PHYSICS

FOR IIT JEE ASPIRANTS OF CLASS 12 FOR PHYSICS

FLUID MECHANICS

SOLVED EXAMPLES

1. If pressure at half the depth of a lake is equal to 2//3 pressure at the bottom of the lake then what is the depth of the lake ?

A. $10m$

B. $20m$

C. $60m$

D. $30m$

Answer: B

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2. Two bodies are in equilibrium when suspended in water from the arms of balance. The mass of one body is 36 g and its density is $9g/cm^3$ If the mass of the other is 46 g, its density in g/cm^3 is

A. $\frac{4}{3}$

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

C. 3

D. 5

Answer: C

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3. An inverted bell lying at the bottom of a lake $47.6m$ deep has $50cm^3$ of air trapped in it. The bell is brought to the surface of the lake. The volume

of the trapped air will be (atmospheric pressure $= 70cm$ of Hg and density of $Hg = 13.6g/cm^3$).

A. $350cm^3$

B. $300cm^3$

C. $250cm^3$

D. $22cm^3$

Answer: B

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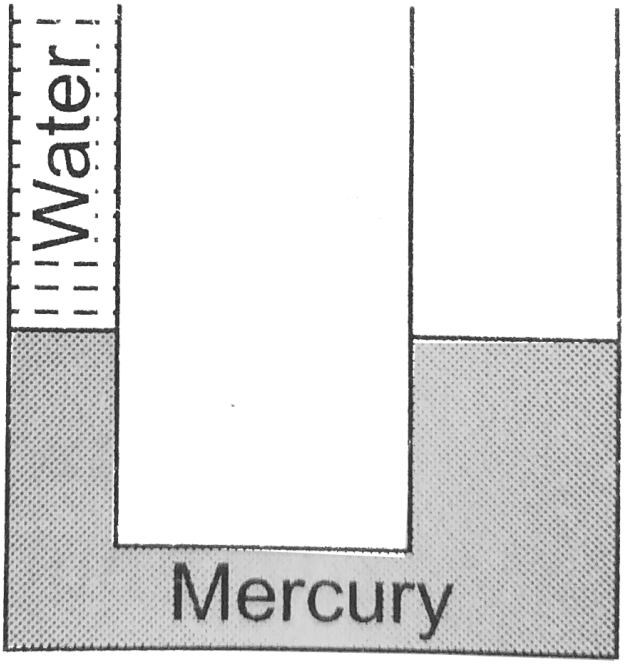
4. A U -tube in which the cross - sectional area of the limb on the left is one quarter, the limb on the right contains mercury $(density 13.6g/cm^3)$. The level of mercury in the narrow limb is at a distance of 36 cm from the upper end of the tube. What will be the rise in the level of mercury in the right limb if the left limb is filled to the top

with water ?



A. $1.2cm$

B. $2.35cm$

C. $0.56cm$

D. $0.8cm$

Answer: C

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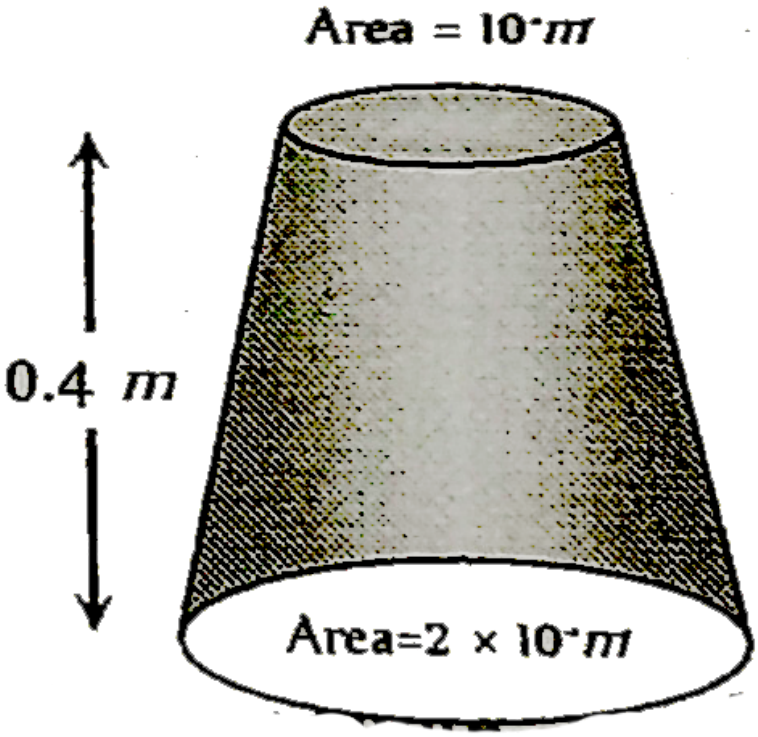
5. A uniformly tapering vessel is filled with a liquid of density $900kg/m$. The force that acts on the base of the vessel due to the liquid is $(g = 10ms^{-2})$



A. $3.6N$

B. $72N$

C. $9.0N$

D. $14.4N$

Answer: B

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6. A tank 5 m high is half filled with water and then is filled to top with oil of density $0.85g/cm^3$ The pressure at the bottom of the tank, due to these liquids is

A. $1.85g/cm^2$

B. $89.25g/cm^2$

C. $462.5g/cm^3$

D. $500g/cm^2$

Answer: C

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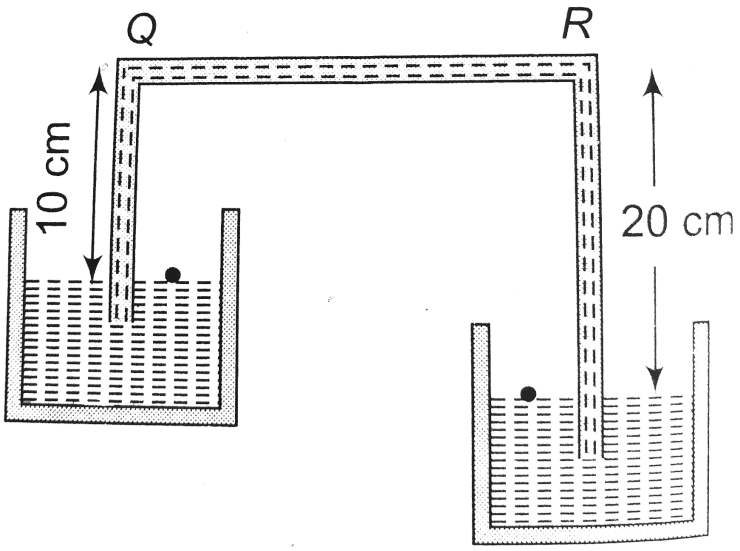
7. A siphon in use is demonstrated in the following in siphon is $1.5gm/cc$.

The pressure difference between the point P and S will be



A. $10^5 N/m$

B. $2 \times 10^5 N/m$

C. Zero

D. Infinity

Answer: C

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8. The height of a mercury barometer is 75 cm at sea level and 50 cm at the top of a hill. Ration of density of mercury to that of air is 10^4. The height of the hill is

A. $250m$

B. $2.5km$

C. $1.25km$

D. $750m$

Answer: B

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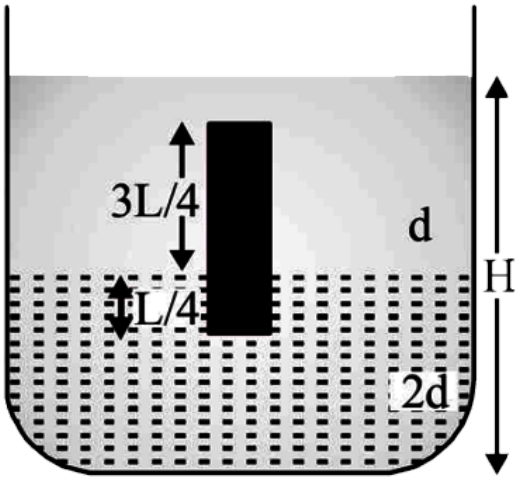
9. A homogeneous solid cylinder of length L(LltH/2), cross-sectional area A/5 is immersed such that it floats with its axis vertical at the liquid-liquid interface with length L/4 in the denser liquid as shown in the figure. The lower density liquid is open to atmosphere having pressure P_0. Then

density D of solid is given by



A. $\frac{5}{4}d$

B. $\frac{4}{5}d$

C. Ad

D. $\frac{d}{5}$

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10. Density of ice is ρ and that of water is σ. What will be the decrease in volume when a mass M of ice melts?

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

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

C. $M\left[\frac{1}{\rho}-\frac{1}{\sigma}\right]$

D. $\frac{1}{M}\left[\frac{1}{\rho}-\frac{1}{\sigma}\right]$

Answer: C

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11. Equal masses of water and a liquid of density 2g/cm3 are mixed together. The density of mixture is:

A. $2/3$

B. $4/3$

C. $3/2$

D. 3

Answer: B

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12. 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. $\rho_1 = 6$ and $\rho_2 = 2$

B. $\rho_1 = 3$ and $\rho_2 = 5$

C. $\rho_1 = 12$ and $\rho_2 = 4$

D. None of these

Answer: A

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13. A body of density d is counterpoised by Mg of weights of density d_1 in air of density d. Then the true mass of the body is

A. M

B. $M\left(1-\frac{d}{d_2}\right)$

C. $M\left(1-\frac{d}{d_1}\right)$

D. $\frac{M(1-d/d_2)}{(1-d/d_1)}$

Answer: D

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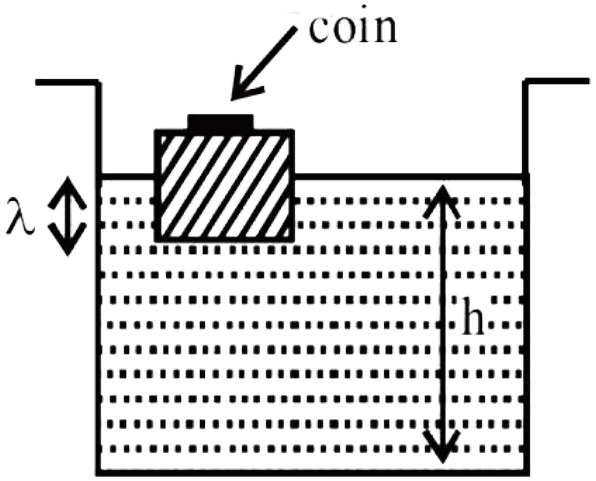
14. A wooden block, with a coin placed on its top, floats in water as shown in figure. The distance l and h are shown here. After some time the coin

falls into water. Then



A. l decreases and h increases

B. l increases and h decreases

C. Both l and h increase

D. Both l and h decrease

Answer: D

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15. A hemispherical bowl just floats without sinking in a liquid of density $1.2 \times 10^3 kg/m^3$. If outer diameter and the density of the bowl are $1m$ and $2 \times 10^4 kg/m^3$ respectively, then the inner diameter of bowl will be

A. $0.94m$

B. $0.97m$

C. $0.98m$

D. $0.99m$

Answer: C

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16. In making an alloy, a substance of specific gravity s_1 and mass m_1 is mixed with another substance of specific gravity of the alloy is

A. $\left(\frac{m_1 + m_2}{s_1 + s_2}\right)$

B. $\left(\frac{s_1 s_2}{m_1 + m_2}\right)$

C. $\frac{m_1 + m_2}{\left(\frac{m_1}{s_1} + \frac{m_2}{s_2}\right)}$

D. $\frac{\left(\frac{m_1}{s_1} + \frac{m_2}{s_2}\right)}{m_1 + m_2}$

Answer: C

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17. A concrete sphere of radius R has cavity of radius r which is packed with sawdust. The specific gravities of concrete and sawdust are respectively $2.4 \text{ and } 0.3$ for this sphere to float with its entire volume submerged under water. Ratio of mass of concrete to mass of swadust will be

A. 8

B. 4

C. 3

D. Zero

Answer: B

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18. A vessel contains oil (density $= 13.6 gm/cm^3$). A uniform sphere floats with half its volume immersed in mercury and the other half in oil. The density of the material of sphere in gm/cm^3 is:

