

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25. Calculate the energy released when 1000 small water drops each of same radius $10^{-7}m$ coalesce to form one large drop. The surface tension of water is $7.0 \times 10^{-2} N/m$.

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26. What should be the pressure inside a small air bubble of $0.1mm$ radius situated just below the water surface. Surface tension of water $= 7.2 \times 10^{-2} N/m$ and atmosphere pressure $= 1.013 \times 10^{5} N/m^{2}$.

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27. Two separate air bubbles (radii $0.002cm$ and 0.004) formed of the same liquid (surface tension $0.07N/m$) come together to form a double bubble. Find the radius and the sense of curvature of the internal film surface common to both the bubbles.

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28. Under isothermal condition two soap bubbles of radii r_1 and r_2 coalesce to form a single bubble of radius r. The external pressure is p_0. Find the surface tension of the soap in terms of the given parameters.

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29. Assume that a drop of liquid evaporates by decreases in its surface energy, so that its temperature remains unchanged. What should be the minimum radius of the drop for this to be possible? The surface tension is T, density of liquid is ρ and L is its latent heat of vaporization.

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30. A capillary tube whose inside radius is $0.5mm$ is dipped in water having surface tension $7.0 \times 10^{-2} N/m$. To what height is the water raised above the normal water level? Angle of contact of water with glass is 0°. Density of water is $10^3 kg/m^3$ and $g = 9.8 m/s^2$.

A. $2.55cm$

B. $2.86cm$

C. $3.76cm$

D. $3.42cm$

Answer: B

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31. A glass tube of radius $0.4mm$ is dipped vertically in water. Find upto what height the water will rise in the capollary? If the tube in inclined at an angle of 60° with the vertical, how much length of the capillary is occupied by water? Suface of water $= 7.0 \times 10^{-2} N/m$,density of water $= 10^3 kg/m^3$.

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32. Mercury has an angle of contact of 120° with glass. A narrow tube of radius $1.0mm$ made of this glass is dipped in a through containig mercury. By what amount dies the mercury dip down in the tube relative to the liquid surface outside. Surface tension of mercury at the temperature of the experiment os $0.5N/m$ and density of mercury is $13.6 \times 10^{3} kg/m^{3}$.

(Take $g = 9.8m/s^{2}$).

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33. If a $5cm$ long capillary tube with $0.1mm$ internal diameter, open at both ends, is slightly dipped in water having surface tension $75dyn/cm$, state whether:

(i) water will rise halfway in the capillary,

(ii) water will rise up to the upper end of capillary,

(iii) water will overflow out of the upper end of capillary.

Explain your answer.

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Solved Examples

1. A block of wood floats in a bucket of water placed in a lift. Will the block sink more or less if the lift starts accelerating up?

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2. A raft of wood (density $= 600 kg / m^3$) of mass $120 kg$ floats in water. How much weight can be put on the raft to make it just sink?

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3. A piece of ice is floating in a glass vessel filled with water. Then prove that level of water in the vessel remains unchanged after melting of ice.

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4. A piece of ice having a stone frozen in it floats in a glass vessel filled with water. How will the level of water in the vessel change when the ice melts?

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5. A solid floats in a liquid of different material. Carry out an analysis to see whether the level of liquid in the container will rise or fall when the solid melts.

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6. A metallic sphere weighs $210g$ in air, 180 g in water and 120 g in an unknown liquid. Find the density of metal and of liquid.

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7. An ornament weighing $50g$ in air weighs only $46g$ in water. Assuming that some copper is mixed with gold to prepare the ornament, find the amount of copper in it. Specific gravity of gold is 20 and that of copper is 10.

A. $20g$

B. $10g$

C. $30g$

D. $40g$

Answer: C

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8. An iron casting containing a number of cavities weight $6000N$ in air and $4000N$ in water. What is the volume of the cavities in the casting? Density of iron is $7.87g/cm^3$. Take $g = 9.8m/s^2$ and density of water $= 10^3 kg/m^3$.

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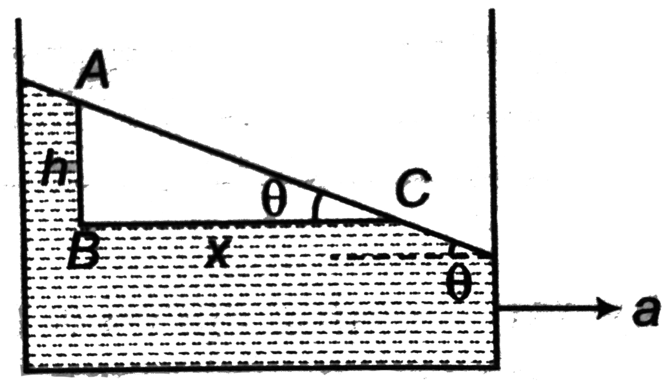
9. A liquid kept in a container has a horizontal acceleration 'a' as shown in figure.



Using the pressure equation along the path ABC find the angle θ.

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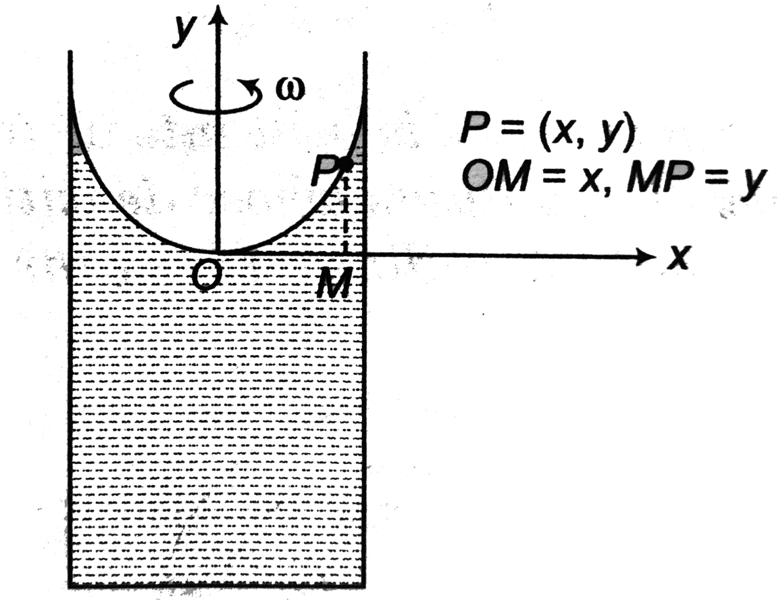
10. A liquid of density $'\rho'$ is rotated with an angular speed $'\omega'$ as shown in figure. Using the pressure equation concept find the equation of free surface of the liquid.



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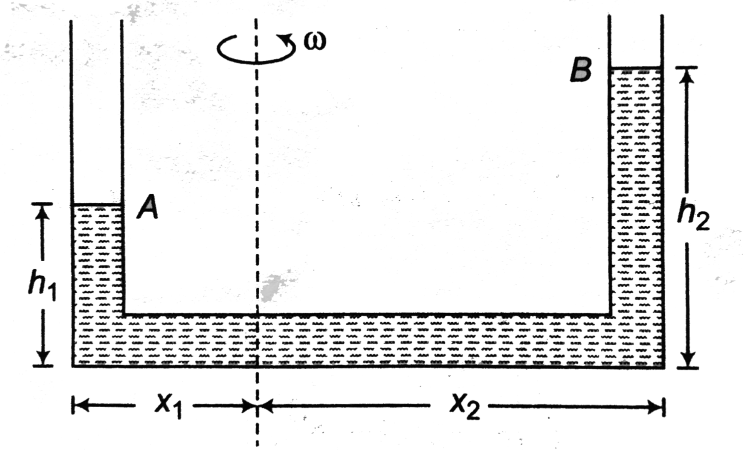
11. 

A liquid of density ρ is rotated by an angular speed ω as shown in figure, Using the concept of pressure equation, find a relation between h_1, h_2, x_1 and x_2.

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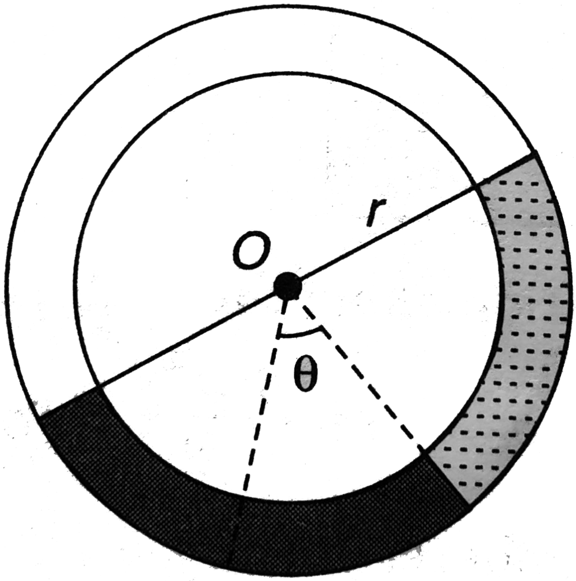
12. A small uniform tube is bent into a circle of radius r whose plane is vertical. Equal volumes of two fluids whose densities areρ and $\sigma(\rho > \sigma)$ fill half the circle. Find the angle that the radius passing through the interface makes with the vertical.



A. $\tan^{-1}\left(\dfrac{\rho+\sigma}{\rho-\sigma}\right)$

B. $\tan^{-1}\left(\dfrac{\rho-\sigma}{\rho-\sigma}\right)$

C. $\tan^{-1}\left(\dfrac{\rho+\sigma}{\rho+\sigma}\right)$

D. $\tan^{-1}\left(\dfrac{\rho-\sigma}{\rho+\sigma}\right)$

Answer: D

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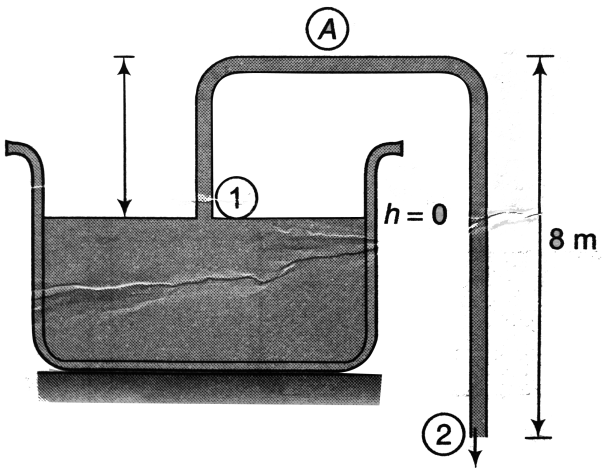
13. The U-tube acts as a water siphon. The bend in the tube is 1m above the water surface. The tube outlet is 7m below the water surface. The water issues from the bottom of the siphon as a free jet at atmospheric pressure. Determine the speed of the free jet and the minimum absolute pressure of the water in the bend. Given atmospheric pressure $= 1.01 \times 10^5 N/m^2, g = 9.8m/s^2$ and density of water

$= 10^3 kg/m^3$



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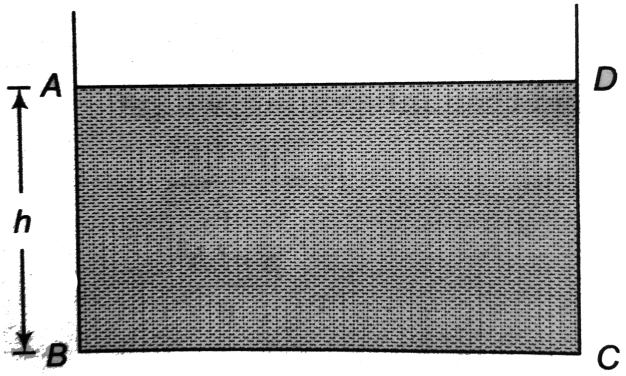
14. A liquid of density ρ is filled upto a geight of 'h' in a container as shown in firgure. Base of the contaimer is a square of side L. Ignoring the atmospheric pressure find



(a) pressure force F_1 on its base.

(b) torque of force F_1 about an axis passing through C and perpendicular to plane of paper.

(c) Pressure force F_2 on the vertical side wall DC.

(d) torque of force F_2 about the same axis mentioned in part (b).

(e) point of application of force F_2

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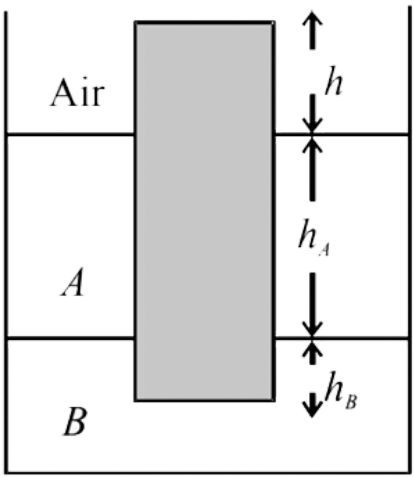
15. A uniform solid cylinder of density $0.8g/cm^3$ floats in equilibrium in a combination of two non-mixing liquids A and B with its axis vertical.

The densities of the liquids A and B are $0.7g/cm^3$ and $1.2g/cm^3$, respectively. The height of liquid A is $h_A = 1.2cm$. The length of the part of the cylinder immersed in liquid B is $h_B = 0.8cm$.



(a) Find the total force exerted by liquid A on the cylinder.

(b) Find h, the length of the part of the cylinder in air.

(c) The cylinder is depressed in such a way that its top surface is just below the upper surface of liquid A and is then released. Find the acceleration of the cylinder immediately after it is released.

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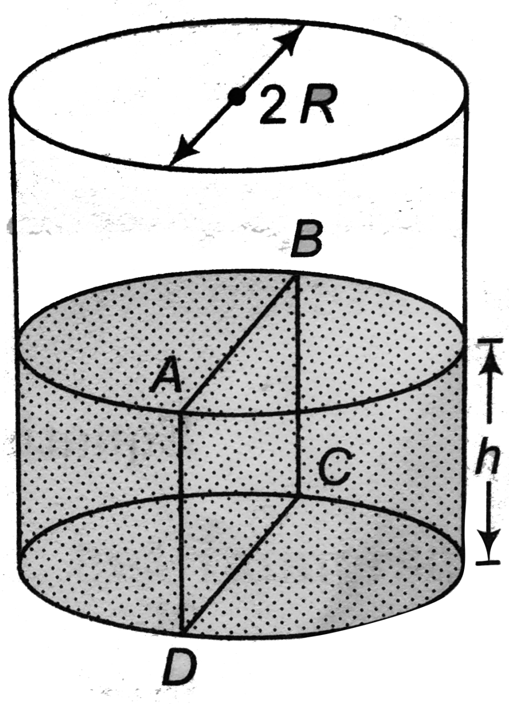
16. Water is filled up to a height h in a beaker of radius R as shown in the figure. The density of water is ρ, the surface tension of water is T and the atmospheric presure is p_0. Consider a vertical section $ABCD$of the water on one side of this section by water on the other side of this section has magnitude



(a) $\left|2p_0Rh + \pi R^2 \rho gh - 2RT\right|$

(b) $\left|2p_0Rh + R\rho gh^2 = 2RT\right|$

(c) $\left|p_0(\pi)R^2 + R\rho gh^2 - 2RT\right|$

(d) $\left|p_0\pi R^2 + R\rho gh^2 + 2RT\right|$.

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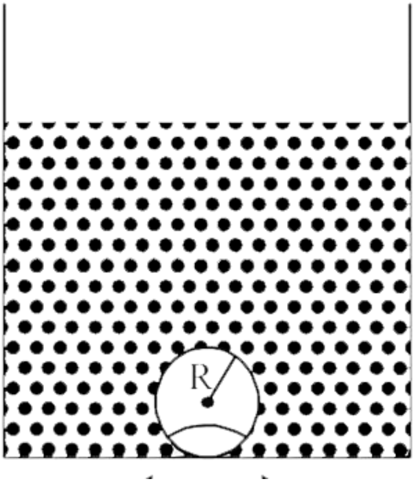
17. On heating water, bubbles being formed at the bottom of the vessel detach and rise. Take the bubbles to be spheres of radius R and making a circular contact of radius r with the bottom of the vessel. If $r < < R$ and the surface tension of water is T, value of r just before bubbles detach is: (density of water is ρ_w)



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18. When liquid medicine of density ρ is to be put in the eye, it is done with the help of a dropper. As the bylb on the top of the dropper is pressed. A drop frons at the opening of the dropper. We wish to estimate the size of the drop.

We first assume that the drop formed at the opening is spherical because that requires a minimum increase in its surface energy, To determine the size. We calculate the net vertical force due to the surface tension T when the radius of the drop is R. when this force become smaller than the weight of the drop the drop gets detached from the dropper.

If the radius of the opening of the dropper is r, the vertical force due to the surface tension on the drop of radius$R$ (assuming $r < < R$) is

A. $2\pi rT$

B. $2\pi RT$

C. $\dfrac{2\pi r^2 T}{R}$

D. $\dfrac{2\pi R^2 T}{r}$

Answer: C

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19. When liquid medicine of density ρ is to be put in the eye, it is done with the help of a dropper. As the bylb on the top of the dropper is pressed. A drop frons at the opening of the dropper. We wish to estimate the size of the drop.

We first assume that the drop formed at the opening is spherical because that requires a minimum increase in its surface energy, To determine the size. We calculate the net vertical force due to the surface tension T when the radius of the drop is R. when this force become smaller than the weight of the drop the drop gets detached from the dropper.

If

$r = 5 \times 10^{-4} m, \rho = 10^3 kgm^{-3}, g = 10 ms^{-2}, T = 0.11 Nm^{-1}$,

The radius of the drop when it detaches from the dropper is approximately,

A. $1.4 \times 10^{-3} m$

B. $3.3 \times 10^{-3} m$

C. $2.0 \times 10^{-3} m$

D. $4.1 \times 10^{-3} m$

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20. When liquid medicine of density ρ is to be put in the eye, it is done with the help of a dropper. As the bulb on the top of the dropper is pressed, a drop forms at the opening of the dropper. We wish to estimate the size of the drop.

We first assume that the drop formed at the opening is spherical because that requires a minimum increase in its surface energy, To determine the size. We calculate the net vertical force due to the surface tension $T = 0.11Nm$ when the radius of the drop is $R = 1.4mm$. When this force become smaller than the weight of the drop, the drop gets detached from the dropper.

After the drop detaches, its surface energy is

A. $1.4 \times 10^{-6} J$

B. $2.7 \times 10^{-6} J$

C. $5.4 \times 10^{-6} J$

D. $8.1 \times 10^{-9} J$

Answer: B

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21. A drop of water of volume $0.05cm^3$ is pressed between two glass plates, as a consequence of which, it spreads and occupies an area of $40cm^2$. If the surface tension of water is $70\text{dyne}/cm$, find the normal force required to separate out the two glass plates in newton.

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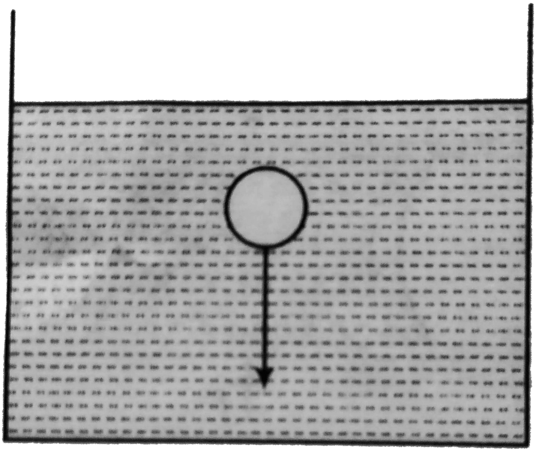
Miscellaneous Examples

1. A ball of volume V and density ρ_1 is moved downwards by a distance 'd' in liquid of density ρ_2. Find total change in potential energy of the system.



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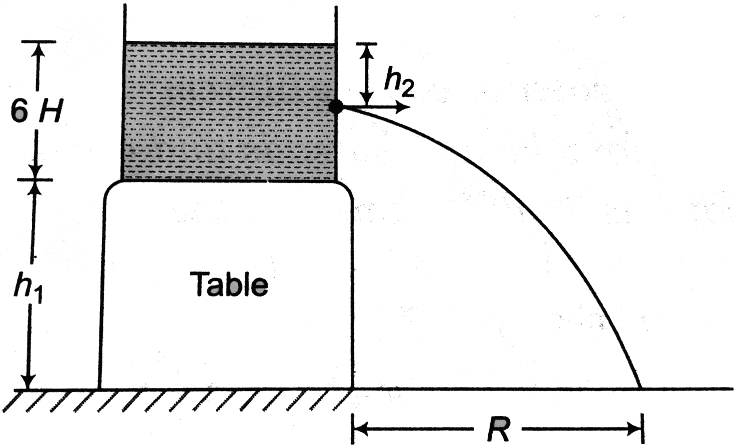
2. In the figure shown find the value of h_2 for maximum range R if



(a) $h_1 = 4H$ (b)$h_1 = 8H$

Also find the value of this maximum range in both cases.

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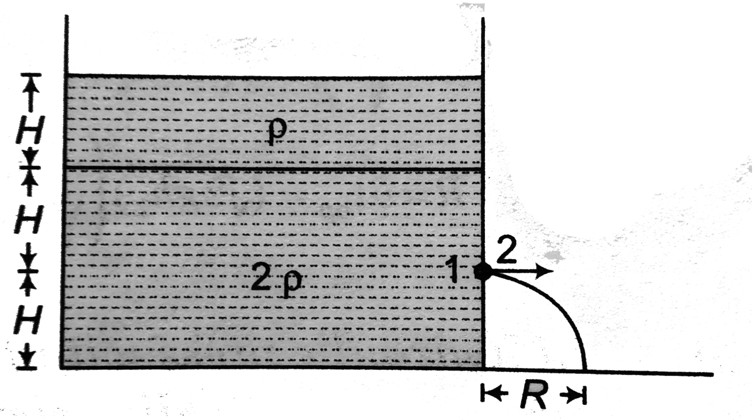
3. In the figure shown,



find the range R.

A. $6H$

B. $\sqrt{3}H$

C. $\sqrt{6}H$

D. $3H$

Answer: C

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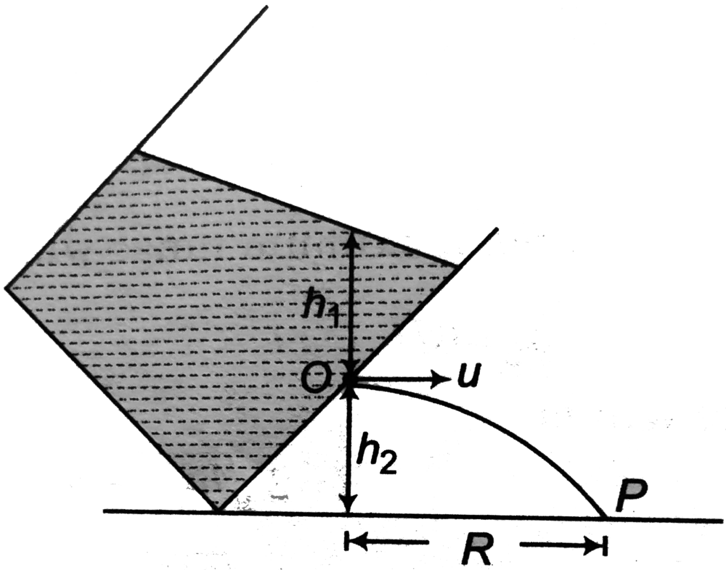
4. In the figure show,



find v, t_{op} and R.

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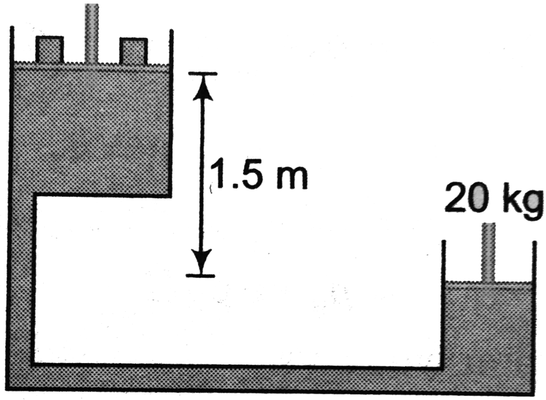
5. Figure shown a hydraulic press with the larger piston if diameter 35 cm at a height of 1.5 cm at a height of 1.5 m relative to the smaller piston of diameter 10cm. The mass on the smaller piston is 20 kg. What is the force exerted on the load by the larger piston? The density of oil in the press is $750kh/m^3$. (Take $g = 9.8m/s^2$)



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6. A glass full of water upto a height of 10 cm has a bottom of are $10cm^2$, top of area $30cm^2$ and volume 1 litre.

(a) Find the force exerted by the water on the bottom.

(b) Find the resultant force exerted by the sides of the glass on the water.

(c) If the glass is convered by a jar and the air inside the jar is completely pumped out, what will be the answer to parts (a) and (b).

(d) If a glass of different shape is used, provided the height, the bottom area, the top area and the volume are unchanged, will the answer to parts (a) and (b) change.

Take $g = 10m/s^3$, density of water $= 10^3 kg/m^3$ and atmospheric pressure $= 1.01 \times 10^5 N/m^2$.

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7. A soild ball of density half that of water falls freely under gravity from a height of 19.6 m and then enters water. Upto what depth will the ball go. How much time will it take to come again to the water surface? Neglect air resistandce and viscosity effects in water. (Take $g = 9.8m/S^2$).

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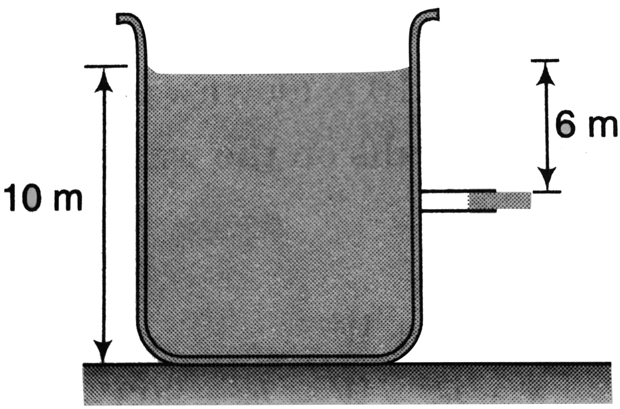
8. A fresh water on a reservoir is $10m$ deep. A horizontal pipe $4.0cm$ in diameter passes through the reservoir $6.0m$ below the water surface as shown in figure . A plug secures the pipe opening.



(a) Find the friction force between the plug and pipe wall.

(b) The plug is removed. What volume of water flows out of the pipe in $1h$? Assume area of reservoir to be too large.

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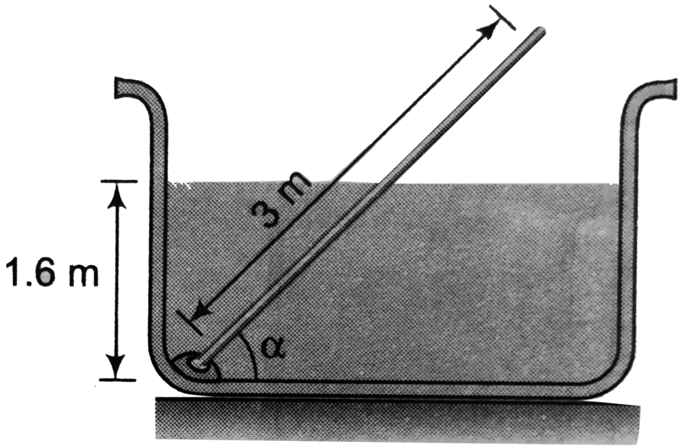
9. A wooden rod weighing $25N$ is mounted on a hinge below the free surface of water as shown. The rod is $3m$ long and uniform in cross section and the support is 1.6m below the free surface. At what angle α rod is in equilibrium? The cross-section of the rod is $9.5 \times 10^{-4} m^2$ in area. Density of water is $1000 kg / m^3$. Assume buoyancy to act at centre of immersion.

$g = 9.8 m / s^2$. Also find reaction on the hinge in this position.



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10. A cylindrical tank has a small hole at bottom. At $t = 0$, a tap starts to supply water into the tank at a constant rate $\beta m^3 / s$.

(a) Find the maximum level of water $H_{\max}$ in the tank ?

(b) At what time level of water becomes $h (h < H_{\max})$ Given a, area of hole, A : area of tank.

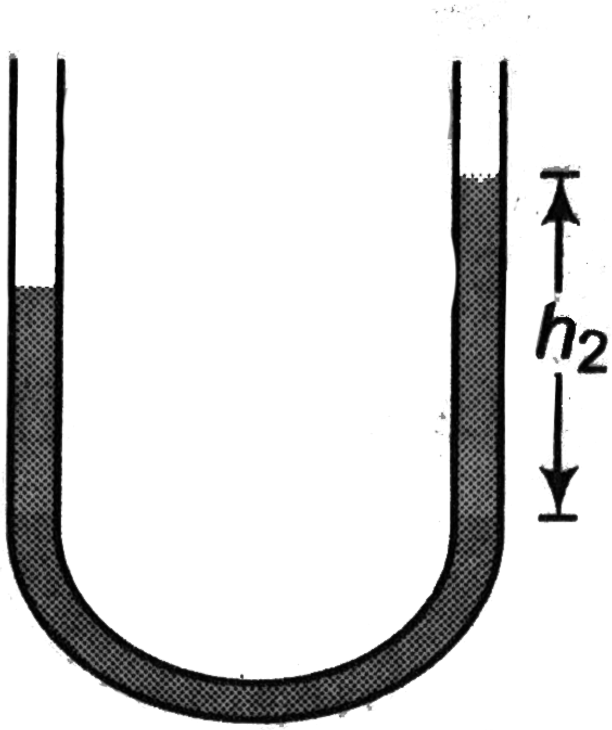
Watch Video Solution

Exercise16.1

1. Water and oil are poured into the two limbs of a U-tube containing mercury. The interface of the mercury and the liquids are at the same height in both limbs.

Determine the height of the water columnh_1 if that of the oil

$h_2 = 20cm$. The density of the oil is 0.9.



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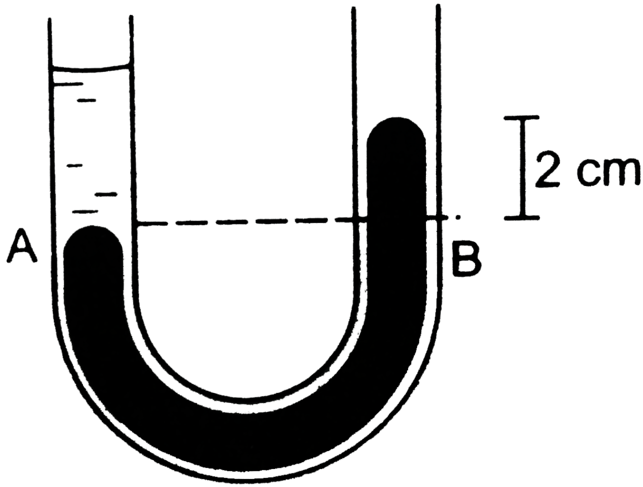
2. The liquids shown in figure in the two arms are mercury (specific gravity =13.6) and water. If the difference of heights of the mercury columns is 2 cm, find the height of the water column.



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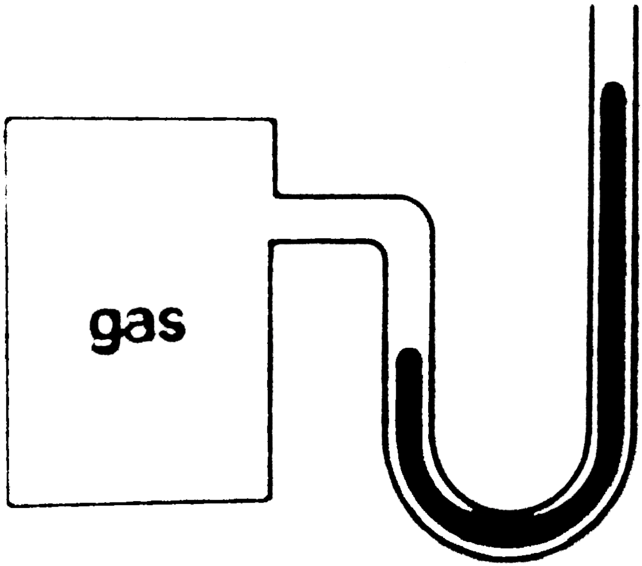
3. The heights of mercury surfaces in the tow arms of the manometer shown in figure are 2 cm and 8cm. Atmospheric pressure $= 1.01 \times 10^5 Nm^{-2}$. Find a. the pressure of the gas in the cylinder and b. the pressure of mercury at the bottom of the U tube.



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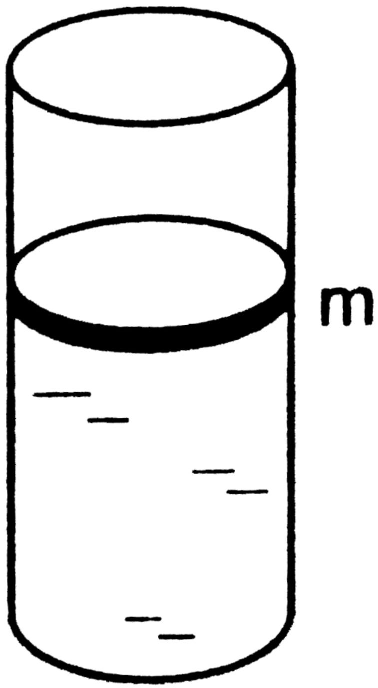
4. A cylidrical vesel containing a liquid is closed by a smooth piston of mass m as shown in the figure. The area of cross section of the piston is A. If the atmospheric pressure is P_0, find the pressure of the liquid just below the piston.



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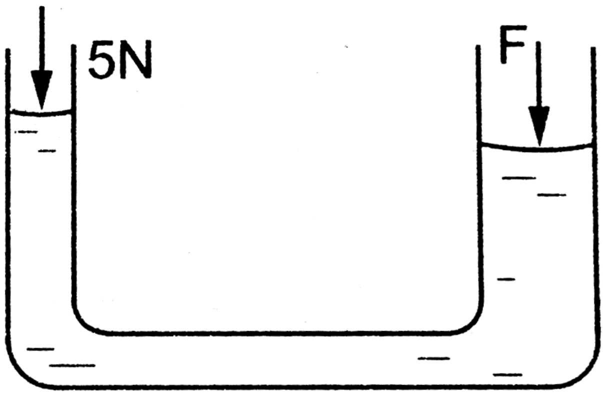
5. The area of cross section of the two arms of a hydraulilc press are 1 cm^2 and 10 cm^2 respectively figure. A force of 5N is applied on the water in the thinner arm. What force should be applied on the water in the thicker arm so that the water may remain in equilibrium?



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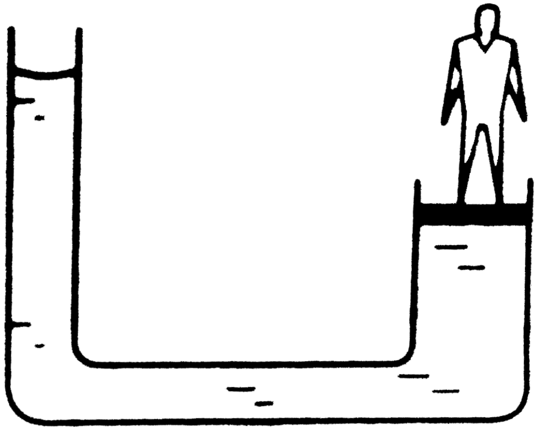
6. The area of cross section of the wider tube shown in figure is $900 cm^2$. If the boy standing on the piston weights 45 kg, find the difference in the levels of water in the two tubes.



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Introductory Exercise

1. In example, which point has the miximum pressure and which has the minimum pressure .

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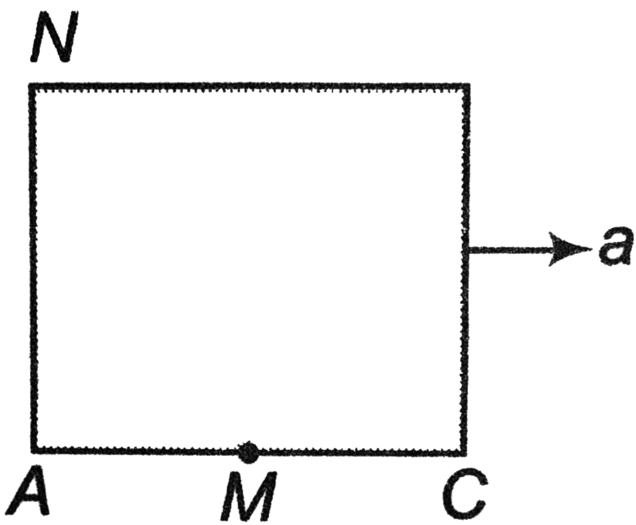
Exercise16.2

1. A cubical closed vessel of side 5m filled with a liquid is accelerated with an acceleration a. Find the value of a so that pressure at mid point$M$ of AC is equal to pressure at N.



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A. g

B. $2g$

C. $\frac{g}{2}$

D. $zero$

Answer: B

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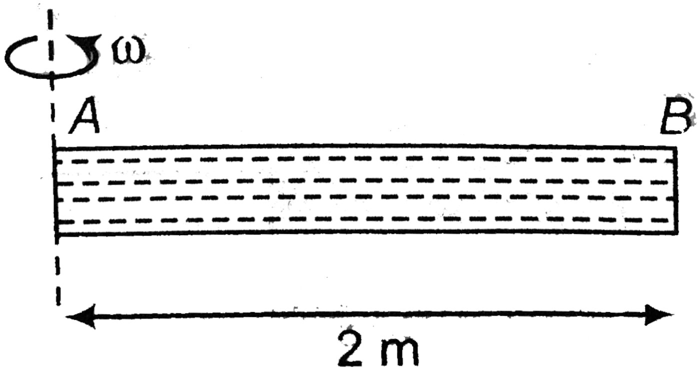
2. Water $\left(\rho = 10^3 kg/m^3\right)$ is filled in tube AB as shown in figure. $(\omega = 10 rad/s)$. Tube is open at end A. Atmospheric pressure is $p_0 = 10^5 N/m^2$. Find absolute pressure at end B.



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Exercise16.3

1. A block of material has a density ρ_1 and floats three-fourth submerged in a liquid of unknown density. Show tht the density ρ_2 of the unknown liquid is given by $\rho_2 = \frac{4}{3}\rho_1$.

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2. A block of wood weighing $71.2N$ and of specific gravity 0.75 is tied by a string to the bottom of a tank of water in order to have the block totally immersed, What is the tension in the string?

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3. A beaker when partly filled with water has total mass $20.00g$. If a piece of metal with density $3.00g/cm^3$ and volume $1.00cm^3$ is suspended by a thin string, so that it is submerged in the water but does not rest on the bottom of the beaker, how much does the beaker then apper to weigh if it is resting on a scale?

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4. A small block of wood of density $0.4 \times 10^3 kg/m^3$ is submerged in water at a depth of $2.9m$. Find

(a) the acceletation of the block towards the surface when the block is released and

(b) the time for the block to reach the surface, Ignore viscosity.

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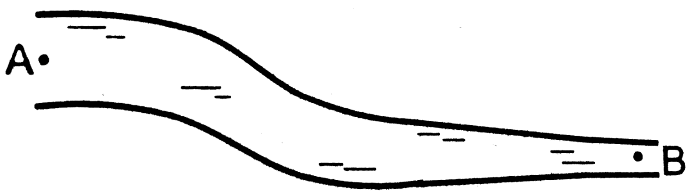
Exercise16.4

1. Water flows through a tube shown in figure. The areas of cross section at A and B are $1cm^2$ and $0.5cm^2$ respectively. The height difference between A and B is 5m. If the speed of water at A is 10 cms^{-1} find a the speed at B and b the difference in pressures at A and B.



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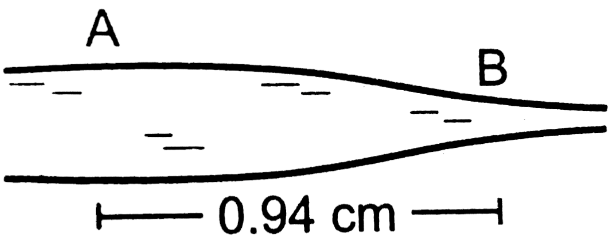
2. Waster flows through a horizontal tube of variable cross section. The area of cross section at A and B are 4 mm^2 and $2mm^2$ respectively. If 1 cc of water enters per seconds through A. Find

a. The speed of water at A,

b. the speed of river at B

c. the pressure difference $P_A - P_B$.



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3. Water from a tap emerges vertically downwards with an initial speed of $1.0ms^{-1}$. The cross-sectional area of the tap is $10^{-4}m^2$. Assume that the pressure is constant throughout the stream of water, and that the flow is steady. The cross-sectional area of the stream $0.15m$ below the tap is

A. $5.0 \times 10^{-4}m^2$

B. $1.0 \times 10^{-4}m^2$

C. $5.0 \times 10^{-5}m^2$

D. $2.0 \times 10^{-5}m^2$

Answer: C

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4. A horizontal pipeline carries water in a streamline flow. At a point along the pipe, where the cross- sectional area is $10cm^2$, the water velocity is $1ms^{-1}$ and the pressure is 2000 Pa. The pressure of water at another point where the cross-sectional area is $5cm^2$, is.........Pa. (Density of water $= 10^3 kg. m^{-3}$)

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Exercise16.5

1. There is a small hole at the bottom of tank filled with water. If total pressure at the bottom is $3atm(1atm = 10^5 Nm^{-2})$, then find the velocity of water flowing from hole.

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2. Liquid is filled in a container upto a height of H. A small hole is made at the bottom of the tank. Time taken to empty from H to $\frac{H}{3}$ is t_0. Find the time taken to empty tank from $\frac{H}{3}$ to zero.

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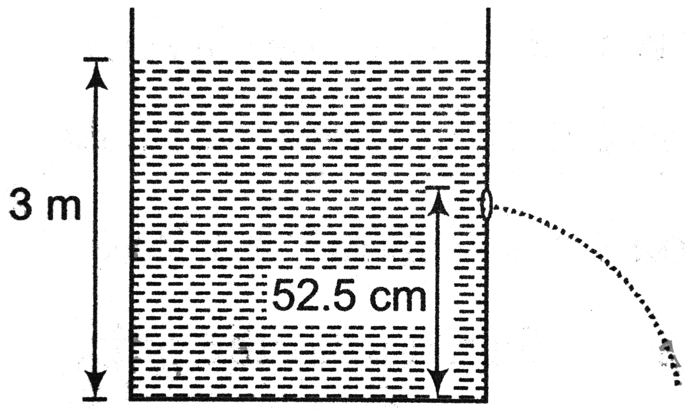
3. Water is filled in a cylindrical container to a height of $3m$. The ratio of the cross-sectional area of the orifice and the beaker is 0.1. The square of the speed of the liquid coming out from the orifice is $\left(g = 10m/s^2\right)$.



A. $50m^2/s^2$

B. $50.5m^2/s^2$

C. $51m^2/s^2$

D. $52m^2/s^2$

Answer: A

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Exercise16.6

1. A typical riverborne silt particle has a radius of $20(\mu)m$ and a density of $2 \times 10^3 kg/m^3$. The viscosity of water is $1.0 mPI$. Find the terminal speed with which such a particle will settle to the bottom of a motionless volume of water.

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2. Two equal drops of water are falling through air with a steady velocity v. If the drops coalesced, what will be the new velocity?

A. $2^{\frac{1}{2}}v$

B. $2^{\frac{2}{3}}v$

C. $2^{\frac{3}{2}}v$

D. None of these

Answer: B

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3. A large wooden plate of area $10m^2$ floating on the surface of river is made to move horizontally wilth a speed of $2ms^{-1}$ by applying a tangential force. If the river is 1m deep and the water contact with the bed is stationary, find the tangential force needed to keep the plate moving. Coefficient of viscosity of water at the temperature of the river $= 10^{-2} poise.$

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4. The velocity of water in a rier is $18 kmh^{-1}$ near the surface. If the river is 5 m deepm, find the shearing stress between the horizontal lyers of water. The coefficient of viscosity of water `=10^-2 poise.

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Exercise16.7

1. A mecury drop of radius 1 cm is sprayed into 10^5 droplets of equal size. Calculate the increase in surface energy if surface tension of mercury is $35 \times 10^{-3} N/m$.

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2. A film of water is formed between two straight parallel wires each $10cm$ long and at a separation of $0.5cm$. Calculate the work required to increase $1mm$ distance between the wires. Surface tension of water $= 72 \times 10^{-3} N/m$.

A. $1.44 \times 10^{-5} J$

B. $14 \times 10^{-5} J$

C. $3.26 \times 10^{-5} J$

D. $32 \times 10^{-5} J$

Answer: A

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3. A soap bubble of radius R has formed at normal temperature and pressure under isothermal conditions. Complete the work done. The surface tension of soap solution is T.

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4. A small air bubble of radius 'r' is at a depth 'h' below the water surface (density of water $= \rho$). Surface tension of water is T, atmospheric pressure is p_0. Find pressure inside the air bubble for the condition $r < < h$

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Exercise16.8

1. Water rises in a capillary tube to a height of 2.0cm. In another capillary tube whose radius is one third of it, how much the water will rise?

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2. Water rises up in a glass capillary upto a height of $9.0cm$, while mercury falls down by $3.4cm$ in the same capillary. Assume angles of contact for water glass and mercury glass 0° and 135° respectively. Determine the ratio of surface tension of mercury and water $(\cos 135^\circ = -0.71)$.

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3. A tube of insufficient length is immersed in water (surface tension $= 0.7N/m$) with 1 cm of it Given, radius of tube $= 1mm.$

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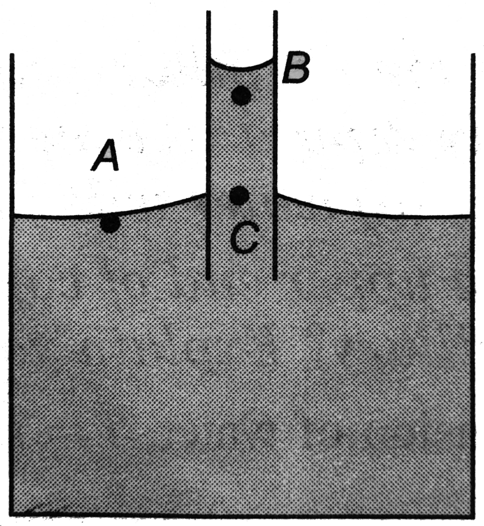
4. A capillary tube is dipped in a liquid. Let pressure at point A, B and C be $p_A p_B$ and p_C respectively, then



A. $p_A = p_B = p_C$

B. $p_A = p_B < p_C$

C. $p_A = p_C < p_B$

D. $p_A = p_C > p_B$

Answer: D

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Level 1 Assertion And Reason

1. Assertion: Pressure is a vector quantity.

Reason: Pressure $P = \frac{F}{A}$. Here F, the force is a vector quantity.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: D

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2. Assertion: Surface tension $\left(T = \frac{F}{l}\right)$ is not a vector quantity.

Reasson: Direction of force is specified.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: A

Watch Video Solution

3. Assertion: At depth h below the water surface pressure is p. Then at depth $2h$ pressure will be $2p$. (Ignore density variation).

Reason: With depth pressure increases linearly.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: D

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4. Assertion: Weight of solid in air is w and in water is $\frac{2w}{3}$ .Then relative density of solid is 3.0.

Reason: Relative density of any solid is given by

$$RD = \frac{\text{Weight in air}}{\text{Change in weight in water}}.$$

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: A

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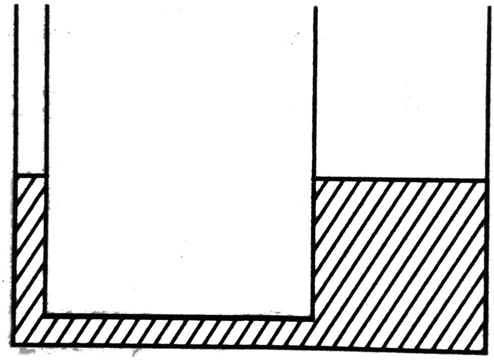
5. Assertion: Water is filled in a U-tube of different cross-sectional area on two sides as shown in figure. Now equal amount of oil $(RD = 0.5)$ is poured on two sides. Level of water on both sides will remain unchanged.



Reason: Same weight of oil poured on two sides will produce on two sides will produce dofferent pressure.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: D

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6. Assertion: An ideal fluid is flowing through a pipe. Speed of fluid particles is more at places where pressure is low.

Reason: Bernoulli's theoren can be derived from work-energy theorem.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

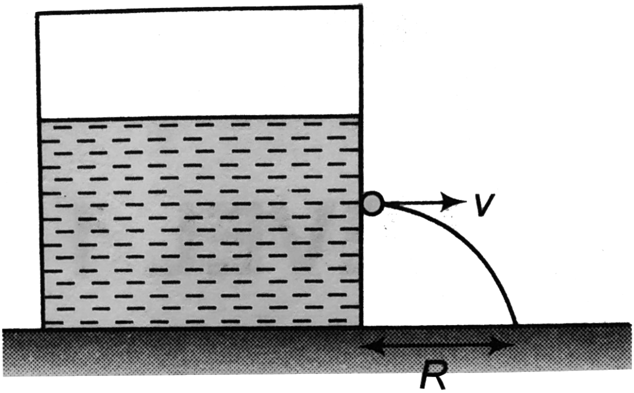
C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: D

Watch Video Solution

7. Assertion: In the figure shown v and R will increase if pressure above the liquid surface inside the chamber is increased.



Reason: Value of v or R is independent of density of liquid.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: B

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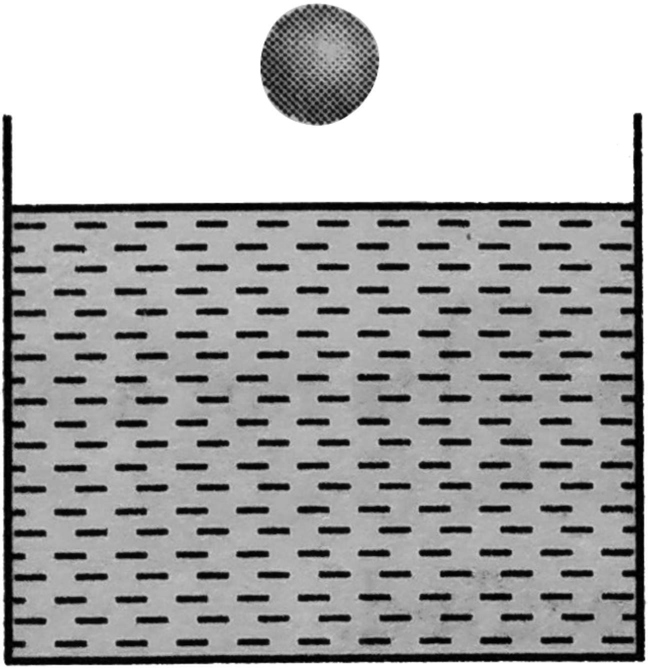
8. Assertion: A ball is dropped from a certain height above the free suface of and ideal fluid. When the ball enters the liquid it mau accelerate or retard.

Reason: Ball accelerates of retards it all depends on the dinsity of ball and the density of liquid.



A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: A

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9. Assertion: On moon, barometer height will be six times compared to the height on earth.

Reason: Value of g on moon's surface is 1/6 the value of g on earth's surface.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: D

Watch Video Solution

10. Assertion: Force of buoyancy due to atmosphere on a small body is almost zero(or negligible).

Reason: If a body is completely submerged in a fluid, then buoyant force is zero.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: C

Watch Video Solution

Assertion and Reason

1. Assertion: In the siphon shown in figure, pressure at P is equal to atmospheric pressure

Reason: Pressure at Q is atmospheric pressure and points P and Q are at same levels.

A. If both Assertion and Reason are true and the Reason is correct explanation of the Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true, but the Reason is false.

D. If Assertion is false but the Reason is true.

Answer: D

View Text Solution

Level 1 Single Correct

1. When a sphere falling in a viscous fluid attains a terminal velocity, then

A. the net force acting on the sphere is zero

B. the drag force balances the buoyant force

C. the drag force balances the weight of the sphere

D. the buoyant force balances the weight and drag force

Answer: A

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2. Which one of the following represents the correct dimensions of the quantity : $x = \frac{\eta}{\rho}$, where η=coefficient of visocosity and ρ =the density of a liquid?

A. $\left[ML^{-2}T^{-1}\right]$

B. $\left[ML^{-4}T^{-2}\right]$

C. $\left[ML^{-5}T^{-2}\right]$

D. $\left[M^0L^2T^{-1}\right]$

Answer: D

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3. Viscosity of liquids

A. increases with increase in temperature

B. is independent of temperature

C. decrease with decreases in temperature

D. decreases with increase in temperature.

Answer: D

Watch Video Solution

4. At critical temperature, the surface tension of a liquid

A. is zero

B. is infinity

C. is same as that at any other temperature

D. cannot be determined

Answer: A

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5. A liquid will not wet the surface of a solid if the angle of contact is

A. 0°

B. 45°

C. 60°

D. $> 90^\circ$

Answer: D

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6. The lower end of a capillary tube touches a liquid whose angle of contact is 110°, the liquid .

A. rises into the tube

B. falls in the tube

C. may rise or fall inside

D. neither rises nor falls inside the tube

Answer: B

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7. When water droplets merge to form a bigger drop

A. liberated

B. absorbed

C. neither liberated nor absorbed

D. sometimes liberated and sometimes absorbed

Answer: A

Watch Video Solution

8. 1000 drops of same size are charged to a potential of 1 V each. If they coalesce to form in single drop, its potential would be

A. increase

B. remain same

C. decrease

D. depend on size

Answer: A

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9. Two soap bubbles in vacuum of radius $3cm$ and$4cm$ coalesce to form a single bubble, in same temperature. What will be the radius of the new bubble?

A. $7cm$

B. $\frac{12}{7}cm$

C. $12cm$

D. $5cm$

Answer: D

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10. A small ball (mass m) falling under gravity in a viscous medium experience a drag force proportional to the instantaneous speed u such that $F_{drag} = ku$. Then the terminal speed of ball within viscous medium is

A. $\frac{k}{mg}$

B. $\frac{mg}{k}$

C. $\sqrt{\frac{mg}{k}}$

D. None of these

Answer: D

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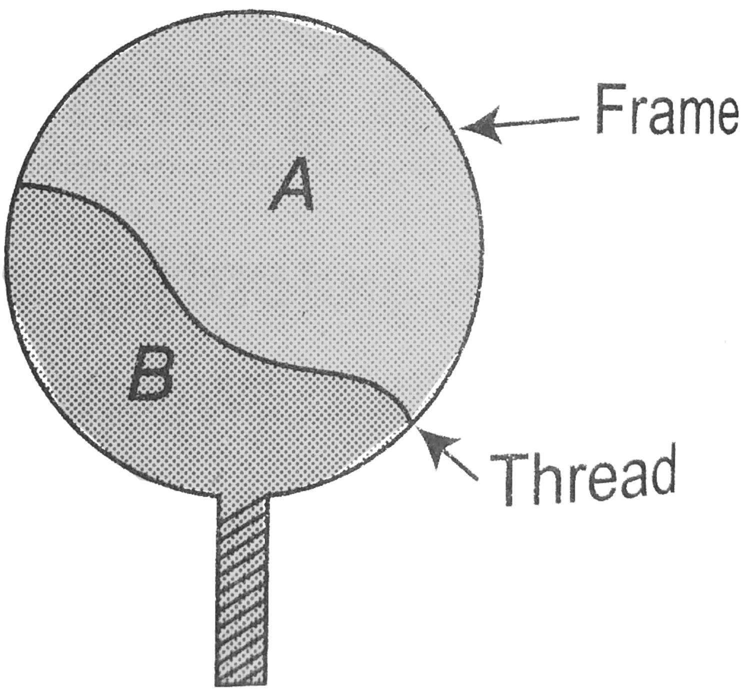

11.

A thread is tied slightly loose to a wire frame as in figure and the frame is dipped into a soap solution and taken out . The frame is comletely covered with the film. When the portion A puntured with a pin The thread.

A. become comcave towards A

B. become convex towards A

C. either (a) or (b) depending on the size of$A$ with respect to B

D. remains in the initial position

Answer: A

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12. A steel ball of mass m falls in a viscous liquid with terminal velocity v, then the steel ball of mass $8m$ will fall in the same liquid with terminal velocity

A. v

B. $4v$

C. $8v$

D. $16\sqrt{2}v$

Answer: B

Watch Video Solution

13. A liquid flows between two parallel plates along the x-axis. The difference between the velocity of two layers separated by the distance dy is dv. If A is the area of each plate, then Newton's law of viscosity may be written as

A. $F = -\eta A \frac{dv}{dx}$

B. $F = +\eta A \frac{dv}{dx}$

C. $F = -\eta A \frac{dv}{dy}$

D. $F = +\eta A \frac{dv}{dy}$

Answer: C

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14. The work done to split a liquid drop id radius R into N identical drops is (taken σ as the surface tension of the liquid)

A. $4\pi R^2 \left(N^{-1/3} - 1\right)\sigma$

B. $4\pi R^2 N \sigma$

C. $4\pi R^2 \left(N^{-1/2} - 1\right)$

D. None of these

Answer: A

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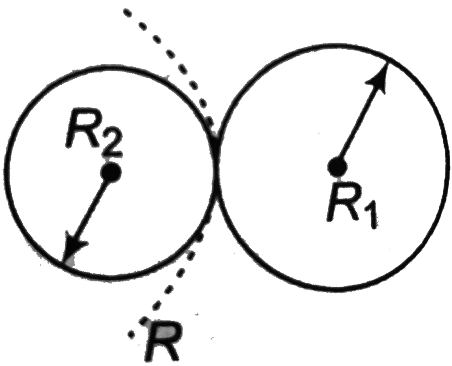
15. Two soap bubble of different radii R_1 and $R_2(\, < R_1)$ coalesce to form an interface of radius R as shown in figure. The correct value of R is



A. $R = R_1 - R^2$

B. $R = \dfrac{R_1 - R^2}{2}$

C. $\dfrac{1}{R} = \dfrac{1}{R_2} - \dfrac{1}{R_1}$

D. $\frac{1}{R} = \frac{1}{R_2} + \frac{1}{R_1}$

Answer: C

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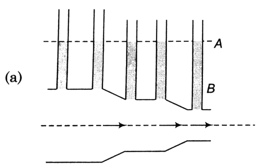
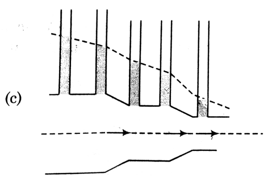
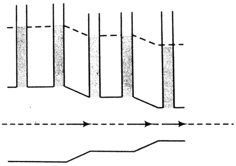
16. A viscous liquid flows through a horizontal pipe of varying cross-sectional area. Identify the option which correctly represents the variation of height of rise of liquid in each vertical tube

A. 

B. 

C. (b) 

D. None of these

Answer: C

Watch Video Solution

17. The terminal velocity of a rain drop is $30cm/s$. If the viscosity of air is $1.8 \times 10^{-5} Nsm^{-2}$.The radius of rain drop is

A. $1\mu m$

B. $0.5mm$

C. $0.05mm$

D. $1mm$

Answer: C

Watch Video Solution

18. If a capillary tube is dipped and the liquid levels inside and outside the tube are same. Then the angle of contact is

A. zero

B. 90°

C. 45°

D. Cannot be obtained

Answer: D

Watch Video Solution

19. Uniform speed of 2 cm diameter ball is $20cm/s$ in a viscous liquid. Then, the speed of 1 cm diameter ball in the same liquid is

A. $5cms^{-1}$

B. $10cms^{-1}$

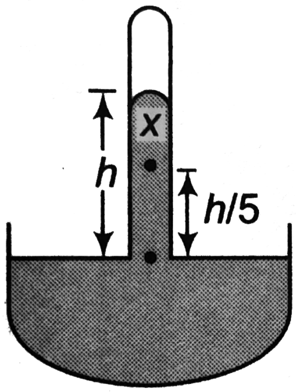
C. $40cms^{-1}$

D. $80cms^{-1}$

Answer: A

Watch Video Solution

20. The height of mercury barometer is h when the atmospheic pressure is $10^5 Pa$. The pressure at x in the shown diagram is



A. $10^5 Pa$

B. $0.8 \times 10^5 Pa$

C. $0.2 \times 10^5 Pa$

D. $120 \times 10^5 Pa$

Answer: B

Watch Video Solution

21. A body floats in water with its one-third volume above the surface. The same body floats in a liquid with one-third volume immersed. The density of the liquid is

A. 9 times more than that of water

B. 2 times more than that of water

C. 3 times more than that of water

D. 1.5 times more than that of water

Answer: B

Watch Video Solution

22. A piece of ice is floating in a beaker containing thick sugar solution of water. As the ice melts, the total level of he liquid

A. increases

B. decreases

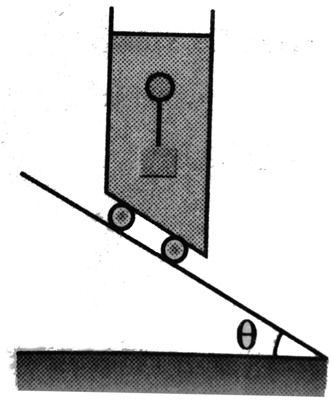
C. remains unchanged

D. insufficent data

Answer: A

Watch Video Solution

23. A body floats in completely immersed condition in water as shown in figure. As the whole system is allowed to slide down freely along the inclined surface, the magnityde of buoyant force



A. remains unchanged

B. increases

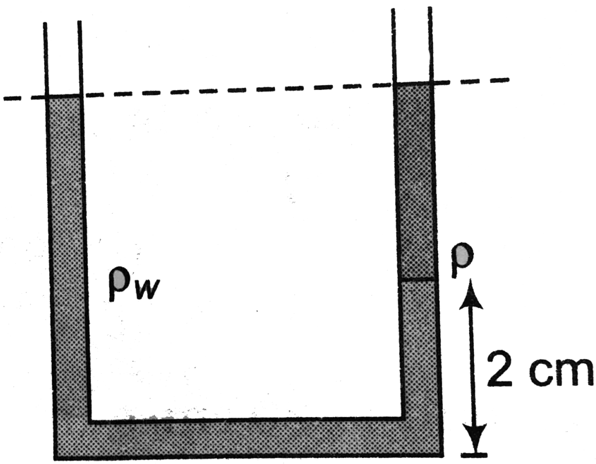
C. decreases

D. becomes zero

Answer: C

Watch Video Solution

24. The figure represents a U-tube of uniform cross-section filled with two immiscible liquids. One is water with density ρ_w and the other liquid is of density ρ . The liquid interface lies $2cm$ above the base. The relation between ρ and ρ_w is



A. $\rho = \rho_w$

B. $\rho = 1.02\rho_w$

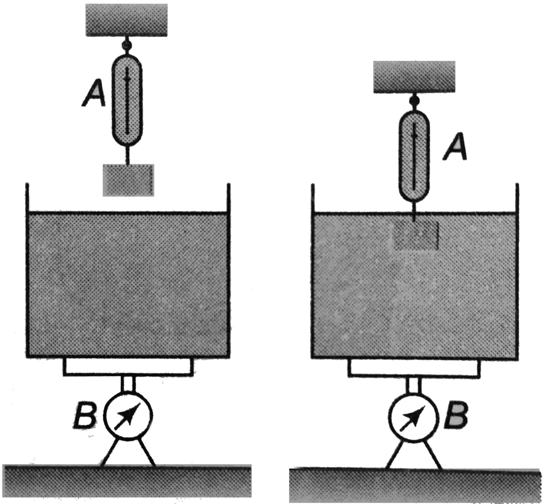
C. $\rho = 1.2\rho_w$

D. None of these

Answer: A

Watch Video Solution

25. for the arrangement shown in figure, initially the balance A and B reads F_1 and F_2 respectively and $F_1 > F_2$. Finally when the block is immersed in the liquid then the readings of balance A and B are f_1 and f_2 respectively. Indentify the statement which is not always (where, F is some force) correct statement.



A. $f_1) > f_2$

B. $F_1 + F > F_2 + F$

C. $f_1 + f_2 = F_1 + F_2$

D. None of these

Answer: A

Watch Video Solution

26. When a tap is closed, the manometer attached to the pipe reads $3.5 \times 10^5 Nm^{-2}$. When the tap is opened, the reading of manometer falls to $3.0 \times 10^5 Nm^{-2}$. The velocity of water in the pipe is

A. $0.1ms^{-1}$

B. $1ms^{-1}$

C. $5ms^{-1}$

D. $10ms^{-1}$

Answer: D

Watch Video Solution

27. A balloon of mass M descends with an acceleration a_0. The mass that must be thrown out in order to give the balloon an equal upwards acceleration will be

A. $\dfrac{Ma_0}{g}$

B. $\dfrac{2Ma_0}{g}$

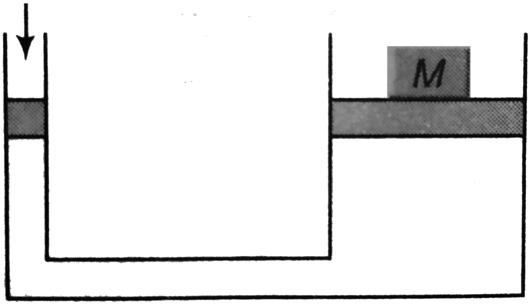
C. $\dfrac{2Ma_0}{g+a_0}$

D. $\dfrac{M(g+a_0)}{a_0}$

Answer: C

Watch Video Solution

28. The hydraulic press shown in the figure is used to raise the mass M through a height of $0.5cm$ by performing $500J$ of work at the small piston. The diameter of the large piston is $10cm$, while that of the smaller one is $2cm$. The mass M is



A. $100kg$

B. $10^6 kg$

C. $10^3 kg$

D. None of these

Answer: D

Watch Video Solution

29. When equal volumes of two substance are mixed, the specific gravity of the mixurie is 4. When equal weights of the same substance are mixed, the specific gravity of the mixture is 3. The soecufuc gravities of the two substance could be

A. 6 and 2

B. 3and 4

C. 2.5 and 3.5

D. 5 and 3

Answer: A

Watch Video Solution

30. A block of ice of total area A and thickness $0.5m$ is floating in water. In order to just support a man of mass $100kg$, the area A should be (the specific gravity of ice is 0.9)

A. $2.2m^2$

B. $1.0m^2$

C. $0.02m^2$

D. None of these

Answer: D

Watch Video Solution

31. A piece of gold $\left(\rho = 19.3g/cm^3\right)$ has a cavity in it. It weights $38.2g$ in air and $36.2g$ in water. The volume of the cavity in glold is

A. $0.2cm^3$

B. $0.04cm^3$

C. $0.02cm^3$

D. $0.01cm^3$

Answer: C

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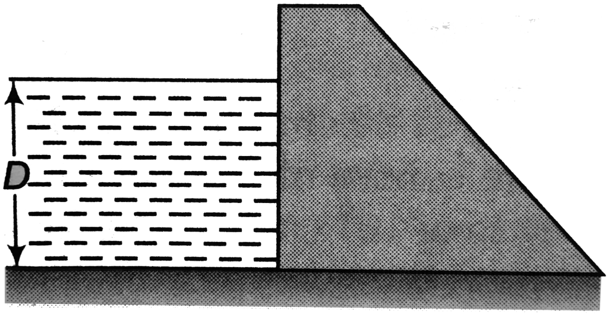
32. Water stands at a depth D behind the vertical upstream face of a dam as shown in the figure. The force exerted on the dam by water per unit width is



A. $\frac{1}{3}\rho g D^2$

B. $\frac{1}{2}\rho g D^2$

C. $\frac{1}{3}\rho g D$

D. $\frac{1}{2}(\rho g D)^2$

Answer: B

Watch Video Solution

33. The volume of a liquid flowing per second out of an orifice at the bottom of a tank does not depend upon

A. the height of the liquid above the orifice

B. the acceleration due to gravity

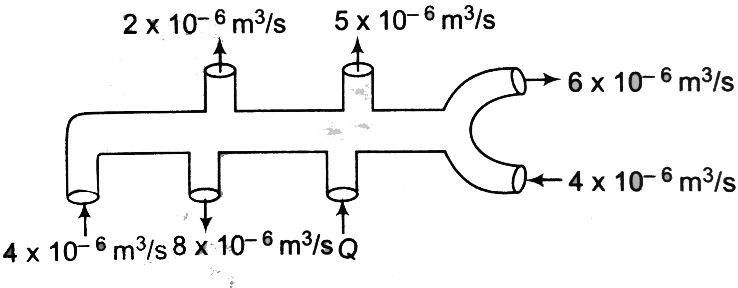
C. the density of the liquid

D. the area of the orifice

Answer: C

Watch Video Solution

34. The pipe shows the volume flow rate of an ideal liquid at certain time and its direction. What is the value of Q in m^3/s? (Assume steady state and equal area of cross section at each opening)



A. 10×10^{-6}

B. 11×10^{-6}

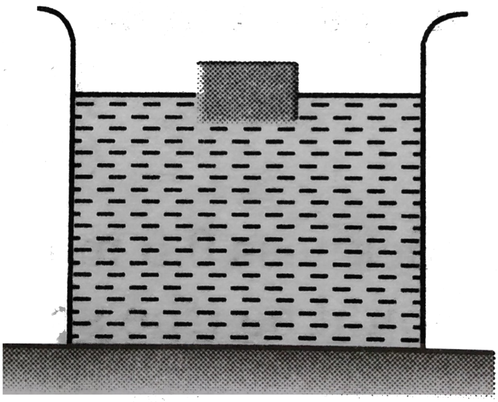
C. 13×10^{-6}

D. 18×10^{-6}

Answer: C

Watch Video Solution

35. A uniform cube of mass M is floating on the surface of a liquid with three fourth of its volume immersed in the liquid $(density = \rho)$. The length of the side of the cube is equal to



A. $(4M/3\rho)^{2/3}$

B. $(M/3\rho)^{2/3}$

C. $(M/4\rho)^{2/3}$

D. None of these

Answer: D

36. Water rises to a height of $10cm$ in a capillary tube and mercury falls to a depth of $3.42cm$ in the same capillary tube. If the density of mercury is $13.6g/c.c.$ and the angles of contact for mercury and for water are 135° and 0°, respectively, the ratio of surface tension for water and mercury is

A. $1:3$

B. $1:4$

C. $1:5.5$

D. $1:6.5$

Answer: D

37. A capillary glass tube records a rise of $20cm$ when dipped in water. When the area of cross-section of the tube is reduced to half of the former value, water will rise to a height of

A. $10\sqrt{2}cm$

B. $10cm$

C. $20cm$

D. $20\sqrt{2}cm$

Answer: D

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38. A cylindrical vessel open at the top is $20cm$ high and $10cm$ in diameter. A circular hole of cross-sectional area $1cm^2$ is cut at the centre of the bottom of the vessel. Water flows from a tube above it into the vessel at the rate of $10^2 cm^3 / s$. The height of water in the vessel under steady state is (Take $g = 10m / s^2$).

A. $20cm$

B. $15cm$

C. $10cm$

D. $5cm$

Answer: D

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39. A horizontal pipeline carries water in a streamline flow. At a point along the tube where the cross sectional area is

$10^{-2}(m^2)$, the water velcity is $2m/s$ and the pressure is 8000Pa. The pressure of water at another point where cross sectional area is $0.5 \times (10)^{-2}(m^2)$ is

A. $4000Pa$

B. $1000Pa$

C. $2000Pa$

D. $3000Pa$

Answer: C

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40. Eight spherical rain drops of the same mass and radius are falling down with a terminal speed of $6cms^{-1}$. If they coalesce to form one big drop, what will be its terminal speed? Neglect the buoyancy due to air

A. $1.5cms^{-1}$

B. $6cms^{-1}$

C. $24cms^{-1}$

D. $32cms^{-1}$

Answer: C

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41. In a surface tension experiment with a capillary tube water rises upto $0.1m$. If the same experiment is repeated in an artificial satellite, which is revolving around the earth, water will rise in the capillary tube upto a height of

A. $0.1m$

B. $0.2m$

C. $0.98m$

D. Full length of tube

Answer: D

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42. Two unequal soap bubbles are formed one on each side of a tube closed in the middle by a tap. What happens when the tap is opened to put the two bubbles in communication?

A. No air passes in any direction as the pressures are the same on two sides of the tap

B. Larger bubble shrinks and smaller bubble increases in size till they bexome equal in size

C. Smaller bubble gradually collapses and the bigger one increases in size

D. None of the above

Answer: C

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43. A capillary tube of radius R is immersed in water and water rises in it to a height H . Mass of water in the capillary tube is . M If the radius of the tube is doubled, mass of water that will rise in the capillary tube will now be

A. $2M$

B. M

C. $\frac{M}{2}$

D. $4M$

Answer: A

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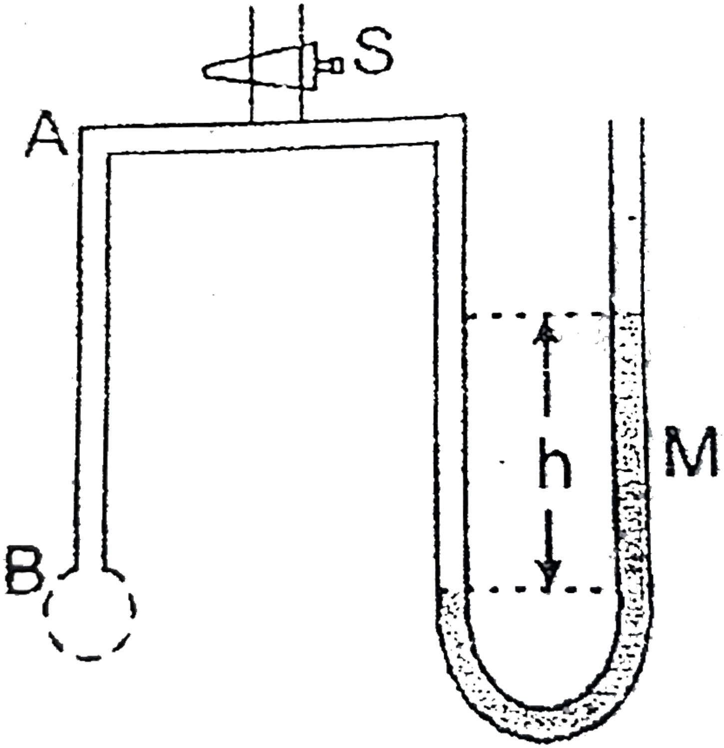
44. A tube of fine bore AB is connected to a manomeer M as shown. The stop cock S controls the flow in air. AB is dipped into a liquid whosw surface tension is σ. On opening the stop cock for a while, a bubble is formed at B and the manometer level is recorded, showing a difference h in the levels in the two arms. If ρ be the density of manometer liquid and r the radius of curvature of the bubble, then the surface tension σ

of the liquid is given by



A. ρhrg

B. $2\rho hrg$

C. $4\rho hrg$

D. $\frac{rh\rho g}{4}$

Answer: D

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45. A vessel whose bottom has round holes with a diameter of $d = 0.1mm$ is filled with water. The maximum height of the water level h at which the water does not flow out, will be (The water does not wet the bottom of the vessel). $[STofwater = 70\text{dyne}/cm]$

A. $h = 24.0cm$

B. $h = 25.0cm$

C. $h = 26.0cm$

D. $h = 28.0cm$

Answer: D

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46. A large number of liquid drops each of radius 'a' coalesce to form a single spherical drop of radish b. The energy released in the process is converted into kinetic energy of the big drops formed. The speed of big drop will be

A. $\sqrt{\frac{6T}{\rho}\left[\frac{1}{a}+\frac{1}{b}\right]}$

B. $\sqrt{\frac{4T}{\rho}\left[\frac{1}{a}+\frac{1}{b}\right]}$

C. $\sqrt{\frac{8T}{\rho}\left[\frac{1}{a}+\frac{1}{b}\right]}$

D. $\sqrt{\frac{5T}{\rho}\left[\frac{1}{a}+\frac{1}{b}\right]}$

Answer: A

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47. A glass capillary tube (closed from tap) of inner diameter $0.28mm$ is lowered vertically into water in a vessel. The pressure in the capillary tube so that water level in the tube is same as that in the vessel is N/m^2 is (surface tension of water $=0.7N/m$ and atmospheric pressure $=10^5 N/m^2$.

A. 10^3

B. 99×10^3

C. 100×10^3

D. 101×10^3

Answer: D

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48. A thin wire is bent in the form of a ring of diameter $3.0 cm$ .The ring is placed horizontally on the surface of soap solution and then raised up slowly. Upward force necessary to break the vertical film formed between the ring and the solution is

A. $6\pi T \text{dyne}$

B. $2\pi T \text{dyne}$

C. $4\pi T \text{dyne}$

D. $3\pi T \text{dyne}$

Answer: A

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49. One end of a glass capillary tube with a radius $r = 0.05 cm$ is immersed into water to a depth of $h = 2 cm$.Excess pressure required to blow an air bubble out of the lower end of the tube will be $(S.T$ of water $= 70 \text{dyne} / cm)$.Take $g = 980 cm / s^2$.

A. $2840 \text{dyne} / cm^2$

B. $5840 \text{dyne} / cm^2$

C. $7840 \text{dyne} / cm^2$

D. $4760 \text{dyne} / cm^2$

Answer: D

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Level 1 Subjective

1. A body of weight w_1 when floats in water displaces an amount of water w_2. Then $w_1 < w_2$. In this statement true or false?

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2. A weightless balloon is filled with water. What will be its apparent weight when weighted in water?

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3. Two vessels A and B have same base area. Equal volumes of a liquid are poured in the two vessel to difference heights h_A and $h_B(> h_A$. In which vessel, the force on the base of vessel will be more?

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4. Work W is required to form a bubble of volume V from a given solution. What amount of work is required to be done to form a bubble of volume $2V$?

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5. A man is sitting in a boat which is floating in a pond. If the man drinks some water from the pond, the level of water in the pond decreases.

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6. A metal ball weighs $0.096N$.When suspended in water it has an apparent weight of $0.071N$. Find the density of the metal.

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7. A block of wood has a mass of $25g$. When a $5g$ metal piece with a volume of $2cm^3$ is attached to the bottom of the block, the wood barely floats in water. What is the volume V of the wood?

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8. What is the minimum volume of a block of wood(density $= 850kg/m^3$) if it is to hold a $50kg$ woman entirely above the water when she stands on it?

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9. A cubical block of ice floating in water has to suport metal piece weighing 0.5 kg. What can be the minimum edge of the block so that it does not sink in water/ specific gravity of ice=0.9.

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10. When a cube of wood floats in water, 60% of its volume is submerged. When the same cube floats in an unknown fluid 85% of its volume is submerged. Find the densities of wood and the unknown fluid.

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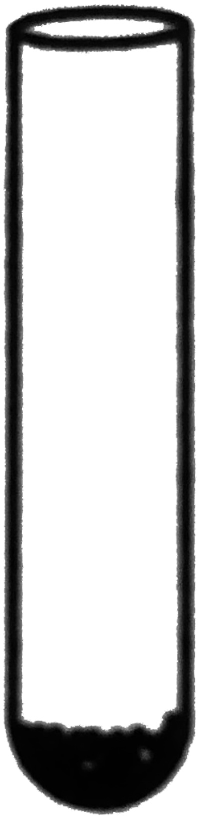
11. A glass tube of radius $0.8 cm$ floats vertical in water, as shown in figure. What mass of lead pellets would cause the tube to sink a further$3 cm$?



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12. A hydraulic automobile lift is designed to lift cars with a maximum mass of $3000 Kg$. The area of cross section of the piston carrying the load is $425 cm^2$. What maximum pressures would the smaller piston have to bear?

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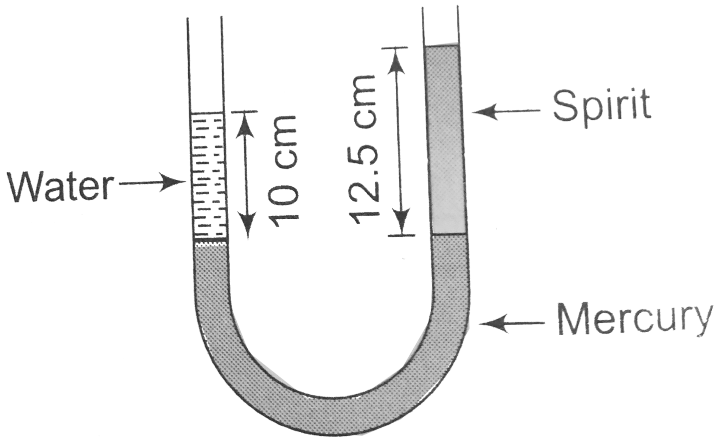
13. A U tube contains water and methylated spirit separated by mercury. The mercury columns in the two arms are at the same level with 10 cm of water in one arm and 12.5 cm of spirit in the other as shown in figure. The relative density of the spirit is



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14. in previous question, if 15 cm of water and spirit each are further poured into the respective arms of the tube. Difference in the level of mercury in the two arms is (Take, relvative density of mercury = 13.6)

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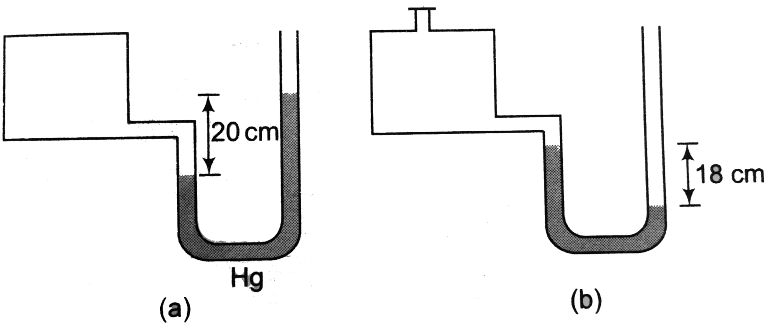
15. A manometer reads the pressure of a gas in a enclosure as shown in figure(a) When some of the gas is removed by a pump, the manometer reads as in (b). The liquid used in the manometers is mercury and the atmospheric pressure is $76 cm$ of mercury.



(i) Give the absolute and gauge pressure of the gas in the enclosure for cases (a) and (b) in units of cm of mercury .

(ii) How would the level change in case (b) if $13.6 cm$ of water are poured into the right limb of the manometer?

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16. Water at 20° is flowing in a pipe of radius $20.0cm$. The viscosity of water at $20^{\circ}C$ is 1.005 centipise. If the water's speed in the centre of the pipe is $3.00m/s$, what is water's speed:

(a) $10.0cm$ from the centre of the pipe(half way between the centre and the walls)

(b) at the wall of the pipe?

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17. An irregular piece of metal weighs 10.00g in air and 8.00g whaen submerged in water

(a) Find the volume of the metal and its density.

(b) If the same piece of metal weighs 8.50g when immersed in a particular oil. What is the density of the oil?

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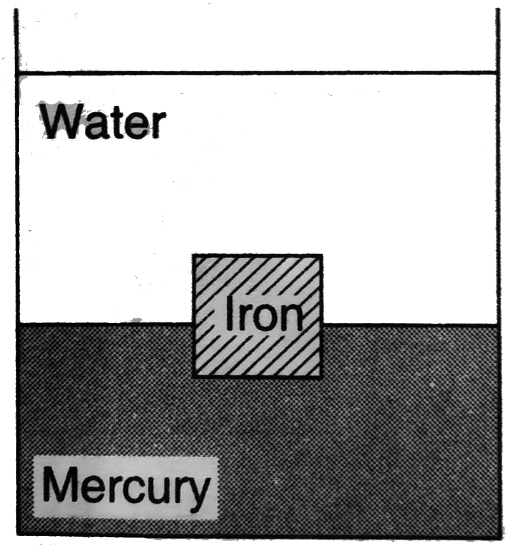
18. A tank contains water on top of mercury . A cube of iron, 60mm along each edge, is sitting upright in equilibrium in the liquids. Find how much of it is in each liquid. The densities of iron and mercury are $7.7 \times 10^3 kg/m^3$ and $13.6 \times 10^3 kg/m^3$ respectively



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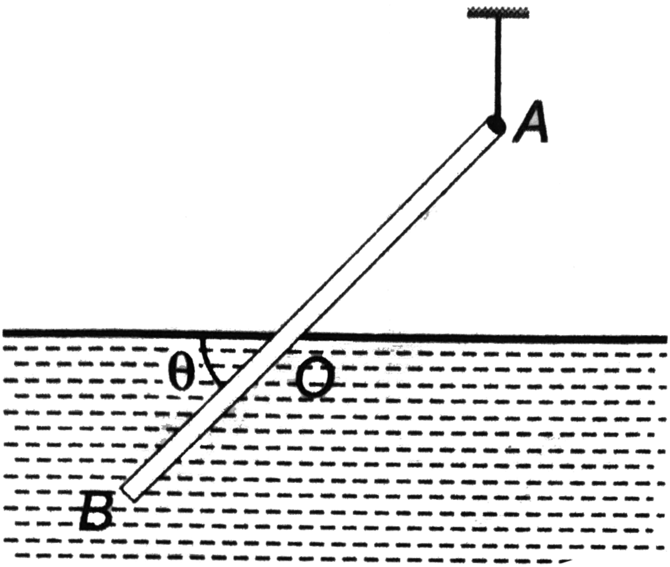
19. A uniform rod AB, 4m long and weighing 12 kg, is supported at end A, with a 6 kg lead weight at B. The rod floats as shown in figure with one-half of its length submerged. The buoyant force on the lead mass is negligible as it is of negligible volume. Find the tension in the cord and the total volume of the rod



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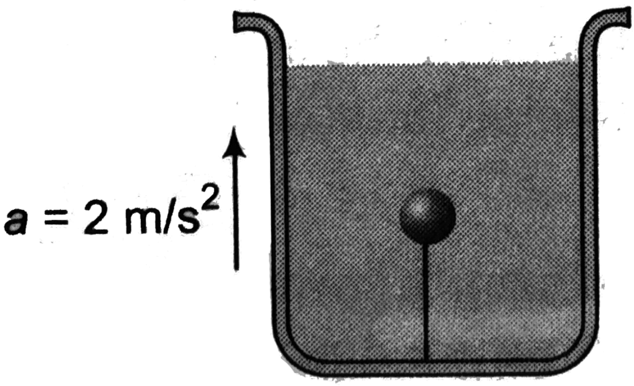
20. A solid sphere of mass $m = 2kg$ and density $\rho = 500kg/m^3$ is held stationary relative to a tank filled with water. The tank is acceerating upward with acceleration $2m/s^2$. Calculate

(a) Tension in the thread connected between the sphere and the bottom of the tank.