A. 3.3

B. 6.4

C. 7.2

D. 12.8

Answer: C

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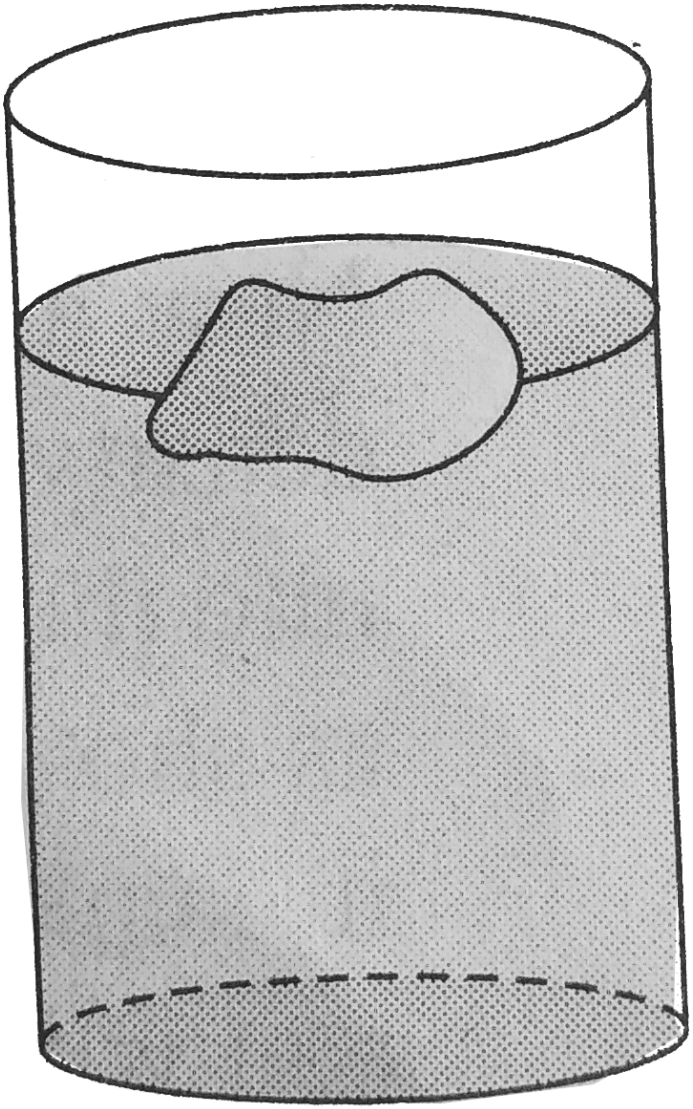
19. A body floats in a liquid contained in a beaker. The whole system as shown falls freely under gravity. The upthrust on the body due to the liquid is



A. Zero

B. Equal to the weight of the liquid displaced

C. Equal to the weight of the body in air

D. Equal to the weight of the immersed position of the body

Answer: A

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20. If a block of iron (density $5gcm^{-3}$) is size 5 cm x 5 cm x 5 cm was weight while completely submerged in water, what would be the apparent weight ?

A. $5 \times 5 \times 5 \times 5gf$

B. $4 \times 4 \times 4 \times 4gf$

C. $5 \times 4 \times 4 \times 4gf$

D. $4 \times 5 \times 5 \times 5gf$

Answer: D

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21. A wooden block of volume $1000cm^3$ is suspended from a spring balance its weight is 12 N in air. It is suspended in water such that half of the block is below the surface of water. The reading of spring balance is

A. $10N$

B. $9N$

C. $8N$

D. $7N$

Answer: D

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22. An iceberg is floating partially immersed in sea water the density of sea water is 1.03 gm/cm^3 and that of ice is $0.92gm/cm^3$ what is the fraction of the total volume of the iceberg above the level of sea-water?

A. 3%

B. 11%

C. 89%

D. 92%

Answer: C

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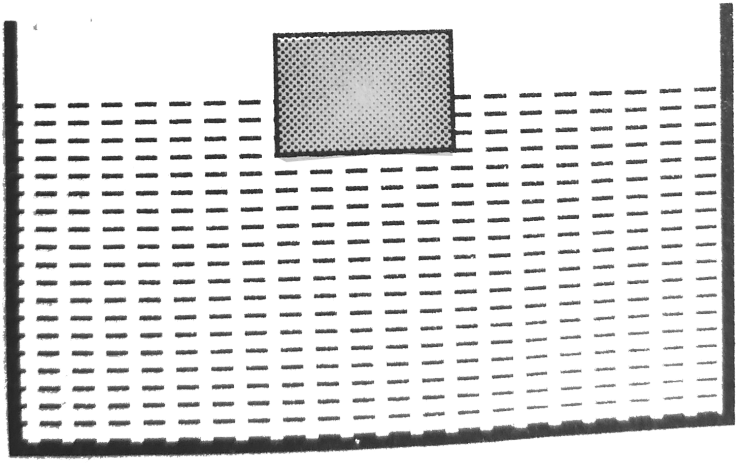
23. A cubical block is floating in a liquid with half of its volume immersed in the liquid. When the whole system accelerates upwards with

acceleration of $g/3$, the fraction of volume immersed in the liquid will be



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

B. $\frac{3}{8}$

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

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

Answer: A

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24. A silver ingot weighing 2.1 kg is held by a string so s to be completely immersed in a liquid of relative density 0.8. The relative density of silver is 10.5. The tension in the string in $kg - wt$ is

A. 1.6

B. 1.94

C. 3.1

D. 5.25

Answer: B

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25. A sample of metal weights 210 grams in air 180 grams n water and 120 grams in an unknown liquid then

A. Metal of 3

B. Metal is 7

C. Liquid of 3

D. Liquid is $\frac{1}{3}$

Answer: B::C

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26. Two solids A and B floats in water. It is observed that A floats with half of its volume immersed and B Floats with $2/3$ of its volume immersed. The ratio of densities of A and B is

A. $4:3$

B. $2:3$

C. $3:4$

D. $1:3$

Answer: C

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27. The fraction of a floating object of volume V_0 and density d_0 above the surface of a liquid of density d will be

A. $\frac{d_0}{d}$

B. $\frac{dd_0}{d+d_0}$

C. $\frac{d-d_0}{d}$

D. $\frac{dd_0}{d-d_0}$

Answer: C

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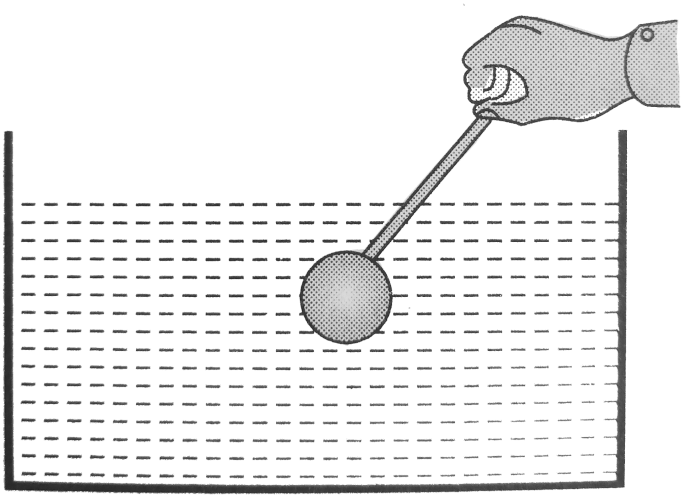
28. A vessel with water is placed on a weighing pan and reads $600g$. Now a ball of 40g and density $0.80g/cc$ is sunk into the water with a pin as

shown in fig. keeping it sunk. The weighing pan will show a reading



A. $600g$

B. $550g$

C. $650g$

D. $632g$

Answer: C

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29. Two water pipes of diameters 2 cm and 4 cm are connected with the main supply line. The velocity of flow of water in the pipe of 2 cm

A. 4 times that in the other pipe

B. $\frac{1}{4}$ times that in the other pipe

C. 2 times that in the other pipe

D. $\frac{1}{2}$ times that in the other pipe

Answer: A

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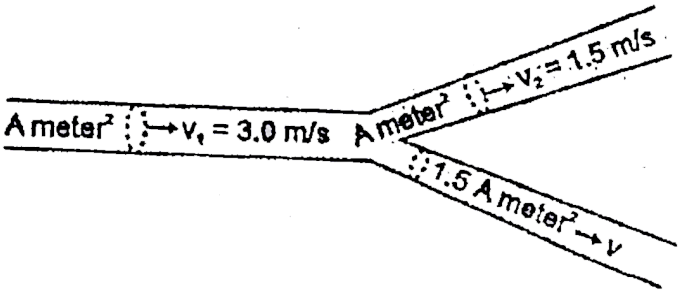
30. An incompressible liquid flows through a horizontal tube as shown in the figure. Then the velocity 'v' of the fluid is:



A. $3.0m/s$

B. $1.5m/s$

C. $1.0m/s$

D. $2.25m/s$

Answer: C

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31. Water enters through end A with a speed v_1 and leaves through end B with a speed v_2 of cylindrical tube AB. The tube is always completely filled with water. In case I the tube is horizontal, in case II it vertical with the

end A upward and in case III it is vertical with the end B upward. We have $v_1 = v_2$for

A. Case I

B. Case II

C. Case III

D. Each case

Answer: D

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32. Water is moving with a speed of $5.18ms^{-1}$ through a pipe with a cross-sectional area of $4.20cm^2$. 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. $3.0ms^{-1}$

B. $5.7ms^{-1}$

C. $3.82ms^{-1}$

D. $2.86ms^{-1}$

Answer: D

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33. The velocity of kerosene oil in a horizontal pipe is $5m/s$. If $g = 10m/s^2$ then the velocity head of oil wlill be

A. $1.25m$

B. $12.5m$

C. $0.125m$

D. $125m$

Answer: A

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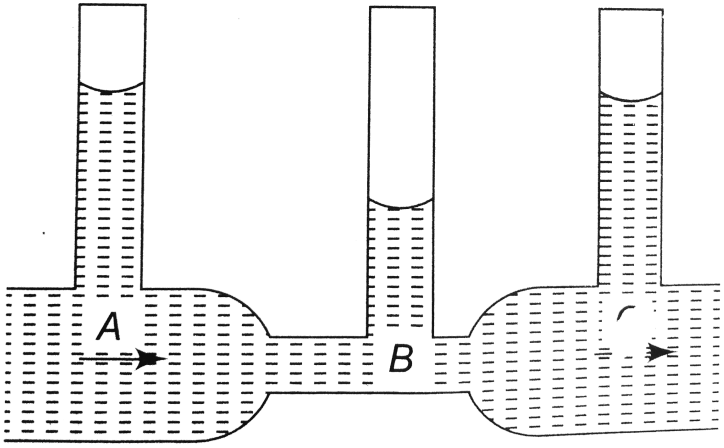
34. In the following fig., the flow of liquid through a horizontal pipe is shown. Three tubes A, B and C are connected to the pipe. The radii of the tubes A, B and C at the junction are respectively $2cm, 1cm$ and $2cm$. It can be said that the



A. Height of the liquid in the tube A is maximum

B. Height of the liquid in the tubes A and B is the same

C. Height of the liquid in all the three tubes is the same

D. Height of the liquid in the tubes A and C is the same

Answer: D

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35. A liquid is kept in a cylindrical vessel which is being rotated about a vertical axis through the centre of the circular base. If the radius of the vessel is r and angular velocity of rotation is ω, then the difference in the heights of the liquid at the centre of the vessel and the edge is.

A. $\frac{r\omega}{2g}$

B. $\frac{r^2\omega^2}{2g}$

C. $\sqrt{2gr\omega}$

D. $\frac{\omega^2}{2gr^2}$

Answer: B

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36. A manometer connected to a closed tap reads $3.5 \times 10^5 N/m^2$.When the value is opened, the reading of manometer fall is $3.0 \times 10^5 N/m^2$, then velocity of flow of water is

A. $100m/s$

B. $10m/s$

C. $1m/s$

D. $10\sqrt{10}m/s$

Answer: B

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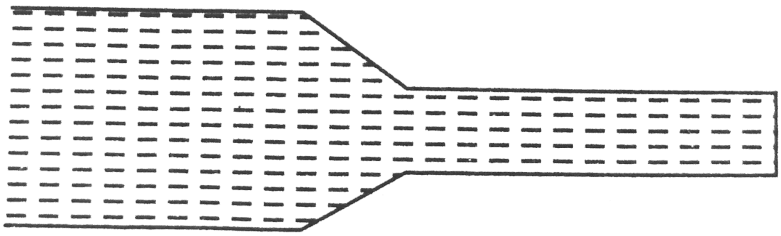
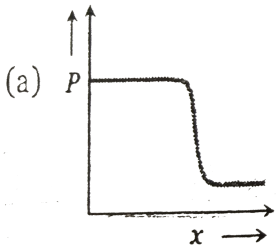
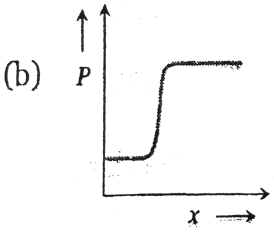
37. Water flows through a frictionless duct with a cross-section varying as shown in fig. Pressure p at points along the axis is represented by



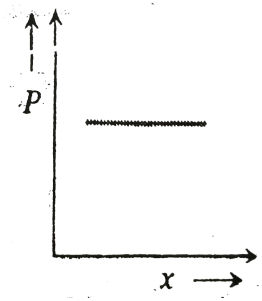
A.