(b) If the thread snaps, calculate the acceleration of sphere with respect to the tank. (Density of water $= 1000kg/m^3$, $g = 10m/s^2$)

10 m/s²)



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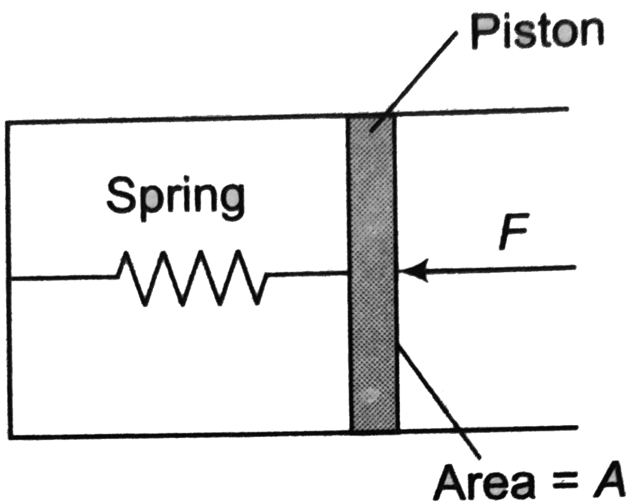
21. The pressure gauge shown in figure has a spring for which $k = 60N/m$ and the area of the piston is $0.50cm^2$. Its right end is connected to a closed container of gas at a gauge pressure of $30kPa$. How far will the spring be compressed if the region containing the spring is (a) in vacuum and (b) open to the atmosphere? Atmospheric pressure is $101kPa$.



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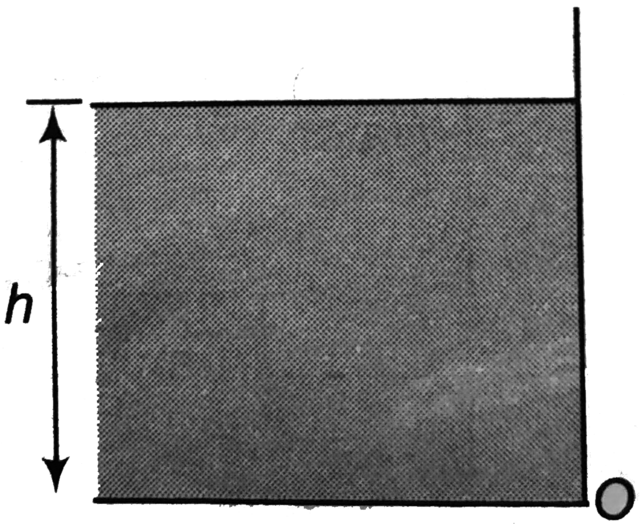
22. Water stands at a depth h behind the vertical face of a dam. It exerts a resultant horizontal force on the dam tendibg to slide it along its foundation and a torque tending to overturn the dam about the point O. Find



(a) Horizontal force,(b) torque about O, (c) the height at which the resultant force would have to act to produce the same torque,l=cross-sectional length and $\rho =$ density of water.

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23. Mercury is poured into a U-tube in which the cross-sectional area of the left-hand limb is three times smaller than that of the right one. The level of the mercury in the narrow limb is a distandce $l = 30cm$ from the upper end of the tube. How much will the mercury level rise in the right-hand limb if the left one is filled to the top with water?

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24. A water barrel stands on a table of height h.If a small hole is punched in the side of the side of the barrel at its base. It is found that the resultant stream of water striks the ground at a horizontal distance R from the barrel. What is the depth of water in the berrel?

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25. A pump is designed as a horizontal cylinder with a piston of areal A and and outlet orifice of areal a arranged mear the cylinder axis. Find the velocity of out flow of the liquid from the pump if the piston moves with a constant velocity under the action of a constant force F. The density of the liquid is ρ.

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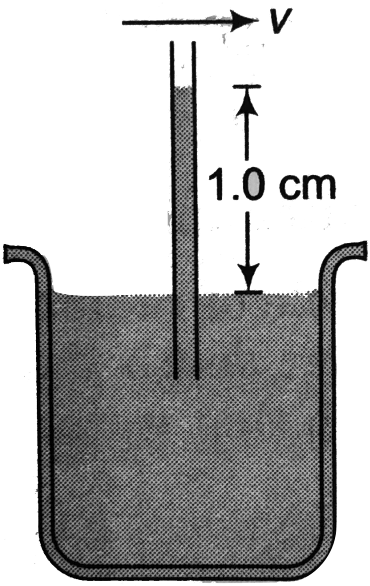
26. When air of density $1.3kg/m^3$ flows across the top of the tube shown in the accompanying figure, water rises in the tube to a height of $1.0cm$. What is the speed of air?



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27. A area of cross section of a large tank is $0.5m^2$. It has an opening near the bottom having area of cross section $1cm^2$. A load of 20 kg is applied on the water at the top. Find the velocity of the water coming out of the opening at the time when the height of water level is 50 cm above the bottom. Take

$g = 10ms^{-2}$

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28. What is the pressure drop (in mm Hg) in the blood as it passes through a capillary $1mm$ long and $2\mu m$ in radius if the speed of the blood through the centre of the capillary is $0.66m\frac{m}{s}$? (The viscosity of whole blood is $4 \times 10^{-3} PI)$

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29. A glass capillary sealed at the upper end is of length $0.11m$ and internal diameter 2×10^{5}m. The tube is immersed vertically into a liquid of surface tension $5.06 \times 10^{-2} N/m$. To what length the capillary has to be immersed so that the liquid level inside and outside the capillary becomes the same. What will happen to water level inside the capillary if the seal is now broken?

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30. A film of water is formed between two straight parallel wires each $10cm$ long and at a seperation of $0.5cm$. Calculate the work required to increase $1mm$ distance between the wires. Surface tension of water $= 72 \times 10^{-3} N/m$.

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31. A barometer contains two uniform capillaries of radii $1.4 \times 10^{-3} m$ and $7.2 \times 10^{-4} m$. If the height of liquid in narrow tube is $0.2m$ more than that in wide tube, calculate the true pressure difference. Density of liquid $= 10^3 kg/m^3$, surface tension $= 72 \times 10^{-3} N/m$ and $g = 9.8ms^{-12}$.

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32. A liquid of specific gravity 1.5 is observed to rise $3.0cm$ in a capillary tube of diameter $0.50mm$ and the liquid wets the surface of the tube. Calculate the excess pressure inside a spherical bubble of $1.0cm$ diameter blown from the same liquid.

Watch Video Solution

33. A glass U-tube is such that the diameter of one limb is $3.0mm$ and that of the other is 6.0mm. The tube is inverted vertically with the open ends below the surface of water in a beaker. What is the difference between the height to which water rises in the two limbs? Surface tension of water is $0.07Nm^{-1}$. Assume that the angle of contact between water and glass is 0°.

Watch Video Solution

34. A minute spherical air bubble is rising slowly through a column of mercury contained in a deep jar. If the radius of the bubble at a depth of $100cm$ is$0.1mm$,Calculate its depth where its radius is $0.126mm$, given that the surface tension of mercury is $567dy \ne /cm$. Assume that the atmosphere pressure is $76cm$ of mercury.

Watch Video Solution

35. If a number of little droplets of water, each of radius r, coalesce to form a single drop of radius R, show that the rise in temperature will be given by $\frac{3T}{J}\left(\frac{1}{r}-\frac{1}{R}\right)$ where T is the surface tension of water and J is the mechanical equivalent of heat.

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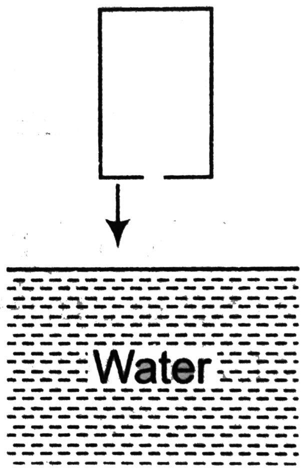
36. An empty container has a circular hole of radius r at its bottom. The container is pused into water very slowly as shown. To what depth the lower surface of container (from surface of water) can be pushed into water such that water does not flow into the container?



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Subjective Question

1. Water at $20^{\circ} C$ is flowing in a horizontal pipe that is $20.0 m$ long.The flow is laminar and the water completely fills the pipe. A pump maintains a gauge pressure of $1400 Pa$, at a large tank at one end of the pipe. The other end of the pipe is open to the air, The viscosity of water at $20^\circ C$ is 1.005 poise

(a) If the pipe has diameter $8.0 cm$, what is the volume flow rate?

(b) What gauge pressure must the pump provide to achieve the same volume flow rate for a pipe with a diameter of $4.0 cm$?

(c) For pipe in part (a) and the same gauge pressure maintained by the pump, what does the volume flow rate become if the water is at a temperature of $60^\circ C$ (the viscosity of water at $60^\circ C$ is 0.469 poise?

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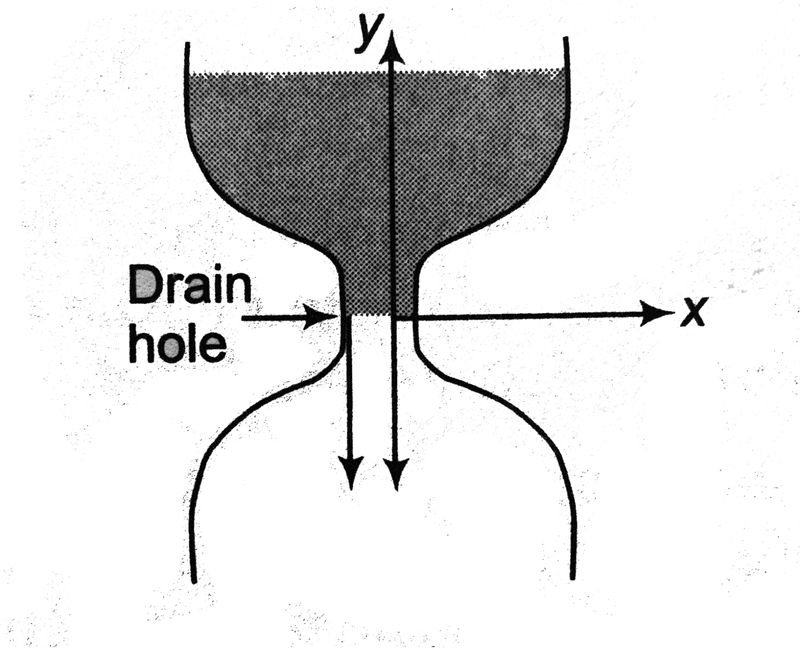
2. The shape of an ancient water clock jug is such that water level descends at a constant rate at all time. If the water level falls by 4cm every hour, determine the shape of the jar, i.e. specify x as a function of y. The radius of drain hole in 2mm and can be assumed to be very small compared to x.



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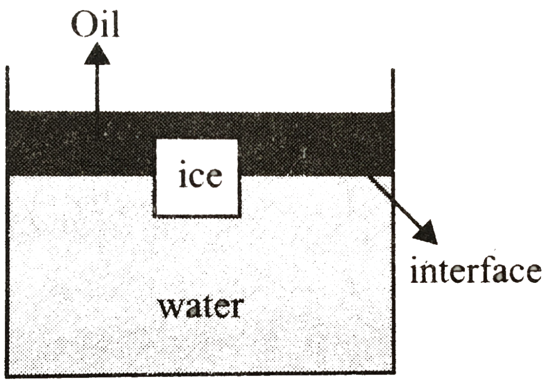
Level 2 Single Correct

1. An ice cube is floating in water above which a layer of a fighter oil is poured. As the ice melts completely, the level If water surface (or interface) and upper level of oil will



A. rise and fall

B. fall and rise

C. not change and no change

D. not change and fall

Answer: A

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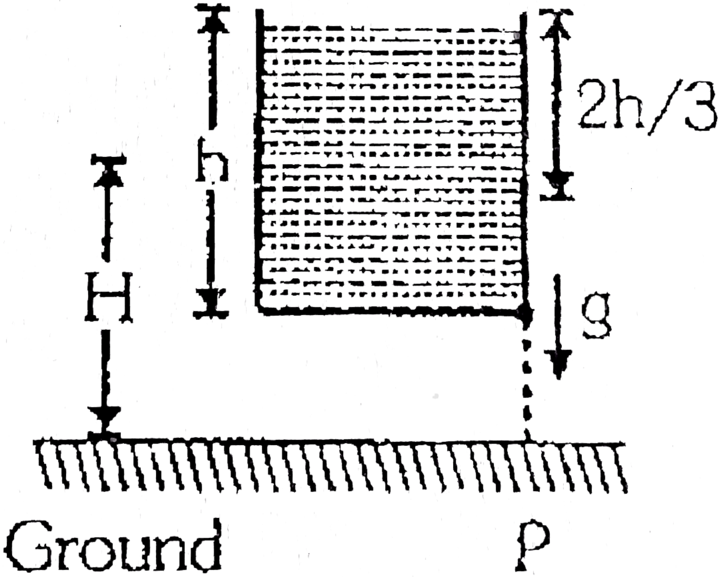


2.

An open vessel full of water is falling freely under gravity. There is a small hole in one face of the vessel, was shown in te figure. The water which comes out from the hole at the instant when hole is at height H above the ground strikes the ground at a distance of x from P. Which of the followin is correct for the situation described?

(a). The value of x is $2\sqrt{\frac{2hH}{3}}$

(b). The value of x is $\sqrt{\frac{4hH}{3}}$

(c). The value ofx can't be computed from information providec.

(d). The question is irrevalent as no water comes out from the hole.

A. The value of x is $2\sqrt{\frac{2hH}{3}}$

B. the value of x is $\sqrt{\frac{4hH}{3}}$

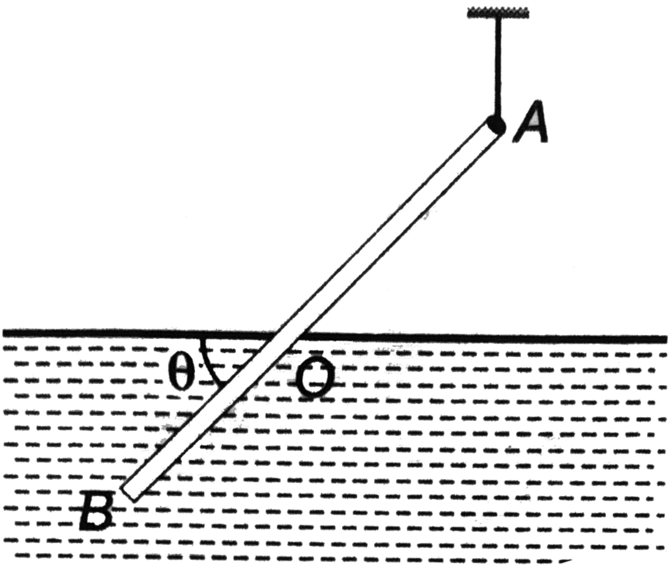
C. The value of x can't be computed from information provied

D. The question is irrevalent as no water comes out from the hole

Answer: D

Watch Video Solution

3. A uniform rod AB, 4m long and weighing 12 kg, is supported at end A, with a 6 kg lead weight at B. The rod floats as shown in figure with one-half of its length submerged. The buoyant force on the lead mass is negligible as it is of negligible volume. Find the tension in the cord and the total volume of the rod



A. The tension in the string is 36g

B. The tension in the string is 12g

C. the volume of the rod is $6.4 \times 10^{-2} m^3$

D. The point of application of the buoyancy force is passing through C (centre of mass of rod)

Answer: C

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4. A water hose pipe of cross-sectional area $5 cm^2$ is used to fill a tank of $120 L$. It has been observed that it takes 2 min to fill the tank. Now, a nozzel with an opening of cross-sectional area $1 cm^2$ is attached to the hose. The nozzel is held so that water is projected horizontally from a point 1m above the ground. The horizontal distance over which the water can be projected is (Take $g = 10 m/s^2$).

A. $3m$

B. $8m$

C. $4.47m$

D. $8.64m$

Answer: C

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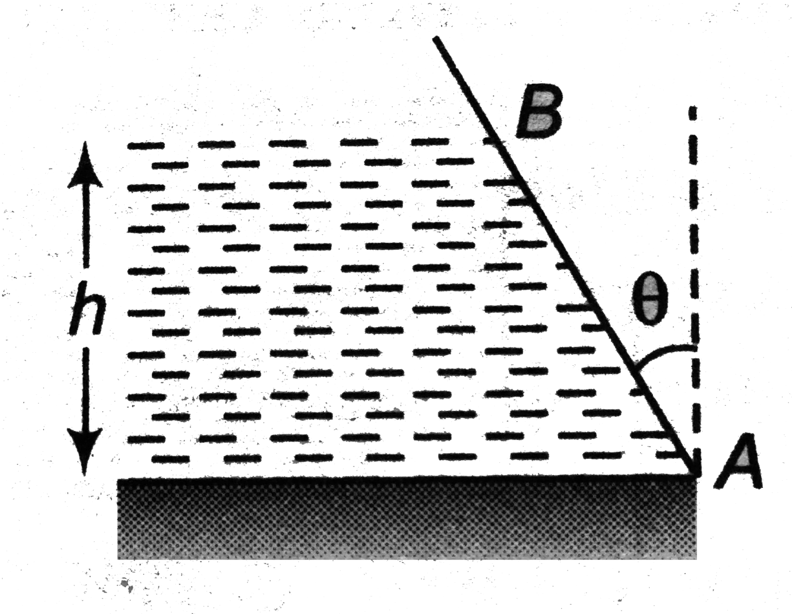
5. The height of water in a vessel is h. The vessel wall of width b is at an angle θ to the vertical. The net force exerted by the water on the wall is



A. $\frac{1}{3}\rho b h^2 g \cos\theta$

B. $\frac{1}{2b}h^2\rho g$

C. $\frac{1}{2}\rho b h^2 g \sec\theta$

D. Zero

Answer: C

Watch Video Solution

6. A body of density ρ is dropped from reat from a height h into a lake of density $\sigma(\sigma > \rho)$. The maximum depth the body sinks inside the liquid is (neglect viscous effect of liquid)

A. $\frac{h\rho}{\sigma - \rho}$

B. $\frac{h\sigma}{\sigma - \rho}$

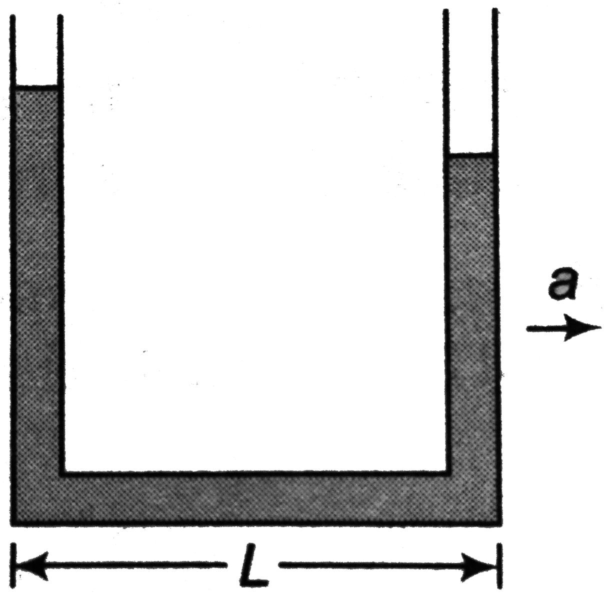
C. $\frac{h\rho}{\sigma}$

D. $\frac{h\sigma}{\rho}$

Answer: A

Watch Video Solution

7. A liquid stands at the plane level in the U-tube when at reat. If areals of cross-section of both the limbs are equal, what will be the difference in height h of the two limbs of U-tube, when the sustem is given an acceleration a in horizontal direction towards right as shown?



A. $\frac{Lg}{a}$

B. $\frac{La}{g}$

C. $\frac{Lg^2}{a^2}$

D. zero

Answer: B

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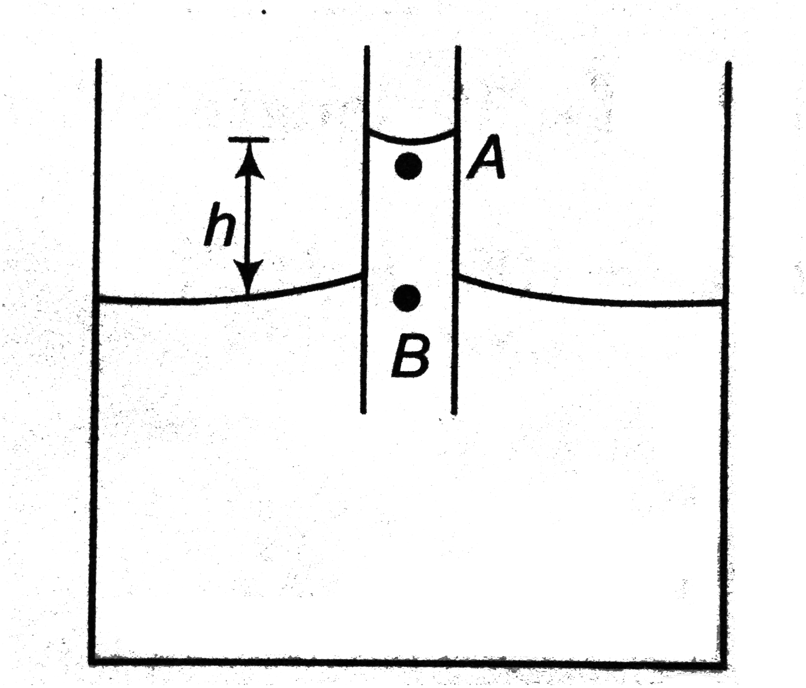
8. A liquid of density ρ and surface tension σ rises in a capillary tube of inner raduis R. The angle of contact between the liquid and the glass is θ. The point A lies just below the maniscus in the tube and the point B lies at the outside level of liquid in the beaker as shown in figure. The pressure at A is



A. $p_B - \rho g h$

B. $p_B - \dfrac{2\sigma\cos\theta}{R}$

C. $p_{atm} - \dfrac{2\sigma\cos\theta}{R}$

D. All of these

Answer: D

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9. A large open tank has two holes in the wall. One is a square hole of side L at a depth y from the top and the other is a circular hole of radius R at a depth 4y from the top. When the tank is completely filled with water, the quantities of water flowing out per second from both holes are the same. Then, R is equal to

A. $\frac{L}{\sqrt{2\pi}}$

B. $2\pi L$

C. L

D. $\frac{L}{2\pi}$

Answer: A

Watch Video Solution

10. Two identical cylindrical vessels with their bases at the same level each, contain a liquid of density ρ. The area of either base is A but in one vessel the liquid height is h_1 and in the other liquid height is $h_2 (h_2 < h_1)$. If the two vessel are connected, the work done by gravity in equalizing the level is

A. $\frac{1}{2}(h_1 - h_2)^2 A\rho g$

B. $\frac{1}{2}(h_1 + h_2)^2 A\rho g$

C. $\frac{1}{2}\left(h_1^2 - h_2^2\right)^2 A\rho g$

D. $\frac{1}{4}(h_1 - h_2)^2 A\rho g$

Answer: D

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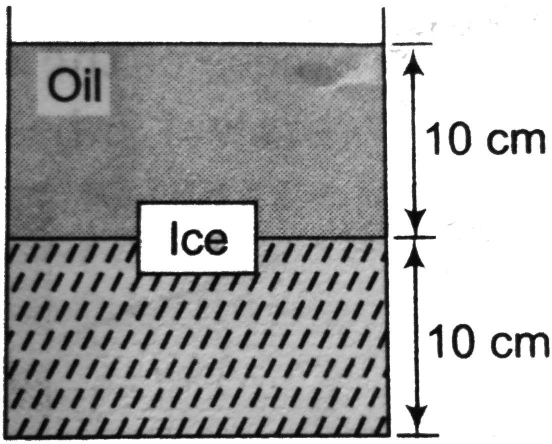
11. A cubical block of side 10cm floats at the interface of an oil and water as shown in the figure. The density of oil is $0.6gcm^{-3}$ and the lower face of ice cube is 2cm below the interface. The pressure above that of the atomosphere at the lower face of the block is



A. $200Pa$

B. $620Pa$

C. $900Pa$

D. $800Pa$

Answer: D

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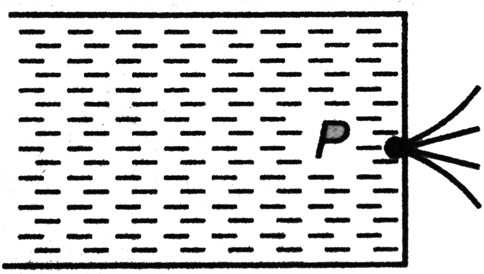
12. A leakage begins in water tank at position P as shown in the figure. The gauge pressure (pressure above that of the atmosphere) at P was $5 \times 10^5 N/m^2$. If the density of water is $1000kg/m^3$ the initial velocity with which water gushes out is approximately



A. $3.2ms^{-1}$

B. $32ms^{-1}$

C. $28ms^{-1}$

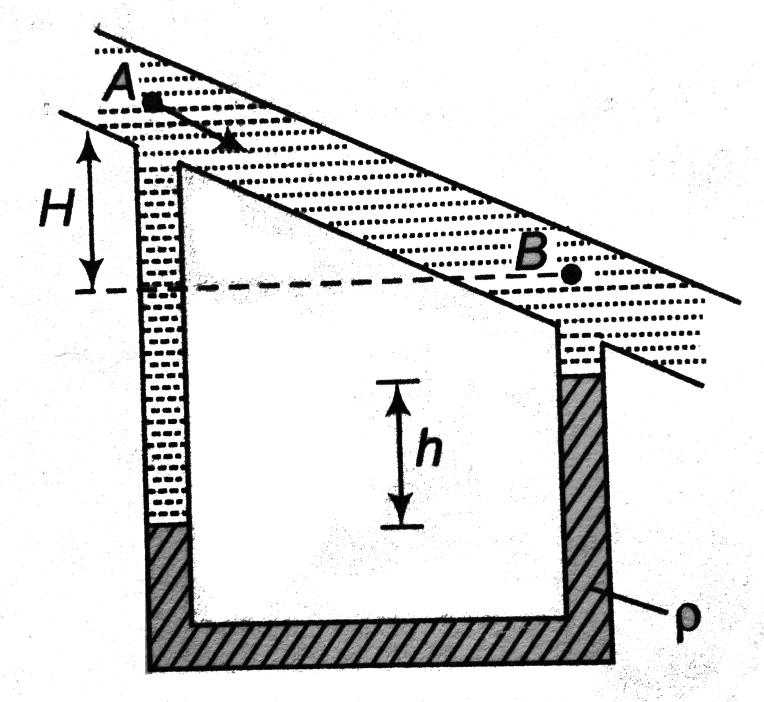
D. $2.8ms^{-1}$

Answer: B

Watch Video Solution

13. The figure shown a pipe of uniform cross-section inclined in a vertical plane. A U-tube manometer is connected between the point A and B. If the liquid of density ρ_0 flows with velocity v_0

in the pipe. Then the reading h of the manometer is



A. $h=0$

B. $h=\frac{v_0^2}{2g}$

C. $h=\frac{\rho_0}{\rho}\left(\frac{v_0^2}{2g}\right)$

D. $h=\frac{\rho_0 H}{\rho-\rho_0}$

Answer: A

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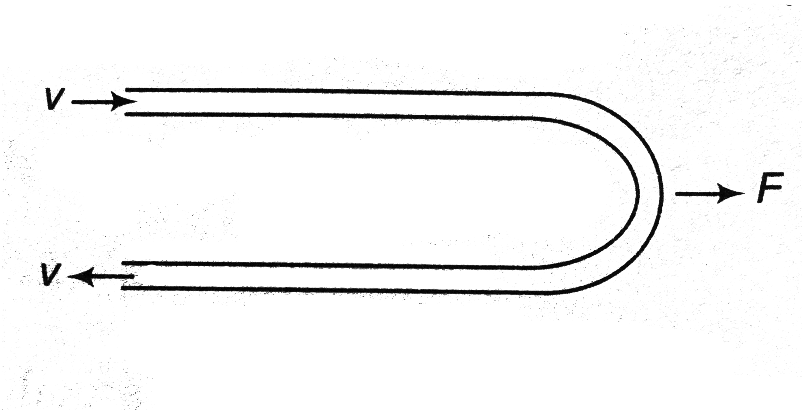
14. A horizontal tube of uniform cross-sectional area A is bent in the form of U as shown in figure. If the liquid of density ρ enters and leaves the tube with velcity v, then the extermal force F requried to hold the bend stationary is



A. $F=0$

B. $\rho A v^2$

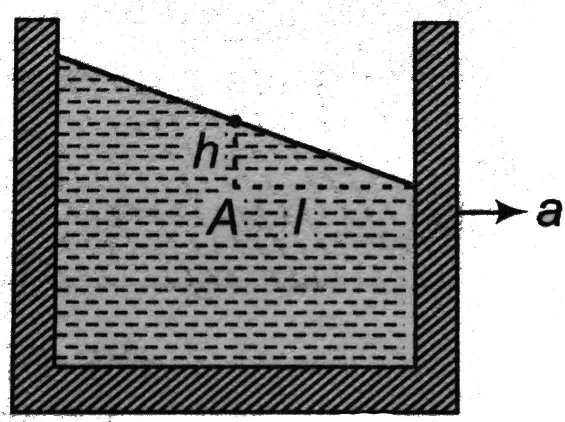
C. $2\rho A v^2$

D. $\frac{1}{2}\rho A v^2$

Answer: C

Watch Video Solution

15. A rectangular container moves with an acceleration a along the positive direction as shown in figure. The pressure at the A in excess of the atmospheric pressure p_0 is (take ρ as the density of liquid)



A. $\rho g h$

B. $\rho a l$

C. $\rho(gh + al)$

D. Both (a) and (b)

Answer: B

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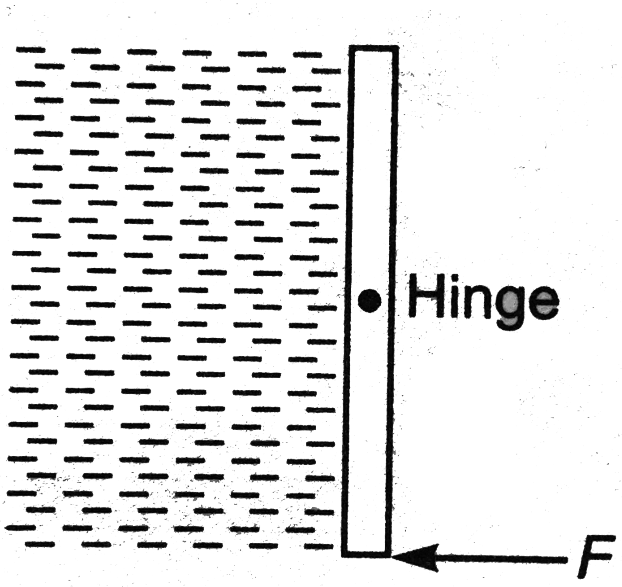
16. A square gate of size $1m \times 1m$ is hinged at its mid point. A fluid of density ρ fill the space to the left of the gate. The force

F required to hold the gate stationary is



A. $\frac{\rho g}{6}$

B. $\frac{1}{2}\rho g$

C. $\frac{\rho g}{6}$

D. None of these

Answer: C

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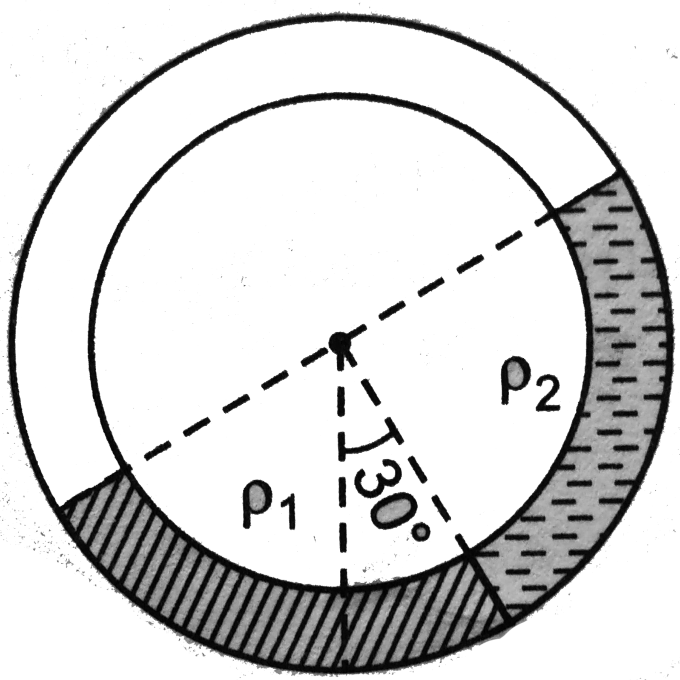
17. A thin uniform circular tube is kept in a vertical plane. Equal volume of two immiscible liquids whose densites are ρ_1 and ρ_2 fill half of the tube as shown. In equilibrium the radius passing through the interface makes an angle of 30° with vertical. The ratio of densities (ρ_1 / ρ_2) is equal to



A. $\dfrac{\sqrt{3}-1}{2-\sqrt{3}}$

B. $\dfrac{\sqrt{3}+1}{2+\sqrt{3}}$

C. $\dfrac{\sqrt{3}-1}{\sqrt{3}+1}$

D. $\dfrac{\sqrt{3}+1}{\sqrt{3}-1}$

Answer: D

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18. A plate moves normally with the speed v_1 towads a horizontal jet of uniform area of cross-section. The jet discharge water at the rate of volume V per second at a speed of v_2. The density of water is ρ. Assume that water splashes along the surface of the plate ar right angles to the original motion. The magnitude of the force action on the plate due to the jet of water is

A. $\rho)Vv_1$

B. $\rho\frac{V}{v_2}(v_1+v_2)^2$

C. $\frac{pV}{v_1 - v_2}(v_1)^2$

D. $pV(v_1+v_2)$

Answer: D

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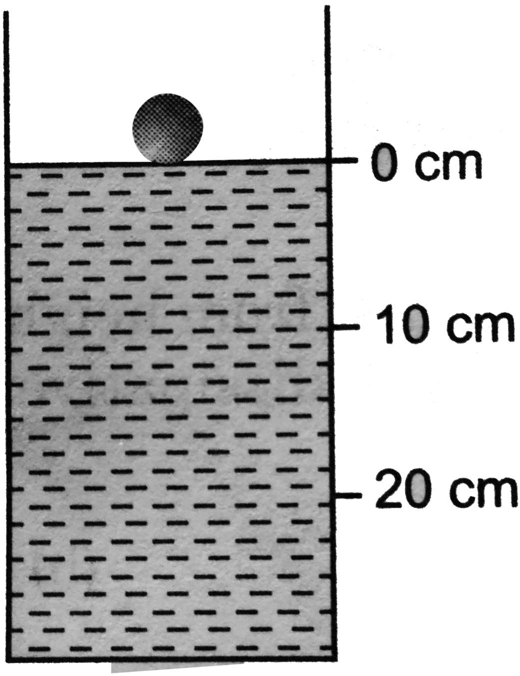
19. A spherical ball of density ρ and radius$0.003m$ is dropped into a tube containing a viscous fluid up to the 0 cm mark as shown in the figure. Viscosity of the fluid $=1.26N-s/m^2$ and its density $\rho_L=\frac{\rho}{2}=1260kg/m^3$. Assume that the ball reaches a terminal speed at 10cm mark. The time taken by the ball to travel the distance between the 10cm and 20cm mark is

$(g = 10m/s^2)$



A. 2s

B. 1s

C. 0.5s

D. 5s

Answer: D

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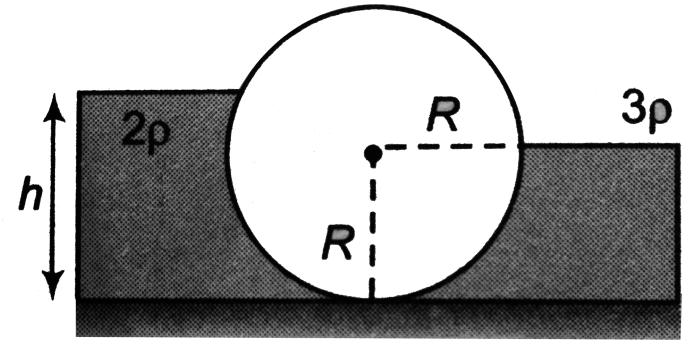
20. In the figure shown, the heavy cylinder (radius R) reasting on a smooth surface separates two liquids of densities 2ρ and 3ρ. The height h for the equilibrium of cylinder must be



A. $3R/2$

B. $R\sqrt{\frac{3}{2}}$

C. $R\sqrt{2}$

D. None of these

Answer: B

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21. A U-tube having horizontal arm of length 20 cm, has uniform cross-sectional area $= 1cm^2$, It is filled with water of volume 60 cc. What volume of a liquid of density $4g/$ should be poured from one side into the U-tube so that no water is left in the horizontal arm of the tube?

A. $60cc$

B. $45cc$

C. $50cc$

D. $35cc$

Answer: D

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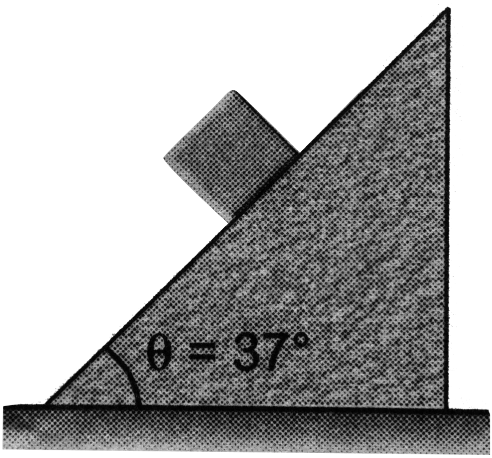
22. A cubical block of side a and density ρ slides over a fixed inclined plane with constant velocity v. There is a thin film of viscon fluid of thickness t between the plane and the block. Then the coefficeint of viscosity of the film will be



A. $\frac{3\rho agt}{5v}$

B. $\frac{4\rho agt}{5v}$

C. $\frac{\rho agt}{5v}$

D. None of these

Answer: A

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23. A spring balance reads $10kg$ when a bucket of water is suspened from it . What will be the reading of the balance when an iron piece of mass $7.2kg$ suspended by a string is immersed with half its volume inside the water in the bucket? Relative density of iron is 7.2

A. $10kg$

B. $10.5kg$

C. $13.6kg$

D. $17.2kg$

Answer: B

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24. Three points A, B,and C on a steady flow of a non-viscon and inconpressible fluid are observed. The pressure, velocity and height of the point A, B and C are (2,3,1),(1,2,2) and (4,1,2) respectively.Density of the fluid is $1kgm^{-3}$ and all other parameters are given in SI unit. Then which of the following is correct?($g = 10ms^{-2}$)

A. Point A and B lie on the same stream line

B. Point B and C lie on the same stream line

C. Point C and A lie on the same stream line

D. None of the above

Answer: D

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25. A body of density ρ is dropped from rest from height h (from the surface of water) into a lake of density of water $\sigma(\sigma > \rho)$. Neglecting all disspative effects, the acceleration of body while it is in the take is

A. $g\left(\frac{\sigma}{\rho} - 1\right)$ upwards

B. $g\left(\frac{\sigma}{\rho} - 1\right)$ downwards

C. $g\left(\frac{\sigma}{\rho}\right)$ upwards

D. $g\left(\frac{\sigma}{\rho}\right)$ downwards

Answer: A

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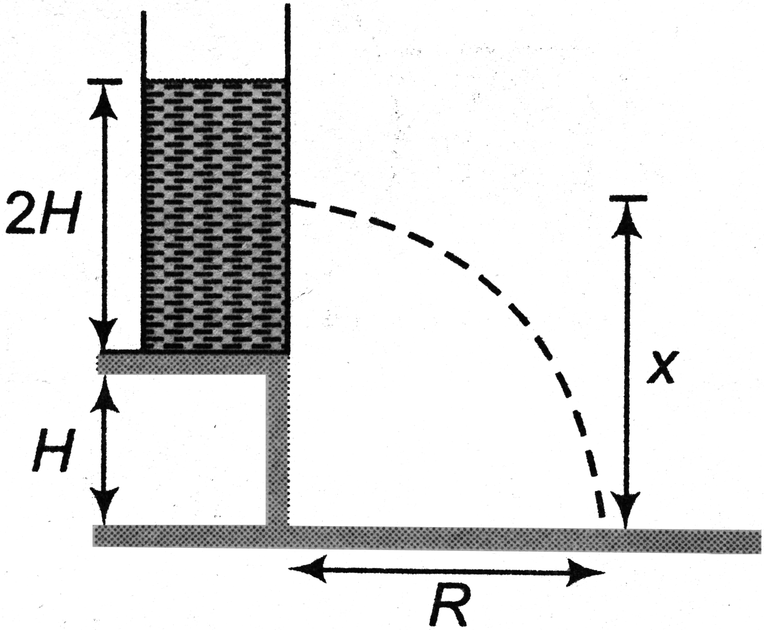
26. A tank is filled up to a height $2H$ with a liquid and is placed on a platform of height H from the ground, the distance x from the ground where a small hole is punched to get the maximum range R is



A. H

B. $1.25H$

C. $1.5H$

D. $2H$

Answer: C

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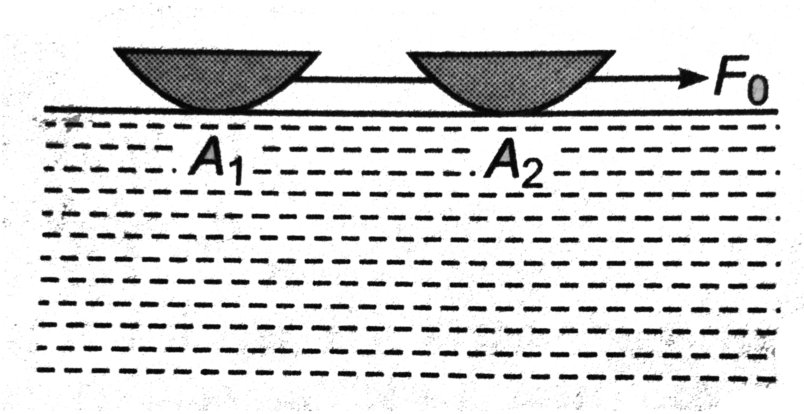
27. Two boats of base areas A_1 and A_2, connected by a string are being pulled by an extermal force F_0. The velosity is η and depth of the water body is H. when the system attains a constant speed. The tension in the trhead will be



A. $F_0\left(\frac{A_1}{A_2}\right)$

B. $F_0\frac{A_2}{(A_1+A_2)}$

C. $F_0\frac{A_1}{(A_1+A_2)}$

D. $F_0\left(\frac{A_2}{A_1}\right)$

Answer: C

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28. A U-tube is partially filled with water. Oil which does not mix with water is next poured into one side, until water rises by 25 cm on the other side. If the density of oil $0.8g/cm^3$. The oil level will stand higher than the water by

A. $6.25cm$

B. $12.50cm$

C. $31.75cm$

D. $25cm$

Answer: B

Watch Video Solution

29. There is a howizontal film of soap solution. On it a thread is placed in the form of a loop. The film is pierced inside the loop and the thread becomes a circular loop of radius R. If the surface tension of the loop be T, then what will be the tension in the thread?