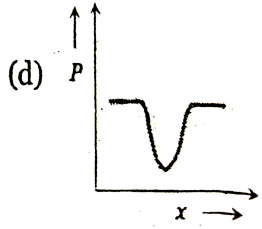
B.



C.



D.



Answer: A

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38. Air is streaming past a horizontal airplane wing such that its speed is $90ms^{-1}$ at the lower surface and $120ms^{-1}$ over the upper surface. The wing is $10m$ long and has an average width of $2m$, the difference of pressure on the two sides and the gross lift on the wing respectively, are (density of air $= 1.3kgm^{-3}$)

A. 4095.0 pascal

B. 409.50 pascal

C. 40.950 pascal

D. 4.0950 pascal

Answer: A

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39. A large tank filled with water to a height h is to be emptied through a small hole at the bottom. The ratio of times taken for the level of water to fall from h to $\frac{h}{2}$ and from $\frac{h}{2}$ to zero is

A. $\sqrt{2}$

B. $\frac{1}{\sqrt{2}}$

C. $\sqrt{2}-1$

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

Answer: C

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40. A cylinder of height 20m is completely filled with water. The velocity of effux of water $\left(\in ms^{-1}\right)$ through a small hole on the side wall of the cylinder near its bottom is

A. 10

B. 20

C. 25.5

D. 5

Answer: B

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

A. $\sqrt{400}m/s$

B. $\sqrt{600}m/s$

C. $\sqrt{600}m/s$

D. None of these

Answer: B

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42. 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. $2\pi L$

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

C. L

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

Answer: B

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43. 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. t

B. $4t$

C. $2t$

D. $t/4$

Answer: C

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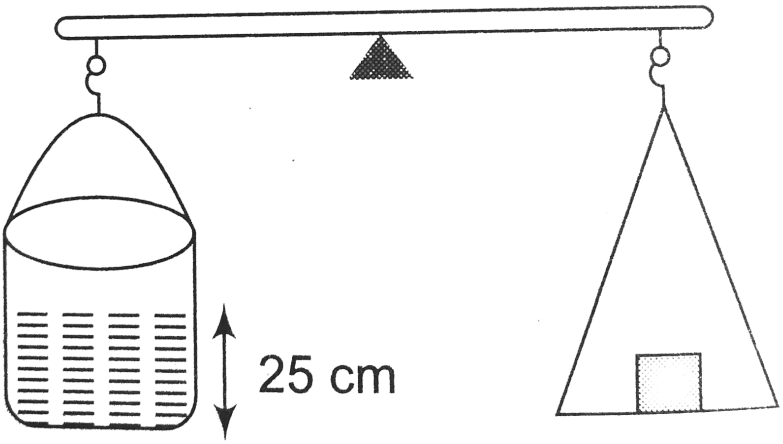
44. A cylinder containing water up to a height of $25cm$ has a hole of cross-section $\frac{1}{4}cm^2$ in its bottom. It is counterpoised in a balance. What is the initial change in the balancing weight when water begin to flow

out?



A. Increase of $12.5gm - wt$

B. Increase of $6.25gm - wt$

C. Decrease of $12.5gm - wt$

D. Decrease of $6.25gm - wt$

Answer: C

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45. A cylindrical tank has a hole of 1 cm in its bottom. If the water is allowed to flow into the tank from a tube above it at the rate of $70cm/\sec$. then the maximum height up to which water can rise in the tank is

A. $2.5cm$

B. $5cm$

C. $10cm$

D. $0.25cm$

Answer: A

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46. A square plate of 0.1 m side moves parallel to a second plate with a velocity of $0.1m/s$, both plates being immersed in water. If the viscous force is 0.002 N and the coefficient of viscosity is 0.01 poise , distance between the plates in m is

A. 0.1

B. 0.05

C. 0.005

D. 0.0005

Answer: D

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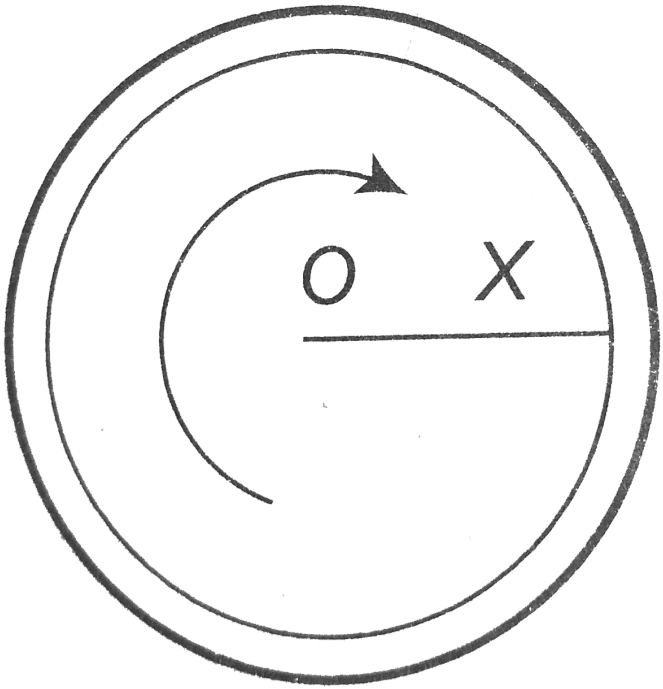
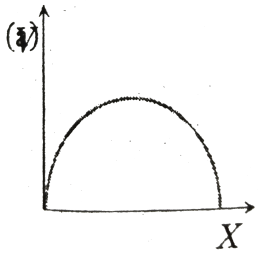
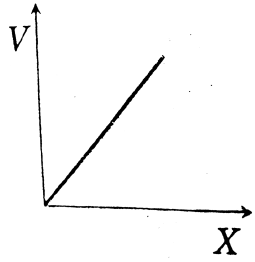
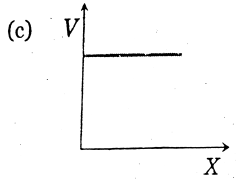


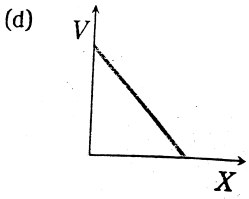
47.

The diagram shows a cup of tea seen from above. The tea has been stirred and is now rotating without turbulence. A graph showing the speed v with which the liquid is crossing points at a distance X from O along a radius OX would took like

A. 

B. 

C. 

D. 

Answer: D

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48. Spherical balls of radius 'R' are falling in a viscous fluid of viscosity $'\eta'$ with a velocity 'v'. The retarding viscous force acting on the spherical ball is

A. Inversely proportional to 'r' but direcly proportional to velocity 'v'

B. Directly proportional to both radius 'r' and velocity 'v'

C. Inversely proportional to both radius 'r' and velocity 'v'

D. Directly proportional to 'r' but inversely proportional to 'v'

Answer: B

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49. A small sphere of mass m is dropped from a height After it has fallen 100 m it has attained its terminal velocity and continues to fall at that speed. The work done by air friction against the sphere during the first 100 m of fall is-

A. Greater than the work done by air friction in the second $100m$

B. Less than the work done by air friction in the second $100m$

C. Equal to $100mg$

D. Greater than $100mg$

Answer: B

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50. Two drops of the same radius are falling through air with a steady velcoity of $5cms^{-1}$. If the two drops coalesce, the terminal velocity would be

A. $10cmper\sec$

B. $2.5cmper\sec$

C. $5\times(4)^{1/3}cm\quad per\sec$

D. $5\times\sqrt{2}cm\quad per\sec$

Answer: C

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51. A ball of radius r and density r falls freely under gravity through a distance h before entering water. Velocity of ball does not change even on entering water. If viscosity of water is η the value of h is given by

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A. $\frac{2}{9}r^2\left(\frac{l-\rho}{\eta}\right)g$

B. $\frac{2}{81}r^2\left(\frac{\rho-1}{\eta}\right)g$

C. $\frac{2}{81}r^4\left(\frac{\rho-1}{\eta}\right)^2 g$

D. $\frac{2}{9}r^4\left(\frac{\rho-1}{\eta}\right)^2 g$

Answer: C

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52. The rate of steady volume flow of water through a capillary tube of length ' l ' and radius ' r ' under a pressure difference of P is V . This tube

is connected with another tube of the same length but half the radius in series. Then the rate of steady volume flow through them is (The pressure difference across the combination is P)

A. $\frac{V}{16}$

B. $\frac{V}{17}$

C. $\frac{16V}{17}$

D. $\frac{17V}{16}$

Answer: B

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53. A liquid is flowing in a horizontal uniform capillary tube under a constant pressure difference P . The value of pressure for which the rate of flow of the liquid is doubled when the radius and length both are doubled is

A. P

B. $\frac{3P}{4}$

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

D. $\frac{P}{4}$

Answer: D

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54. Two capillary tubes of same radius r but of lengths l_1 and l_2 are fitted in parallel to the bottom of a vessel. The pressure to the bottom of a vessel. The pressure head is P. What should be the length of a single tube of same radius that can replace the two tubes so that the rate of flow is same as before?

A. $l_1 + l_2$

B. $\frac{l}{l_1} + \frac{l}{l_2}$

C. $\frac{l_1 l_2}{l_1 + l_2}$

D. $\frac{l}{l_1 + l_2}$

Answer: C

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55. We have two (narrow) capillary tubes T and T . Their lengths are l and l and radii of cross-section are r and r respectively. The rate of flow of water under a pressure difference P through tube T is $8cm3/\sec$. If $l = 2l$ and $r = r$ what will be the rate of flow when the two tubes are connected in series and pressure difference across the combinatin is same as before $(= P)$

A. $4cm^3/\sec$

B. $(16/3)cm^3/\sec$

C. $(8/17)cm^3/\sec$

D. None of these

Answer: B

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56. A capillary tube is attached horizontally to a constant pressure head arrangement. If the radius of the capillary tube is increased by $10\ \%$, then the rate of flow of the liquid shall change nearly by

A. $+10\ \%$

B. $+46\ \%$

C. $-10\ \%$

D. $-40\ \%$

Answer: B

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57. A wooden stick 2m long is floating on the surface of water. The surface tension of water 0.07 N/m. By putting soap solution on one side of the sticks the surface tension is reduced to 0.06 N/m. The net force on the stick will be

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58. 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. If the disc displaces 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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59. 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. $0.1N/m$

B. $0.2N/m$

C. $0.001N/m$

D. $0.002N/m$

Answer: A

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60. 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. $\pi R^2/T$

B. $\pi R^2 T$

C. $2\pi RT$

D. $2RT$

Answer: D

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61. A liquid is filled into a semi elliptical cross section with a as semi major axis and b as semi minor axis. The ratio of surface tension forces on the curved part and the plane part of the tube in vertical position will be

A. $\frac{\pi(a+b)}{4b}$

B. $\frac{2\pi a}{b}$

C. $\frac{\pi a}{4b}$

D. $\frac{\pi(a-b)}{4b}$

Answer: A

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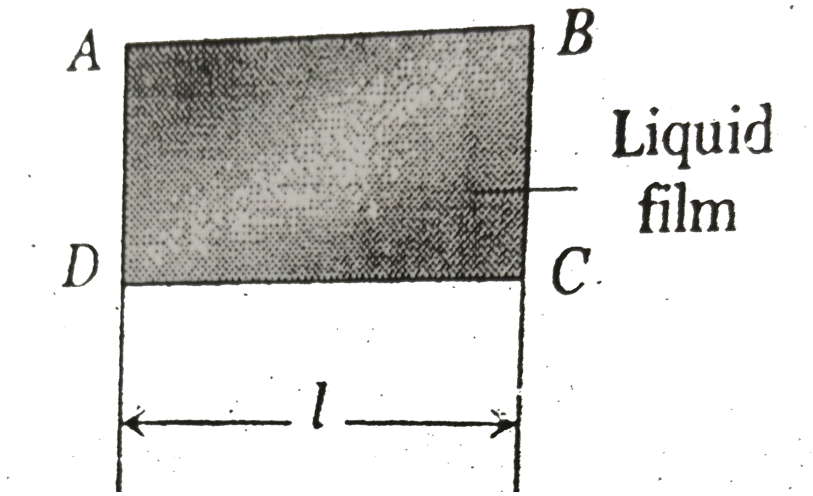
62. A liquid film is formed over a frame $ABCD$ as shown in figure. Wire CD can slide without friction. The mass to be hung from CD to keep it in equilibrium is



A. $\frac{Tl}{g}$

B. $\frac{2Tl}{g}$

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

D. $T \times l$

Answer: B

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63. Two small drops of mercury, each of radius R, coalesce to form a single large drop. The ratio of the total surface energies before and after the change is

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64. Radius of a soap bubble is increased from R to 2 R work done in this process in terms of surface tension is

A. $24\pi R^2 S$

B. $48\pi R^2 S$

C. $12\pi R^2 S$

D. $36\pi R^2 S$

Answer: A

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65. The work done in blowing a soap bubble of 10 cm radius is (Surface tension of the soap solution is $\frac{3}{100}$ N/m)

A. $75.36 \times 10^{-4} J$

B. $37.68 \times 10^{-4} J$

C. $150.72 \times 10^{-4} J$

D. 75.3^{6J}

Answer: A

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66. A drop of mercury of radius 2 mm is split into 8 identical droplets. Find the increase in surface energy. Surface tension of mercury $= 0.465 Jm^{-2}$

A. $23.4 \mu J$

B. $18.5 \mu J$

C. $26.8\mu J$

D. $16.8\mu J$

Answer: A

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67. The work done in increasing the size of a soap film from $10cm \times 6cm$ to $10cm \times 11cm$ is 3×10^{-4} Joule. The surface tension of the film is

A. $1.5 \times 10^{-2} Nm^{-1}$

B. $3.0 \times 10^{-2} Nm^{-1}$

C. $6.0 \times 10^{-2} Nm^{-1}$

D. $11.0 \times 10^{-2} Nm^{-1}$

Answer: B

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68. A film of water is formed between two straight parallel wires of length 10 cm each separated by $0.5cm$ If their separation is increased by $1mm$ while still maintaining their parallelism, how much work will have to be done (Surface tension of water $= 7.2 \times 10^{-2} \frac{N}{m}$)

A. $7.22 \times 10^{-6} J$

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

C. $2.88 \times 10^{-5} J$

D. $5.76 \times 10^{-5} J$

Answer: B

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69. The work done in blowing a bubble of volume V is W, then what is the work done in blowing a soap bubble of volume $2V$?

A. $W/2$

B. $\sqrt{2}W$

C. $.^{3}\sqrt{2}W$

D. $.^{3}\sqrt{4}W$

Answer: D

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70. Several spherical drops of a liquid of radius r coalesce to form a single drop of radius R. If T is surface tension and V is volume under consideration, then the release of energy is

A. $3VT\left(\frac{1}{r}+\frac{1}{R}\right)$

B. $3VT\left(\frac{1}{r}-\frac{1}{R}\right)$

C. $VT\left(\frac{1}{r}-\frac{1}{R}\right)$

D. $VT\left(\frac{1}{r^2}+\frac{1}{R^2}\right)$

Answer: B

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71. The pressure inside a small air bubble of radius $0.1mm$ situated just below the surface of water will be equal to $\left(\text{Take surface tension of water} 70 \times 10^{-3} 1^{J} m^{-1} \text{and atmospheric pressure} =\right.$

A. $2.054 \times 10^{3} Pa$

B. $1.027 \times 10^{3} Pa$

C. $1.027 \times 10^{5} Pa$

D. $2.054 \times 10^{5} Pa$

Answer: C

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72. If the radius of a soap bubble is four times that of another, then the ratio of their pressures will be

A. $1:4$

B. $4:1$

C. $16:1$

D. $1:16$

Answer: A

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73. Pressure inside two soap bubbles are 1.01 and 1.02 atmospheres. Ratio between their volumes is

A. $102:101$

B. $(102)^3:(101)^3$

C. $8:1$

D. $2:1$

Answer: C

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74. The excess pressure inside an air bubble of radius r just below the surface of water is P_1. The excess pressure inside a drop of the same radius just outside the surface is P_2. If T is surface tension then

A. $P_1 = 2P_2$

B. $P_1 = P_2$

C. $P_2 = 2P_1$

D. $P_2 = 0, P_1 \neq 0$

Answer: B

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

? If the first capillary tube is inclined at an angle of 60° with the vertical then what will be the position of water in the tube.

A. $2.0cm$

B. $4.0cm$

C. $\frac{4}{\sqrt{3}}cm$

D. $2\sqrt{2}cm$

Answer: B

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76. Two capillary tubes of same diameter are put vertically one each in two liquids whose relative densities are 0.8 and 0.6 and surface tensions are 60 dyne/cm and 50 dyne/cm respectively. Ratio of heights of liquids in the two tubes $\frac{h_1}{h_2}$ is

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77. 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

B. $2M$

C. $M/2$

D. $4M$

Answer: B

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78. Water rises to a height h in a capillary at the surface of earth. On the surface of the moon the height of water column in the same capillary will be-

A. $6h$

B. $\frac{1}{6}h$

C. h

D. Zero

Answer: A

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79. If the surface tension of water is 0.06 Nm, then the capillary rise in a tube of diameter 1mm is $(\theta = 0^\circ)$

A. $1.22cm$

B. $2.44cm$

C. $3.12cm$

D. $3.86cm$

Answer: B

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80. Two capillaries made of same material but of different radii are dipped in a liquid. The rise of liquid in one capillary is 2.2 cm and that in the other is 6.6 cm . The ratio of their radii is

A. $9:1$

B. $1:9$

C. $3:1$

D. $1:3$

Answer: C

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81. The lower end of a capillary tube is at a depth of $12cm$ and water rises $3cm$ in it. The mouth pressure required to blow an air bubble at the lower end will be xcm of water column, where x is

A. 3

B. 9

C. 12

D. 15

Answer: D

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82. The lower end of a capillary tube of radius r is placed vertically in water of density ρ , surface tension S. The rice of water in the capillary tube is upto height h, then heat evolved is

A. $+\frac{\pi^2 r^2 h^2}{J} dg$

B. $+\frac{\pi r^2 h^2 dg}{2J}$

C. $-\frac{\pi r^2 h^2 dg}{2J}$

D. $-\frac{\pi r^2 h^2 dg}{J}$

Answer: B

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83. 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 6×10^-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

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84. The radii of two soap bubbles are r_i and r_2. In isothermal conditions, two meet together in vacuum. Then the radius kof the resultant bubble is given by

A. $R = (r_1 + r_2)/2$

B. $R = r_1(r_1 r_2 + r_2)$

C. $R^2 = r_1^2 + r_2^2$

D. $R = r_1 + r_2$

Answer: C

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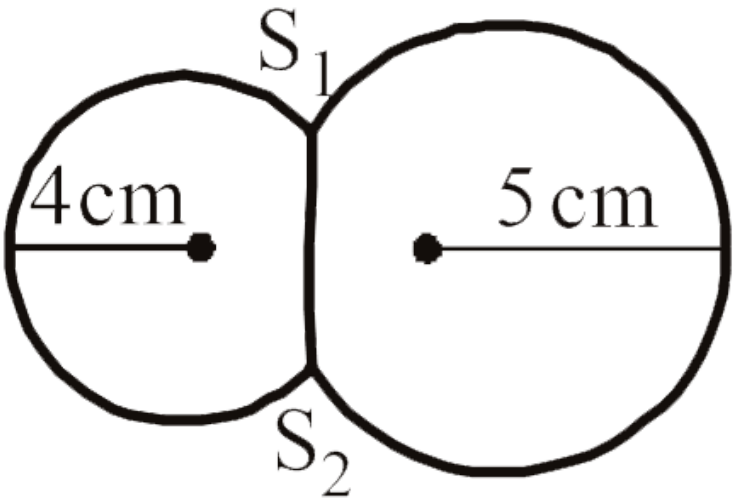
85. Two soap bubbles of radii r_1 and r_2 equal to 4 cm and 5 cm are touching each other over a common surface $S_1 S_2$ (shown in figure). Its

radius will be



A. $4cm$

B. $20cm$

C. $5cm$

D. $4.5cm$

Answer: B

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86. An air bubble in a water tank rises from the bottom to the top. Which of the following statements are true?

A. Bubble rises upwards because pressure at the bottom is less than that at the top

B. Bubble rises upwards because pressure at the bottom is greater then that at the top

C. As the bubble rises, its size increases

D. As the bubble rises, its size decrease

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87. The radii of two soap bubbles are R_1 and R_2 respectively. The ratio of masses of air in them will be

A. $\frac{R_1^3}{R_2^3}$

B. $\frac{R_2^3}{R_1^3}$

C. $\left(\frac{P+\frac{4T}{R_1}}{P+\frac{4T}{R_2}}\right)\frac{R_1^3}{R_2^3}$

D. $\left(\frac{P+\frac{4T}{R_2}}{P+\frac{4T}{R_1}}\right)\frac{R_2^3}{R_1^3}$

Answer: C

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88. On dipping one end of a capiilary in liquid and inclining the capillary at an angles 30° and 60° with the vertical, the lengths of liquid columns in it are found to be l_1 and l_2 respectively. The ratio of l_1 and l_2 is

A. $1:\sqrt{3}$

B. $1:\sqrt{2}$

C. $\sqrt{2}:1$

D. $\sqrt{3}:1$

Answer: A

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89. A drop of water of volume V is pressed between the two glass plates so as to spread to an area. A. If T is the surface tension, the normal force required to separate the glass plates is

A. $\frac{TA^2}{V}$

B. $\frac{2TA^2}{V}$

C. $\frac{4TA^2}{V}$

D. $\frac{TA^2}{2V}$

Answer: B

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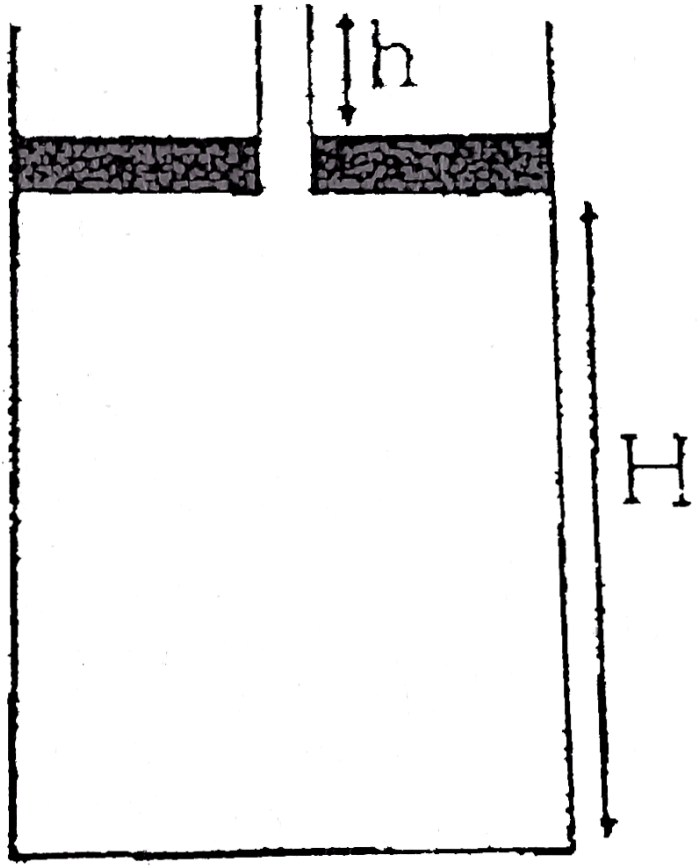
EXERCISE # I



1.

A piston of mass M=3kg and radius R=4cm has a hole into which a thin pipe of radius r=1 cm is inserted the piston can enter a cylinder tightly and without friction an initially it is at the bottom of the cylinder 750 gm of water is now poured into the pipe so that the piston&pipe and lifted up as shown find the height H of water in the cylinder and height h of water in the pipe.