A. $\pi \frac{R^2}{T}$

B. $\pi^2 R^2 T$

C. $2\pi RT$

D. $2RT$

Answer: D

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30. A thin metal disc of radius r floats on water surface and bends the surface downwards along the perimeter making an angle θ with vertical edge of the disc of the disc. If the disc dispplaces a weight of water W and surface tension of water is T, then the weight of metal disc is

A. $2\pi rT = w$

B. $2\pi rT \cos\theta - w$

C. $2\pi rT \cos\theta + w$

D. $w - 2\pi rT \cos\theta$

Answer: C

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31. The radii of the two column is U-tube are r_1 and $r_2(> r_1)$. When a liquid of density ρ (angle of contact is 0°)) is filled in it, the level different of liquid in two arms is h. The surface tension of liquid is

($g =$ acceleration due to gravity)

A. $\dfrac{\rho g h r_1 r_2}{2(r_2 - r_1)}$

B. $\dfrac{\rho g h (r_1 r_2)}{2r_2 - r_1}$

C. $\dfrac{2(r_1 r_2)}{\rho g h r_2 - r_1}$

D. $\dfrac{\rho g h}{2(r_2 - r_1)}$

Answer: A

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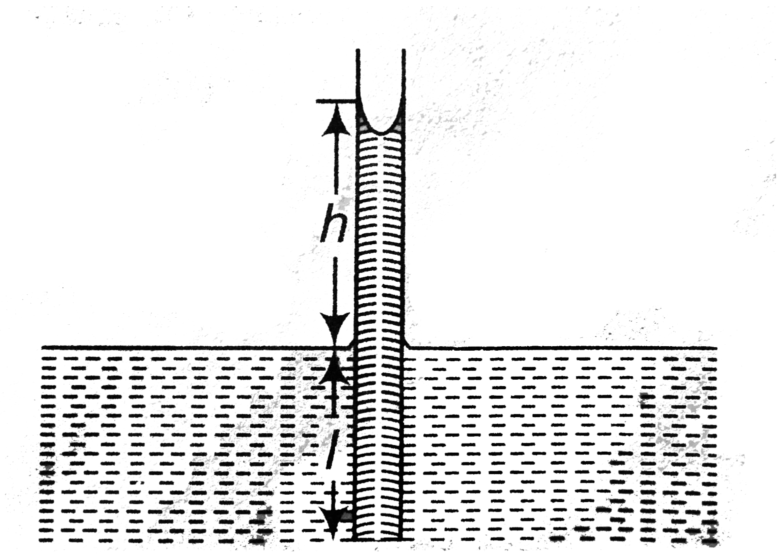
32. Water rises to a height h in a capillary tube lowered vertically into water to a depth l as shown in the figure. The lower end of the tube is now closed, the tube is the taken out of the water and opend again. The length of the eater column remaining in the tube will be



A. $2h$ if $l \geq h$ and $l + h$ if $l \leq h$

B. h if $l \geq h$ and $l + h$ if $l \leq h$

C. $4h$ if $l \geq h$ and $l - h$ if $l \leq h$

D. $\frac{h}{2}$ if $l \geq h$ and $l + h$ if $l \leq h$

Answer: A

Watch Video Solution

33. Two parallel glass plates are dipped partly in the liquid of denstiy 'd' keeping them vertical. If the distance between the plates is 'x', Surface tension is T and angle of contact is θ then ries of liquid between the plates due to capillary will be

A. $\frac{T\cos\theta}{xd}$

B. $\frac{2T\cos\theta}{xdg}$

C. $\frac{2T}{xdg\cos\theta}$

D. $\frac{t\cos\theta}{xdg}$

Answer: B

Watch Video Solution

34. Two spherical soap bubble coalesce. If V is the consequent change in volume of the contained air and S the change in total surface area, show that

$3PV + 4ST = 0$

where T is the surface tension of soap bubble and P is Atmospheric pressure

A. $3p_0V + 4ST = 0$

B. $4p_0V + 3ST = 0$

C. $p_0V + 4TS = 0$

D. $4p_0V + ST = 0$

Answer: A

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35. A cylinder with a movable piston contains air under a pressure p_1 and a soap bubble of radius 'r' . The pressure p_2 to which the air should be compressed by slowly pushing the poston into the cylinder for the soap bubble to reduce its size by hald will be (The surface tension is σ and the temperature T is maintained constant).

A. $\left[8p_1 + \dfrac{24\sigma}{r}\right]$

B. $\left[4p_1 + \dfrac{24\sigma}{r}\right]$

C. $\left[2p_1 + \dfrac{24\sigma}{r}\right]$

D. $\left[p_1 + \dfrac{24\sigma}{r}\right]$

Answer: A

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36. A thin metal ring of internal radius 8 cm and external radius 9 cm is supported horizontally from the pan of a balance so that it comes in contact with water in a glass vessel. If is found that an extrea weight of $7.48g$ is required to pull the ring out of water. The surface tension of water is $\left(g = 10m/s^2\right)$

A. $80 \times 10^{-3} N/m$

B. $25 \times 10^{-3} N/m$

C. $45 \times 10^{-3} N/m$

D. $70 \times 10^{-3} N/m$

Answer: D

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Level 2 More Than One Correct

1. A large wooden plate of area $10m^2$ floating on the surface of river is made to move horizontally wilth a speed of $2ms^{-1}$ by applying a tangential force. If the river is 1m deep and the water contact with the bed is stationary, find the tangential force needed to keep the plate moving. Coefficient of viscosity of water at the temperature of the river $= 10^{-2} poise.$

A. velocity gradient is $2s^{-1}$

B. velocity gradient is $1s^{-1}$

C. force required to keep the plate moving with constant speed is 0.02N

D. force required to keep the plate moving with constant speed is 0.01N

Answer: A::C

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2. Choose the correct options.

A. Viscosity of liquids increases with temperature

B. Viscosity of gases increases with temperature

C. surface tension of liquids decreases with temperature

D. For angle of contact$(\theta) = (0^\circ)$, liquid neither rises nor falls on capillary

Answer: B::C

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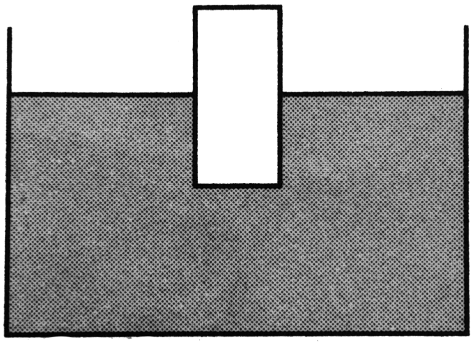
3. A plank is floating in a non-viscous liquid as shown, Choose the correct option



A. Equilibrium of plank is stable in vertical direction

B. For small oscillations of plank in vertical direction motion is simple harmonic

C. Even if oscillations are large, motion is simple harmonic till it is not fully immersed

D. On vertical displacement motion is periodic but not simple harmonic

Answer: A::B::C

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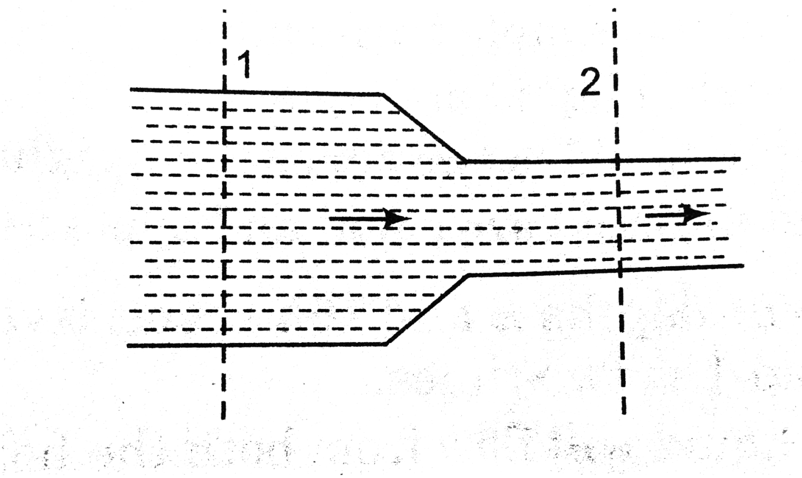
4. A non viscous inconpressible liquid is flowing from a horizontal pipe of non-uniform cross section as shown, Choose the correct option



A. speed of liquid at section-2 is more

B. volume of liquid flowing per second from section-2 is more

C. mass of liquid flowing per second at both the sections is same

D. pressure at section-2 is less

Answer: A::C::D

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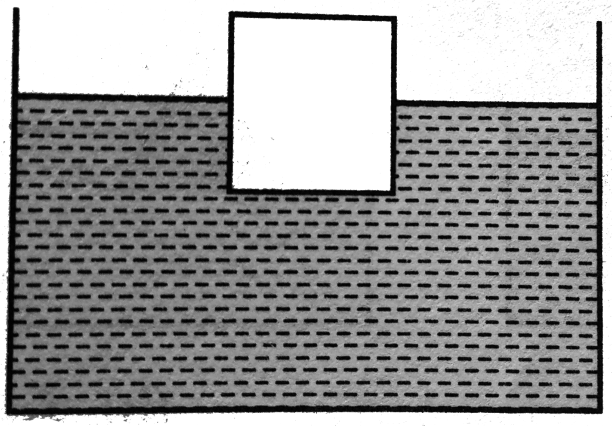
5. A plank is floating in a liquid as shown, Fraction f of its volume is immersed. Choose the correct options



A. If the system is taken to a place where atmospheric pressure is more. F will increase

B. In above condition f will remain unchanged

C. If temperature is increasesd and expansion of only liquid is considered f will increases

D. If temperature is increased and expansion of only plank is considered f will decrease

Answer: B::C::D

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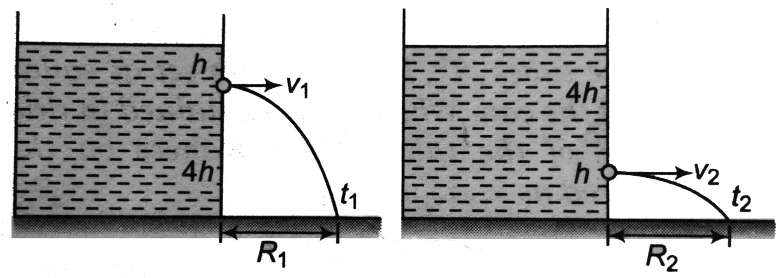
6. In two figure,



A. $v_1 / v_2 = \frac{1}{2}$

B. $t_1 / t_2 = 2$

C. $R_1 / R_2 = 1$

D. $v_1 / v_2 = \frac{1}{4}$

Answer: A::B::C

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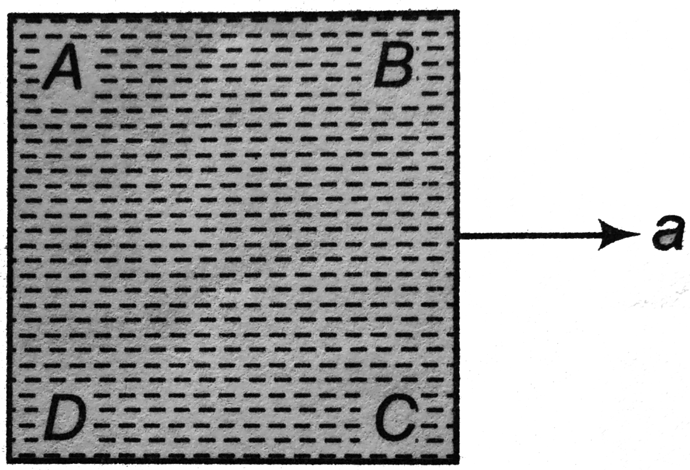
7. A liquid is filled in a container is accelarated towards right. There are four points A, B, C and D in the liquid. Choose the correct options.



A. $p_A > p_B$

B. $p_C > p_A$

C. $p_D > p_B$

D. $p_A > p_C$

Answer: A::C

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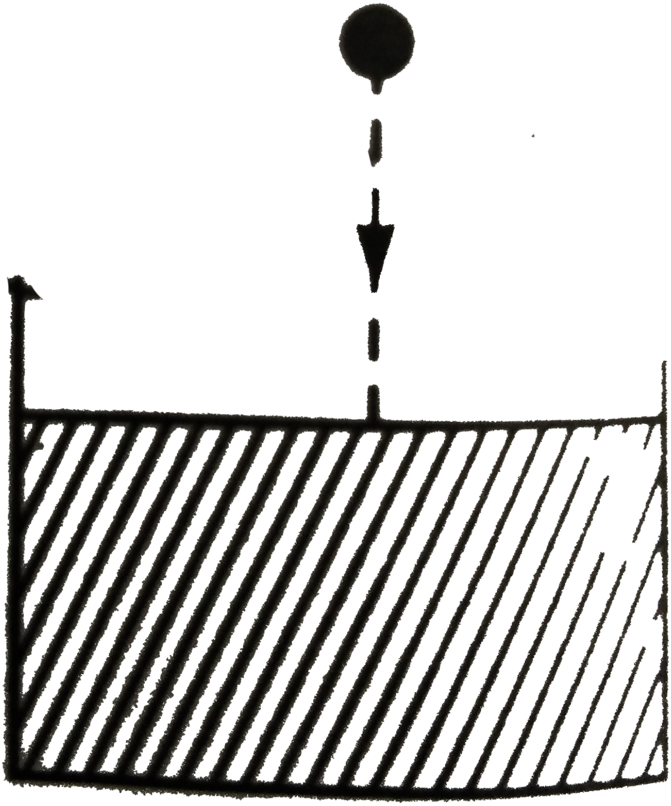
8. A ball of density ρ is dropped from a height on the suraca of a non-visous liquid of dinsity 2ρ. Choose the correct options.



A. Motion of ball is periodic but not simple harmonic

B. Acceleration of ball in air and in liquid are equal

C. Magnitude of upthrust in the liquid is two times the weight of ball

D. Net force on ball in air and in liquid are equal and opposite,

Answer: A::C::D

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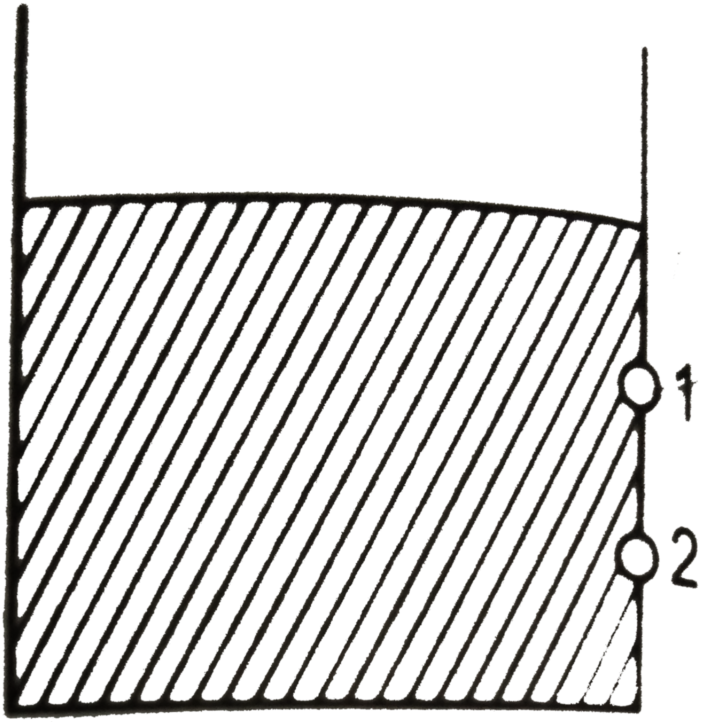
9. Two holes 1 and 2 are made at depths h and 16h reapectively. Both the holes are circular but radius of hole-1 is two times.



A. Initially equal volumes of liquid will flow from both the holes in unit time

B. Intially more volume of liquid will flow from hole-2 per unit time.

C. Afer some time more volume of liquid will flow from hole-1 per unit time.

D. After some time more volume of liquid will flow from hole-2 per unit time

Answer: A::D

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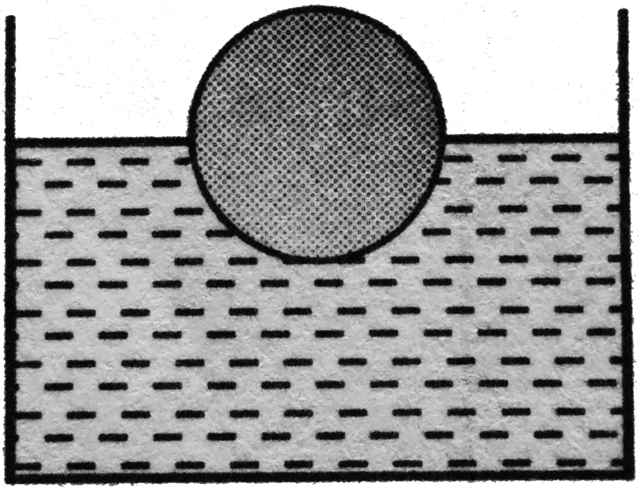
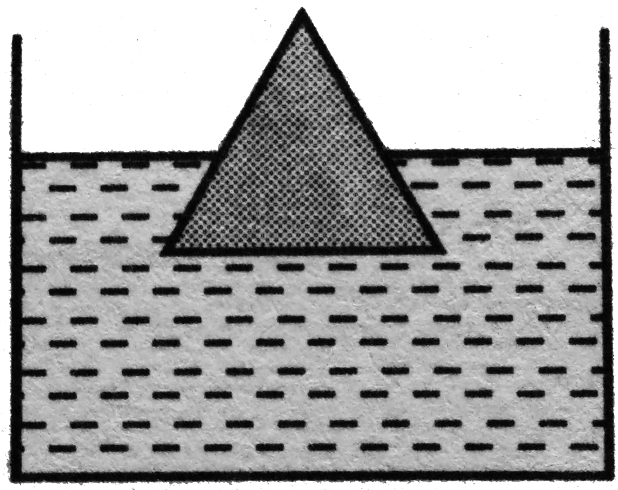
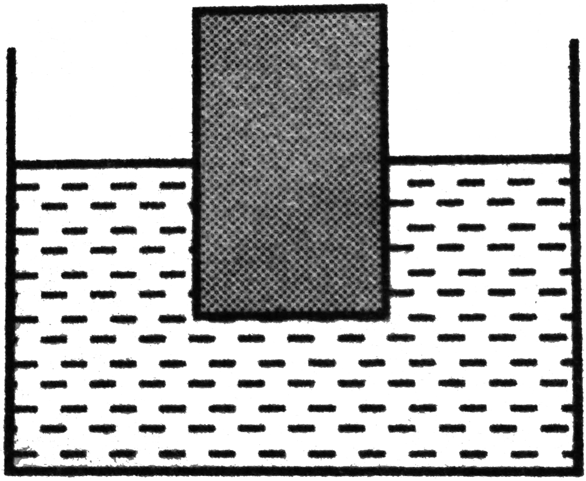
10. A solid sphere a cone and a cylinder are floating in water. All have same mass, density and radius. Let $f_1 f_2$,and f_3 are the fraction of their volumes inside the water and h_1, h_2 and h_3 are depths inside water. Then







A. $f_1 = f_2 = f_3$

B. $f_3 > f_2 > f_1$

C. $h_3 < h_1$

D. $h_3 < h_2$

Answer: A::C::D

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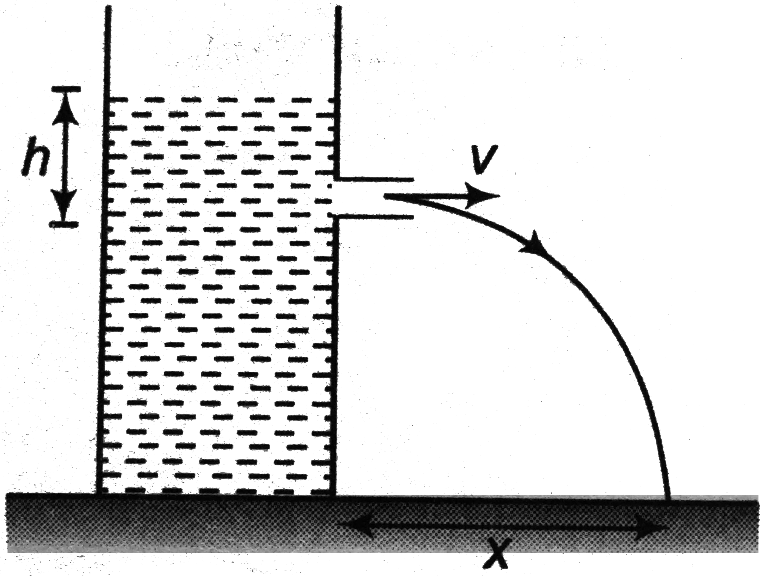
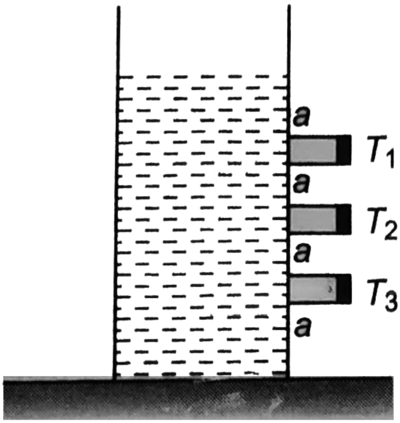
Level 2 Comprehension Based

1. The spouting can is something used to demonstrate the variation fo pressure with depth. When the corks are removed from the tubes in the side of the can, water flows out with a speed that depends on the depth. In a certain can, three tubes T_1, T_2 and T_3 are set at equal distance 'a' above the base of the can. When water contained in this can is allowed to came out of hte tubes, the distance on the horizontal surface are measured as (x_1), (x_2) and (x_3) .





1. speed of efflux is

A. $\sqrt{3gh}$

B. $\sqrt{2gh}$

C. $\sqrt{gh}$

D. $\frac{1}{2}\sqrt{2gh}$

Answer: B

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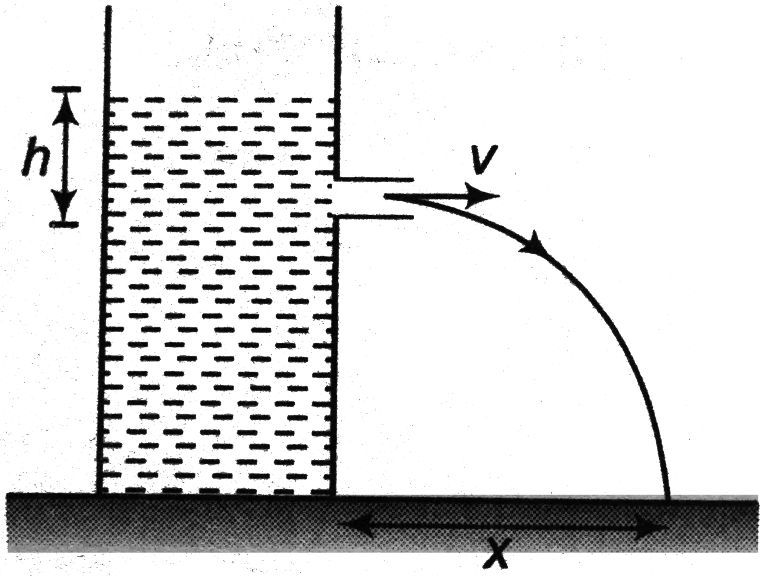
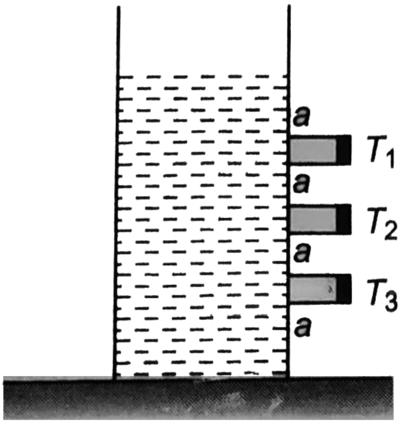
2. The spouting can is something used to demonstrate the variation fo pressure with depth. When the corks are removed from the tubes in the side of the can, water flows out with a speed that depends on the depth. In a certain can, three tubes T_1, T_2 and T_3 are set at equal distance 'a' above the base of the can. When water contained in this can is allowed to came out of hte tubes, the distance on the horizontal surface are measured as x_1, x_2 and x_3 .





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Distance x_3 is given by

A. $\sqrt{3}a$

B. $\sqrt{2}a$

C. $\frac{1}{2}\sqrt{3}a$

D. $2\sqrt{3}a$

Answer: D

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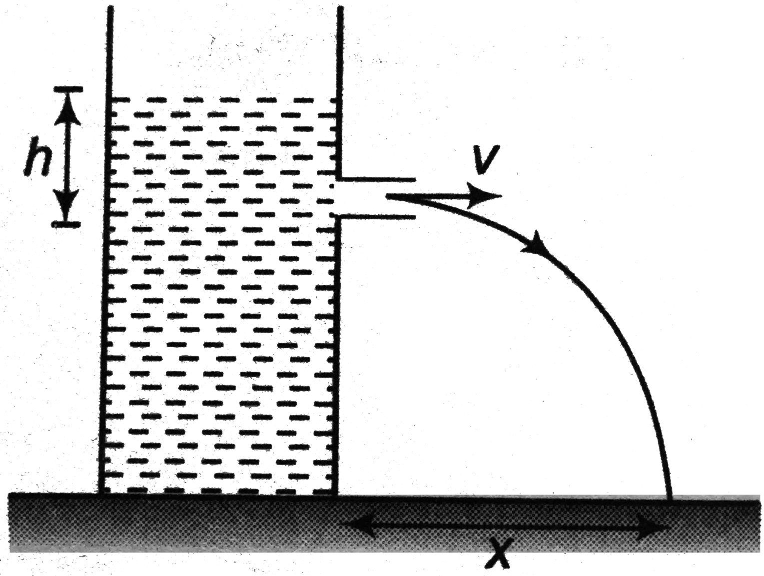
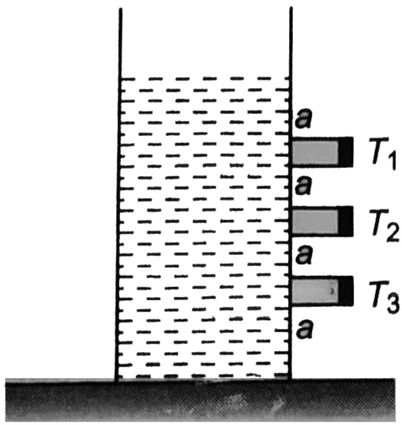
3. The spouting can is something used to demonstrate the variation fo pressure with depth. When the corks are removed from the tubes in the side of the can, water flows out with a speed that depends on the depth. In a certain can, three tubes T_1, T_2 and T_3 are set at equal distance 'a' above the base of the can. When water contained in this can is allowed to came out of hte tubes, the distance on the horizontal surface are measured as x_1, x_2 and x_3 .





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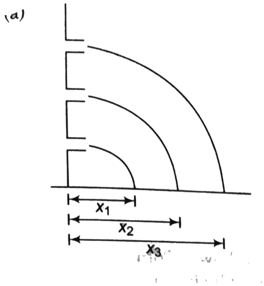
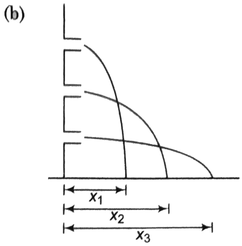
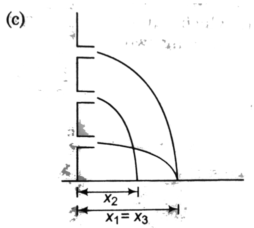
The correct sketch is

A. 

B. 

C. 

D. None of these

Answer: D

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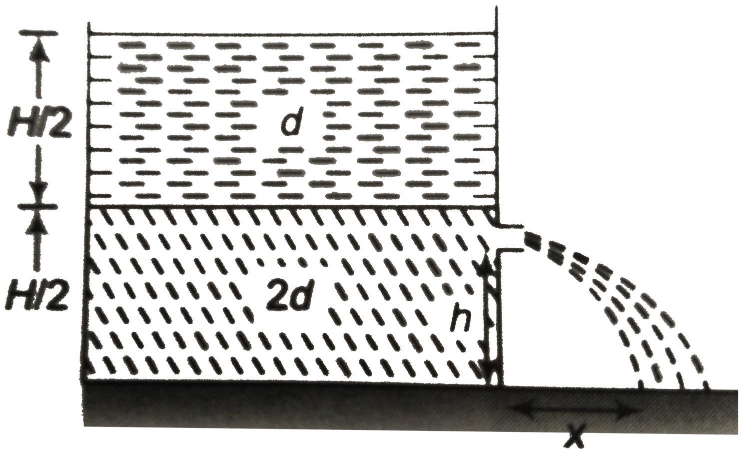
4. A container of large uniform cross-sectional area A resting on a horizontal surface, holes two immiscible, non-viscon and incompressible liquids of densities d and 2d each of height $H/2$ as shown in the figure. The lower density liquid is open to the atmosphere having pressure P_0. A homogeneous solid cylinder of length $L(L < H/2)$ and cross-sectional area $A/5$ is immeresed such that it floats with its axis vertical at the liquid-liquid interface with length $L/4$ in the denser liquid,



The cylinder is then removed and the original arrangement is restroed. a tiny hole of area $s(s < < A)$ is punched on the vertical side of the container at a height $h(h < H/2)$. As a result of this, liquid starts flowing out of the hole with a range x on the horizontal surface.

The density D of the material of the floation cylinder is

A. $5d/4$

B. $3d/4$

C. $4d/5$

D. $4d/3$

Answer: A

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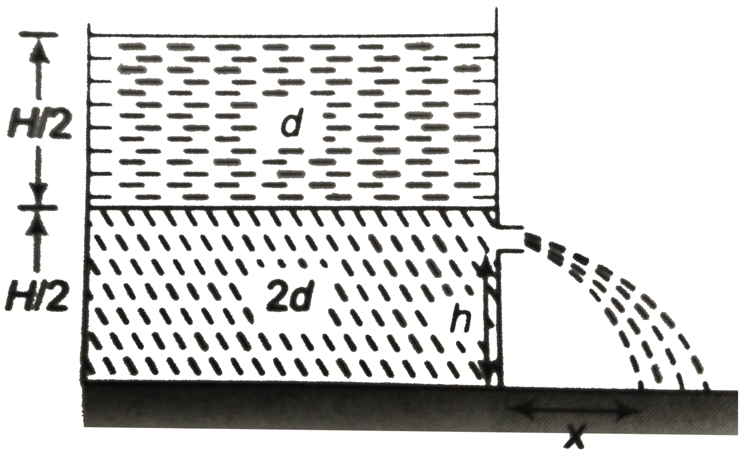
5. A container of large uniform cross-sectional area A resting on a horizontal surface, holes two immiscible, non-viscon and incompressible liquids of densities d and 2d each of height $H/2$ as shown in the figure. The lower density liquid is open to the atmosphere having pressure P_0. A homogeneous solid cylinder of length $L(L < H/2)$ and cross-sectional area $A/5$ is immeresed such that it floats with its axis vertical at the liquid-liquid interface with length $L/4$ in the denser liquid,



The cylinder is then removed and the original arrangement is restroed. a tiny hole of area $s(s << A)$ is punched on the vertical side of the container at a height $h(h < H/2)$. As a result of this, liquid starts flowing out of the hole with a range x on the horizontal surface.

The total pressure with cylinder, at the bottom of the container is

A. $p_0 + \frac{(6L+H)}{4}dg$

B. $p_0 + \frac{(L+6H)}{4}dg$

C. $p_0 + \frac{(L+3H)}{4}dg$

D. $p_0 + \frac{(L+2H)}{4}dg$

Answer: B

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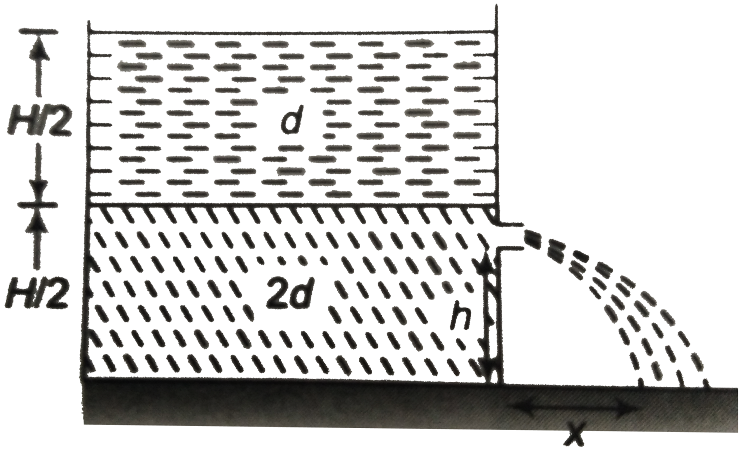
6. A container of large uniform cross-sectional area A resting on a horizontal surface, holes two immiscible, non-viscon and incompressible liquids of densities d and 2d each of height

$H/2$ as shown in the figure. The lower density liquid is open to the atmosphere having pressure P_0. A homogeneous solid cylinder of length $L(L < H/2)$ and cross-sectional area $A/5$ is immeresed such that it floats with its axis vertical at the liquid-liquid interface with length $L/4$ in the denser liquid,



The cylinder is then removed and the original arrangement is restroed. a tiny hole of area $s(s < < A)$ is punched on the vertical side of the container at a height $h(h < H/2)$. As a result of this, liquid starts flowing out of the hole with a range x on the horizontal surface.

The initial speed of efflux without cylinder is

A. $v = \sqrt{\frac{g}{3}[3H + 4h]}$

B. $v = \sqrt{\frac{g}{3}[4H - 3h]}$

C. $v = \sqrt{\frac{g}{3}[3H - 4h]}$

D. None of these

Answer: C

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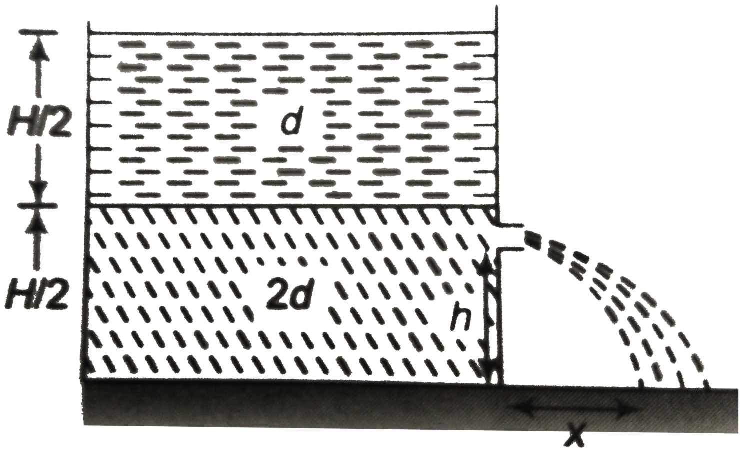
7. A container of large uniform cross-sectional area A resting on a horizontal surface, holes two immiscible, non-viscon and incompressible liquids of densities d and 2d each of height $H/2$ as shown in the figure. The lower density liquid is open to the atmosphere having pressure P_0. A homogeneous solid cylinder of length $L(L < H/2)$ and cross-sectional area $A/5$ is immeresed such that it floats with its axis vertical at the liquid-liquid interface with length $L/4$ in the denser liquid,



The cylinder is then removed and the original arrangement is restroed. a tiny hole of area $s(s < < A)$ is punched on the vertical side of the container at a height $h(h < H/2)$. As a result of this, liquid starts flowing out of the hole with a range x on the horizontal surface.

The initial value of x is

A. $\sqrt{(3H+4h)h}$

B. $\sqrt{(3h+4H)h}$

C. $\sqrt{(3H-4h)h}$

D. $\sqrt{(3H-3h)h}$

Answer: C

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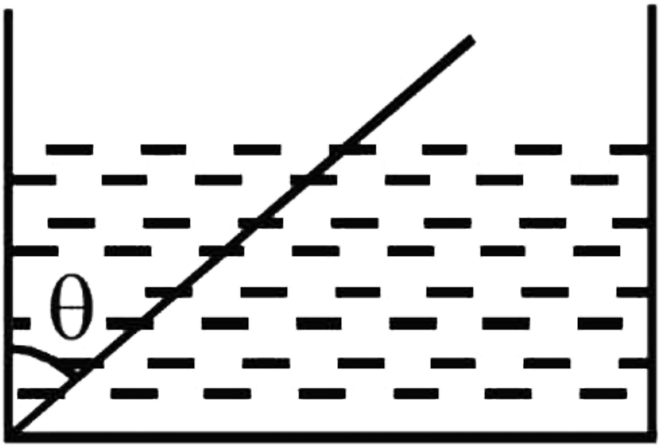
Subjective

1. A wooden plank of length 1m and uniform cross-section is hinged at one end to the bottom of a tank as shown in fig. The tank is filled with water upto a hight 0.5m. The specific gravity of the plank is 0.5. Find the angle θ that the plank makes with the vertical in the equilibrium position. (Exclude the case $\theta = \theta^{\circ}$)



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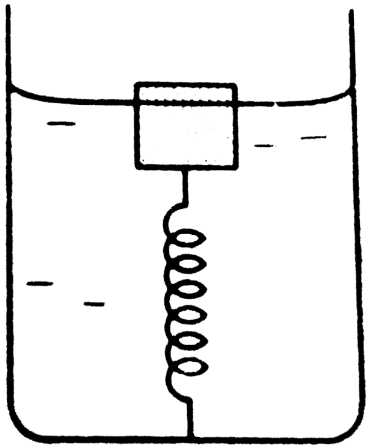
2. A cubical block of wood of edge 3 cm floats in water. The lower surface of the cube just touches the free end of a vertical spring fixed at the bottom of the pot. Find the maximum weight that can be put on the block without wetting it. Density of wood =$800 kgm^{-3}$ and spring constant of the spring

$= 50Nm^{-1}Take g = 10ms^{-2}$.



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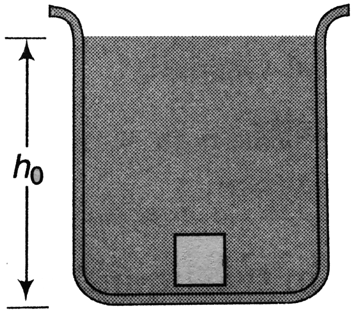
3. Figure shown a container having liquid of variable density. The density of liquid veriesas $\rho = \rho_0\left(4 - \frac{3h}{h_0}\right)$. Here, h_0 and ρ_0 are constants and h is measured from bottom of the container. A solid block of small dimensions whose density is $\frac{5}{2}\rho_0$ and mass m is released from bottom of the tank. Prove that the block will execute simple harmonic motion. Find the frequency of oscillation.



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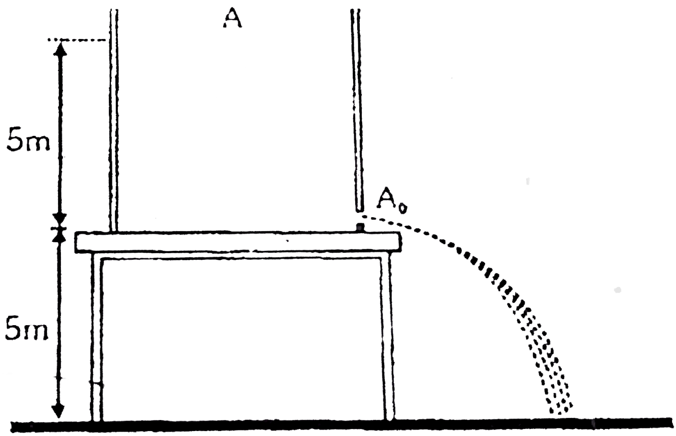
4.



A cylinderical tank 1 m in radius rests on a plaform 5 m high. Initially the tank is filled with upto a height of 5m a plug whose area is $10^{-4} cm^2$ is removed from an orifice on the side of the tank at the bottom.

Calculate (a). Initial speed with which the water flows from the orifice

(b). Initial speed with which the water strikes the ground.