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2. 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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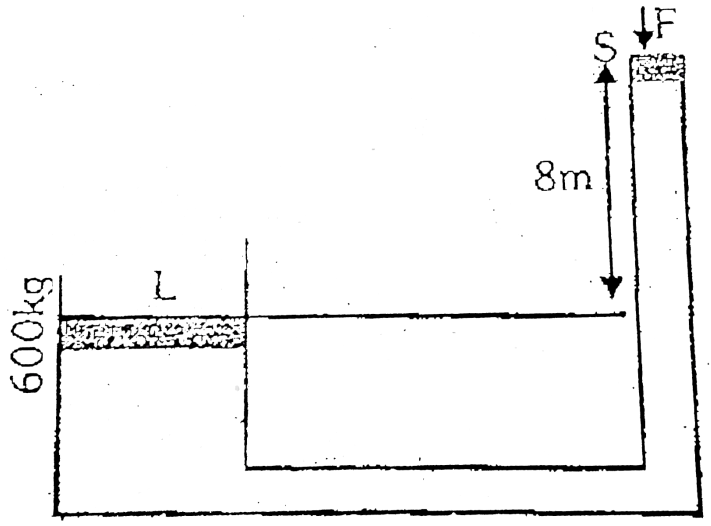
3.



For the system shown in the 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 $\left(\rho = 0.75gm/cm^3\right)$ find the force F required to hold the system in equilibrium.

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4. (a) A spherical tank of $1.2m$ radius is half filled with oil of relaive density 0.8. If the tank is given a horizontal acceleration of $10m/s^2$. Calculate the inclination of the oil surface to horizontal and maximum pressure on the tank.

(b) The volume of an air bubble is doubled as it rises from the bottom of a lake to its surface. If the atmospheric pressure is Hm of mercury $\&$ the density of mercury is n times that of lake water. Find the depth of the lake.

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5. A test tube of thin walls has some lead shots in it at its bottom and the system floats vertically in water,sinking by a length $l_o = 10cm$. A

liquid of density less than that of water, is poured into the tube till the levels inside and outside the tube are even. If the tube now sinks to a length $l_o = 40cm$, the specific gravity of the liquid is___.

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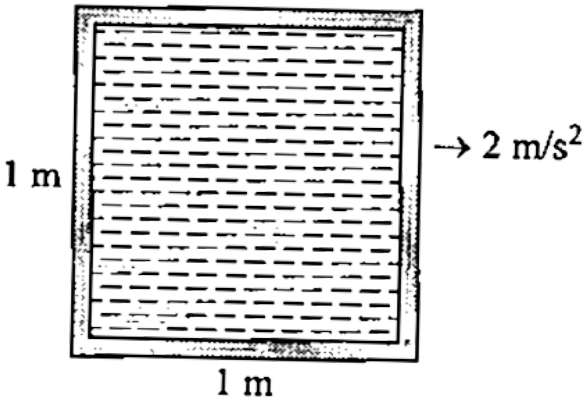
6. An open cubical tank completely filled with water is kept on a horizontal surface. Its acceleration is then slowly increasesd to $2m/s^2$ as shown in the figure. The side of the tank is 1m. Find the mass of water that would spill out of the tank.



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7. Computer the work which must be performed to slowly pump the water out of a hemispherical reservoir of radius $R = 0.6m$.

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8. A vertical uniform U tube open at both ends contains mercury. Water is poured in one limb until the level of mercury is depressed $2cm$ in that limb. What is the length of water column when this happens.

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9. An expansible balloon filled with air floats on the surface of a lake with $2/3$ of its volume submerged. How deep must it be sunk in the water so that it is just in equilibrium neither sinking further nor rising? Is is assumed that the temperature of the water is constant $\&$ that the height of the water barometer is 9 meters.

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10. In a sonometer wire, the tension is maintained by suspending a 50.7 kg mass from the free end of the wire. The suspended mass has a volume of 0.0075 m 3. The fundamental frequency of the wire is 260 Hz . If the suspended mass is completely submerged in water, the fundamental frequency will become (take $g = 10ms^{-2}$) [

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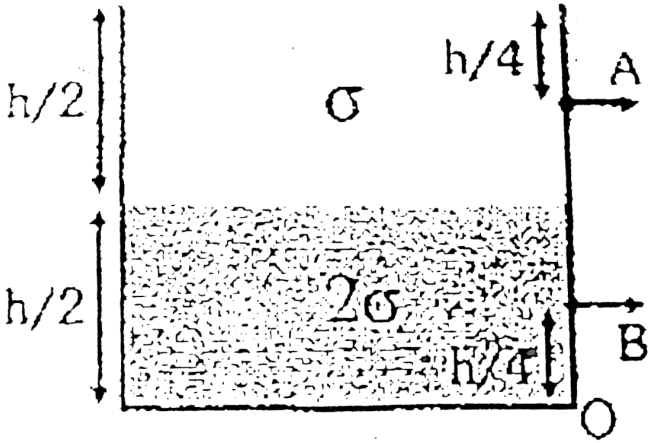

11.

A large tank is filled with two liquids of specific gravities 2σ and σ. Two holes are made on the wall of the tank as shown. Find the ratio of the

distance from O of the points on the ground where the jets from holes A & B strike.

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12. A jet of water having veloctiy $= 10m/s$ and stream cross-section $= 2cm^2$ hits a flat plate perpendicularly, with the water splashing out parallel to plate. Find the force that the plate experiences.

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13. A laminar stream is flowing vertically down from a tap of cross-section area $1cm^2$. At a distance 10 below the tap, the cross-section area of the stream has reduced to $1/2cm^2$. Find the volumetric flow rate of water from the tap.

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14. 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 $10^2cm^3/s$. The height of water in the vessel under steady state is (Take $g = 10m/s^2$).

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15. 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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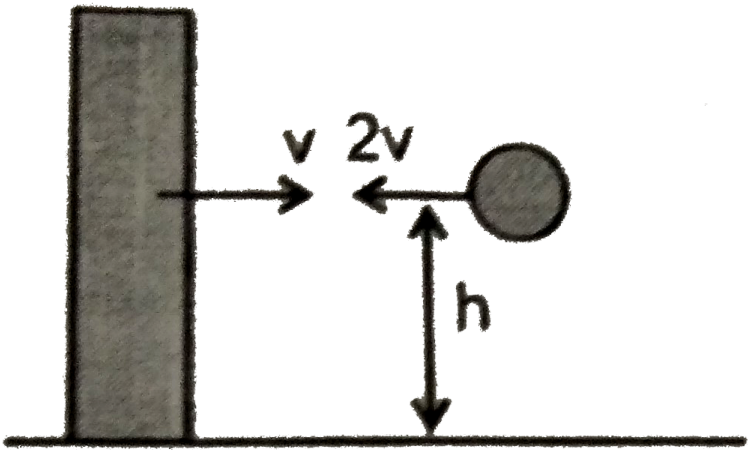
16. A ball collides elastically with a massive wall moving towards it with a velocity of v as shown. The collision occurs at a height of h above ground level and the velocity of the ball just before collision is $2v$ in horizontal direction. The distance between the foot of the wall and the point on the

ground where the ball lands, at the instant the ball lands, will be :



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17. 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 $9.8 \times 10^{-6} N - s/m^2$

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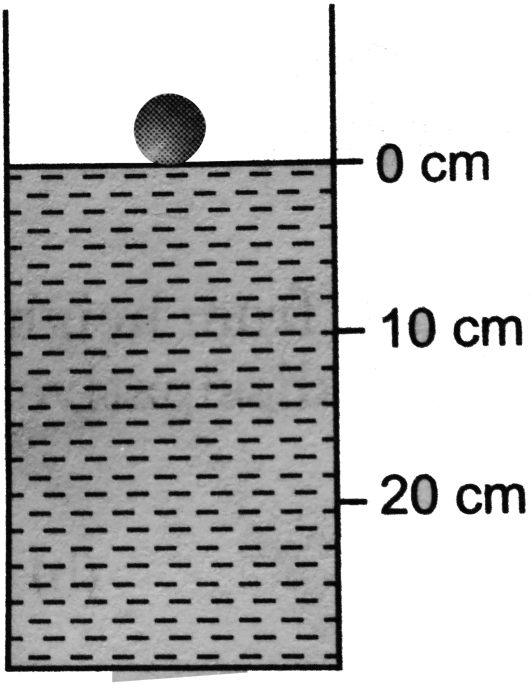
18. A spherical ball of density ρ and radius$0.003m$ is dropped into a tube containing a viscous fluid up to the 0 cm mark as shown in the figure. Viscosity of the fluid $= 1.26N - s/m^2$ and its density $\rho_L = \frac{\rho}{2} = 1260kg/m^3$. Assume that the ball reaches a terminal speed at 10cm mark.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



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19. 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 $1.0 \times 10^{3} kg/m^{3}$.

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

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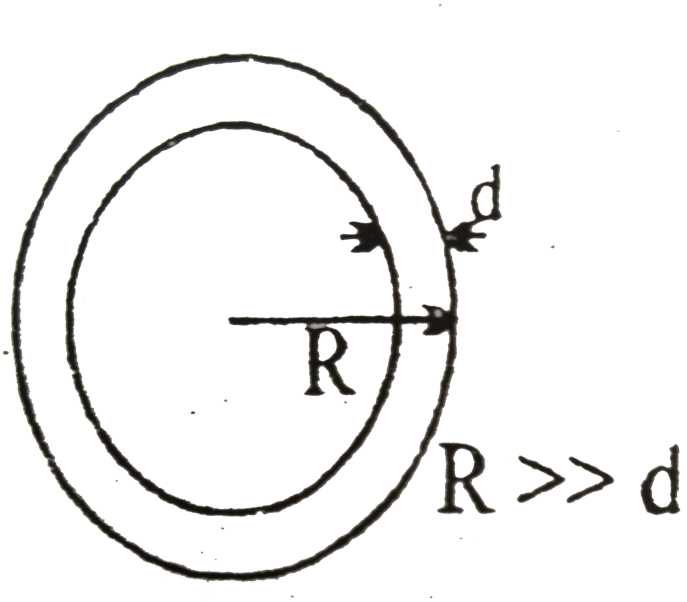
20. A soap bubble has radius R and thickness $d(< < R)$ as shown. It collapses into a spherical drop. The ratio of excess pressure in the drop

to the excess pressure inside the bubble is



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21. 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 $r = \frac{r_1 r_2}{r_2 - r_1}$

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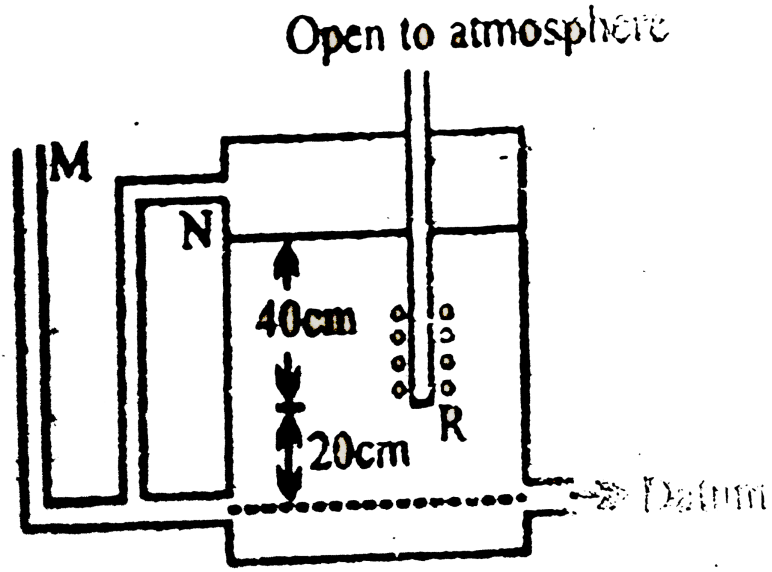
EXERCISE # II

1. The tank in fig discharge water at constant rate for all water levels above the air inlet R The height above datum to which water would rise in the manometer tubes M and N respectively are _ _ _ & _ _ _



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2. A solid cube, with faces either vertical or horizontal, is floating in a liquid of density $6g/cc$. It has two third of its volume submerged. If enough water is added from the top so as to completely cover the cube, what fraction of its volume will remain immersed in the liquid?

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3. A glass beaker is placed partially filled with water in a sink it has a mass of 390 gm and an interior volume of $500cm^2$ when water starts filling the sink, it is found that if beaker is less than half full it will float but if it is more than half full it remains on the bottom of the sink as the water rises to its rim, what is the density of the material of which the beaker is made?

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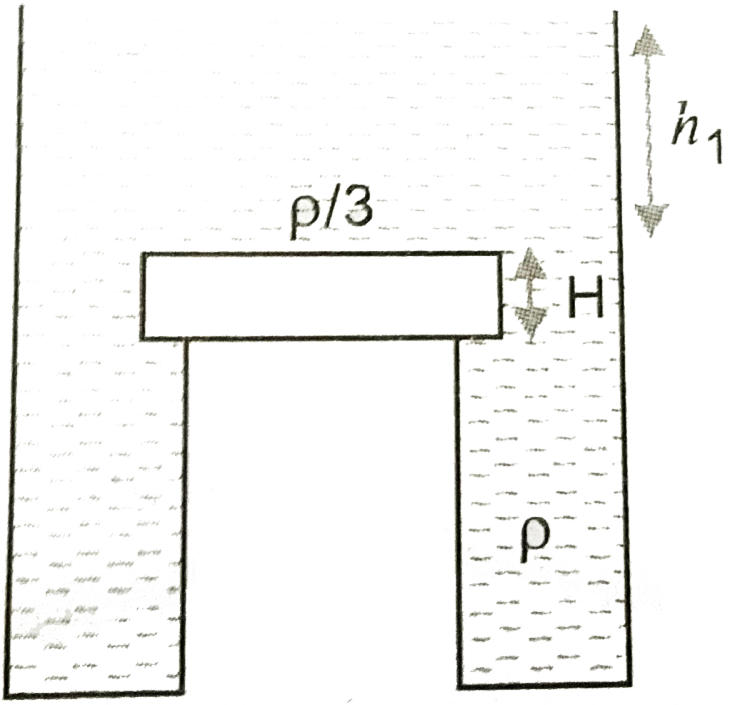
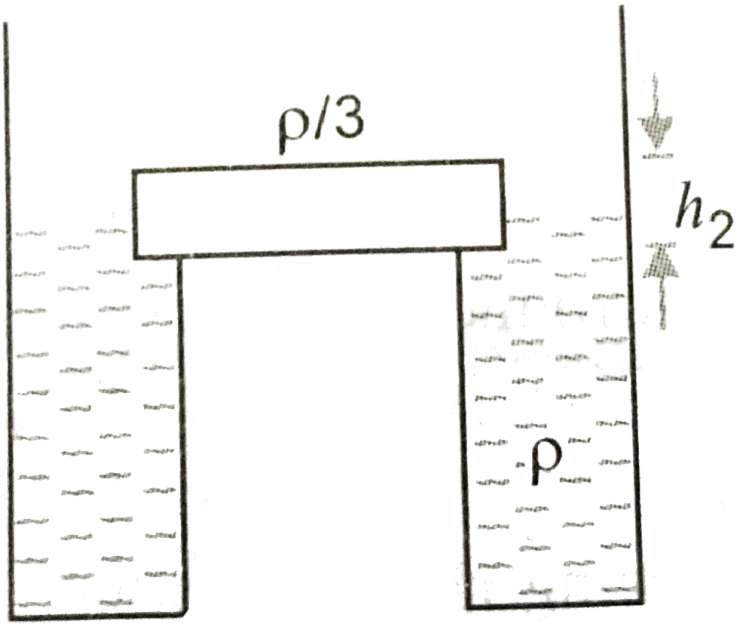
4. A wooden cylinder of diameter 4 r, height H and density $\rho/3$ is kept on a hole of diameter 2 r of a tank, filled with water of density ρ as shown in

the



The block in the above question is maintained by external means and the level of liquid is lowered. The height h_2 when this external force reduces

to zero is



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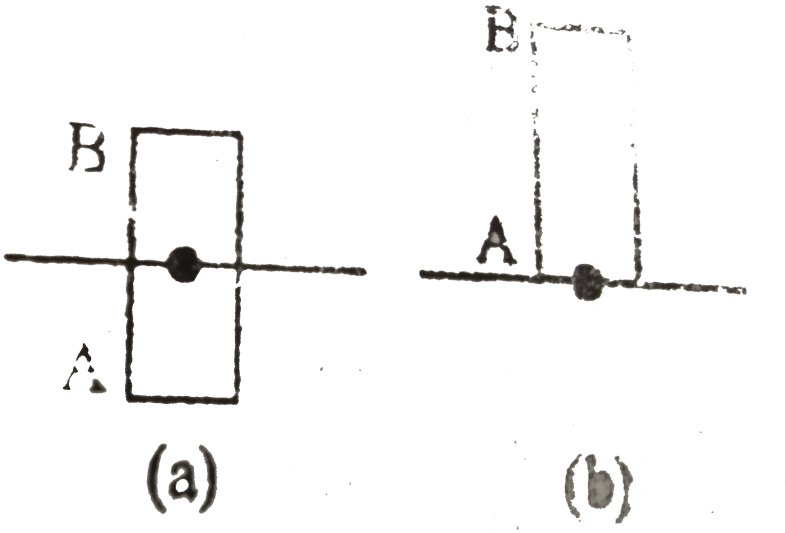
5. A cylindrical rod of length $l = 2m\&$ density $\frac{\rho}{2}$ floats vertically in a liquid of density ρ as shown in Fig (a)



(a) Show that it performs SHM when pulled slightly up & released & find its time period. Neglect change in liquid level.

(b) Find the time taken by the rod to completely immerse when released from position showm in (b). Assume that it remains vertical throughout its its motion $\left(\text{take} g = \pi^2 m / s^2\right)$

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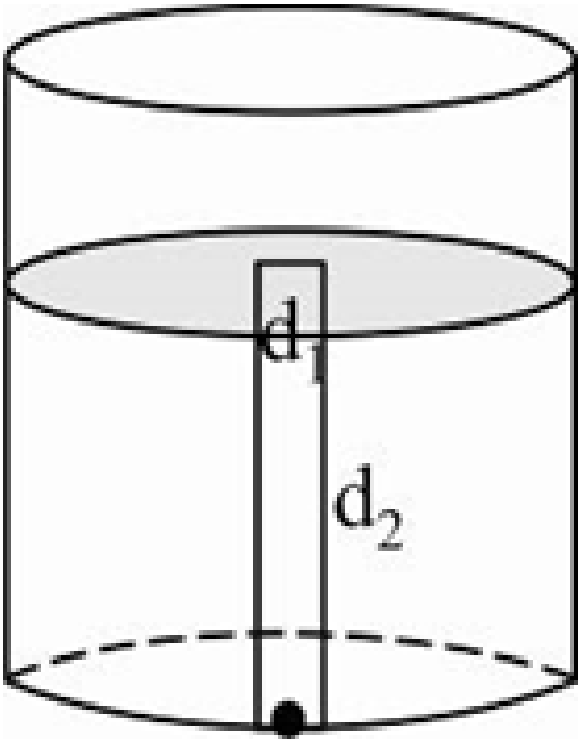
6. A thin rod of length L and area of cross section S is pivoted at its lowest point P inside a stationary, homogeneous and non-viscous liquid. The rod is free to rotate in a vertical plane about a horizontal axis passing through P. The density d_1 of the rod is smaller than the density d_2

of the liquid. The rod is displaced by a small angle theta from its equilibrium position and then released. Shown that the motion of the rod is simple harmonic and determine its angular frequency in terms of the given parameters _____ .



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7. A hollow cone floats with its axis vertical upto one third of its height in a liquid in a liquid of relative density 0.8 and with its vertex submerged. When another liquid of relative density ρ is filled in it upto one third of its height, the cone floats upto half its vertical height. The height of the cone is $0.10m$ and the radius of the circular base is $0.05m$. Find the specific gravity ρ is given.

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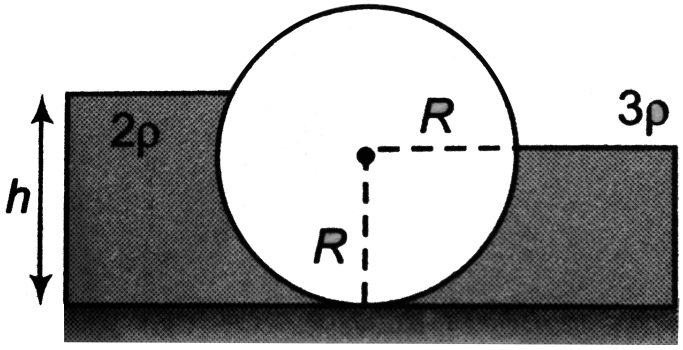
8. In the figure shown, the heavy cylinder (radius R) reasting on a smooth surface separates two liquids of densities 2ρ and 3ρ. The height h for the equilibrium of cylinder must be



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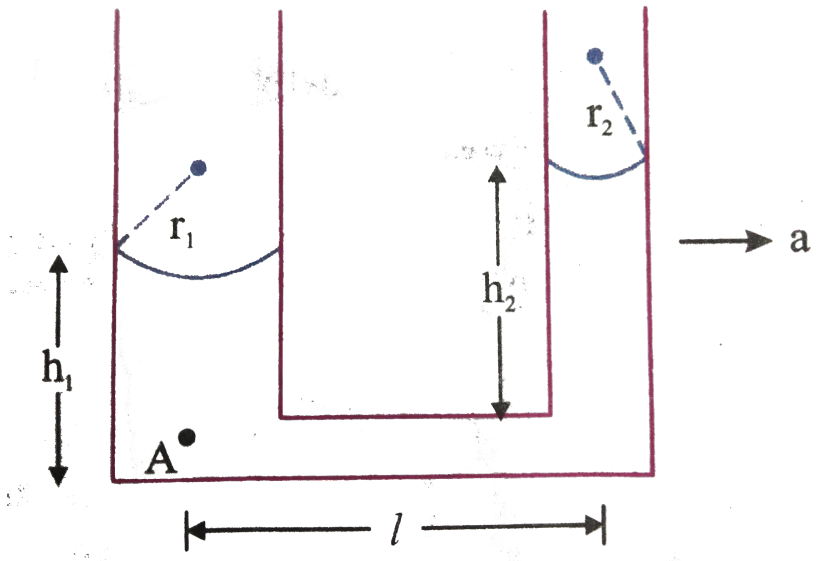

9.

A vertical communicating tube contains a liquid of density ρ. If it moves with a horizontal acceleration a, pressure at A is equal to :

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10. A wooden stick of length L, radius R and density ρ has a small metal piece of mass m (of negligible volume) attached to its one end. Find the

minimum value for the mass m (in terms of given parameters) that would make the stick float vertically in equilibrium in a liquid of density $\sigma(>\rho)$.

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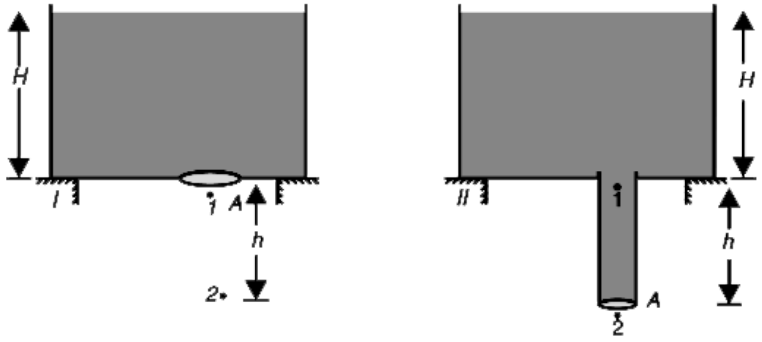
11. There are two large identical open tanks as shown in figure. In tanks 1 there is a small hole of cross sectional area A at its base. Tank II has a similar hole, to which a pipe of length h has been connected as shown. The internal cross sectional area of the pipe can be considered to be equal



to A. Point 1 marked in both figures, is a point just below the opening in the tank and point 2 marked in both figures, is a point h below point 1 (In fig II, point 2 is just outside the opening in the pipe)

(a) Find the speed of flow at point 2 in both figures.

(b) Find the ratio of speed of flow at point 1 is first the ratio of speed of flow at point 1 is first figure to that in second figure.

(c) Find the difference in pressure at point 1 in both figures.