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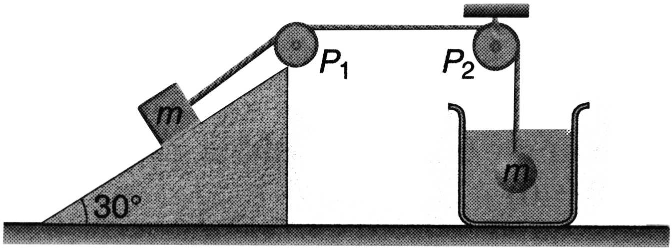
5. A block of mass m is kept over a fixed smooth wedge. Block is attached to a sphere of same mass through fixed massles pullies P_1 and P_2, sphere is dipped inside the water as shown. If specfic gravity of material of sphere is 2. Find the acceleration of sphere.



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6. A cubic body floats on mercury with 0.25 fraction of its volume below the surface. What fraction of the volume of the body will be immeresed in the mercury if a layer of water poured on top of the mercury covers the body conpletely.

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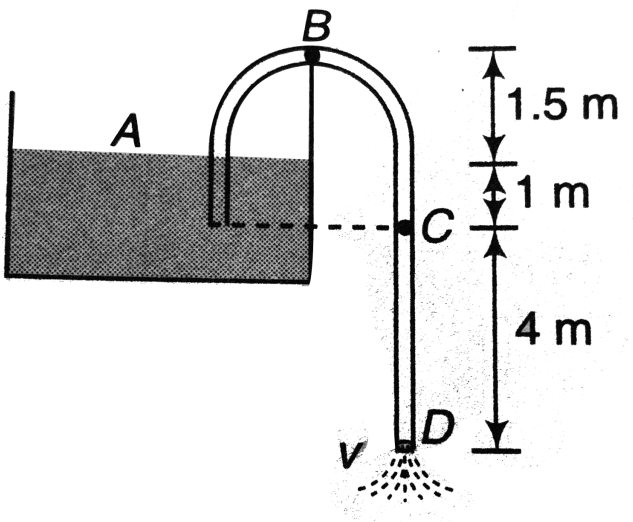
7. A siphon tube is discharging a liquid of specific gravity 0.9 from a reservoir as shown in the figure.



(a) Find the velocity of the liquid through the siphon.

(b) Find the pressure at the highest point B.

(c) Find the pressure at point C.

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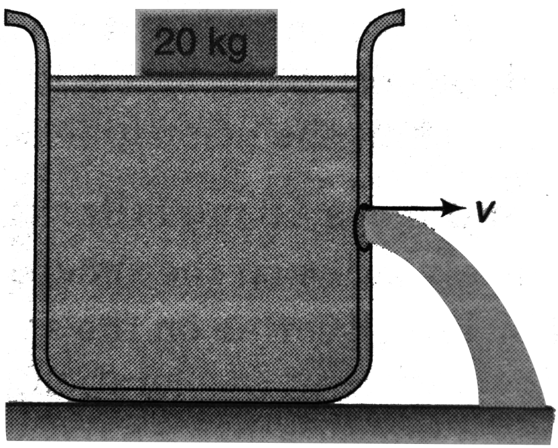
8. A long cylindrical tank of cross-sectional area $0.5m^2$ is filled with water. It has a small hole at a height $50cm$ from the bottom. A movable piston of cross-sectional area almost equal to $0.5m^2$ is fitted on the top of the tank such that it can slide in the tank freely. A load of $20kg$ is applied on the top of the water by piston, as shown in the figure. Calculate the speed of the water jet with which it hits the surface when piston is 1m above the bottom. (Ignore the mass of the piston)



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9. A spring is attached to the bottom of an swimming pool, with the axis of the spring oriented vertically. An 8.00 kg block of wood $(\rho = 840kh / m^3)$ is fixed to the top of the spring and compressed it. Then the pool is filled with water, completely covering the block. the spring is now observed to be stretched twice as much as it had been conpressed. Determine the percentage of the block's total volume that is hollow. Ignore any air in the hollow space.

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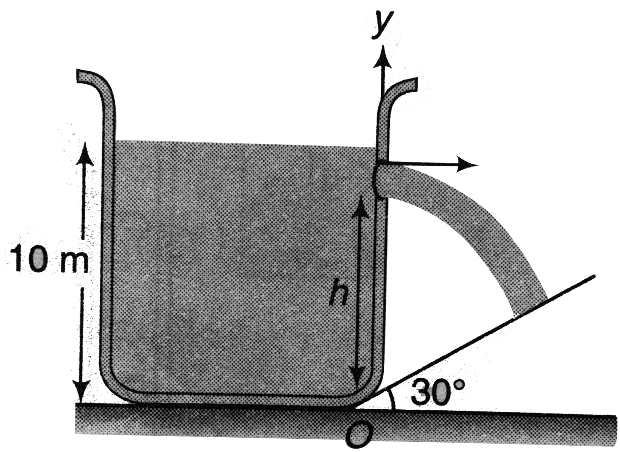
10. A rectangular tank of height 10m filled with water, is placed near the bottom of a plane inclined at an angle 30° with

horizontal. At height h form bottom a small hole is made (as shown in figure) such that the stream coming out from hole, strikes the inclined plane normally.Calculate h.



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11. A ball of density d is dropped on to a horizontal solid surface. It bounces elastically from the surface and returns to its original position in a time t_1. Next, the ball is released and it falls through the same height before striking the surface of a liquid of density of d_L

(a) If $d < d_L$, obtain an expression (in terms of d, t_1 and d_L) for the time t_2 the ball takes to come back to the position from which it was released.

(b) Is the motion of the ball simple harmonic?

(c) If $d = d_L$, how does the speed of the ball depend on its depth inside the liquid? Neglect all frictional and other dissipative forces. Assume the depth of the liquid to be large.

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12. Thre is an air bubble of radius .0 mm in a liquid of surface tension $0.075 Nm^{-1}$ and density $1000 kgm^{-3}$. The bubble is at a depth of 10 cm below the free surface. By than the atmospheric presure? Take $g = 9.8 ms^{-2}$.

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13. A metal sphere of radius 1 mm and mass 50 mg falls vertically in glycerine. Find (a) the viscous force exerted by the glycerine on the sphere when the speed of the sphere is 1 cm s-1, (b) the hydrostatic force exerted by the glycerine on the sphere and (c) the terminal velocity with which the sphere will move down without acceleration. Density of glycerine $= 1260 kgm^{-3}$ and its coefficient of viscosity at room temperature = 8.0 poise.

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14. A wire forming a loop is dipped into soap solution and taken out so that a film of soap solution is formed. A loop of 6.28 cm long thread is gently put on the film and the film is pricked with a needle inside the loop. The thread loop takes the shape of a circle. Find the tension in the thread. Surface tension of soap solution $= 0.030 Nm^{-1}$.

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15. A cylindrical vessel is filled with water upto a height of 1m. The cross-sectional area of the orifice at the bottom is $(1/400)$ that of the vessel.

(a) What is the tiome required to empty the tank through the orifice at the bottom?

(b) What is the time required for the same amount of water to flow out if the water level in tank is maintained always at a height of 1m from orifice?

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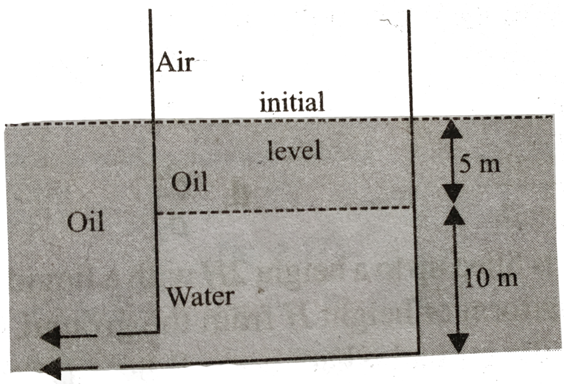
16. A tank with a small orifice contains oil on top of water. It is immersed in a large tank of the same oil. Water flows through the hole. Assuming the level of oil outside the tank above orifice does not change.

a. What is the velocity of this flow initially?

b. When the flow stops, what would be the position of the oil-water interface in the tank?

c. Determine the time at which the flow stops. Density,of oil $800kg/m^3$.



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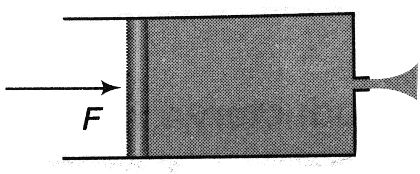
17. What work should be done in order to sqeeze all water from a horizontally located cylinder (figure) during the time t by means of a constant force acting on the poston? The volume of water in the cylinder is equal to V, the cross-sectional area of the orifice is s, with s being considerablu less than the piston area. The friction and viscosity are negligibly small. Density of water is ρ



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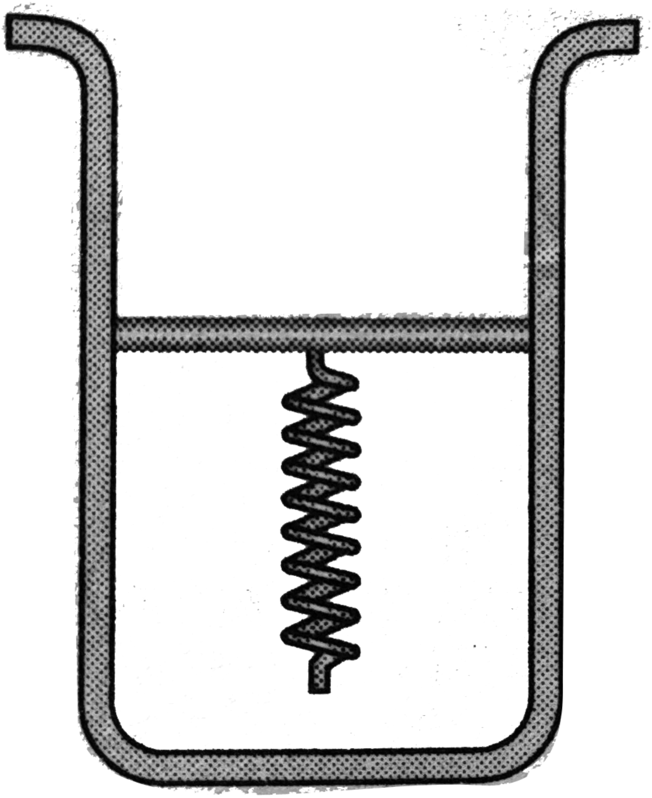
18. A cylinder is fitted with a piston, beneath which is a spring, as in the figure. The cylinder is open at the top. Friction is absent. The spring is $3600N/m$. The piston has a negligible mass and a radius of 0.025m (a) when air beneath the piston is conpletely pumped out, how much does the atmospheric pressure cause the spring to compress? (b) How much work

does the atmospheric pressure do in compressing the spring?



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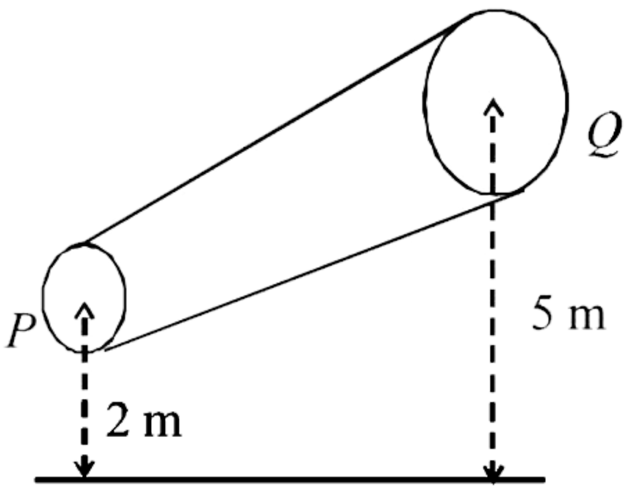
19. A non-viscous liquid of constant density $1000 kg/m^3$ flows in a streamline motion along a tube of variable cross section.

The tube is kept inclined in the vertical plane as shown in Figure. The area of cross section of the tube two point P and Q at heights of 2 metres and 5 metres are respectively $4 \times 10^{-3} m^2$ and $8 \times 10^{-3} m^2$. The velocity of the liquid at point P is $1 m / s$. Find the work done per unit volume by the pressure and the gravity forces as the fluid flows from point P to Q.



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20. A glass plate of length $10cm$, breadth $1.54cm$ and thickness $0.20cm$ weigh $8.2g$ in air. It is held vertically with the long side horizontal and the lower half under water. Find the apparent weight of the plate. Surface tension of water $= 7.3 \times 10^{-2} N/m$ and $= 9.8ms^{-12}$

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21. Two narrow bores of diameters 3.0mm and 6.0 mm are joined together to form a U-shaped tube open at both ends. If th U-tube contains water, what is the difference in its levels in the two limbs of the tube? Surface tension of water at the temperature of the experiment is $7.3 \times 10^{-2} Nm^{-1}$. Take the angle of contact to be zero. and density of water to be

$1.0 \times 10^3 kg/m^3$.

$(g = 9.8ms^{-2})$

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22. Two identical soap bubbles each of radius r and of the same surface tension T combine to form a new soap bubble of radius R. The two bubbles contain air at the same temperature. If the atmospheric pressure is p_0 then find the surface tension T of the soap solution in terms of p_0, r and R. Assume process is isothermal.

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23. A soap bubble of radius r and surface tension T is given a potential V. Show that the new radius R of the bubble is related with the initial radius by the equation

$P(R^3 - r^3) + 4T(R^2 - r^2) = \dfrac{\in_0 V^2 R}{2}$ where P is the atmospheric pressure.

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24. If the radius and surface tension of a spherical soap bubble are 'R' and 'T' respectively, Then show that the charge required to double its radius would be $8\pi R, [\varepsilon_0 R[7p_0 R + 12T]]^{\frac{1}{2}}$.

Where p_0 is the atmospheric pressure.

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Example 13.1

1. An open container has dimensions of $4.0m \times 5.0m$ and height of 3.0 m.

(i) Find the weight of the air in the container at $20^{\circ} C$.

(ii) What is the weight of an equal volume of water ? Also find pressure at the base of container due to this weight pof water.

(iii) What is the total downward force on the base of the container due to air pressure of 1.0 atm ?

Take the denities of air and water as $1.2 kg / m^3$ and $10^3 kg / m^3$ respectively.

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Example 13.2

1. Relative density of an oil is 0.8.Find the absolute density of oil in CGS and SI units.

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Example 13.3

1. Two liquids of densities ρ and 3rho` having volumes 3V and V are mixed together. Find density of the mixture.

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Example 13.4

1. Find the pressure exerted below a column of water, open to the atmosphere, at depth

(i) 10 m " " (ii) 30 m

(Given, density of water $= 1 \times 10^3 kgm^{-3}, g = 10ms^{-2}$)

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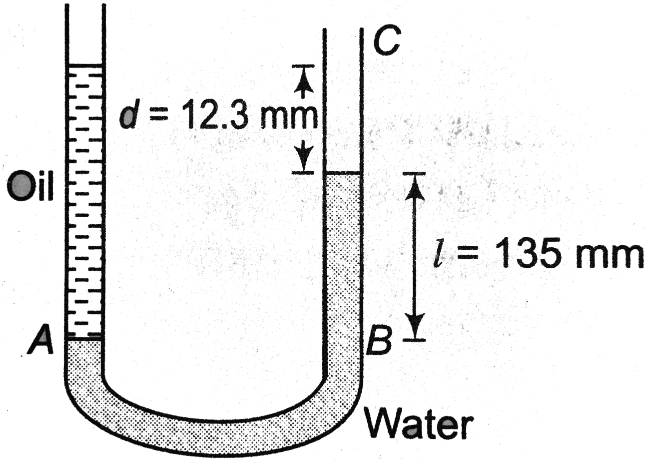
Example 13.5

1. For the arrangement shown in the figure, what is the density of oil?



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Example 13.6

1. A curved glass vessel full of water upto a height of 10 cm has a bottom of area $10cm^2$, top of area $30cm^2$ and volume 1 L.

(i) Find the force exerted by the water on the bottom.

(ii) Find the resultant force exerted by the sides of the glass on the water.

(iii) If the glass vessel is covered by a jar and the air inside the jar is completely pumped out, what will be the answers to parts (a) and (b)

(iv) If a glass vessel of different shape is used provided the height, the bottom area and the volume are unchanged, will the answers to parts (a) and (b) change.

(Take, $g = 10ms^{-2}$, density of water $=10^3 kgm^{-2}$ and atmospheric pressure $= 1.01 \times 10^5 Nm^{-2}$)

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Example 13.7

1. A hydraulic press with the larger piston of diameter 35 cm at a heigth of 1.5 m relative to the smaller piston of diameter 10 cm. The mass on the smaller piston is 20 kg. What is the force exerted on the load placed. On the larger piston ? The density of oil in the press is $750 kgm^{-3}$

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Example 13.8

1. Two pistons of a hydraulic machine have diameters 20 cm and 2 cm. Find the force exerted on the larger piston when 50 kg wt is placed on the smaller piston. When the smaller piston moves is throught 50 cm, by what distance the other piston moves out ?

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Example 13.9

1. What will be the length of mercury column in a barometer tube, when the atmospheric pressure is 76 cm of mercury and the tube is inclined at an angle of 30° with the horizontal direction ?

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Example 13.10

1. A manometer tube contains a liquid of density $4 \times 10^3 kgm^{-3}$. When connected to a vessel containing a gas, the liquid level in the other arm of the tube is higher by 20 cm. When connected to another sample of enclosed gas, the liquid level in the other arm of the manometer tube falls 8 cm below

the liquid level in the first arm. Which of the two samples exerts more pressure and by what amount ?

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Example 13.11

1. An ornament weighing $50g$ in air weighs only $46g$ is water. Assuming that some copper is mixed with gold the prepare the ornament. Find the amount of copper in it. Specific gravity of gold is 20 and that of copper is 10.

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Example 13.12

1. Density of ice is $900kg/m^3$. A piece of ice is floating in water of density $1000kg/m^3$. Find the fraction of volume of the picec of ice outside the water.

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Example 13.13

1. A piece of ice is floating in a glass vessel filled with water. How will the level of water in the vessel change when the ice melts ?

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Example 13.14

1. A piece of ice having a stone frozen in it floats in a glass vessel filled with water. How will the level of water in the vessel change when the ice melts?

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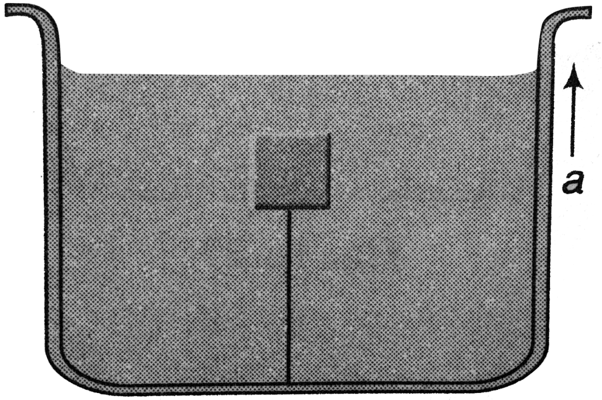
Example 13.15

1. The tension in a string holding a solid block below the surface of a liquid (of density greater than that of solid) as shown in figure is T_0 when the system is at rest. What will be the tension in the string if the system has an upward acceleration a?



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Example 13.16

1. Water is flowing in a pipe of diameter 6 cm with an average velocity $7.5 cms^{-1}$ and its density is $10^3 kgm^{-3}$. What is the nature of flow ? Given coefficient of viscosity of water is $10^{-3} kgm^{-1}s^{-1}$.

A. Laminar

B. Streamline

C. Turbulent

D. Data is insufficient

Answer: C

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Example 13.17

1. Water is flowing through a horizontal tube of non-uniform cross-section. At a place, the radius of the tube is $1.0 cm$ and the velocity of water is $2m/s$. What will be the velocity of water where the radius of the pipe is $2.0 cm$?

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Example 13.18

1. Calculate the rate of flow of glycerine of density $1.25 \times 10^3 kgm^{-3}$ through the conical section of a pipe, if the radii of its ends are0.1 m and 0.04 m and the pressure drop across its length is $10Nm^{-2}$.

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Example 13.19

1. The flow of blood in a large artery of an anesthetised dog is diverted through a venturimeter. The wider part of the meter has a cross-sectional area equal to that of the artery, $A = 16mm^2$. The narrower part has an area $a = 9mm^2$. The pressure drop in the artery is 24 Pa. What is the speed of the blood in the artery ?

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Example 13.20

1. If the water emerge from an orifice in a tank in which the gauge pressure is $4 \times 10^5 Nm^{-2}$ before the flow starts, then what will be the velocity of the water emerging out ? Take density of water is $1000kgm^{-3}$

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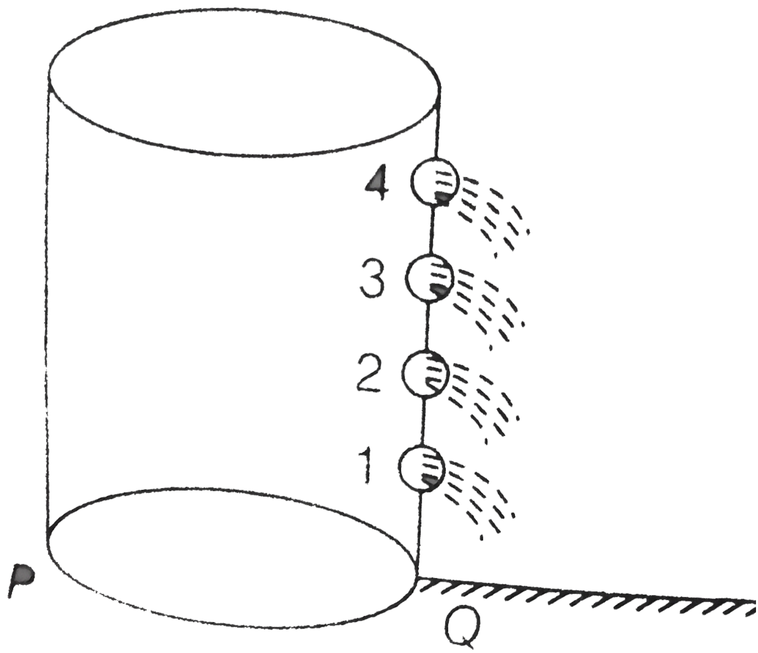
Example 13.21

1. A cylindrical vessel of 90 cm height is kept filled with water upto the rim. It has four holes 1,2,3,4 which are respectively at heights of 20 cm 45 cm and 50 cm from the horizontal floor PQ. Through which of the holes water is falling at the maximum horizontal distance ?



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Example 13.22

1. A tank is filled with a liquid upto a height H, A small hole is made at the bottom of this tank Let t_1 be the time taken to empty first half of the tank and t_2 time taken to empty rest half of the tank then find $\frac{t_1}{t_2}$

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Example 13.23

1. A plate of area $2m^2$ is made to move horizontally with a speed of $2m/s$ by applying a horizontal tangential force over the free surface of a liquid. If the depth of the liquid is 1m and the liquid in contact with the bed is stationary. Coefficient of viscosity of liquid is 0.01 poise. Find the tangential force needed to move the plate.

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Example 13.24

1. Water is conveyed through a horizontal tube 8 cm in diameter and 4 kilometer in length at the rate of 20 litre/s Assuming only viscous resistance , calculate the pressure required to maintain the flow . Coefficient of viscosity of water is 0.001 pa s

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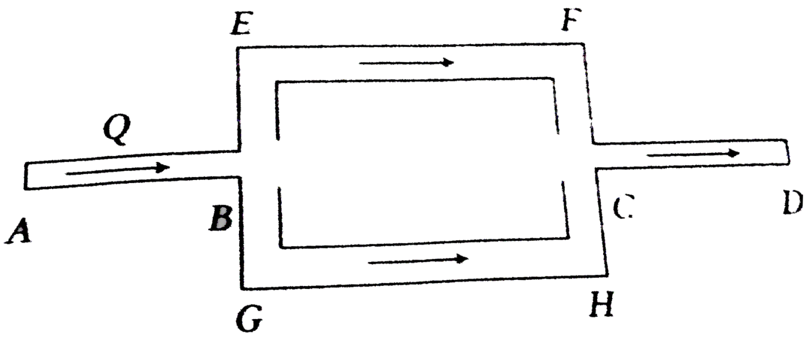
Example 13.25

1. A liquid is flowing through horizonatal pipes as shown in figure.



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Example 13.26

1. With what terminal velocity will an air bubble $0.8mm$ in diameter rise in a liquid of viscosity $0.15N - s/m^2$ and specific gravity 0.9? Density of air is $1.293kg/m^3$.

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Example 13.27

1. Two spherical raindrops of equal size are falling vertically through air with a velocity of $1m/s$. What would be the terminal speed if these two drops were to coalesce to form a large spherical drop?

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Example 13.28

1. A liquid is kept in a beaker of radius 4 cm. Consider a diameter of the beaker on the surface of the water. Find the force by which the surface on one side of the diameter pulls the surface on the other side. Surface tension of liquid $= 0.075Nm^{-1}$

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Example 13.29

1. How much work will be done in increasing the diameter of a soap bubble from 2 cm to 5 cm. Surface tension of soap solution is $3.0 \times 10^{-1}Nm^{-1}$.

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Example 13.30

1. Calculate the energy released when 1000 small water drops each of same radius $10^{-7}m$ coalesce to form one large drop. The surface tension of water is $7.0 \times 10^{-2} N/m$.

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Example 13.31

1. 0.04 cm liquid column balances the excess pressure inside a soap bubble of radius 6 mm. Evaluate density of the liquid. Surface tension of soap solurtion =$0.03 Nm^{-1}$.

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Example 13.32

1. Two separate air bubbles (radii $0.002cm$ and 0.004) formed of the same liquid (surface tension $0.07N/m$) come together to form a double bubble. Find the radius and the sense of curvature of the internal film surface common to both the bubbles.

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Example 13.33

1. What should be the pressure inside a small air bubble of $0.1mm$ radius situated just below the surface of water? Surface tension of water $= 72 \times 10^{-3}N/m$ and atmospheric pressure $= 1.013 \times 10^{5}N/m^{2}$

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Example 13.34

1. A capillary tube whose inside radius is $0.5mm$ is dipped in water having surface tension $7.0 \times 10^{-2} N/m$. To what height is the water raised above the normal water level? Angle of contact of water with glass is 0°. Density of water is $10^3 kg/m^3$ and $g = 9.8m/s^2$.

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Example 13.35

1. A glass tube of radius $0.4mm$ is dipped vertically in water. Find upto what height the water will rise in the capollary? If the tube in inclined at an angle of 60° with the vertical, how much length of the capillary is occupied by water? Suface of water $= 7.0 \times 10^{-2} N/m$,density of water $= 10^{3} kg/m^{3}$.

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Check point 13.1

1. A fluid comparises of

A. liquid only

B. gases only

C. Neither liquid nor gases

D. Both (a) and (b)

Answer: D

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2. Thd dimensional formula of pressure is

A. $[M^0L^0T^0]$

B. $[ML^{-1}T^{-2}]$

C. $[M^0L^1T^{-2}]$

D. $[M^{\circ}L^1T^0]$

Answer: B

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3. Pins and nails are made to have ponted end because

A. it transmits very small pressure

B. it transmits a large pressure

C. it provide a large area

D. None of the above

Answer: B

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4. The two thigh bones each of cross-sectional area $15cm^2$ support the upper part of a person of mass 70 kg. The pressure sustained by these thigh bones is

A. $2.5 \times 10^5 Nm^2$

B. $1.33 \times 10^5 Nm^2$

C. $4.66 \times 10^5 \times 10^5 Nm^2$

D. $2.33 \times 10^5 Nm^2$

Answer: D

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5. Which of the following is correct.

A. Gauge pressure=absolute pressure+atmospheric pressure

B. Absolute pressure=gauge pressure-atmospheric pressure

C. Gauge pressure=absolute pressure-atmospheric pressure

D. Absolute pressure=atmospheric pressure -gauge pressure

Answer: C

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6. At a depth of 500m in an ocean (a) what is the absolute pressure? (b) What is the gauge pressure? Density of sea water is $1.03 \times 10^3 kg/m^3, g = 10ms^{-2}$. Atmospheric pressure = $1.01 \times 10^5 Pa.$

A. 40 atm

B. 52 atm

C. 32 atm

D. 62 atm

Answer: B

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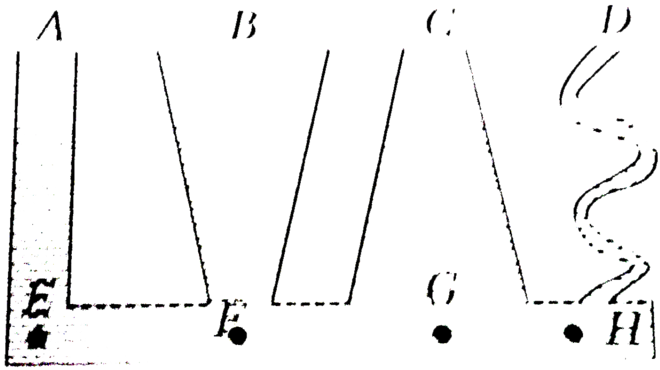
7. Four vessels A, B, C and D have different shapes and hold different amount of water. Which of the following is correct.



A. $P_E > P_F > P_G > P_H$

B. $P_E < P_F < P_G < P_H$

C. $P_E = P_F = P_G = P_H$

D. $P_E = P_F > P_G = P_H$

Answer: C

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8. Two liquids of densities 2ρ and ρ having their volumes in the ratio $3:2$ are mixed together. Density of the mixture will be

A. $\frac{2\rho}{3}$

B. $\frac{\rho}{2}$

C. $\frac{8\rho}{5}$

D. $\frac{4\rho}{5}$

Answer: C

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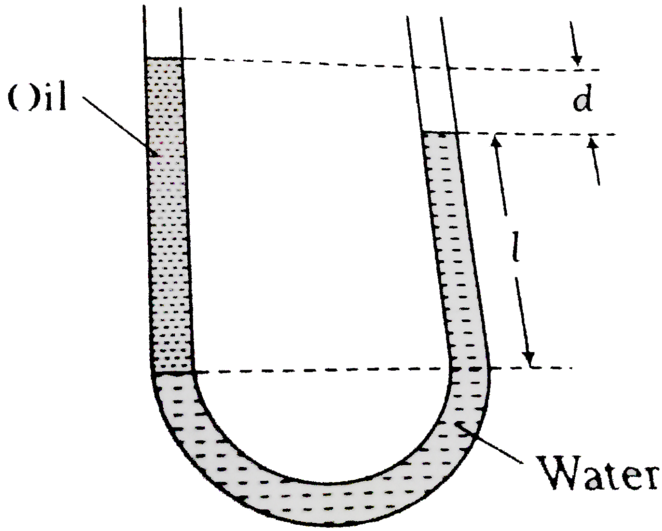
9. The U-tube in figure contains two different liquids in static equilibrium, water in the right arm and oil of unknown density ρ_x in the left. If/=135 mm and d=15 mm. Density of the oil is



A. $1000 kgm^3$

B. $920 kgm^3$

C. $895 kgm^3$

D. $900 kgm^3$

Answer: D

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10. Increase in pressure at one point of the enclosed liquid in equilibrium at rest is transmitted equally to all other points. This is as per

A. impluse

B. Pascal's law

C. conservation of momentum

D. None of the above

Answer: B

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11. In a vehicle lifter the enclosed gas exerts a force F on a small piston having a diameter of 8 cm. This pressure is transmitted to a second piston of diameter 24 cm. If the mass of the vehicle to be lifted is 1400 kg then value of F is

A. 1200 N

B. 1800 N

C. 1600 N

D. 700 N

Answer: C

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12. What will be the length of mercury column in a barometer tube when the atmospheric pressure is x cm of mercury and the tube is inclined at an angle ϕ with the vertical direction ?

A. $\frac{x}{\sin \phi}$

B. $\frac{x}{\cos \phi}$

C. $\frac{x}{\tan \phi}$

D. x

Answer: B

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13. A boat carrying a large number of stones is floating in a water tank. What will happen to water level if the stone are unloaded into water?

A. increase

B. remains same

C. decreases

D. data is insufficient

Answer: C

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14. An iron casting containing a number of cavities weight $6000N$ in air and $4000N$ in water. What is the volume of the cavities in the casting? Density of iron is $7.87g/cm^3$. Take $g = 9.8m/s^2$ and density of water $= 10^3 kg/m^3$.

A. $0.16m^3$

B. $0.2m^3$

C. $0.12m^3$

D. $0.14m^3$

Answer: C

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15. A body floats in water with 40% of its volume outside water. When the same body floats in an oil. 60% of its volume remians outside oil. The relative density of oil is

A. 0.9

B. 1.0

C. 1.2

D. 1.5

Answer: D

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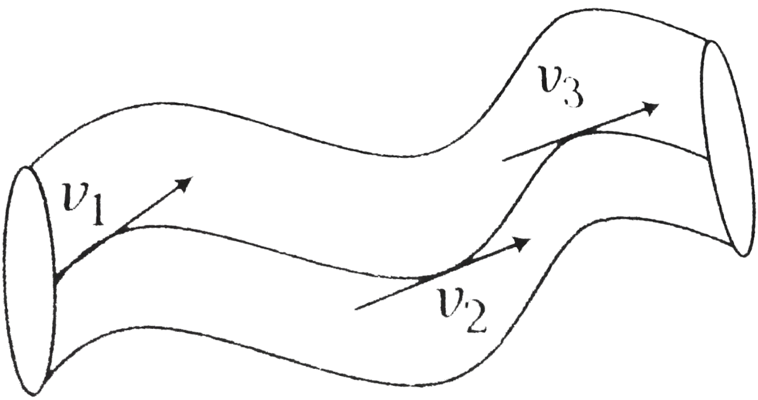
Check point 13.2

1. Consider streamline flow of a liquid flowing through a tube as shown in the figure which of the following is correct regarding velcities of liquid at different points ?



A. $v_1 = \text{constant}, v_2 = \text{constant}, v_3 = \text{constant}$

B. $v_1 \neq v_2 \neq v_3$

C. $v_1 = v_2 = v_3$

D. Both (a) and (b) current

Answer: D

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2. If R_e is the Reynold's number, then which of the following is incorrect

A. For R_e flow is laminer

B. For $1000 < R_e < 2000$, flow is steady

C. For $R_e > 2000$ flow is turbulent

D. All are incorrect

Answer: B

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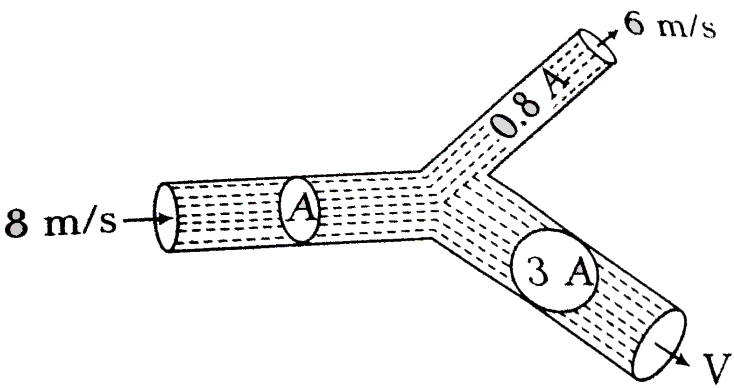
3. An incompressible liquid is flowing through a horizontal pipe as shown in figure. The value of speed v is



A. $1.1ms^{-1}$

B. $2.1ms^{-1}$

C. $3.1ms^{-1}$

D. $5.1ms^{-1}$

Answer: A

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4. Bernoulli's theorem is a cosequence of

A. conservation of mass

B. conservation of energy

C. conservation of linear momentum

D. conservation of angular momentum

Answer: B

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5. A horizontal pipeline carries water in a streamline flow. At a point along the pipe, where the cross- sectional area is $10cm^2$, the water velocity is $1ms^{-1}$ and the pressure is 2000 Pa. The pressure of water at another point where the cross-sectional area is $5cm^2$, is........Pa. (Density of water $= 10^3 kg.\ m^{-3}$)

A. 4000 Pa

B. 2000 Pa

C. 1000 Pa

D. 500 Pa

Answer: B

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6. If the velocity head of a stream of water is equal to 10 cm, then its speed of flow is approximately

A. $1.0ms^{-1}$

B. $1.4ms^{-1}$

C. $140ms^{-1}$

D. $10ms^{-1}$

Answer: B

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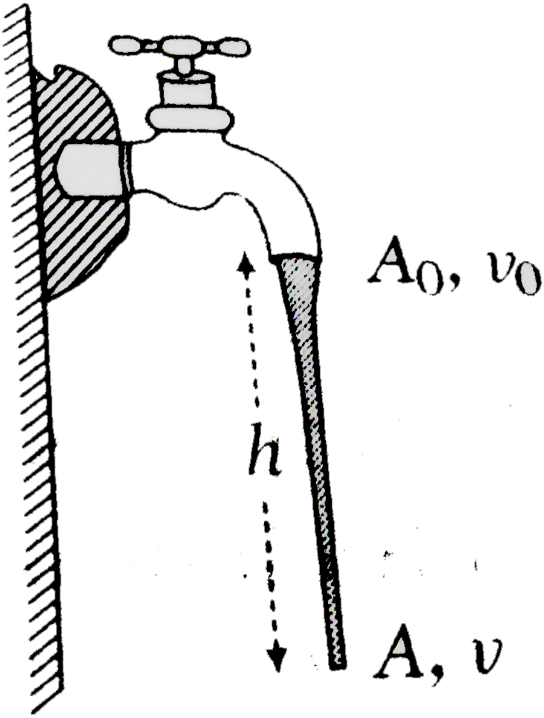
7. Water falls from a tap with $A_0 = 4m^2, A = 1m^2$ and h=2 m, then velocity v is



A. $2.5ms^{-1}$

B. $6.5ms^{-1}$

C. $4.5ms^{-1}$

D. $1.5ms^{-1}$

Answer: B

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8. The velocity of efflux of a liquid through an orifice in the bottom of a tank does not depend upon

A. density of liquid

B. height of the liquid column above orifice

C. acceleration due to gravity

D. None of the above

Answer: A

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9. The dynamic lift of an aeroplane is based on

A. Torricelli's theorem

B. Bernoulli's principle

C. law of gravitation

D. continuity equation

Answer: B

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10. A tank is filled to a height H. The range of water coming out of a hole which is a depth $H/4$ from the surface of water level is

A. $\dfrac{2H}{\sqrt{3}}$

B. $\dfrac{\sqrt{3}H}{2}$

C. $\sqrt{3}H$

D. $\frac{3H}{4}$

Answer: B

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Check point 13.3

1. The SI unit of viscosity coefficient is

A. Nms^{-1}

B. Nm^2s^{-1}

C. $Nm^{-2}s$

D. None of these

Answer: C

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2. As the temperature of water increases, its viscosity

A. remains unchanged

B. decreases

C. increases

D. increases or decreases depending on the external pressure

Answer: B

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3. The rate of flow of liquid in a tube of radius r, length l, whose ends are maintained at a pressure difference P is $V = \frac{\pi QPr^4}{\eta l}$ where η is coefficient of the viscosity and Q is

A. 8

B. $\frac{1}{8}$

C. 16

D. $\frac{1}{16}$

Answer: B

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4. Two capillary tubes of the same length but different radii r1 and r2 are fitted in parallel to the bottom of a vessel. The pressure head is P . What should be the radius of a single tube that can replace the two tubes so that the rate of flow is same as before

A. $r_1 + r_2$

B. $\dfrac{r_1 r_2}{r_1 + r_2}$

C. $\dfrac{r_1 + r_2}{2}$

D. None of these

Answer: D

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5. A small steel ball of mass m and radius r is falling under gravity through a viscous liquid of coefficient of viscosity η. If g

is the value of acceleration due to gravity. Then the terminal velocity of the ball is proportional to (ignore buoyancy)

A. $V \propto \frac{mgr}{\eta}$

B. $V \propto mg\eta r$

C. $V \propto \frac{mg}{\eta r}$

D. $V \propto \frac{\eta mg}{r}$

Answer: C

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6. The ratio of the terminal velocities of two drops of radii R and $R/2$ is

A. 2

B. 1

C. $1/2$

D. 4

Answer: D

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7. An air bubble rises from the bottom of a lake of large depth. The rising speed of air bubble will

A. go on increasing till it reaches surface

B. go on decreasing till it reaches surface

C. increases in two beginning, then will become constant

D. be constant all throughout.

Answer: C

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8. Two equal drops of water are falling through air with a steady velocity v. If the drops coalesced, what will be the new velocity?

A. 2v

B. $\sqrt{2}v$

C. $2^{2/3}v$

D. $\frac{v}{\sqrt{2}}$

Answer: C

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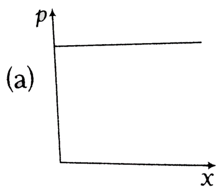
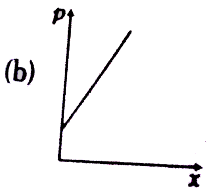
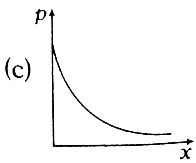
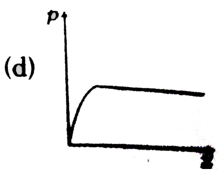
9. From amongst the following curves, which one shows the variation of the velocity v with time t for a small sized spherical body falling vertically in a long column of a viscous liquid

A. 

B. 

C. 

D. 

Answer: D

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10. A spherical ball of radius 3×10^{-4}m and density $10^4 kg / m^3$ falls freely under gravity through a distance h before entering a tank of water. If after entering the water the velocity of the ball does not change, find h the viscosity of water is $9.8 \times 10^{-6} N - s / m^2$

A. $1.65 \times 10^3 m$

B. $2.65 \times 10^2 m$

C. $3.65 \times 10^4 m$

D. $1.45 \times 10^2 m$

Answer: A

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Check point 13.4

1. Which of the following in not the unit of surface tension ?

A. $\text{newton}/\text{metre}$

B. $\text{joule}/(\text{metre})^2$

C. $\text{kg}/(\text{second})^2$

D. watt/metre

Answer: D

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2. A square wire frame of size L is dipped in a liquid . On taking out , a membrane is formed . If the surface tension of liquid is T, then force acting per unit length of the frame is

A. 2 TL

B. 4 TL

C. TL

D. $\frac{TL}{2}$

Answer: A

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3. A 10 cm long wire is placed horizontal on the surface of water and is gently pulled up with a force of 2×10^{-2} N to keep the wire in equilibrium. The surface tension, in Nm^{-1} of water is

A. 0.1

B. 0.2

C. 0.001

D. 0.002

Answer: A

Watch Video Solution

4. If temperature increases, the surface tension of a liquid

A. increase

B. decreases

C. remains the same

D. first increases then discreases

Answer: B

Watch Video Solution

5. If work W is done in blowing a bubble of radius R from a soap solution. Then the work done is blowing a bubble of radius $2R$ from the same solution is

A. $W/2$

B. $2W$

C. $4W$

D. $2\frac{1}{3}W$

Answer: C

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6. If two soap bubbles of equal radii r coalesce then the radius of curvature of interface between two bubbles will be

A. r

B. 0

C. infinity

D. $\frac{r}{2}$

Answer: C

Watch Video Solution

7. The surface of soap solution is $25 \times 10^{-3} Nm^{-1}$. The excess pressure inside a soap bubble of diameter 1 cm is

A. 10 Pa

B. 20 Pa

C. 5 Pa

D. None of these

Answer: B

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8. If a liquid does not wet glass, its angle of contact is

A. zero

B. obtuse

C. acute

D. 90°

Answer: B

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9. Surface tension is due to

A. friction forces between molecules

B. cohesive force between molecules

C. adhesive forces between molecules

D. gravitational forces

Answer: B

Watch Video Solution

10. Water rises in a capillary tube to a height of 2.0cm. In another capillary tube whose radius is one third of it, how much the water will rise?