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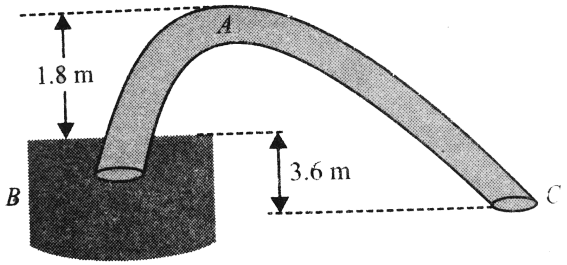
12. A siphon has a uniform circular base of diameter $8/\sqrt{\pi}cm$ with its crest A, $1.8m$ above the water level vessel B is of large cross section ($g = 10m/s^2$ and atmospheric pressure $P_0 = 10^5 N/m^2$).



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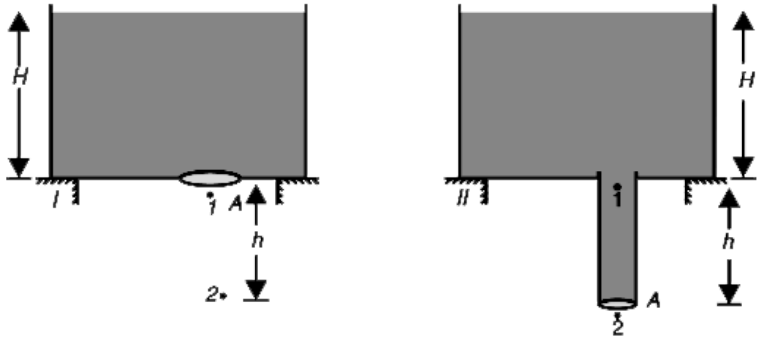
13. There are two large identical open tanks as shown in figure. In tanks 1 there is a small hole of cross sectional area A at its base. Tank II has a

similar hole, to which a pipe of length h has been connected as shown. The internal cross sectional area of the pipe can be considered to be equal



to A. Point 1 marked in both figures, is a point just below the opening in the tank and point 2 marked in both figures, is a point h below point 1 (In fig II, point 2 is just outside the opening in the pipe)

(a) Find the speed of flow at point 2 in both figures.

(b) Find the ratio of speed of flow at point 1 is first the ratio of speed of flow at point 1 is first figure to that in second figure.

(c) Find the difference in pressure at point 1 in both figures.

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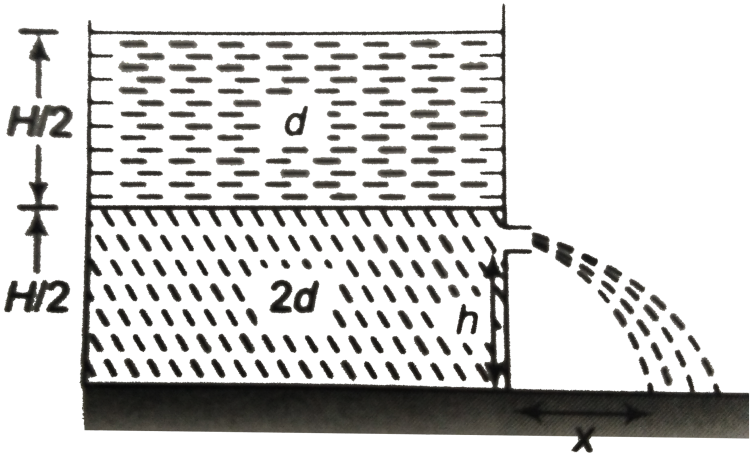
14. A container of large uniform cross-sectional area A resting on a horizontal surface, holes two immiscible, non-viscon and incompressible liquids of densities d and 2d each of height $H/2$ as shown in the figure. The lower density liquid is open to the atmosphere having pressure P_0. A homogeneous 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

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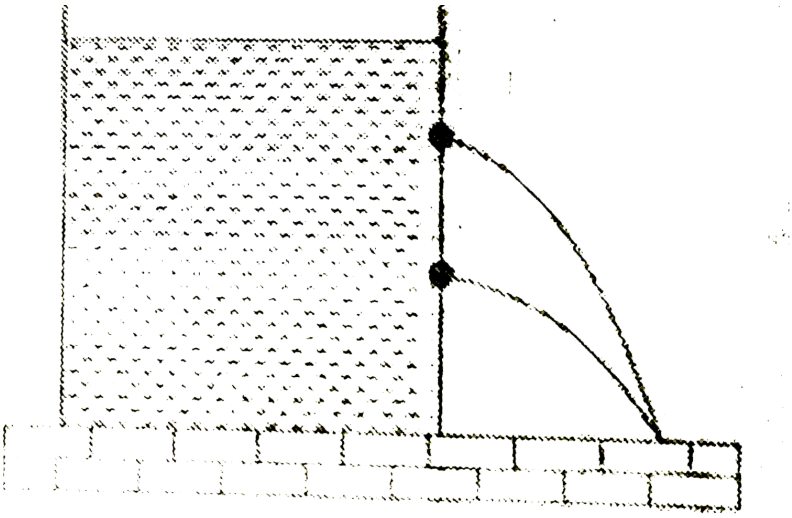
15. In a cylindrical vessel containing liquid of density ρ there are two holes in the side walls at heights of h_1 and h_2 respectively such that the range of efflux at the bottom of the vessel is same. The height of a hole for which the range of efflux would be maximum, will be



A. $h_2 - h_1$

B. $h_2 + h_1$

C. $\frac{h_2 - h_1}{2}$

D. $\frac{h_2 + h_1}{2}$

Answer: A::B

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16. A large open top container of negligible mass and uniform cross-sectional area A has a small hole of croos-sectional area $\frac{A}{100}$ in its side wall near the bottom.The container is kept on a smooth horizontal floor and contains a liquid of density ρ and mass m_0. Assuming that the liquid starts flowing out horizontally through the hole at $t = 0$, The acceleration of the container is $\frac{x}{10} m / s^2$ than x is -

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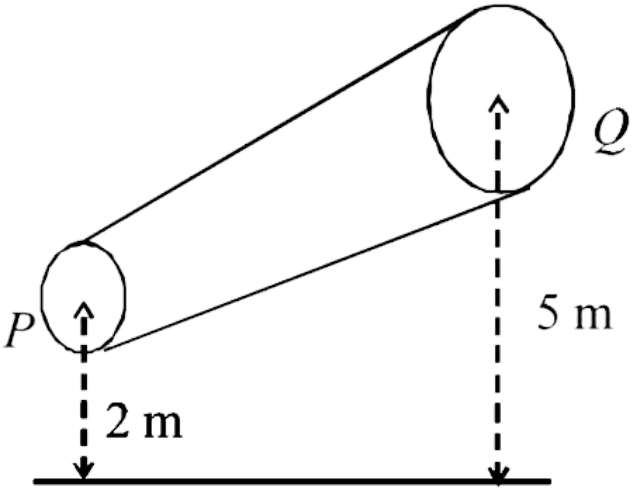
17. A non-viscous liquid of constant density $1000 kg / m^3$ flows in a streamline motion along a tube of variable cross section. The tube is kept

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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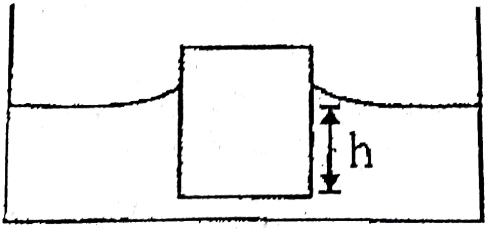

18.

A cube with mass m completely wettable by water floats on the surface of water each side of the cube is a what is the distance h between the lower face of cube and the surface of the water if surafce tension is S. Take densities of water as ρ_w take angle of contact is zero.

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EXERCISE # III

1. 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

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2. A $3.6m$ long vertical pipe resonates with a source of frequency $212.5Hz$ when water level is at certain height in the pipe. Find the height of water level (from the bottom of the pipe) at which resonance occurs. Neglect end correction. Now , the pipe is filled to a height $H(\approx 3.6m)$. A small hole is drilled very close to its bottom and water is allowed to leak. Obtain an expression for the rate of fall of water level in the pipe as a function of H. If the radii of the pipe and the hole are $2 \times 10^{-2}m$ and $1 \times 10^{-3}m$ respectively, Calculate the time interval between the

occurance of first two resonances. Speed of sound in air $340m/s$ and $g = 10m/s^2$.

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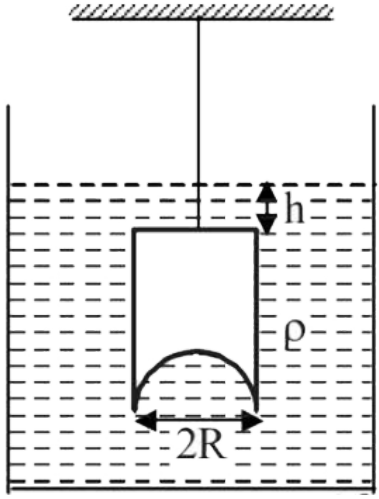
3. A hemispherical portion of radius R is removed from the bottom of a cylinder of radius R. The volume of the remaining cylinder is V and its mass M. It is suspended by a string in a liquid of density ρ where it stays vertical. The upper surface of the cylinder is at a depth h below the liquid surface. The force on the bottom of the cylinder by the liquid is



A. Mg

B. $Mg - v\rho g$

C. $Mg + \pi R^2 h\rho g$

D. $\rho g\left(V + \pi R^2 h\right)$

Answer: D

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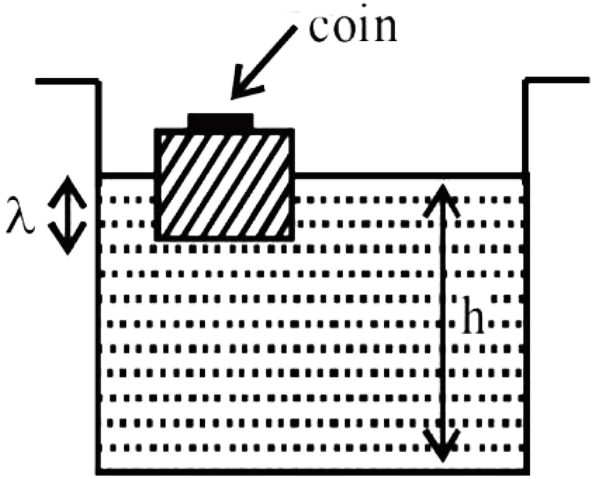
4. A wooden block, with a coin placed on its top, floats in water as shown in figure. The distance l and h are shown here. After some time the coin falls into water. Then



A. l decreases and h increases

B. l increase and h decreases

C. both l and h increase

D. both l and h decrease

Answer: D

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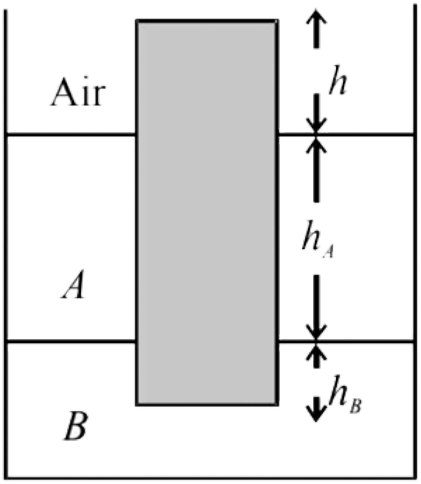
5. A uniform solid cylinder of density $0.8g/cm^3$ floats in equilibrium in a combination of two non-mixing liquids A and B with its axis vertical. The densities of the liquids A and B are $0.7g/cm^3$ and $1.2g/cm^3$, respectively. The height of liquid A is $h_A = 1.2cm$. The length of the part of the 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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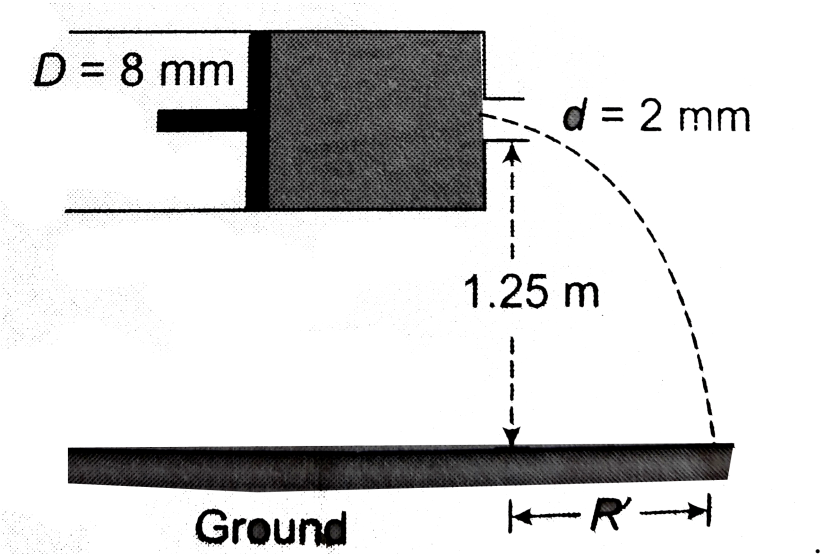
6. Consider a horizontally oriented syringe containing water located of a height of $1.25m$ above the ground. The diameter of plunger is $8mm$ and the diameter if the nozzle is $2mm$. The plunger is pushed with a constant speed of $0.25m/s$. Find the horizontal range of water stream on the

ground. Take $g = 10m/s^2$.