A. 6.0 cm

B. 2.0 cm

C. 4.0 cm

D. 8.0 cm

Answer: A

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Taking it together

1. The property of surface tension is obtained in

A. solids, liqquids and grass

B. liquids

C. gases

D. matter

Answer: B

Watch Video Solution

2. The water droplets in free fall are spherical due to

A. gravity

B. viscosity

C. surface tension

D. inter-molecular attraction

Answer: C

Watch Video Solution

3. Due to capillary action, a liquid will rise in a tube, if the angle of contact is

A. acute obtuse

B. obtuse

C. 90°

D. zero

Answer: A

Watch Video Solution

4. A liquid wets a solid completely. The meniscus of the liquid in a sufficiently long tube is

A. flat

B. concave

C. convex

D. cylindrical

Answer: B

Watch Video Solution

5. A glass plate is partly dipped vertically in the mercury and the angle of contact is measured. If the plate is inclined, then the angle of contact will

A. increase

B. remain same

C. increase or decrease

D. decrease

Answer: B

Watch Video Solution

6. Hair of shaving brush cling together when it is removed from water due to

A. force of attraction between hair

B. surface tension

C. viscosity of water

D. characteristic property of hair

Answer: B

Watch Video Solution

7. Coatings used on raincoat are waterproof because they

A. increases angle of contact

B. decreases angle of contact

C. does not alters angle of contact

D. forms a smooth surface

Answer: A

Watch Video Solution

8. Small droplets of liquid are usually more spherical in shape than larger drops of the same liquid because

A. Force of surface tension is equal and opposite to the force of gravity

B. force of surface tension predominates the force of gravity

C. force of gravity predominates the force of surface tension

D. force of gravity and force of surface tension act in the same direction and are equal

Answer: B

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9. Water does not wet an oily glass because

A. cohesive force of oil $>$ adhesive force between oil and glass

B. cohesive force of oil $>$ cohesive force of water

C. oil repels water

D. cohesive force of water $>$ adesive force between water and oil molecules

Answer: D

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10. Which of the fact is not due to surface tension

A. Dancing of a camphor piece over the surface of water

B. Small mercury drop itself becomes spherical

C. A liquid surface comes at rest after stirring

D. Mercury does not wet the glass vessel

Answer: C

Watch Video Solution

11. On mixing the salt in water, the surface tension of water will

A. increase

B. decrease

C. remains unchanged

D. None of these

Answer: A

Watch Video Solution

12. If two identical mercury drops are combined to form a single drop, then its temperature will

A. decrease

B. increases

C. remains the same

D. None of these

Answer: B

Watch Video Solution

13. A water proofing agent chages the angle of contact from

A. from acute to 90°

B. from obtuse to 90°

C. from an acute to obtuse value

D. from an obtuse to acute value

Answer: C

Watch Video Solution

14. Along a streamline,

A. the velocity of a fluid particle remains constant

B. the velocity of all fluid particles crossing a given position is constant

C. the valocity of all fluid particles at a given instant is constant

D. the speed of a fluid particle remains constant

Answer: B

Watch Video Solution

15. In a streamline flow

A. the speed of a particle always remains same

B. the velocity of a particle always remains same

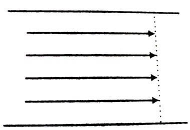
C. the kinetic energies of all particles arriving at a given point are the same

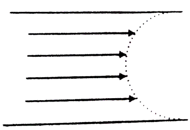
D. the potential eenergies of all the particles arriving at a given point are the same

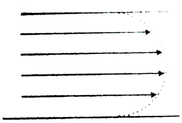
Answer: C

Watch Video Solution

16. A viscous fluid is flowing through a cylindrical tube. The velocity distribution of the fluid is best represented by the diagram

A. (a) 

B. (b) 

C. (c) 

D. None of these

Answer: C

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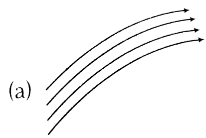
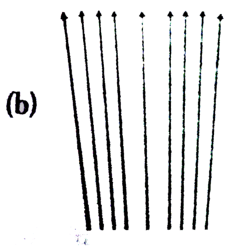
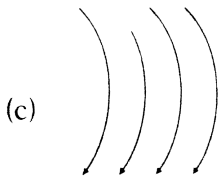
17. Which of the following diagrams does not represent a streamline flow?

A. 

B. 

C. 

D. 

Answer: D

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18. A body measures 5 N in air and 2 N when put in water. The buoyant force is

A. 7 N

B. 9 N

C. 3 N

D. None of these

Answer: C

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19. The reading of a spring balance when a block is suspended from it in air is 60 N. This reading is changed to 40 N when the block is submerged in water. The relative density of the block is:

A. 3

B. 2

C. 6

D. $3/2$

Answer: A

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20. A hole is made at the bottom of the tank filled with water (density $= 1000 kg m^{-3}$). If the total pressure at the bottom of the tank is three atmospheres (1 atmosphere $= 10^5 N m^{-2}$), then the velocity of efflux is nearest to

A. $\sqrt{400} m s^{-1}$

B. $\sqrt{200} m s^{-1}$

C. $\sqrt{600} m s^{-1}$

D. $\sqrt{500} m s^{-1}$

Answer: A

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21. An iron block is on a boat which floats in a pond. The block is thrown into the water. The level of water in the pond will be

A. equal to the earlier level

B. less than the earlier level

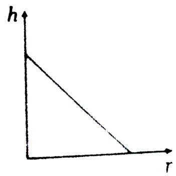
C. more than the earlier level

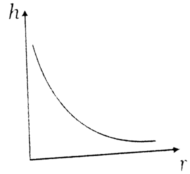
D. depends on how large the block is

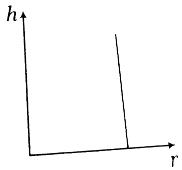
Answer: B

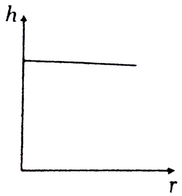
Watch Video Solution

22. The correct curve between the height or depression h of liquid in a capillary tube and its radius is

A. (a) 

B. 

C. 

D. 

Answer: B

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23. When two capillary tubes of different diameters are dipped vertically, the rise of the liquid is

A. same in both the tubes

B. more in the tube of larger diameter

C. less in the tube of smaller diameter

D. more in the tube of smaller diameter

Answer: D

Watch Video Solution

24. The liquid in the capillary tube will rise if the angle of contact is

A. 120°

B. 90°

C. obtuse

D. acute

Answer: D

Watch Video Solution

25. The surface tension of liuid at its boiling point

A. becomes zero

B. becomes infinity

C. is equal to the value at room temperature

D. is half to the value at the room temperature

Answer: A

Watch Video Solution

26. When the temperature increased the angle of contact of a liquid

A. increases angle of contact

B. decreases

C. remains the same

D. first increases and then decreases

Answer: B

Watch Video Solution

27. The surface tension of a soap solution is $2 \times 10^{-2} N/m$. To blow a bubble of radius 1cm, the work done is

A. $4\pi \times 10^{-6} J$

B. $8\pi \times 10^{-6} J$

C. $12\pi \times 10^{-6} J$

D. $16\pi \times 10^{-6} J$

Answer: D

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28. A liquid is coming out from a vertical tube. The relation between the weight of the drop W , surface tension of the liquid T and radius of the tube r is given by, if the angle of contact is zero

A. $W = \pi r^2 T$

B. $W = 2\pi r T$

C. $W = 2r^2 \pi T$

D. $W = \frac{3}{4}\pi r^3 T$

Answer: B

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29. Prove that if two bubbles of radii r_1 and $r_2(r_1 < r_2)$ come in contact with each other then the radius of curvature of the common surface $r = \frac{r_1 r_2}{r_2 - r_1}$

A. $r_2 - r_1$

B. $\frac{r_2 - r_1}{r_1 r_2}$

C. $\frac{r_1 r_2}{r_2 - r_1}$

D. $r_2 + r_1$

Answer: C

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30. The excess pressure due to surface tension in a spherical liquid drop of radius r is directly proportional to

A. r

B. r^2

C. r^{-1}

D. r^{-2}

Answer: C

Watch Video Solution

31. If two soap bubble of different radii are in communication with each other

A. air flows from larger bubble into the smaller one

B. the size of the bubbles remains the same

C. air flows from the smaller bubble into the large one and the larger bubble grows at the expense of the smaller one

D. None of the above

Answer: C

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32. Assuming that the atmosphere has the same density anywhere as at sea level $(\rho = 1.3 kgm^{-3})$ and g to be constant $(g = 10 ms^{-2})$. What should be the approximate height of atmosphere ?

$(\rho_0 = 1.01 \times 10^5 Nm^{-2})$

A. 6 km

B. 8 km

C. 12 km

D. 18 km

Answer: B

Watch Video Solution

33. If the angle of contact is less than 90° the pressure just inside the surface of a meniscus

A. is less than atmospheric pressure

B. is greater than atmospheric pressure

C. is same as the atmospheric pressure

D. None of the above

Answer: A

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34. The spider and insect move and run about on the surface of water without sinking because

A. elastic membrane is formed on water due to property of surface tension

B. spiders and insects are lighter

C. spiders and insects swim on water

D. spiders and insects experience upthrust

Answer: A

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35. If two glass plates are quite nearer to each other in water, then there will be force of

A. attraction

B. repulsion

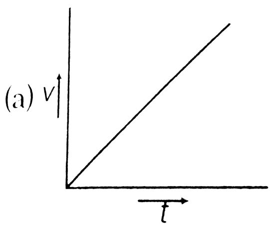
C. attraction or repulsion

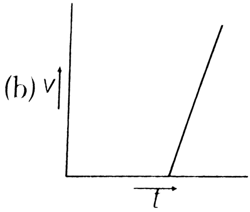
D. Neither attraction nor repulsion

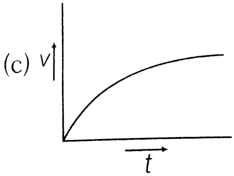
Answer: A

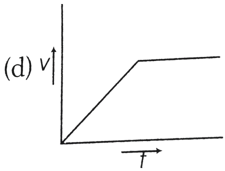
Watch Video Solution

36. A tall cylinder is filled with viscous oil. A round pebble is dropped from the top with zero initial velocity. From the plot shown in figure, indicate the one that represents the velocity (v) of the pebble as a function of time (t)

A. 

B. 

C. 

D. 

Answer: C

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37. A tank if filled with water upto height H. When a hole is made at a distance h below the level of water. What will be the horizontal range of water jet ?

A. $2\sqrt{h(H-h)}$

B. $4\sqrt{h(H+h)}$

C. $4\sqrt{h(H-h)}$

D. $2\sqrt{h(H+h)}$

Answer: A

Watch Video Solution

38. A tank is filled to a height H. The range of water coming out of a hole which is a depth $H/4$ from the surface of water level is

A. $\frac{2H}{\sqrt{3}}$

B. $\frac{\sqrt{3}H}{2}$

C. H

D. $\frac{3H}{4}$

Answer: C

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39. The density of ice $x cm^{-3}$ and that of water is $y g cm^{-3}$.

What is the change in volume when mg of ice melts?

A. $m(y-x)$

B. $\frac{y-x}{m}$

C. $my(y-x)$

D. $\frac{m}{y}-\frac{m}{x}$

Answer: D

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40. Two capillary tubes P and Q are dipped in water. The height of water level in capillary P is 2/3 to the height in Q capillary. The ratio of their diameters is

A. $2:3$

B. $3:2$

C. $3:4$

D. $4:3$

Answer: B

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41. In a surface tension experiment with a capillary tube water rises up to $0.1m$. If the same experiment is repeated in an artificial satellite, which is revolving around the earth, water will rise in the capillary tube up to a height of

A. 0.1 m

B. 0.2 m

C. 0.98 m

D. full length of the capillary tube

Answer: D

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42. Two parallel glass plates separated by a small distance x are dipped partly in a liquid of density " d" keeping them vertical .The surface tension of the liquid is T and angle of contact is θ . What is the rise of the liquid between the plates due to capillarity ?

A. $\frac{T\cos\theta}{xd}$

B. $\frac{2T\cos\theta}{xdg}$

C. $\frac{2T}{xdg\cos\theta}$

D. $\frac{T\cos\theta}{xdg}$

Answer: B

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43. A balloon has volume of $2000m^3$. It is filled with hydrogen $(\rho = 0.009gL^{-1})$. If the density of air is $1.29gL^{-1}$, it can lift a total weight of

A. 600 kg

B. 2400 kg

C. 300 kg

D. 1800 kg

Answer: B

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44. A raft of mass M=600 kg floats in calm water with 7 cm submerged. When a man stands on the raft, 8.4 cm are submerged, the man's mass is

A. 30 kg

B. 60 kg

C. 90 kg

D. 120 kg

Answer: D

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45. A cylinder of mass M and density d_1 hanging from a string, is lowered into a vessel of cross-sectional area A, containing a liquid of density $d_2 (d_2 < d_1)$ until it is fully immersed. The increase in pressure at the bottom of the vessel is

A. $\frac{Md_2g}{d_1A}$

B. $\frac{Mg}{A}$

C. $\frac{Md_1g}{d_2A}$

D. zero

Answer: A

Watch Video Solution

46. Which of the following statements are ture in case when two water drops coalesce and make a bigge drop:

A. energy is released

B. energy is absorbed

C. the surface area of the bigger drop is greater than the sum of the surface areas of both the drops

D. the surface area of the bigger drop is same that of the sum of the surface areas of both the drops

Answer: A

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47. A piston of cross-sectional area $100 cm^2$ is used in a hydraulic pressure to exert a force of 10^7 dyne on the water. The cross-sectional area of the other piston which support a truck of mass 2000 kg is

A. $9.8 \times 10^2 cm^2$

B. $9.8 \times 10^3 cm^2$

C. $1.96 \times 10^3 cm^2$

D. $1.96 \times 10^4 cm^2$

Answer: D

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48. An ideal fluid flows through a pipe of circular cross-section made of two sections with diameters $2.5cm$ and $3.75cm$. The ratio of the velocities in the two pipes is

A. $9:4$

B. $3:2$

C. $\sqrt{3}:\sqrt{2}$

D. $\sqrt{2}:\sqrt{3}$

Answer: A

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49. The angle of contact at the interface of water glass is 0° ethylalcohol-glass is 0° mercury glass is 140° and methyliodide-glass is 30° A glass capillary is put in a through containing one of these four liquids. It is observed that the meniscus is convex. The liquid in the through is

A. water

B. ethylalcohol

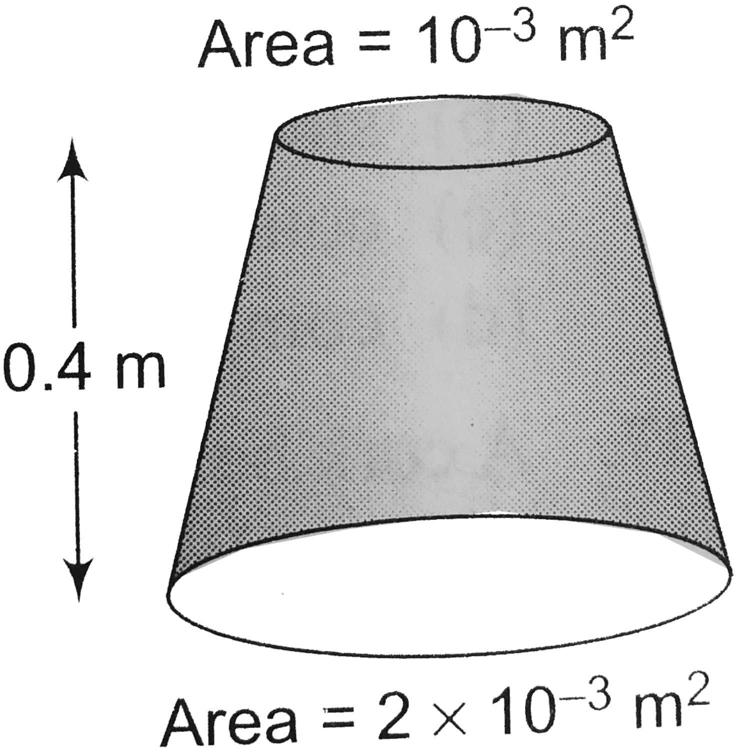
C. mercury

D. methyliodide

Answer: C

Watch Video Solution

50. A uniformly tapering vessel is filled with a liquid of density $900 km / m^3$. The force that acts on the base of the vessel due to the liquid is $\left(g = 10 m s^{-2}\right)$



A. 3.6 N

B. 7.2 N

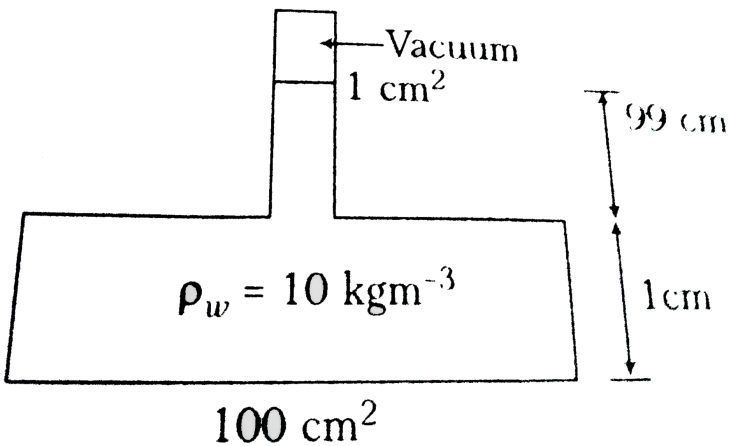
C. 9.0 N

D. 12.6 N

Answer: B

Watch Video Solution

51. For the arrangement shown in the figure, the force at the bottom of the vessel is



A. 200 N

B. 100 N

C. 20 N

D. 2 N

Answer: B

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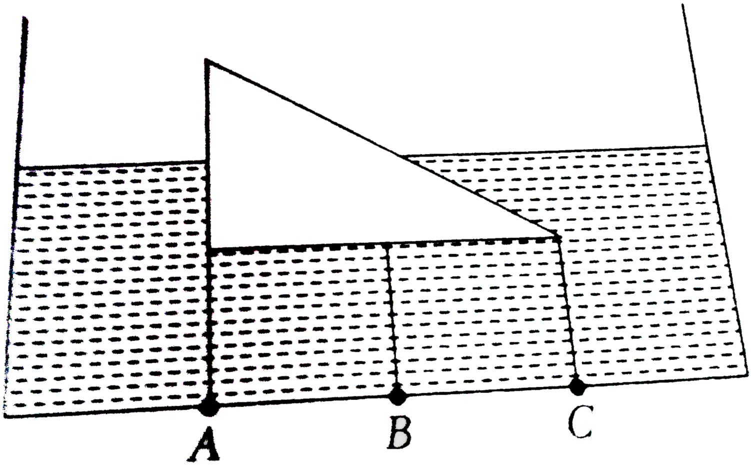
52. An object of uniform density is allowed to float in water kept in a beaker. The object has triangular cross-section as shown in the figure. If the water pressure measured at the three points A, B and C below the object are P_A, P_B and P_C

respectively. Then



A. $p_A > p_B > p_C$

B. $p_A > p_B < p_C$

C. $p_A = p_B = p_C$

D. $p_A = p_B < p_C$

Answer: C

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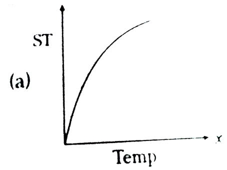
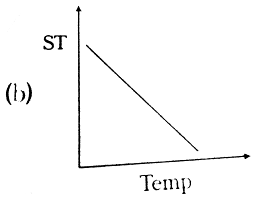
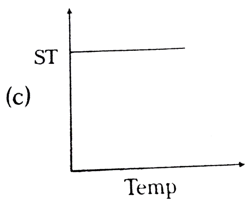
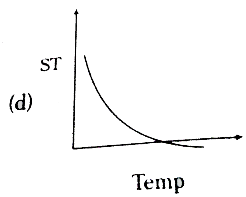
53. Which graph represents the variation of surface tension with temperature over small temperature ranges for water?

A. 

B. 

C. 

D. 

Answer: B

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54. A cylindrical vessel of 100 cm height is kept filled upto the brim. It has four holes 1,2,3,4 which are respectively at heights of 27 cm, 30 cm , 50 cm and 80 cm from the horizontal floor. The water falling at the maximum horizontal distance from the vessel comes from

A. hole number 4

B. hole number 3

C. hole number 2

D. hole number 1

Answer: B

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55. A solid shell loses half, its weight in water. Relative density of shell is 0.5 what fraction of its volume is hollow ?

A. $\frac{3}{5}$

B. $\frac{2}{5}$

C. $\frac{1}{5}$

D. $\frac{4}{5}$

Answer: A

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56. A tank full of water has a small hole at its bottom. Let t_1 be the time taken to empty the first half of the tank and t_2 be the time needed to empty the rest half of the tank, then

A. $t_1 = t_2$

B. $t_1 > t_2$

C. $t_1 < t_2$

D. $t_1 = 0.523t_2$

Answer: B

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57. An open U-tube contains mercury. When 11.2 cm of water is poured into one of the arms of the tube, how high does the mercury rise in the other arm from its initial level ?

A. 0.82 cm

B. 1.35 cm

C. 0.41 cm

D. 2.32 cm

Answer: C

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58. A small ball (mass m) falling under gravity in a viscous medium experience a drag force proportional to the instantaneous speed u such that $F_{drag} = ku$. Then the terminal speed of ball within viscous medium is

A. $\frac{k}{mg}$

B. $\frac{mg}{k}$

C. $\sqrt{\frac{mg}{k}}$

D. None of these

Answer: D

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59. A capillary tube of radius R is immersed in water and water rises in it to a height H . Mass of water in the capillary tube is . M If the radius of the tube is doubled, mass of water that will rise in the capillary tube will now be

A. $M/2$

B. M

C. 2M

D. 4M

Answer: C

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60. The pressure of water in a pipe when tap is closed is $5.5 \times 10^5 Nm^{-2}$. The velocity with which water comes out on opening the tap is

A. $10ms^{-1}$

B. $5ms^{-1}$

C. $20ms^{-1}$

D. $15ms^{-1}$

Answer: A

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61. The level of water in a tank is 5 m high. A hole of area of cross section 1 cm^2 is made at the bottom of the tank. The rate of leakage of water for the hole in m^3s^{-1} is $(g = 10ms^{-2})$

A. $10^{-3}m^3s^{-1}$

B. $10^{-4}m^3s^{-1}$

C. $10m^3s^{-1}$

D. $10^{-2}m^3s^{-1}$

Answer: A

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62. Water is flowing through two horizontal pipes of different diameters which are connected together. The diameters of the two pipes are 3 cm and 6 cm respectively. If the speed of water in the narrower tube is $4ms^{-1}$. Then the speed of water in the wider tube is

A. $16ms^{-1}$

B. $1ms^{-1}$

C. $4ms^{-1}$

D. $2ms^{-1}$

Answer: B

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63. A block of wood floats in water with $(4/5)th$ of its volume submerged. If the same block just floats in a liquid, the density of liquid in (kgm^{-3}) is

A. 1250

B. 600

C. 400

D. 800

Answer: D

Watch Video Solution

64. Water flows along horizontal pipe whose cross-section is not constant. The pressure is 1 cm of Hg, where the velocity is 35 cm/s . At a point where the velocity is 65cm/s then pressure will be

A. 0.89 cm of Hg

B. 0.62 cm of Hg

C. 0.5 cm of Hg

D. 1 cm of Hg

Answer: A

Watch Video Solution

65. For a body immersed in a liquid, when the weight of the body is less than the upthrust then the body will

A. float partially immersed

B. sink

C. float full immersed

D. both (a) and (c)

Answer: A

Watch Video Solution

66. Three liquids of equal masses are taken in three identical cubical vessels A, B and C. Their densities are ρ_A, ρ_B and ρ_C respectively but $\rho_A < \rho_B < \rho_C$. The force exerted by the liquid on the base of the cubical vessel is

A. maximum in vessel C

B. minimum in vessel C

C. the same in all the vessels

D. maximum in vessel A

Answer: C

Watch Video Solution

67. A solid of density D is floating in a liquid of density d. If v is the volume of solid submerged in the liquid and V is the total volume of the solid, then v/V equal to

A. $\frac{d}{D}$

B. $\frac{D}{d}$

C. $\frac{D}{D+d}$

D. $\frac{D+d}{D}$

Answer: B

Watch Video Solution

68. An object weights m_1 in a liquid of density d_1 and that in liquid of density d_2 is m_2. The density of the object is

A. $\dfrac{m_2d_2 - m_1d_1}{m_2 - m_1}$

B. $\dfrac{m_1d_1 - m_2d_2}{m_2 - m_1}$

C. $\dfrac{m_2d_1 - m_1d_2}{m_1 - m_2}$

D. $\dfrac{m_1d_2 - m_2d_1}{m_1 - m_2}$

Answer: D

Watch Video Solution

69. An iceberg of density $900kg/m^3$ is floating in water of density $1000kg/m^3$. The percentage of volume of ice cube outside the water is

A. 0.2

B. 0.8

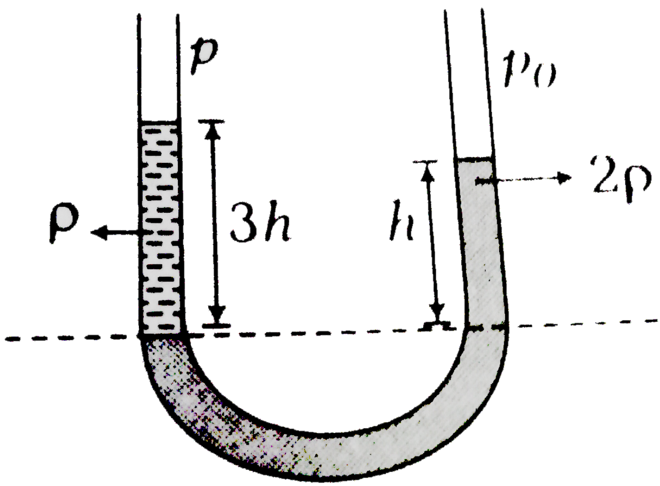
C. 0.1

D. 0.9

Answer: C

Watch Video Solution

70. In the figure shown,



A. $p_0 > p$

B. $p > p_0$

C. $p = p_0$

D. $p = 0$

Answer: A

Watch Video Solution

71. A balloon has volume of $1000m^3$. It is filled with hydrogen $\left(\rho = 0.09gL^{-1}\right)$. If the density of air is $1.29gL^{-1}$, it can lift a total weighht of

A. 600 kg

B. 1200 kg

C. 300 kg

D. 1800 kg

Answer: B

Watch Video Solution

72. A boat having a length of 3 m and breadth of 2 m is floating on a lake. The boat sinks by 1 cm when a man gets on it. The mass of the mas is:

A. 60 kg

B. 72 kg

C. 52 kg

D. 65 kg

Answer: A

Watch Video Solution

73. A small block of wood of relative density 0.5 is submerged in water. When the block is released, it stats moving upwards, the acceleration of the block is $(g = 10ms^{-2})$

A. $5ms^{-2}$

B. $10ms^{-2}$

C. $7.5ms^{-2}$

D. $15ms^{-2}$

Answer: B

Watch Video Solution

74. A raft of wood (density $= 600 kg/m^3$) of mass $120 kg$ floats in water. How much weight can be put on the raft to make it just sink?

A. 80 kg

B. 50 kg

C. 60 kg

D. 30 kg

Answer: A

Watch Video Solution

75. An object of w and density ρ is submerged in liquid of density σ, its apparent weight will be

A. $(\rho - \sigma)$

B. $(\rho - \sigma)/w$

C. $w\left(1 - \frac{\sigma}{\rho}\right)$

D. $w\left(1 - \frac{\rho}{\sigma}\right)$

Answer: C

Watch Video Solution

76. A stone of relative density K is released from rest on the surface of a lake. If viscous effects are Ignored, the stone sinks in water with an acceleration of

A. $g(1 - K)$

B. $g(1 + K)$

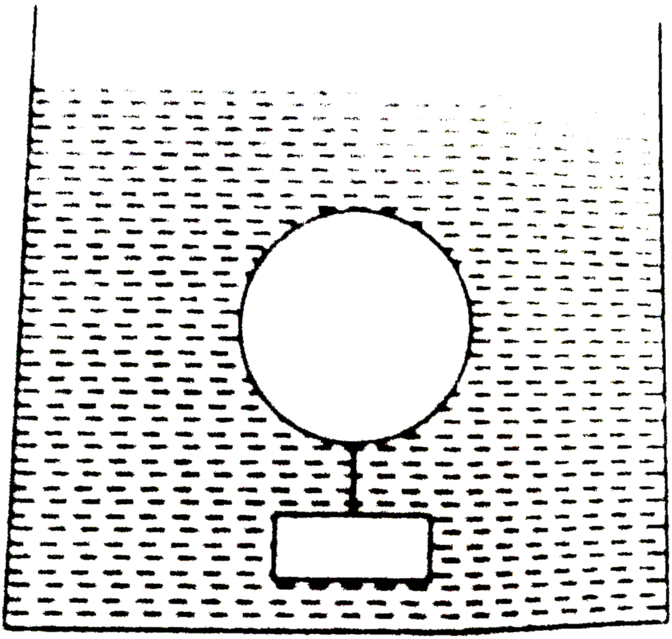
C. $g\left(1-\frac{1}{K}\right)$

D. $g\left(1+\frac{1}{K}\right)$

Answer: C

Watch Video Solution

77. A body floats in a liquid contained in a beaker. The whole system shown in figure is falling under gravity, the upthrust on the body due to the liquid is



A. zero

B. equal to weight of the body in air

C. equal to weight of liquid displaced

D. equal to the weight of the immersed part of the body

Answer: A

Watch Video Solution

78. The relative density of ice is 0.9 and that of sea water is 1.125. What fraction of the whole volume of an iceberg appears above the surface of the sea ?

A. $1/5$

B. $2/5$

C. $3/5$

D. $4/5$

Answer: A

Watch Video Solution

79. A metallic sphere floats in immiscible mixture of water (density $10^3 kgm^{-3}$) and a liquid (density $8 \times 10^3 kgm^{-3}$) such that its $(2/3)$ part is in water and $(1/3)$ part in the liquid. The density of the metal is

A. $\frac{5000}{3} kgm^{-3}$

B. $\frac{10000}{3} kgm^{-3}$

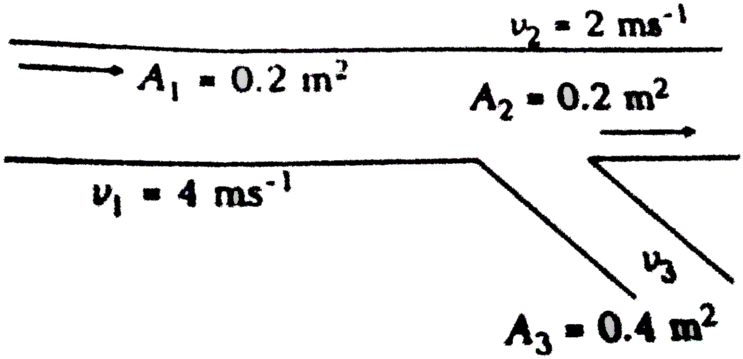
C. $5000 kgm^{-3}$

D. $2000 kgm^{-3}$

Answer: B

Watch Video Solution

80. In the given figure, the velocity v_3 will be



A. $2ms^{-1}$

B. $4ms^{-1}$

C. $1ms^{-1}$

D. $3ms^{-1}$

Answer: C

Watch Video Solution

81. A water tank standing on the floor has two small holes punched in the vertical wall one above the other. The holes are 2.4 cm and 7.6 cm above the floor. If the jest of water from the holes hit the floor at the same point, then the height of water in the tank is

A. 10 cm

B. 5 cm

C. 20 cm

D. 4.8 cm

Answer: A

Watch Video Solution

82. A body of volume V and desnity ρ is initially submerged in a non-viscous liquid of density $\sigma(> \rho)$. If it is rises by itself through a height h in the liquid. Its kinetic energy will

A. increase by h V $(\sigma - \rho)g$

B. increase by hV$(\rho + \sigma)$g

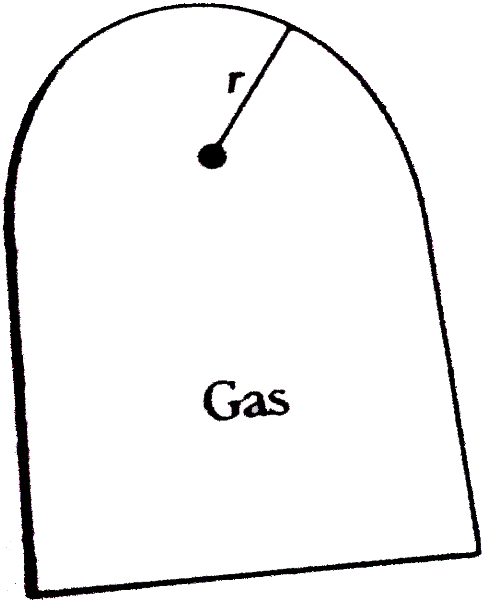
C. increase by $\frac{hV\rho g}{\sigma}$

D. decrease be $\frac{hV\rho g}{\sigma}$

Answer: A

Watch Video Solution

83. The pressure of the gas in a cylindrical chamber is p_0. The vertical force exerted by the gas on its hemispherical end is



A. $p_0 r^2$

B. $4p_0 \pi r^2$

C. $2p_0 \pi r^2$

D. $p_0 \pi r^2$

Answer: D

Watch Video Solution

84. Water rises in a capillary tube to a certain height such that the upward force due to surface tension is balanced by 75×10^{-4} newton force due to the weight of the liquid. If the surface tension of water is $6 \times$ 10^-2` newton/metre the inner circumference of the capillary must be:

A. $1.25 \times 10^{-2} m$

B. $0.50 \times 10^{-2} m$

C. $6.5 \times 10^{-2} m$

D. $12.5 \times 10^{-2} m$

Answer: D

Watch Video Solution

85. Water rises upto 10 cm height in a long capillary tube. If this tube is immersed in water so that the height above the water surface is only 8 cm, then

A. water flows out continuously from the upper end

B. water rises upto upper end and forms a spherical surface

C. water only rises upto 6 cm height

D. water does not rise at all

Answer: B

Watch Video Solution

86. If a capillary tube is dipped into liquid and the levels of the liquid inside and outside are same, then the angle of contact is

A. 120°

B. 90°

C. 45°

D. 30°

Answer: B

Watch Video Solution

87. Water rises to a height of 30 mm in a capillary tube. If the radius of the capillary tube is made $3/4$ of its previous value. The height to which the water will rise in the tube is

A. 30 mm

B. 20 mm

C. 40 mm

D. 10 mm

Answer: C

Watch Video Solution

88. A vessel, whose bottom has round holes with diameter of 0.1 mm , is filled with water. The maximum height to which the water can be filled without leakage is (S.T. of water =75 dyne/cm , g=1000 cm/s)

A. 100 cm

B. 75 cm

C. 50 cm

D. 30 cm

Answer: D

Watch Video Solution

89. A long cylinderical glass vessel has a small hole of radius r at its bottom. The depth to which the vessel can be lowered vertically in a deep water (surface tension S) without any water entering inside is

A. $4T / \rho r g$

B. $3T / \rho r g$

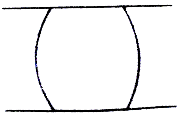
C. $2T / \rho r g$

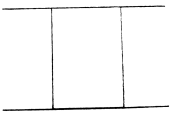
D. $T / \rho r g$

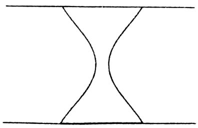
Answer: C

Watch Video Solution

90. If a water drop is kept between two glass plates, then its shape is

A. (a) 

B. (b) 

C. (c) 

D. None of these

Answer: C

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91. Two small drops of mercury each of radius r form a single large drop. The ratio of surface energy before and after this change is

A. $2 : 2^{2/3}$

B. $2^{2/3} : 1$

C. $2 : 1$

D. $1 : 2$

Answer: A

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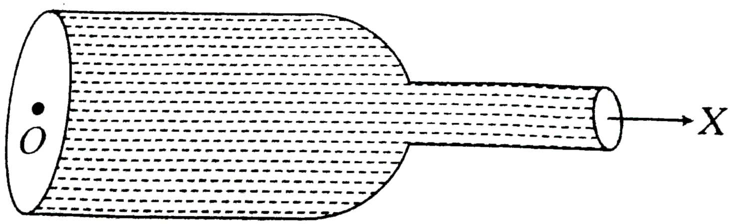
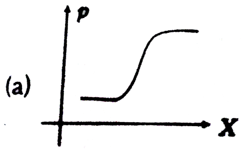
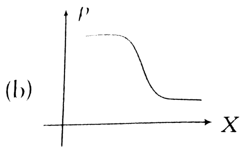
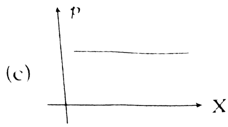
92. A non viscous liquid is flowing through a frictionless duct, cross-section varying as shown in figure.

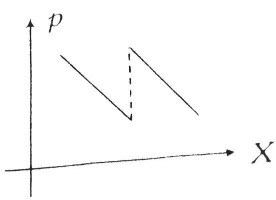


Which of the following graph represents the variation of pressure p along the axis of tube ?

A. 

B. 

C. 

D. 

Answer: B

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93. There is a hole at the bottom of a large open vessel. If water is filled upto a height h, it flows out in time t. if water is filled to a height 4h, it will flow out in time

A. $\frac{t}{4}$

B. 2t

C. 4t

D. $\frac{t}{2}$

Answer: B

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94. A container has a small hole at its bottom. Area of cross-section of the hole is A_1 and that of the container is A_2. Liquid is poured in the container at a constant rate Qm^3s^{-1}. The maximum level of liquid in the container will be

A. $\frac{Q^2}{2gA_1A_2}$

B. $\frac{Q^2}{2gA_1^2}$

C. $\frac{Q}{2gA_1A_2}$

D. $\frac{Q^2}{2gA_{2^{\hat{}}}(2)}$

Answer: B

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95. Air stream flows horizontally past an aeroplane wing of surface area $4m^2$. The speed of air over the top surface is $60ms^{-1}$ and under the bottom surface is $40ms^{-1}$ The force of lift on the wing is (density of air $=1kgm^{-3}$)

A. 800 N

B. 1000 N

C. 4000 N

D. 3200 N

Answer: C

Watch Video Solution

96. Water from a tap emerges vertically downwards with an initial spped of $1.0ms^{-1}$. The cross-sectional area of the tap is $10^{-4}m^2$. Assume that the pressure is constant throughout the stream of water, and that the flow is steady. The cross-sectional area of the stream 0.15 m below the tap is

A. $5.0 \times 10^{-4}m^2$

B. $1.0 \times 10^{-5}m^2$

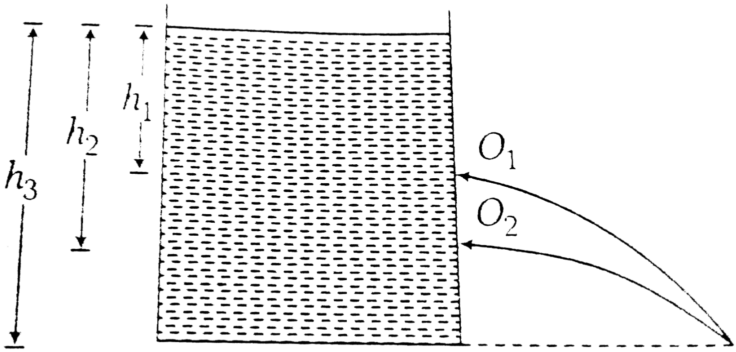
C. $5.0 \times 10^{-5}m^2$

D. $2.0 \times 10^{-5}m^2$

Answer: C

Watch Video Solution

97. There are two holes O_1 and O_2 in a tank of height H. The water emerging from O_1 and O_2 strikes the ground at the same points, as shown in figure. Then



A. $H = h_1 + h_2$

B. $H = h_2 - h_1$

C. $H = \sqrt{h_1 h_2}$

D. None of these

Answer: A

Watch Video Solution

98. Two rain drops of same radius r falling with terminal velocity v merge and from a bigger drop of radius R. The terminal velocity of the bigger drop is

A. $v\frac{R}{r}$

B. $v\frac{R^2}{r^2}$

C. v

D. 2v

Answer: B

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99. A cubical vessel of height 1 m is full of water. What is the workdone in pumping water out of the vessel?

A. 1250 J

B. 5000 J

C. 1000 J

D. 2500 J

Answer: B

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100. A cubical block of steel of each side equal to 1 is floating on mercury in vessel. The densities of steel and mercury are

ρ_s and ρ_m. The height of the block above the mercury level is given by

A. $l\left(1+\frac{\rho_s}{\rho_m}\right)$

B. $l\left(1-\frac{\rho_s}{\rho_m}\right)$

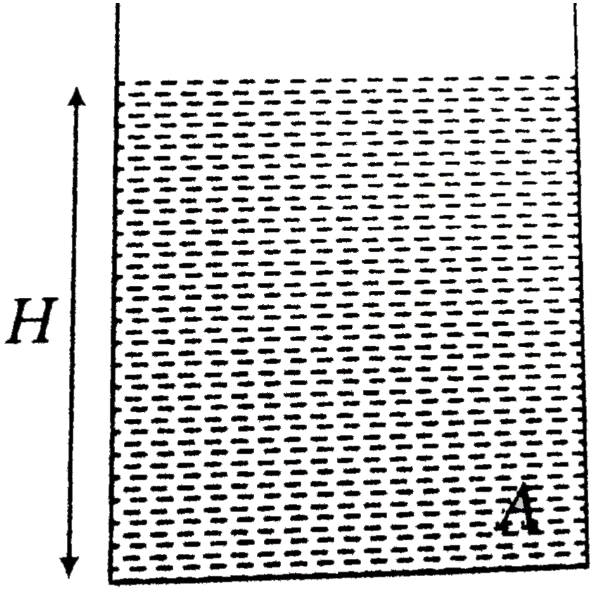
C. $l\left(1+\frac{\rho_m}{\rho_s}\right)$

D. $l\left(1-\frac{\rho_m}{\rho_s}\right)$

Answer: B

Watch Video Solution

101. A cylindrical tank contains water up to a height H. If the tank is accelerated upwards with acceleration a, the pressure at the A is p_1. If the tank is accelerated downwards with acceleration a the pressure at A is p_2. Then



A. $p_1 < p_2$

B. $p_1 = p_2$

C. $p_1 > p_2$

D. Data insufficient

Answer: C

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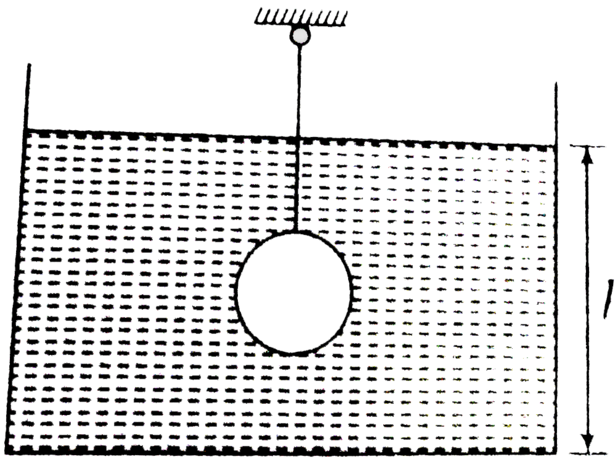
102. A metal sphere connected by a string is dipped in a liquid of density ρ as shown in figure. The pressure at the bottom of the vessel will be, (p_0=atmospheric pressure)



A. $p = p_0 = \rho g h$

B. $p > p_0 + \rho g h$

C. $p < p_0 + \rho g h$

D. p_0

Answer: A

Watch Video Solution

103. An air bubble of radius 1mm is formed inside water at a depth 10m below free surface (where air pressure is $10^5 \frac{N}{m^2}$). The pressure inside the bubble is – (Surface tension of water = $7x \times 10^{-2} N/m)$

A. $2.28 \times 10^5 Nm^{-2}$

B. $2.0028 \times 10^5 Nm^{-2}$

C. $2.14 \times 10^5 Nm^{-2}$

D. $2.0014 \times 10^5 Nm^{-2}$

Answer: D

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104. A block of mass 4 kg and volume $5 \times 10^{-4} m^3$ is suspended by a spring balance in a lift which is accelerating. The apparent weight shown by the spring balance is 3 kg. Now the block is immersed in water in kg shown by the spring balance is

A. 2.375

B. 2.625

C. 2.5

D. 3.125

Answer: B

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105. A cubical block of wood of specific gravity 0.5 and chunk of concrete of specific gravity 2.5 are fastened together. the ratio of mass of wood to the mass of concrete which makes the combination to float with entire volume of the combination submerged in water is

A. $1/5$

B. $1/3$

C. $3/5$

D. $2/3$

Answer: C

Watch Video Solution

106. Two identical cylindrical vessel with their bases at the same level each contain a liquid of density ρ. The height of the liquid in one vessel is h_1 and in the other is h_2 the area of either base is A. What is the work done by gravity is equalising the levels when the two vessels are connected?

A. $2\rho Ag(h_2 - h_1)^2$

B. $\rho Ag(h_2 - h_1)^2$

C. $\frac{1}{2}\rho Ag(h_2 - h_1)^2$

D. $\frac{1}{4}\rho Ag(h_2 - h_1)^2$

Answer: D

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107. A small ball of density ρ is immersed in a liquid of density $\sigma(> \rho)$ to a depth h and released. The height above the surface of water up to which the ball will jump is

A. $\dfrac{\sigma h}{\rho}$

B. $\left(\dfrac{\sigma}{\rho} - 1\right)h$

C. $\left(1 - \dfrac{\sigma h}{\rho}\right)h$

D. $\dfrac{\rho}{\sigma}$

Answer: B

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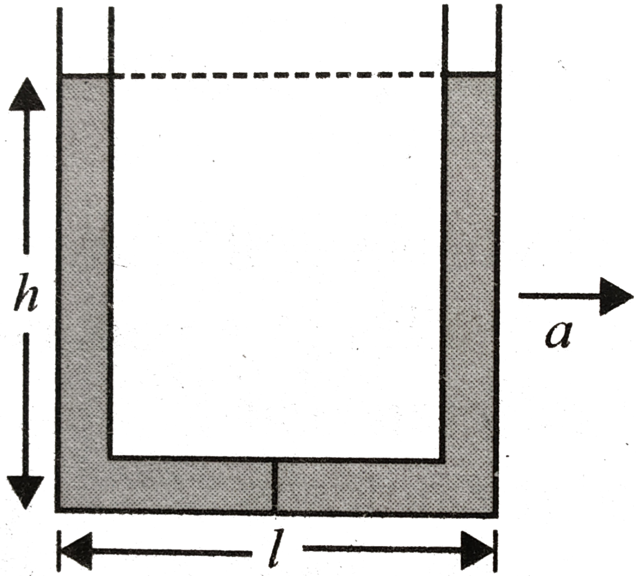
108. A U-tube of base length l filled with the same volume of two liquids of densities ρ and 2ρ is moving with an acceleration $'a'$ on the horizontal plane. If the height difference between the two surfaces (open to atmosphere) becomes zero, then the height h is given by



A. $\frac{al}{g}$

B. $\frac{3al}{2g}$

C. $\frac{2gl}{3g}$

D. $\frac{al}{2g}$

Answer: B

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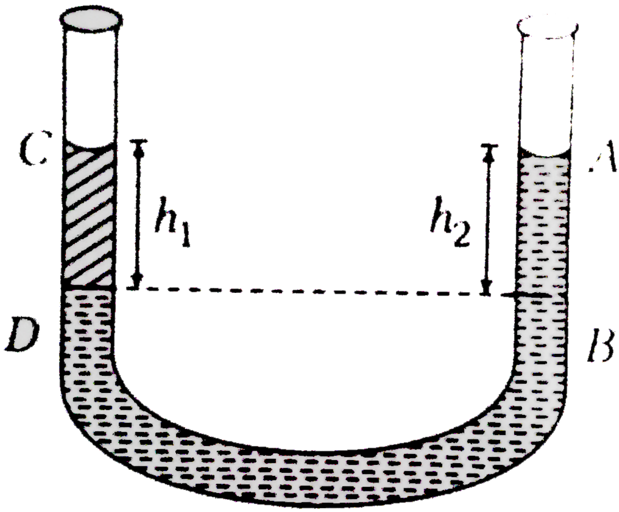
109. In a U-tube experiment, a column AB of water is balanced by a column CD of paraffin. The relative density of paraffin is



A. $\frac{h_2}{h_1}$

B. $\frac{h_1}{h_2}$

C. $\dfrac{h_2 - h_1}{h_1}$

D. $\dfrac{h_2}{h_1 + h_2}$

Answer: A

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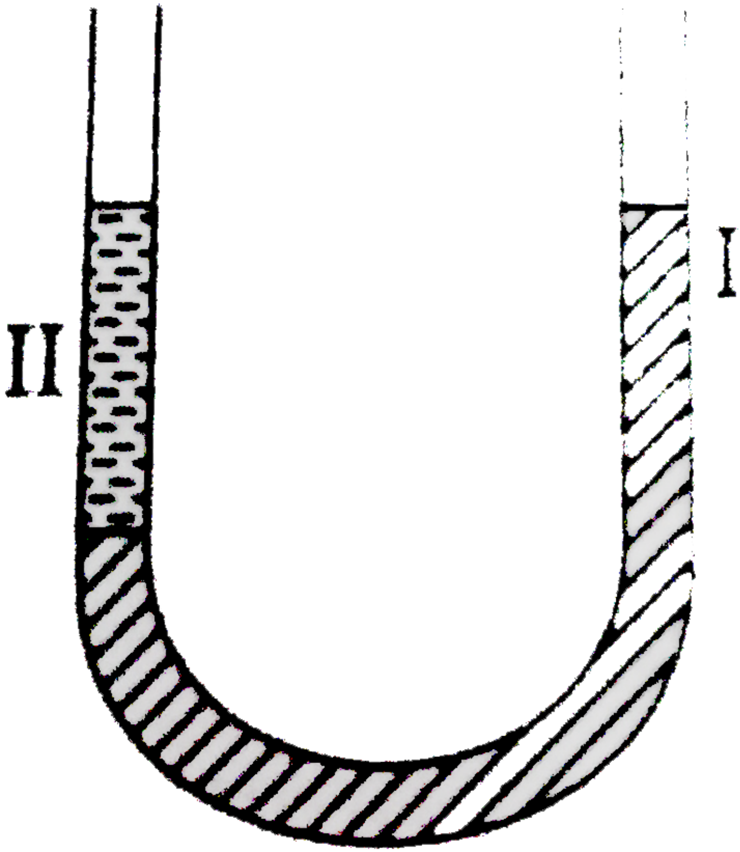
110. A U-tube of uniform cross-section shown in figure is partially filled with liquid Igt Another liquid II which does not mix with I is poured into one side. The liquid levels of the two sides is found the same, while the level of liquid I has risen by 2 cm. If the specific gravity of liquid I is 1.1, then specific gravity of liquid II must be



A. 1.2

B. 1.1

C. 1.3

D. 1.0

Answer: B

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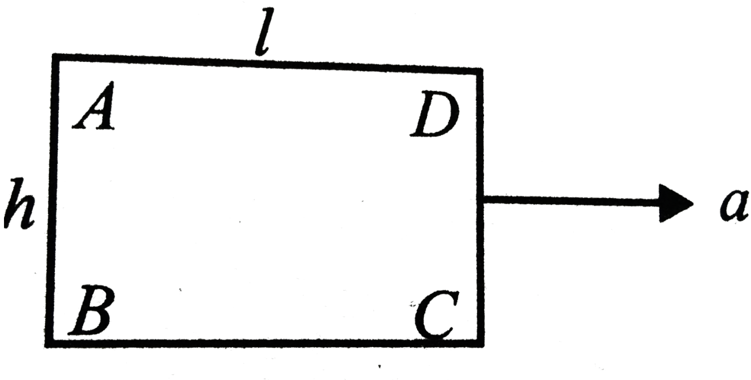
111. A closed rectangular tank is completely filled with water and is accelerated horizontally with an acceleration towards the right. Pressure is i. maximum and ii. minimum at



A. (i) B ii (D)

B. (i) C (ii) D

C. (i) B (ii) C

D. (i) B (ii) A

Answer: A

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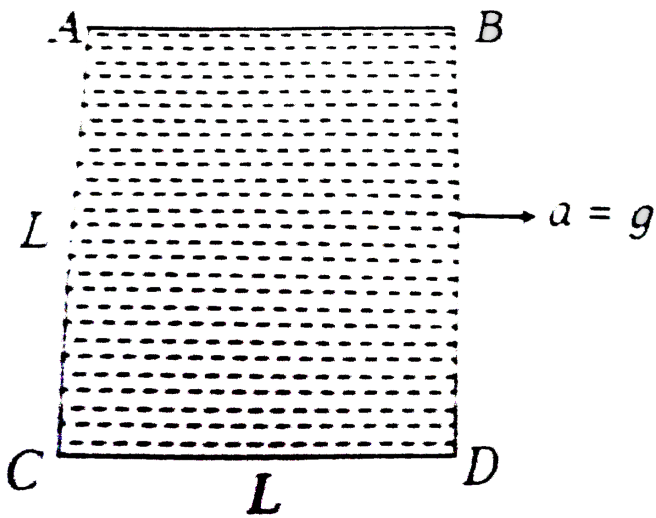
112. The liquid inside the container has density ρ. Choose the correct option.



A. $p_A - p_C = 2\rho g L$

B. $p_C - p_B = \sqrt{2}\rho g L$

C. $p_C - p_D = \rho g L$

D. $p_A - p_D = 0\rho g L$

Answer: C

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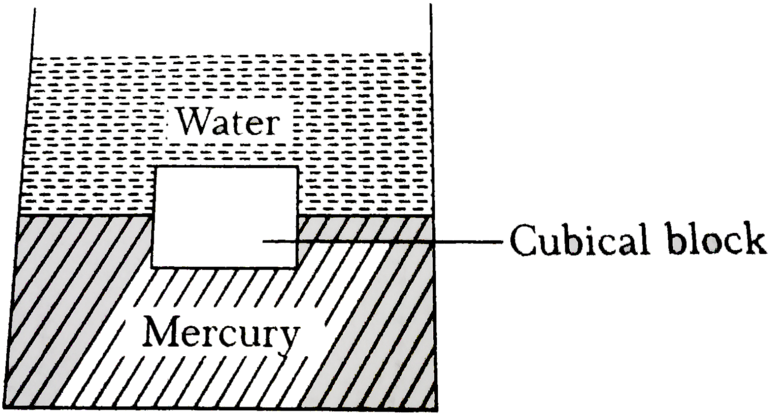
113. A tank contains water on top of mercury as shown in figure. A cubical block of side 10 cm is in equilibrium inside the tank. The depth of the block inside mercury is (RD of the material of block =8.56, RD of mercury =13.6)



A. 6 cm

B. 5 cm

C. 7 cm

D. 8 cm

Answer: A

Watch Video Solution

114. If T is the surface tension of a liquid, the energy needed to break a liquid drop of radius R into 64 drops is

A. $6\pi R^2 T$

B. $\pi R^2 T$

C. $12\pi R^2 T$

D. $8\pi R^2 T$

Answer: C

Watch Video Solution

115. Two solid spheres of same metal but of mass M and 8M fall simultaneously on a viscous liquid and their terminal velocitied are v and n v, then value of n is

A. 16

B. 8

C. 4

D. 2

Answer: C

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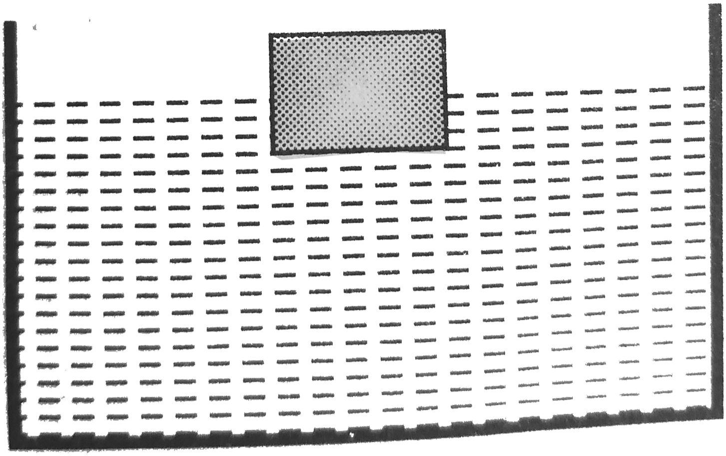
116. A cubical block is floating in a liquid with half of its volume immersed in the liquid. When the whole system accelerates upwards with acceleration of $g/3$, the fraction of volume immersed in the liquid will be



A. $1/2$

B. $3/8$

C. $2/3$

D. $3/4$

Answer: A

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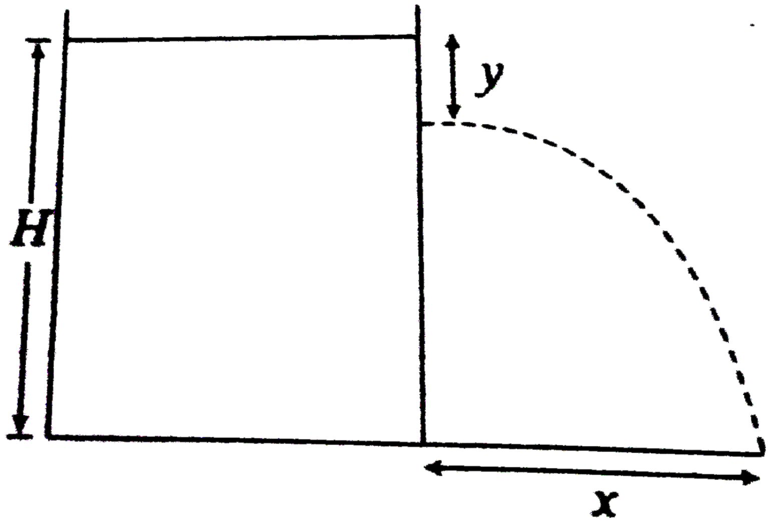
117. A cylindrical vessel is filled with a liquid up to a height H. A small hole is made in the vessel at a distance y below the liquid surface as shown in figure. The liquid emerging from the hole strike the ground at distance x



A. x is equal if hole is at depth y or H-y

B. x is maximum for y $= H/2$

C. Both (a) and (b) are correct

D. Both (d) and (d) are wrong

Answer: C

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118. Water flows along horizontal pipe whose cross-section is not constant. The pressure is 1 cam of Hg, where the velocity is 35 cm/s . At a point where the velocity is 65cm/s then pressure will be

A. 0.89 cm of Hg

B. 8.9 cm of Hg

C. 0.5 cm of Hg

D. 1 cm of Hg

Answer: A

Watch Video Solution

119. Two capillary of length L and 2L and of radius R and 2R are connected in series. The net rate of flow of fluid through them will be (given rate to the flow through single capillary,

$$\left(\mathrm{X}=\frac{\pi \mathrm{PR}^{4}}{8 \eta \mathrm{L}}\right)$$

A. $\frac{8}{9} X$

B. $\frac{9}{8} X$

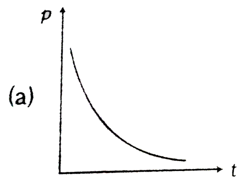
C. $\frac{5}{7} X$

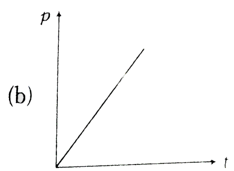
D. $\frac{7}{5} X$

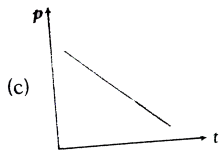
Answer: A

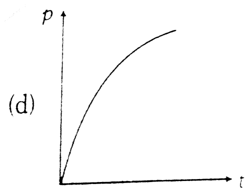
Watch Video Solution

120. A soap bubble is blown with the help of mechanical pump at the mouth of a tube. The pump produces a cartain increase per minute in the volume of the bubble, irrespective of its internal pressure. The graph between the pressure inside the soap bubble and time t will be

A. 

B. 

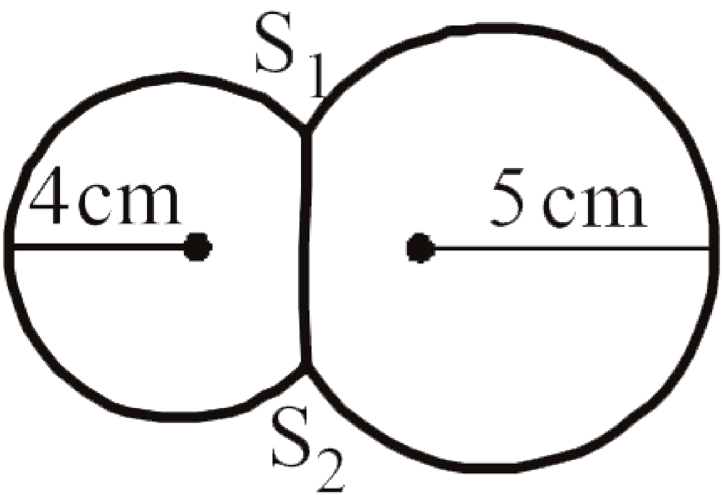
C. 

D. 

Answer: A

Watch Video Solution

121. Two soap bubbles of radii r_1 and r_2 equal to 4 cm and 5 cm are touching each other over a common surface S_1S_2 (shown in figure). Its radius will be



A. 4 cm

B. 20 cm

C. 5 cm

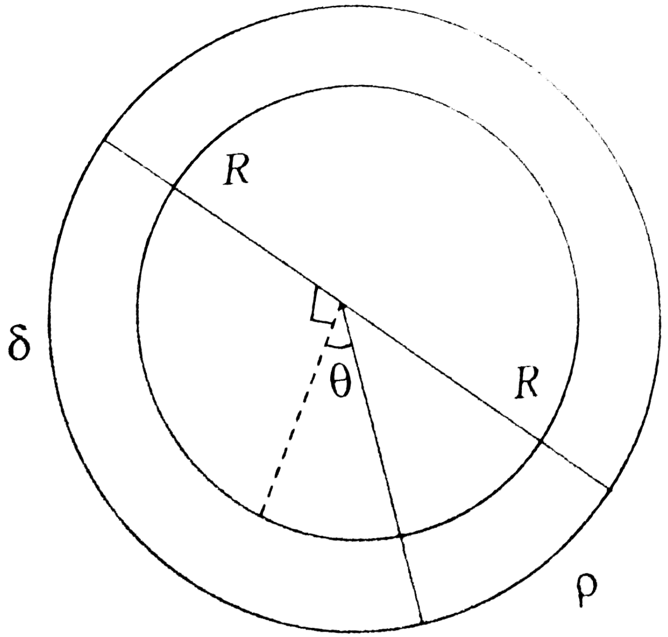
D. 4.5 cm

Answer: B

Watch Video Solution

122. A uniform long tube is bent into a circle of radius R and it lies in vertical plane. Two liquids of same volume but densities

ρ and δ fill half the tube. The angle θ is



A. $\tan^{-1}\left(\frac{\rho-\delta}{\rho+\delta}\right)$

B. $\tan^{-1}\left(\frac{\rho}{\delta}\right)$

C. $\tan^{-1}\left(\frac{\delta}{\rho}\right)$

D. $\tan^{-1}\left(\frac{\rho+\delta}{\rho-\delta}\right)$

Answer: A

Watch Video Solution

123. Two substances of densities ρ_1 and ρ_2 are mixed in equal volume and the relative density of mixture is 4. When they are mixed in equal masses, the relative density of the mixture is 3. the values of ρ_1 and ρ_2 are:

A. $\rho = 6 \quad \text{and} \quad \rho_2 = 2$

B. $\rho_3 \quad \text{and} \quad \rho_2 = 5$

C. $\rho_1 = 12 \quad \text{and} \quad \rho_2 = 4$

D. None of these

Answer: A

Watch Video Solution

124. A large block of ice 10 cm thick with a vertical hole drilled through it is floating in a lake. The minimum of water through the hole is (density of ice $= 0.9 gcm^{-3}$)

A. 0.5 m

B. 1.0 m

C. 1.2 m

D. 1.8 m

Answer: B

Watch Video Solution

125. A body of density ρ is dropped from reat from a height h into a lake of density $\sigma(\sigma > \rho)$. The maximum depth the body sinks inside the liquid is (neglect viscous effect of liquid)

A. $\frac{h\rho}{\sigma-\rho}$

B. $\frac{h\sigma}{\sigma-\rho}$

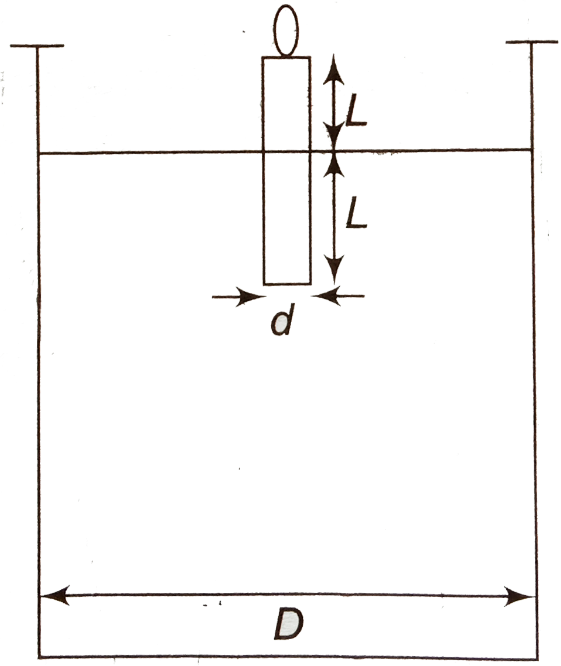
C. $\frac{h\rho}{\sigma}$

D. $\frac{h\sigma}{\rho}$

Answer: A

Watch Video Solution

126. A candle of diameter d is floating on a liquid in a cylindrical container of diameter $D(D < < d)$ as shown in figure. If is burning at the rate of $2cm/h$ then the top of the candle will :



A. remain at the same height

B. fall at the rate $1 cm h^{-1}$

C. fall at the rate $2 cm h^{-1}$

D. go up at the rate of $1 cm h^{-1}$

Answer: B

Watch Video Solution

127. A spherical object of mass 1 kg and radius 1m is falling vertically downward inside a viscous liquid in a gravity free space. At a certain instant the velocity of the sphere is $2ms^{-1}$. If the coefficient of viscosity of the liquid is $\frac{1}{6\pi}$ SI units, then velocity of ball will become $0.5ms^{-1}$ after a time.

A. In 4 s

B. 2 In 4 s

C. 3 In 4 s

D. 3 In 2 s

Answer: A

Watch Video Solution

128. A wooden block of mass 8 kg is tied to a string attached to the bottome of the tank. In the equilibrium the block is completely immersed in water. If relative density of wood is 0.8 and $g = 10ms^{-2}$, the tension T, in the string is

A. 120 N

B. 100 N

C. 80 N

D. 20 N

Answer: D

Watch Video Solution

129. A metal ball immersed in alcohol weighs w_1 and$0^\circ C$ andw_2 at $59^\circ C$. The coefficient of cubical expansion of the metal is less than that of alcohol. Assuming that the density of the metal is large compared to that of alcohol, it can be shown that

A. $w_1 > w_2$

B. $w_1 = w_2$

C. $w_1 < w_2$

D. $w_1 = (w_1 / 2)$

Answer: C

Watch Video Solution

130. A barometer kept in an elevator reads 76 cm when it is at rest. If the elevator goes up with increasing speed, the reading will be

A. zero

B. 76 cm

C. $> 76cm$

D. $< 76cm$

Answer: D

Watch Video Solution

131. The surface energy of a liquid drop is E. It is sprayed into 1000 equal droplets. Then its surface energy becomes

A. S

B. 10 S

C. 100 S

D. 1000 S

Answer: B

Watch Video Solution

132. An open tank containing non-viscous liquid to a height of 5 m is placed over the ground. A heavy sperical ball falls from height 40 m over the ground which ball will go back. Collision between ball and bottom of tank is perfectly elastic

A. 45 m

B. 35m

C. 40 m

D. 20 m

Answer: C

Watch Video Solution

133. A large open tank has two holes in the wall. One is a square hole of side L at a depth y from the top and the other is a circular hole of radius R at a depth 4y from the top. When the tank is completely filled with water, the quantities of water flowing out per second from both holes are the same. Then, R is equal to

A. $L/\sqrt{2\pi}$

B. $2\pi L$

C. L

D. $L / 2\pi$

Answer: A

Watch Video Solution

134. A piece of steel has a weight w in air, w_1 when completely immersed in water and w_2 when completely immersed in an unknown liquid. The relative density (specific gravity) of liquid is

A. $\frac{w - w_1}{w - w_2}$

B. $\frac{w - w_2}{w - w_1}$

C. $\frac{w_1 - w_2}{w - w_1}$

D. $\frac{w_1 - w_2}{w - w_2}$

Answer: B

Watch Video Solution

135. Two cylinders of same cross-section and length L but made of two different materials of densities d_1 and d_2 are cemented together to from a cylinder of length 2L. The combination floats in a liquid of density d $\quad d_1 < d_2$ then

A. $d_1 < \frac{3}{4}d$

B. $\frac{d}{2} > d_1$

C. $\frac{d}{4} > d_1$

D. $d_1 > \frac{d}{4}d$

Answer: A

Watch Video Solution

136. A block of wood is floating on the surface of water in a beaker. The beaker is covered with a bell jar and the air is evacuated. What will happen to the block ?

A. Sink a little

B. Rise a little

C. Remain unchanged

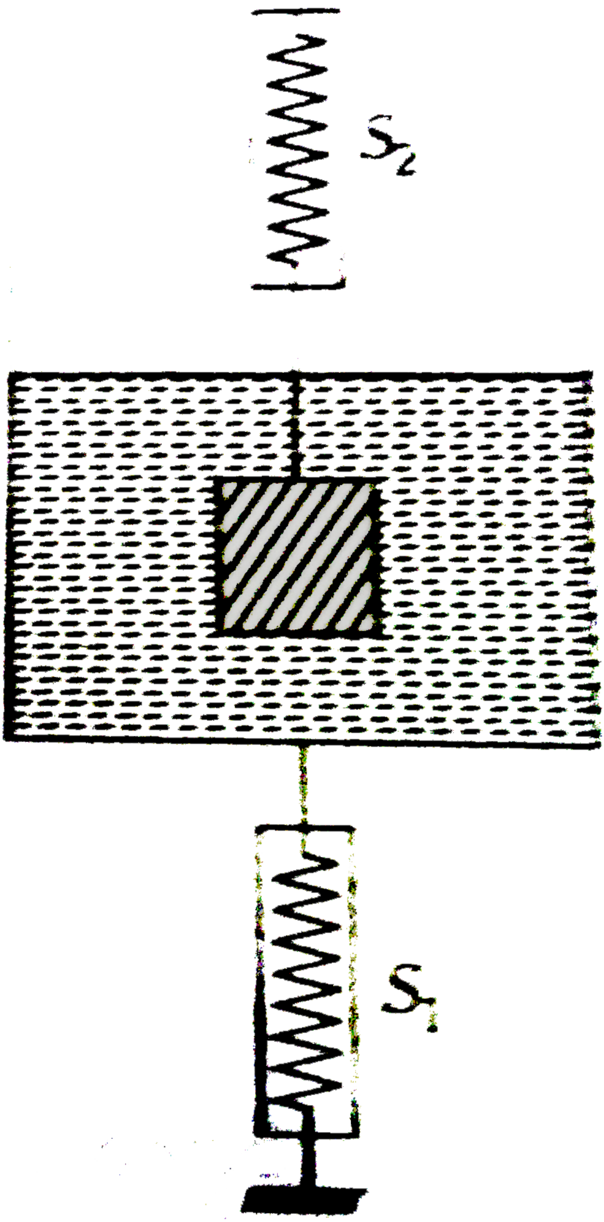
D. Sink completely

Answer: C

Watch Video Solution

137. A beaker containing water is kept on a spring scale. The mass of water and beaker is 5 kg . A block of mass 2 kg and specific gravity 10 is suspended by means of thread from a spring balance as shown. The readings of scales S_1 and S_2

are respectively Take, $g = 10ms^{-2}$



A. 52 N and 20 N

B. 50 N and 18 N

C. 52 N and 18 N

D. 52 N and 22 N

Answer: C

Watch Video Solution

138. A sphere of solid material of specific gravity 8 has a concentric spherical cavity and just sinks in water. The ratio of radius of cavity to that of outer radius of the sphere must be

A. $\frac{\sqrt[3]{3}}{2}$

B. $\frac{\sqrt[3]{5}}{2}$

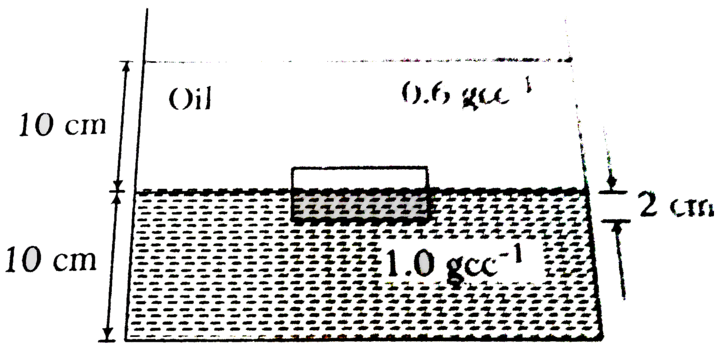
C. $\frac{\sqrt[3]{7}}{2}$

D. $\frac{2}{\sqrt[3]{7}}$

Answer: C

Watch Video Solution

139. A cubical block of side 10 cm floats at the interface of an oil and water. The pressure above that of atmosphere at the lower face of the block is



A. $200 Nm^{-2}$

B. $680Nm^{-2}$

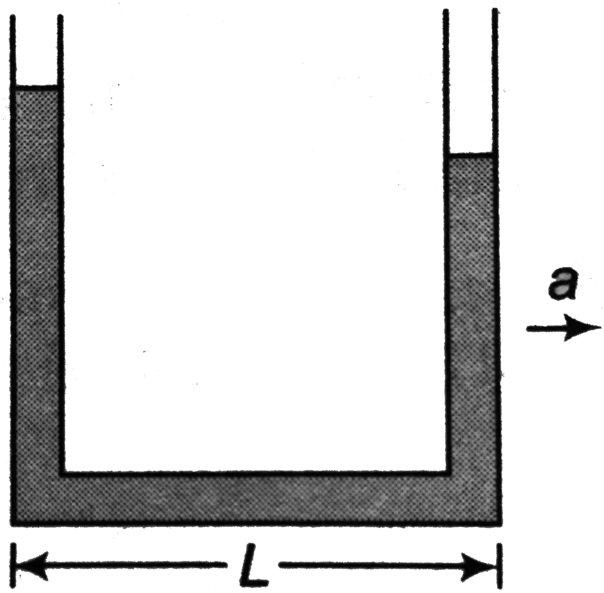
C. $400Nm^{-2}$

D. $800Nm^{-2}$

Answer: D

Watch Video Solution

140. A liquid stands at the plane level in the U-tube when at reat. If areals of cross-section of both the limbs are equal, what will be the difference in height h of the two limbs of U-tube, when the sustem is given an acceleration a in horizontal direction towards right as shown?



A. $\frac{g}{a} \frac{L^2}{H}$

B. $\frac{La}{g}$

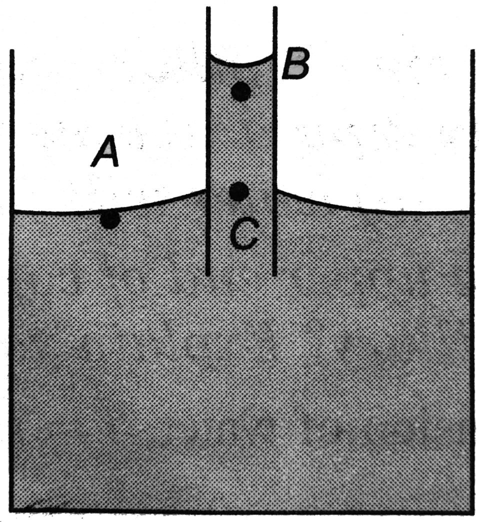
C. $\frac{L^2}{H} \frac{a}{g}$

D. $\frac{Lg}{a}$

Answer: B

Watch Video Solution

141. A capillary tube is dipped in a liquid. Let pressure at point A, B and C be $p_A p_B$ and p_C respectively, then



A. $p_A = p_B = p_C$

B. $p_A = p_B < p_C$

C. $p_A = P_C < p_B$

D. $p_A = p_C > p_B$

Answer: D

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142. The volume of an air bubble becomes three times as it rises from the bottom of a lake to its surface. Assuming atmospheric pressure to be 75 cm of Hg and the density of water to be $1/10$ of the density of mercury, the depth of the lake is

A. 5 m

B. 10 m

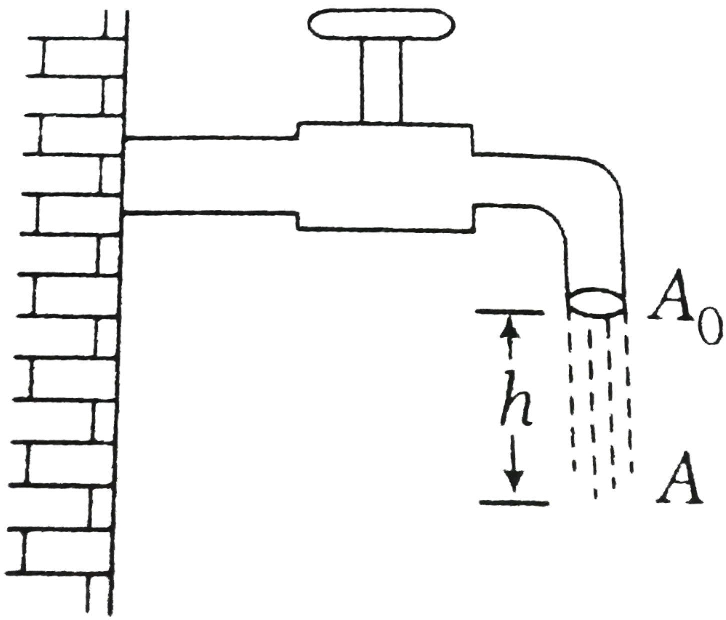
C. 15 m

D. 20 m

Answer: C

Watch Video Solution

143. Figure shows how the stream of water emerging from a faucet necks donw as it falls. The area changes from A_0 to A through a fall of h. At what rate does the water flow from the tap ?



A. $A_0\sqrt{\dfrac{2ghA^2}{A_0^2-A^2}}$

B. $2A_0\sqrt{\frac{ghA^2}{A_0^2 - A^2}}$

C. $A_0\sqrt{\frac{gh}{2}}$

D. $2A\sqrt{\frac{ghA_0^2}{A_0^2 - A^2}}$

Answer: A

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144. A ball of relative density 0.8 falls into water from a height of 2 m. The depth to which the ball will sink is (neglect viscous forces)

A. 8 m

B. 2 m

C. 6 m

D. 16 m

Answer: A

Watch Video Solution

145. A pump is designed as a horizontal cylinder with a piston of areal A and and outlet orifice of areal a arranged mear the cylinder axis. Find the velocity of out flow of the liquid from the pump if the piston moves with a constant velocity under the action of a constant force F. The density of the liquid is ρ.

A. $\sqrt{\frac{F}{A\rho}}$

B. $\sqrt{\frac{2F}{A\rho}}$

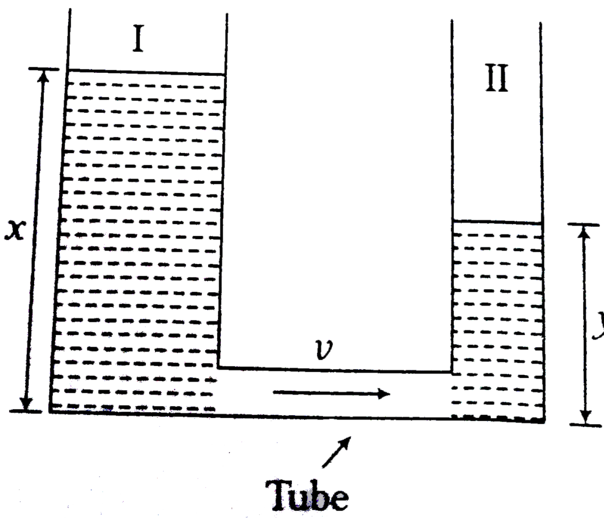
C. $\sqrt{\frac{A\rho}{F}}$

D. $\sqrt{\frac{A\rho}{2F}}$

Answer: B

Watch Video Solution

146. If cross- sectional area of limb I is A_1 and that of limb II is A_2 then velocity of the liquid in the tube will be, (cross-sectional area of tube is very small)



A. $\sqrt{2g(x-y)}$

B. $\frac{A_1}{A_2}\sqrt{2g(x-y)}$

C. $\frac{A_2}{A_1}\sqrt{2g(x-y)}$

D. None of these

Answer: A

Watch Video Solution

147. Two capillaries of same length and radii in the ratio $1:2$ are connected in series. A liquid flows through them in streamlined condition. If the pressure across the two extreme ends of the combination is 1 m of water, the pressure difference across first capillary is

A. 9.4 m

B. 4.9 m

C. 0.49 m

D. 0.94 m

Answer: D

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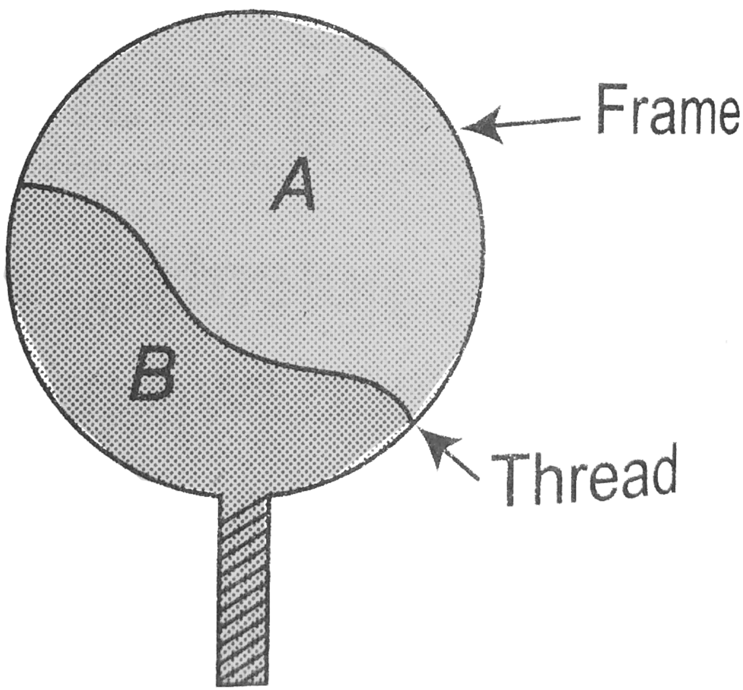


148.

A thread is tied slightly loose to a wire frame as in figure and the frame is dipped into a soap solution and taken out . The frame is comletely covered with the film. When the portion A puntured with a pin The thread.

A. thread will become concave on seeing from side A

B. thread will become concave on seeing from side B

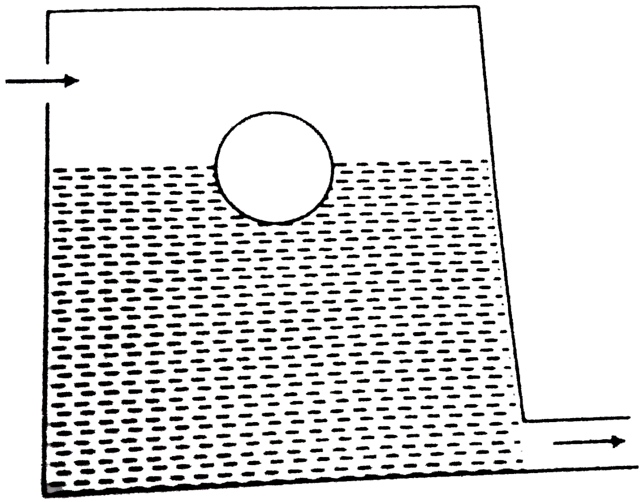
C. thread will become straight

D. thread will remain as it is

Answer: A

Watch Video Solution

149. A tank filled with water has two taps to exhaust and pour. A hollow sperical ball is half submerged in water. Through one tap, water is taken out and through another tap, a liquid of density double the density of water is poured in tank such that volume of liquid in tank remains constant. Sphere will



A. go down

B. go up

C. maintain same height

D. sink to bottom

Answer: B

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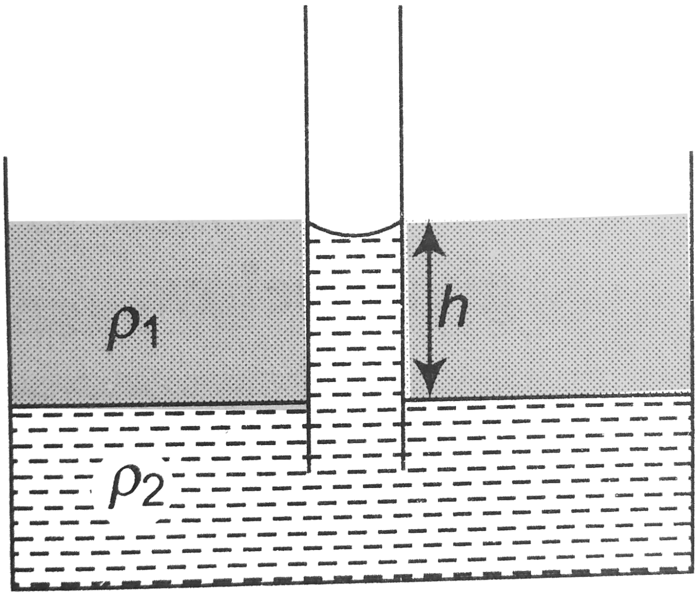

150.

A container is partially filled with a liquid of density ρ_2 A capillary tube of radius r is vertically inserted in this liquid. Now another liquid of density $\rho_1 (\rho_1 < \rho_2)$ is slowly poured in the container to a height h as shown. There is only denser liquid in the capillary tube. The rise of denser liquid in the capillary tube is also h. Assuming zero contact angle, the surface tension of heavier liquid is

A. $2\pi r \rho_2 gh$

B. $\dfrac{\rho_2 rgh}{2}$

C. $\dfrac{r}{2}(\rho_2 - \rho_1)gh$

D. $2\pi r(\rho_2 - \rho_1)gh$

Answer: C

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151. A ball of mass 1 kg falls from a height of 5m above the free surface of water. The relative density of the solid ball is $s = 2/3$. The ball travels a distance of 2m under water and becomes stationary. The work done by the resistive forces of water is

A. $-50J$

B. $-20J$

C. $-40J$

D. $-30J$

Answer: C

Watch Video Solution

152. Under isothermal condition two soap bubbles of radii r_1 and r_2 coalesce to form a single bubble of radius r. The external pressure is p_0. Find the surface tension of the soap in terms of the given parameters.

A. $\dfrac{2p_0\left(r^3 - r_1^3 - r_2^3\right)}{4\left(r_1^2 + r_2^2 - r^2\right)}$

B. $\dfrac{p_0\left(r^3 - r_1^3 - r_2^3\right)}{4\left(r_1^2 + r_2^2 - r^2\right)}$

C. $\dfrac{p_0(r^3 + r_1^2 + r_2^3)}{4(r_1^2 + r_2^2 + r^2)}$

D. None of these

Answer: B

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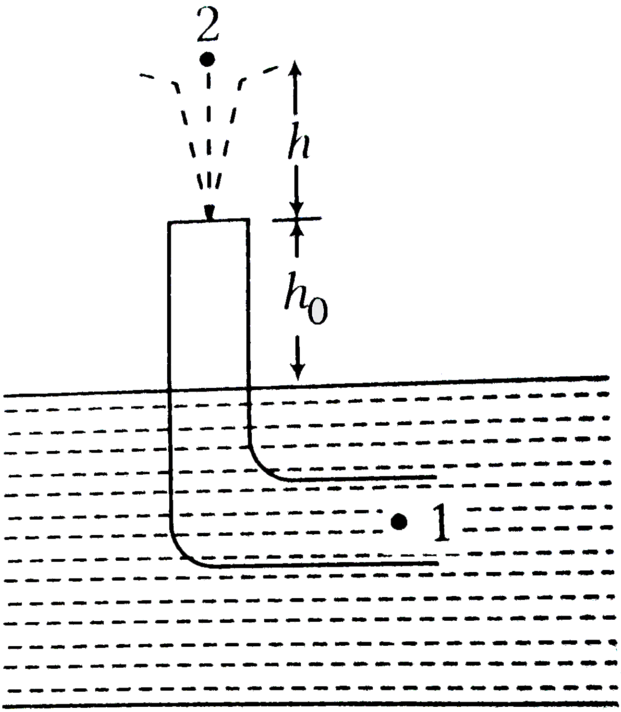
153. A bent tube is lowered into the stream as shown in the figure below. The velocity of the stream relative to the tube equal to v. The closed upper end of the tube located at the light h_0. To what height h will the water jet spurt ?



A. $\dfrac{v^2}{2g}$

B. $\dfrac{v^2}{2g} + h_0$

C. $\dfrac{v^2}{2g} - h_0$

D. $\dfrac{v^2}{4g} - h_0$

Answer: C

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154. A solid ball of density half that of water falls freely under gravity from a height of 19.6 m and then enters water. Up to what depth will the ball go. How much time will it take to come again to the water surface? Neglect air resistance and viscosity effects in water. (Take $g = 9.8m / S^2$).

A. 4 s

B. 8s

C. 6s

D. 2s

Answer: A

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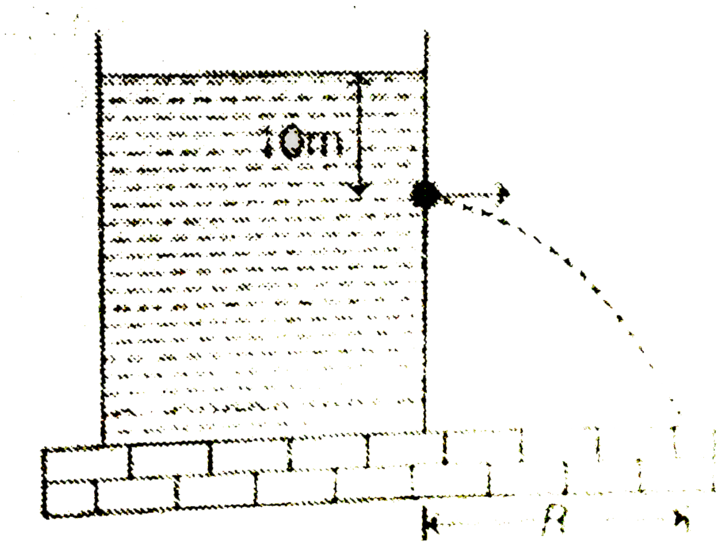
155. A large tank is filled waith water (density $= 10^3 kg/m^3$). A small hole is made at a depth 10 m below water surface. The range of water issuing out of the hole is R on ground. Approximately what extra pressure must be applied on the water surface so that the range becomes 2R

(take $1atm = 10^5 Pa$ and $g = 10m/s^2$)



A. 1 atm

B. 2 atm

C. 4 atm

D. 3 atm

Answer: D

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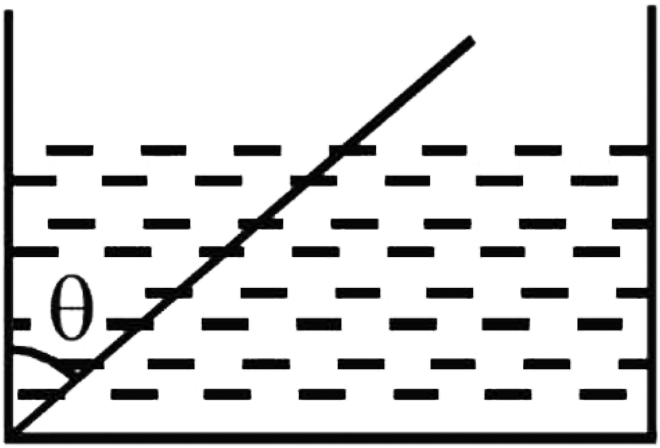
156. A wooden plank of length 1m and uniform cross-section is hinged at one end to the bottom of a tank as shown in fig. The tank is filled with water upto a hight 0.5m. The specific gravity of the plank is 0.5. Find the angle θ that the plank makes with the vertical in the equilibrium position. (Exclude the case

$\theta = \theta^\circ$)



A. 30°

B. 45°

C. 60°

D. 90°

Answer: B

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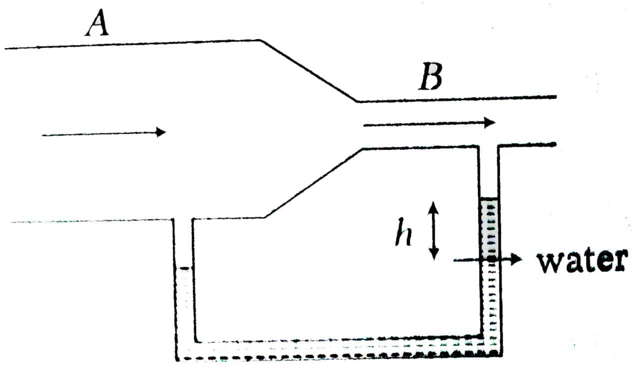
157. Air is blown through a pipe AB at a rate of $10\mathrm{L}\min^{-1}$. The cross-sectional area of the broad portion of the pipe AB is $2cm^2$ and that of the narrow portion is $0.5cm^2$. The difference in water level h is (density of air $= 1.32kgm^{-3}$)



A. 16 mm

B. 1.5 mm

C. 10 mm

D. 3.2mm

Answer: B

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B) Medical entrance special format question

1. Assertion : Density of an incompressible liquid is constant.

Reason : An ideal fluid is incompressible.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: B

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2. Assertion : In a freely falling liquid container, upthrust force is zero.

Reason : In freely falling case value of effective value of g is zero.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: A

View Text Solution

3. Assertion : Bulk modulus of an incompressible liquid is infinite.

Reason : Compressibility is inverse of bulk modulus.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: B

View Text Solution

4. Assertion If angle of contact is 0°, then liquid will neither rise nor fall in a capillary.

Reason : When angle of contact is 0°, surface is neither convex nor concave inside the capillary. It is flat.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If both Assertion and Reason are false.

Answer: D

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5. Assertion : Deep inside a liquid density is more than the density on surface.

Reason : Density of liquid increases with increase in depth.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: A

View Text Solution

6. Assertion : Small water drops are sperical while bigger water drops are not.

Reason : In small water drops surface tension forces dominate while in bigger water drops gravity forces dominate.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: B

View Text Solution

7. Assertion : When an ideal fluid flows through a pipe of non-uniform cross-section, then pressure is more at that section where area is more if the pipe is horizontal.

Reason : According to Bernoulli's theorem speed at broader cross-section will be less.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: D

View Text Solution

8. Assertion : If ice is floating in water and it melts, then level of water remains unchanged.

Reason : When the ice is floating, weight of liquid displaced is equal to the weight of ice.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: B

Watch Video Solution

9. Assertion : An ice ball is floating in water. Some stone pieces are embedded inside the ice. When ice will melt, level of water will fall.

Reason : In floating condition, stone pieces will displace more liquid compared to the condition when they sink.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: D

View Text Solution

View Text Solution

10. Assertion : A solid is floating in a liquid of density ρ_1. When the solid melts its density becomes ρ_2 in liquid state. If $\rho_1 > \rho_2$ level of liquids will increase after melting.

Reason : In liquid state volume always increases after a solid melts.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: C

View Text Solution

11. Assertion : A solid sphere and a hollow sphere both of same material are immersed in a liquid , then change in weight in both the spheres will be same.

Reason : Upthrust depends upon the volume of the solid immersed not the mass.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: A

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12. Assertion : If water is filled in a balloon and this is immersed in water itself. Then volume of water displaced is equal to the volume of water filled in the ballon.

Reason : Volume of a liquid displaced is equal to the volume of solid immersed in that liquid.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: A

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13. Assertion : At same level of same liquid pressure is always same.

Reason : When any fluid travels from a region of higher pressure to lower pressure (At same levels) it gains same speed.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: D

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14. Assertion : A solid is floating in a liquid . If temperature is increased and expansion of solid is ignored, then fraction of volume immersed will increase.

Reason : By increasing the temperature density of liquid will decrease.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: A

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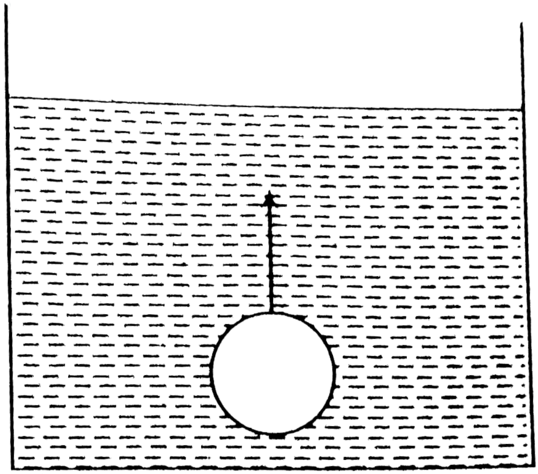
15. Assertion : A ball is released from the bottom of a tank filled with a liquid. It moves upwards . In moving upwards upthrust will decrease.



Reason : Density of ball is less than the density of liquid.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: A

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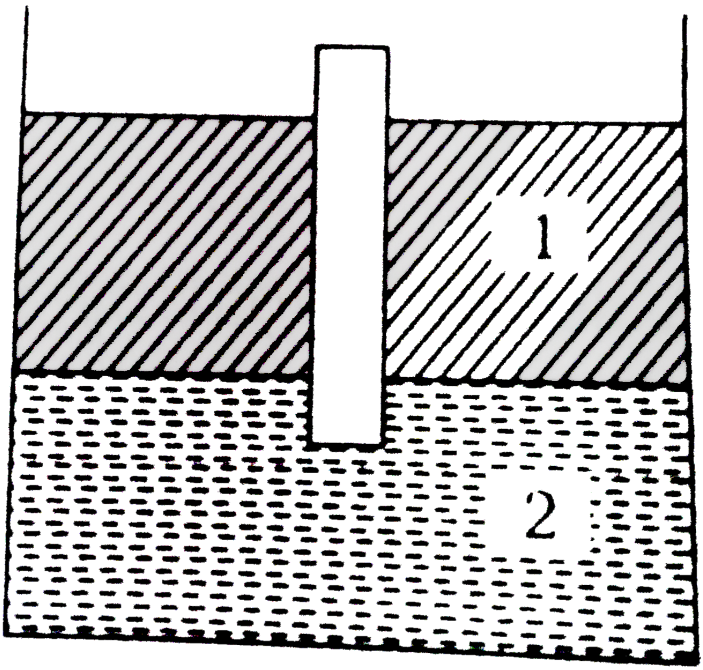
16. Assertion : A wooden plank is floating in two liquids as shown. Net force applied by liquid-1 on plank is zero.

Reason : Contribution in upthrust due to liquid -1 is $V_1\rho_1 g$. Where V_1= volume immersed in liquid -1 and ρ_1 is the is the density of liquid -1.



A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: D

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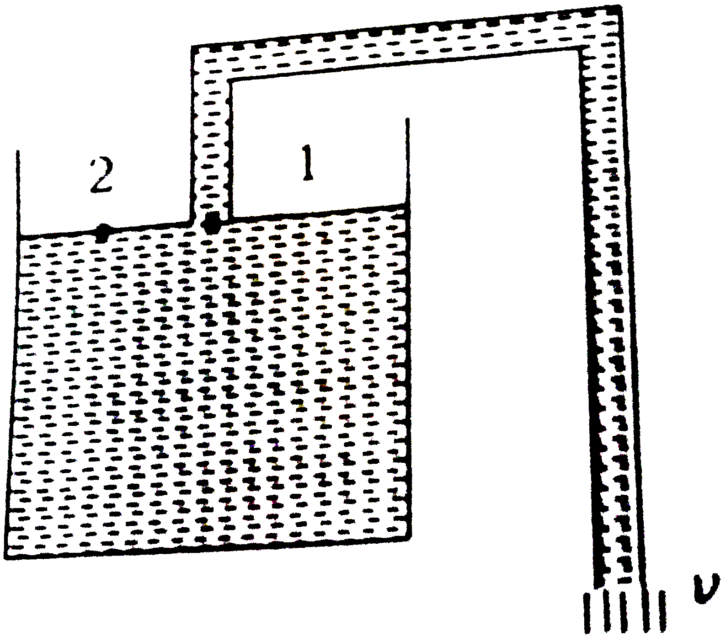
17. Assertion : In the given figure shown, $p_1 = p_2$.



Reason : Pressure at 1 is less than the atmospheric pressure.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: D

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18. Assertion : A solid object of iron is dipped in water, both are at same temperature of $2^\circ C$. If the temperature of water is increased by $2^\circ C$, then the buoyancy force action of the object will increase.

Reason : If we increase the temperature of water from $2^\circ C$ to $4^\circ C$, then density of water will increase. Ignore expansion of solid sphere.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: A

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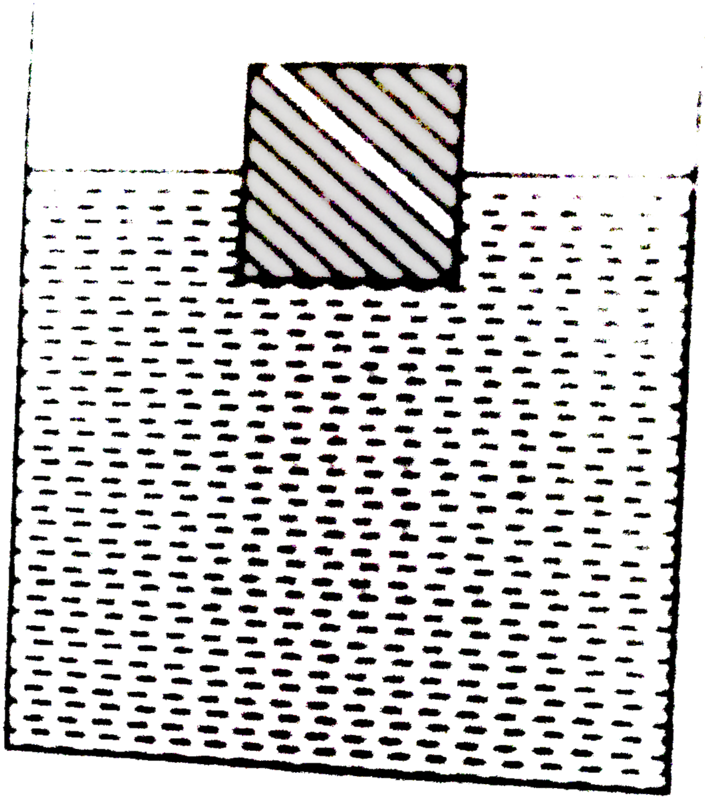
19. Mass of solid floating in liquid is m_1 and mass of liquid is m_2. Base area is A. Then pressure at bottom is $p_0 + \dfrac{(m_1 + m_2)g}{A}$



Reason : Upward force on liquid from base of vessel is pA, where p is pressure at bottom.

A. If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If Assertion is false but Reason is true.

Answer: B

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Match the columns

1. A liquid is flowing through a pipe of non-uniform cross-section. At a point where area of cross-section of the pipe is less, match the following columns.

Column I		Column II	
(A)	Volume of liquid flowing per second	(p)	Is less
(B)	Speed of liquid	(q)	Is more
(C)	Pressure of liquid	(r)	Is same

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2. Two soap bubbles coalesce to form a single large drop. Match the following.

	Table-1		Table-2
(A)	Surface energy in the process will	(P)	increase
(B)	Temperature of the drop will	(Q)	decrease
(C)	Pressure inside the soap bubble will	(R)	remain same

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3. There are two point A and B inside a liquid as shown in figure. Now the vessel starts moving upwards with an acceleration a. Match the following.

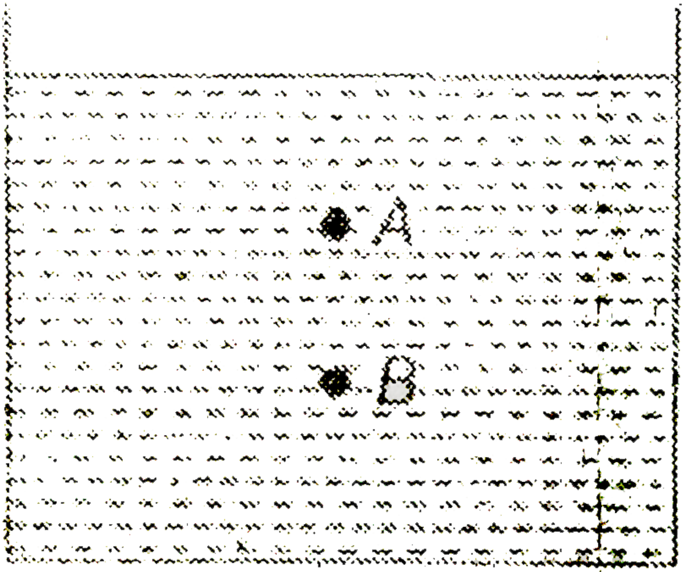

	Table-1		Table-2
(A)	Pressure at B will	(P)	increase
(B)	Pressure difference between A and B will	(Q)	decrease
(C)	Upthrust on an object inside the verssel will	(R)	remain same

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4. A tube is inverted in a mercury vessel as shown in figure. If pressure P is increased, then

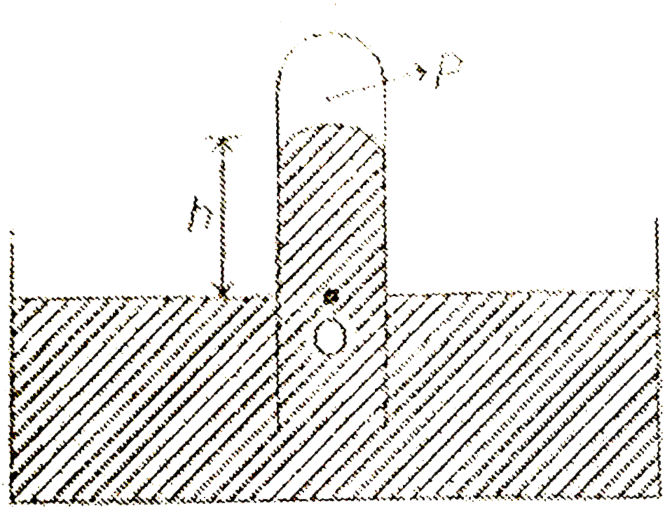

	Table-1		Table-2
(A)	Height h	(P)	will increase
(B)	Pressure at O	(Q)	will decrease
(C)	Pressure at 1 cm above O	(R)	will remain same

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5. In the figure shown, velocity of liquid which comes out is v, time of liquid to fall to ground is t and range on ground is R. If the vessel is taken to a mountain, match the following.

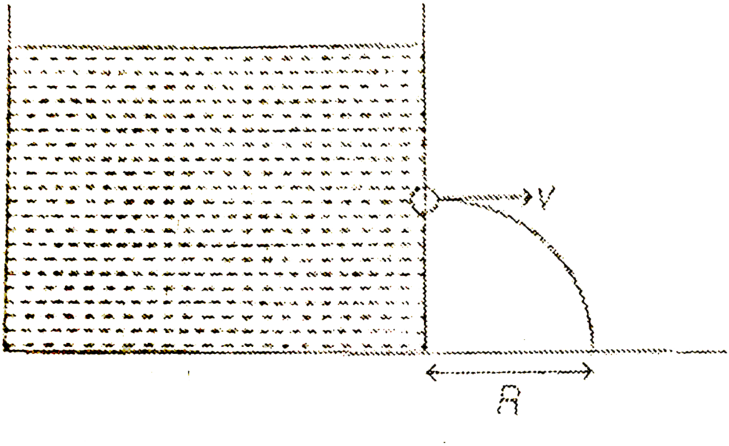

	Table-1		Table-2
(A)	V	(P)	will increase
(B)	t	(Q)	will decrease
(C)	R	(R)	will remain same

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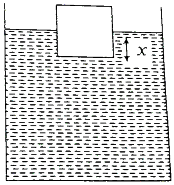
6. A cube is floating in liquid as shown in figure. Match the following columns.



Column I		Column II
(A) If density of liquid decreases x will	(p)	Increase
(B) If size of cube is increased x will	(q)	Decrease
(C) If the whole system is accelerated upwards x will	(r)	Remain same

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Medical entranes gallery

1. A rectangular film of liquid is extended from $(4cm \times 2cm)$ to $(5cm \times 4 \times cm)$. If the work done is $3 \times 10^{-4} J$, the value of the surface tension of the liquid is

A. $0.250 Nm^{-1}$

B. $0.125 Nm^{-1}$

C. $0.2 Nm^{-1}$

D. $8.0 Nm^{-1}$

Answer: B

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2. Three liquids of densities ρ_1, ρ_2 and ρ_3 (with $\rho_1 > \rho_2 > \rho_3$), having the same value of surface tension T, rise to the same height in three identical capillaries. The angles of contact θ_1, θ_2 and θ_3 obey

A. $\frac{\pi}{2} > \theta_1 > \theta_2 > \theta_3 \geq 0$

B. $0 \leq \theta_1 < \theta_2 < \theta_3 < \frac{\pi}{2}$

C. $\frac{\pi}{2} < \theta_1 < \theta_2 < \theta_3 < \pi$

D. $\pi > \theta_1 > \theta_2 > \theta_3 > \frac{\pi}{2}$

Answer: B

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3. Two non-mixing liquids of densities ρ and $(n > 1)$ are put in a container. The height of each liquid is h. A solid cylinder of length L and density d is put in this container. The cylinder floats with its axis vertical and length $pL(p < 1)$ in the denser liquid. The density d is equal to :

A. $\{2 + (n + 1)p\}\rho$

B. $\{2 + (n - 1)p\}\rho$

C. $\{1 + (n - 1)p\}\rho$

D. $\{1 + (n + 1)p\}\rho$

Answer: C

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4. A wind with speed $40 m / s$ blows parallel to the roof of a house. The area of the roof is $250 m^2$. Assuming that the pressure inside the house is atmospheric pressure, the force exerted by the wind on the roof and the direction of the force will be $(P_{air} = 1.2 kg / m^3)$

A. 4.8×10^5 N, downwards

B. 4.8×10^5 N, upwards

C. 2.4×10^5 N, upwards

D. 2.4×10^5 N, downwards

Answer: C

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5. The approximate depth of an ocean is $2700m$. The compressibility of water is $45.4 \times 10^{-11} Pa^{-1}$ and density of water is $10^3 \frac{kg}{m^3}$. What fractional compression of water will be obtained at the bottom of the ocean?

A. 0.8×10^{-2}

B. 1×10^{-2}

C. 1.2×10^{-2}

D. 1.4×10^{-2}

Answer: C

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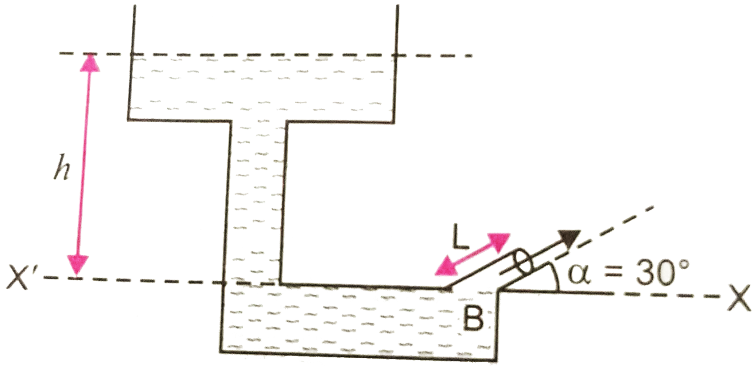
6. Determine the height above the dashed line XX' attained by the water stream coming out through the hole is situated at point B in the diagram given below. Given that $h = 10m$, $L = 2m$ and $\alpha = 30^\circ$.



A. 10m

B. 7.1 m

C. 5 m

D. 3.2 m

Answer: D

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7. A water drop of radius 10^{-2} m is brokenn into 1000 equal droplets. Calculate the gain in surface energy. Surface tension of water ils $0.075Nm^{-1}$

A. $16.96 \times 10^{-4}J$

B. $8.48 \times 10^{-4}J$

C. $4.24 \times 10^{-4}J$

D. $2.12 \times 10^{-4}J$

Answer: B

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8. The lower end of a capillary tube is dipped into water and it is seen that the water rises through 7.5 cm in the capillary. Find the radius of the capilary. Surface tension of water $= 7.5 \times 10^{-2} Nm^{-1}$. Contact angle between water and glass $= 0^{\circ}. Take g = 10 ms^{-2}$.

A. 0.2 cm

B. 0.1 cm

C. 0.4 mm

D. 0.2 mm

Answer: D

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9. A soap bubble of diameter a is produced using the soap solution of surface tension T. Find the energy required to double the radius of the bubble without change of temperature.

A. $2\pi a^2 T$

B. $6\pi a^2 T$

C. $3\pi a^2 T$

D. $12\pi a^2 T$

Answer: B

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10. A boat floating in a water tank is carrying a number of large stones. If the stones are unloaded into water, what will happen to the water level?

A. rises till half the number of stones are unladed and then begins to fall

B. remains unchanged

C. rises

D. falls

Answer: D

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11. Choose the correct statement.

A. Terminal velocities of rain drops are proportional to square of their radii

B. Water proof agents decrease the angle of contact between water and fibres

C. Detergents increase the surface tension of water

D. Hydraullic machines work on the principle of Torricelli's law

Answer: A

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12. A 20 cm long capillary tube is dipped vertically in water and the liquid rises upto 10 cm. If the entire system is kept is a freely falling platform, the length of the water column in the tube will be

A. 5 cm

B. 10 cm

C. 15 cm

D. 20 cm

Answer: D

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13. By sucking a straw a student can reduce the pressure in his lungs to $750mm$ of $Hg(\text{density}) = 13.6kg/cm^3)$ Using the straw, he can drink water from a glass up to a maximum depth of :

A. 10.2 cm

B. 75.3 cm

C. 13.6 cm

D. 1.96 cm

Answer: C

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14. What is ratio of surface energy of 1 small drop and 1 large drop, if 1000 small drops combined to form 1 large drop

A. $1:100$

B. $1:1000$

C. $1:10$

D. $0.1 : 1$

Answer: A

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15. A solid floats such that its $1/3$ part is above the water surface. Then, the density of solid is

A. $744 kgm^{-3}$

B. $\frac{1000}{3} kgm^{-3}$

C. $\frac{2000}{3} kgm^{-3}$

D. $910 kgm^{-3}$

Answer: C

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16. The amount of work done in blowing a soap bubble such that its diameter increases from d to D is (T=surface tension of the solution)

A. $2\pi\left(D^2 - d^2\right)S$

B. $\pi\left(D^2 - d^2\right)S$

C. $4\pi\left(D^2 - d^2\right)S$

D. $8\pi\left(D^2 - d^2\right)S$

Answer: A

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17. When the temperature increased the angle of contact of a liquid

A. increases

B. decreases

C. remains constant

D. first increases and then decreases

Answer: B

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18. A bubble is at the bottom of the lake of depth h. As the bubble comes to sea level, its radius increases three times. If atmospheric pressure is equal to l metre of water column, then h is equal to

A. $26l$

B. l

C. $25l$

D. $30l$

Answer: A

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19. A wooden block is floating on water kept in a beaker. 40% of the block is above the water surface. Now the beaker is kept inside a lift that starts going upward with acceleration equal to $g/2$. The block will then

A. sink

B. float with 10% above the water surface

C. float with 40% above the water surface

D. float with 70% above the water surface

Answer: B

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20. A small metal sphere of radius a is falling with a velocity υ through a vertical column of a viscous liquid. If the coefficient of viscosity of the liquid is η, then the sphere encounters an opposing force of

A. $6\pi\eta a^2\upsilon$

B. $\dfrac{6\eta\upsilon}{\pi a}$

C. $6\pi\eta a v$

D. $\dfrac{\pi\eta v}{6a^3}$

Answer: C

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21. A flow of liquid is streamline, if the Reynolds' number is

A. less than 1000

B. greater than 1000

C. between 2000 to 3000

D. between 4000 to 5000

Answer: A

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22. A certain number of spherical drops of a liquid of radius r coalesce to form a single drop of radius R and volume V. If T is the surface tension of the liquid, then

A. energy=4VT $\left(\frac{1}{r}-\frac{1}{R}\right)$ is released

B. energy = 3 VT $\left(\frac{1}{r}+\frac{1}{R}\right)$ is absorbed

C. energy $=3VT\left(\frac{1}{R}-\frac{1}{r}\right)$ is released

D. energy is neither released nor absorbed

Answer: C

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23. A drop of some liquid of volume $0.04 cm^3$ is placed on the surface of a glass slide. Then, another glass forms a thin layer of area $20 cm^2$ between the surfaces of the two slides. To separate the slides a force of 16×10^5 dyne has to be applied normal to the surfaces. The surface tension of the liquid is (in dyne cm^{-1})

A. 60

B. 70

C. 80

D. 90

Answer: C

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24. Under isothermal condition, energy E is supplied to a soap bubble of surface tension σ and radius r, to double the radius of the soap bubble. The value of E is

A. $16\pi r^2\sigma$

B. $24\pi r^2\sigma$

C. $8\pi r^2\sigma$

D. $12\pi r^2\sigma$

Answer: A

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25. A 20 cm long capillary tube is dipped in water. The water rises up to 8 cm. If the entire arrangement is put in a freely falling elevator, the length of water column in the capillary tube will be

A. 4 cm

B. 20 cm

C. 8 cm

D. 10 cm

Answer: B

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26. The wattability of a surface by a liquid depends primarily on

A. viscosity

B. surface tension of liquid and air

C. density

D. angle of contact between the surface and the liquid

Answer: D

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27. The pressure exerted at any point in an enclosed fluid is transmitted equally in all directions. This is known as

A. Archimedes principle

B. Law of floatation

C. Pascal's law

D. Bernoulli's principle

Answer: C

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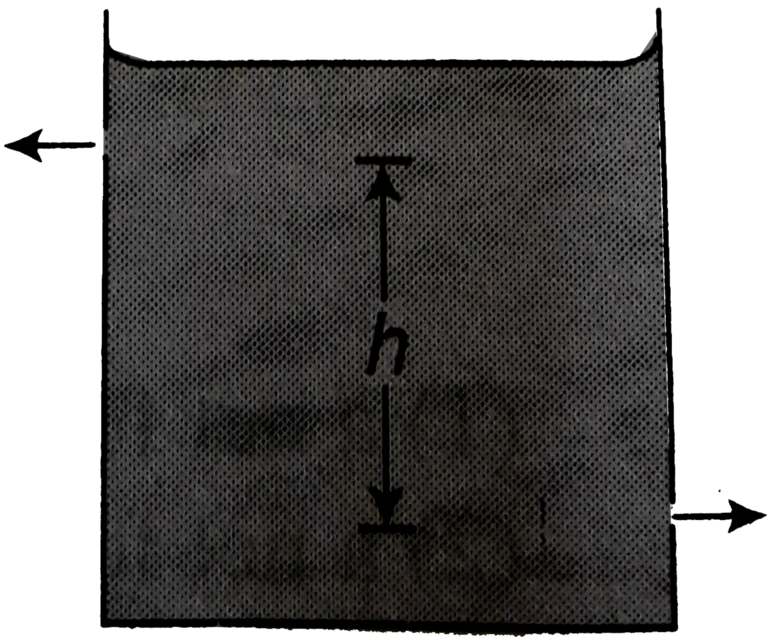
28. There are two identical small holes on the opposite sides of a tank containing a liquid. The tank is open at the top. The difference in height between the two holes is h. As the liquid comes out of the two holes. The tank will experience a net horizontal force proportional to.



A. $\sqrt{h}$

B. h

C. $h^{3/2}$

D. h^2

Answer: B

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29. Water rises to a height of 10 cm. in a certain capillary tube. If in the same tube, level of Hg is depressed by 3.42 cm., compare the surface tension of water and mercury. Sp. Gr. Of Hg is 13.6 the angle of contact for water is zero and that for Hg is 135°.

A. $13:2$

B. $5:16$

C. $16:5$

D. $2:13$

Answer: D

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30. Two capillary tubes of lengths in the ratio $2:1$ and radii in the ratio $1:2$ are connected in series. Assume the flow of the liquid through the tube is steady. Then, the ratio of pressure difference across the tubes is

A. $1:8$

B. $1:16$

C. $32:1$

D. $1:1$

Answer: C

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31. Two spherical soap bubbles of diameters 10 cm and 6 cm are formed, one at each end of a narrow horizontal glass tube. If the surface tension of the soap solution is $0.03Nm^{-1}$, then the pressure difference in pascal between the two ends of the tube is

A. 16

B. 1.6

C. 0.016

D. 0.08

Answer: B

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32. The ratio of inetial force to viscous force of a fluid is called

A. coefficient of viscosity

B. surface tension

C. Reynolds number

D. specific gravity

Answer: C

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33. The excess pressure inside one soap bubble is three times that inside a second bubble. The ratio of the volume of first bubble to that of the second

A. $1:27$

B. $27:1$

C. $1:9$

D. $9:1$

Answer: A

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34. Water rises to a height of 20 mm in a capillary. If the radius of the capillary is made one-third of its previous value, then the new value of capillary rise will be

A. $\frac{20}{3} mm$

B. 60 mm

C. $\frac{20}{9} mm$

D. 180 mm

Answer: A

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35. The unit of viscosity in the CGS system is poise (P) and that in SI is poiseuille (Pl). Which of the following statement is correct ?

A. 1 P = 1 Pl

B. 1 P= 10 Pl

C. 10 P = 1Pl

D. None of these

Answer: C

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36. Liquid rises to a height of 2 cm in a capillary tube and the angle of contact between the solid and the liquid is zero. If the tube is depressed more now so that top of capillary is only 1 cm above the liquid, then the apparent angle of contact between the solid and the liquid is

A. 0°

B. 30°

C. 60°

D. 90°

Answer: C

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37. The ratio of radii of two bubbles is $2:1$. What is the ratio of excess pressures inside them ?

A. $1:2$

B. $1:4$

C. $2:1$

D. $4:1$

Answer: A

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38. A solid of density D is floating in a liquid of density d. If V is the volume of solid submerged in the liquid and V is the total volume of the solid, then V/V is equal to

A. $\frac{d}{D}$

B. $\frac{D}{d}$

C. $\frac{D}{d+D}$

D. $\frac{D+d}{D}$

Answer: B

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39. A rectangular vessel when full of water takes 10 minutes to be emptied through an orifice in its bottom. How much time will it take to be emptied when half filled with water

A. 3 min

B. 5 min

C. 7 min

D. 9 min

Answer: C

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40. Water is moving with a speed of $5.18 ms^{-1}$ through a pipe with a cross-sectional area of $4.20 cm^2$. The water gradually descends $9.66m$ as the pipe increase in area to $7.60cm^2$. The speed of flow at the lower level is

A. $2.86ms^{-1}$

B. $3.0ms^{-1}$

C. $3.82ms^{-1}$

D. $5.7ms^{-1}$

Answer: A

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41. A block of ice in which a piece of stone is embedded is floating on water contained in a beaker. When all the ice melts the level of water in the beaker

A. rises

B. falls

C. remains unchanged

D. None of the above

Answer: B

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42. Assertion : The water rises higher in a capillary tube of smell diameter than in the capillary tube of large diameter.

Reason : Height through which liquid rise in capillary tube inversely proportional to the capillary tube.

A. If both Assertion and Reason ar true and Reason is the correct explanation of Assertion.

B. If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

C. If Assertion is true but Reason is false.

D. If both Assertion and Reason are false.

Answer: A

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43. Water rises in plant fibres due to

A. capillarity

B. viscosity

C. fluid pressure

D. osmosis

Answer: A

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44. The excess pressure inside a spherical soap bubble of radius 1 cm is balanced by a column of oil (specific gravity $= 0.8$), 2 mm high, the surface tension of the bubble is

A. $3.92 Nm^{-1}$

B. $0.0392 Nm^{-1}$

C. $0.392 Nm^{-1}$

D. $0.00392 Nm^{-1}$

Answer: B

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45. Water from a tap emerges vertically downwards with initial velocity $4ms^{-1}$. The cross-sectional area of the tap is A. The flow is steady and pressure is constant throughout the stream of water. The distance h vertically below the tap, where the cross-sectional area of the stream becomes $\left(\frac{2}{3}\right)A$ is $\left(g = 10m/s^2\right)$

A. 2 m

B. 1 m

C. 0.5 m

D. 4 m

Answer: B

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46. At $20.$ C, to attain the terminal velocity how fast willan aluminium sphre of radii 1 mm fall though water. Assume flow to be laminar flow and specific gravity (Al)

$= 2.7\eta_{\text{water}} = 8 \times 10^{-4} Pa$

A. $9.2ms^{-1}$

B. $6.9ms^{-1}$

C. $4.6ms^{-1}$

D. $2.3ms^{-1}$

Answer: C

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47. Water flows in a streamline manner through a capillary tube of radius a. The pressure difference being P and the rate of flow is Q . If the radius is reduced to $a/2$ and the pressure difference is increased to 2P, then find the rate of flow.

A. 4Q

B. Q

C. $\frac{Q}{4}$

D. $\frac{Q}{8}$

Answer: D

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48. A rain drop of radius 0.3 mm has a terminal velocity in air 1m/s. the viscosity of air is 18×10^{-5} poise. The viscous force on it is-

A. 101.37×10^{-4} dyne

B. 101.73×10^{-2} dyne

C. 16.95×10^{-5} dyne

D. 16.95×10^{-4} dyne

Answer: B

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49. If two soap bubbles of different radii are connected by a tube

A. air flow from bigger bubble to the smaller bubble till sizes becomes equal

B. air flow from bigger bubble to the smaller bubble till sizes are interchanges

C. air flow from smaller bubble to bigger bubble

D. there is no flow of air

Answer: C

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