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7. A solid sphere of radius R is floating in a liquid of density σ with half of its volume submerged. If the sphere is slightly pushed and released , it starts axecuting simple harmonic motion. Find the frequency of these oscillations.

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8. Water is filled in a container upto height 3m. A small hole of area 'a' is punched in the wall of the container at a height 52.5 cm from the bottom. The cross sectional area of the container is A. If $a/A = 0.1$ then v^2 is (where v is the velocity of water coming out of the hole)

A. 48

B. 51

C. 50

D. 51.5

Answer: C

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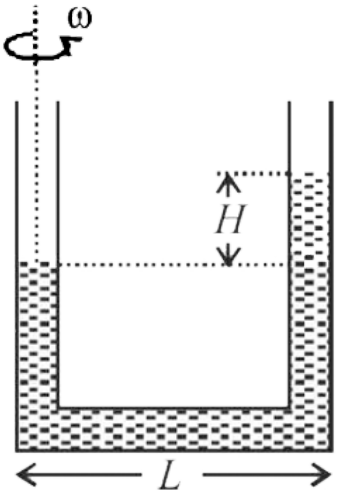
9. A U tube is rotated about one of it's limbs with an angular velocity ω. Find the difference in height H of the liquid (density ρ) level, where

diameter of the tube $d << L$.



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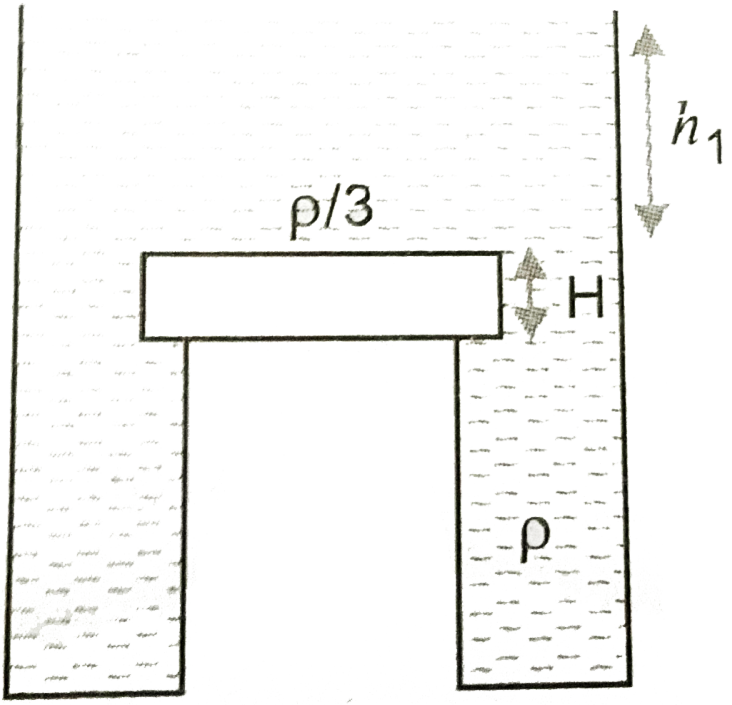
10. A wooden cylinder of diameter 4 r, height H and density $\rho/3$ is kept on a hole of diameter 2 r of a tank, filled with water of density ρ as shown in the



If level of liquid starts decreasing slowly, when the level of liquid is at a height h_1 above the cylinder, the block just start moving up. Then the value of h_1 is

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

B. $\frac{5h}{4}$

C. $\frac{5h}{3}$

D. $\frac{5h}{2}$

Answer: C

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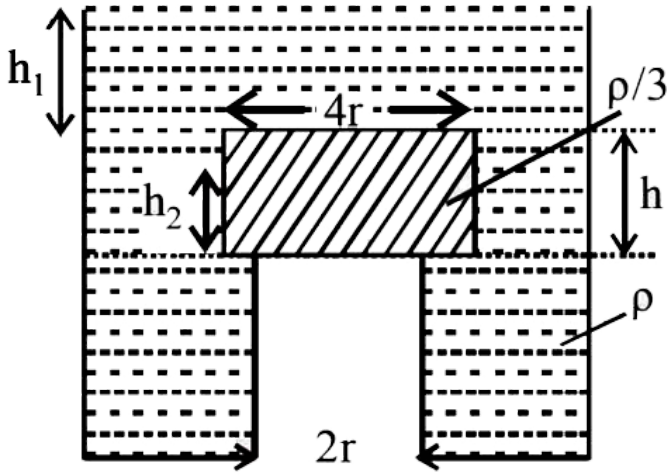
11. A cylindrical tank has a hole of diameter 2r in its bottom. The hole is covered wooden cylindrical block of diameter 4r, height h and density $\rho / 3$.



Situation I: Initially, the tank is filled with water of density ρ to a height such that the height of water above the top of the block is h_1 (measured from the top of the block).

Situation II: The water is removed from the tank to a height h_2 (measured from the bottom of the block), as shown in the figure. The height h_2 is

smaller than h (height of the block) and thus the block is exposed to the atmosphere.

Find the height of the water level h_2 (in situation 2), for which the block remains in its origin) position whithout the application of any external force

A. $\frac{h}{3}$

B. $\frac{4h}{9}$

C. $\frac{2h}{3}$

D. h

Answer: B

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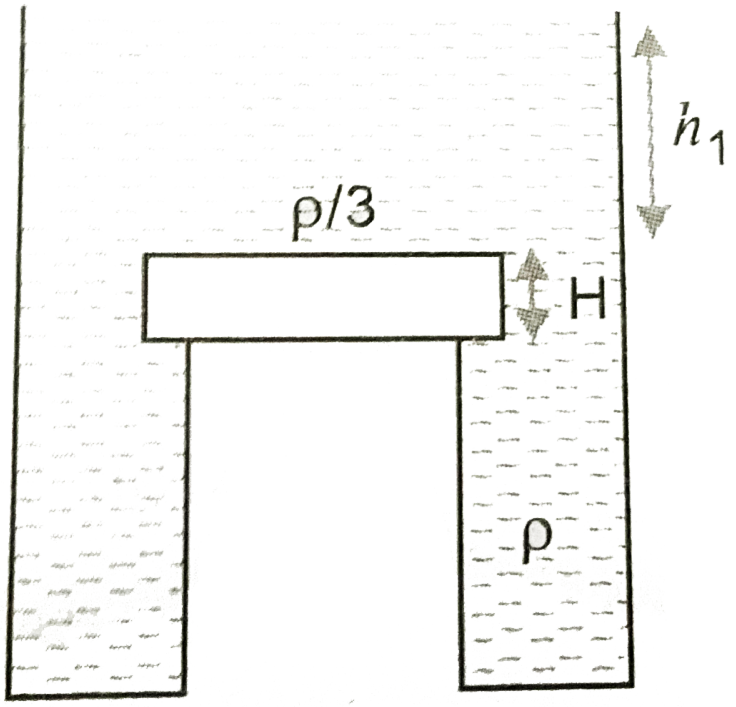
12. A wooden cylinder of diameter 4 r, height H and density $\rho/3$ is kept on a hole of diameter 2 r of a tank, filled with water of density ρ as shown in the



If height h_2 of water level is further decreased, then

A. cylinder will not move up and remains at its original position.

B. for $h_2 = h/3$, cylinder again starts moving up

C. for $h_2 = h/4$, cylinder again starts moving up

D. for $h_2 = h/5$ cylinder again starts moving up

Answer: A

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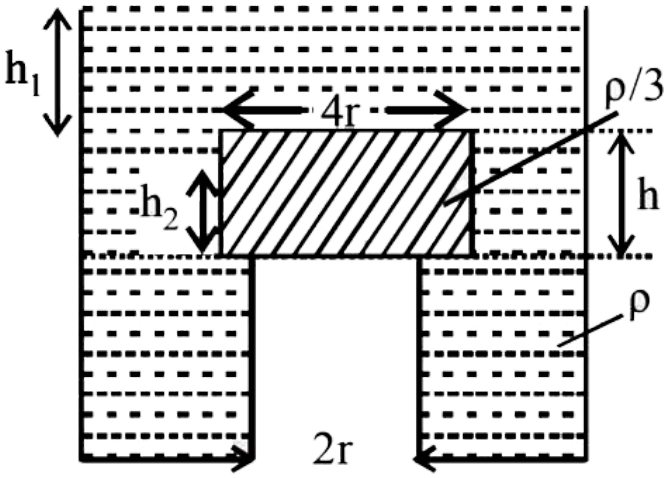
13. A cylindrical tank has a hole of diameter 2r in its bottom. The hole is covered wooden cylindrical block of diameter 4r, height h and density $\rho/3$.



Situation I: Initially, the tank is filled with water of density ρ to a height such that the height of water above the top of the block is h_1 (measured from the top of the block).

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Find the height of the water level h_2 (in situation 2), for which the block remains in its origin) position whithout the application of any external force

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. $\left|P_0\pi R^2 + R\rho gh^2 - 2RT\right|$

Answer: B

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14. Statement-1 : The stream of water flowing at high speed from a garden hose pipe tends to spread like a foundtion when held vertically up, but tends to narrow down when held vertically down.

Statement-2 : In any steady flow of an incompressible fluid, the volume flow rate of the fluid remain constant.

A. Statement-1 is true, Statement-2 is true, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is true, Statement-2 is true, Statemnet-2 is not a correct explanation for Statement-1

C. Statement-1 is true, Statement-2 is false

D. Statement-1 is false Statement-2 is true

Answer: A

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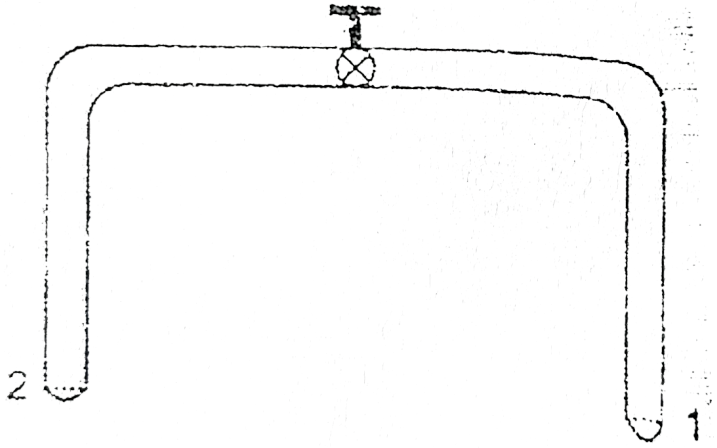
15. A glass tube of uniform internal radius (r) has a valve separating the two identical ends. Initially, the valve is in a tightly closed position. End 1 has a hemispherical soap bubble of radius r. End 2 has sub-hemispherical

soap bubble as shown in figure. Just after opening the valve.



A. air from end 1 flows towards end 2. No change in the volume of the soap bubbles

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

C. no change occurs

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

Answer: B

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16. A cylindrical vessel of height 500mm has an orifice (small hole) at its bottom. The orifice is initially closed and water is filled in it up to height H. Now the top is completely sealed with a cap and the orifice at the bottom is opened. Some water comes out from the orifice and the water level in the vessel becomes steady with height of water column being 200mm. Find the fall in height(in mm) of water level due to opening of the orifice.

[Take atmospheric pressure $= 1.0 \times 10^5 N/m^2$, density of water=1000kg//m^3 and g=10m//s^2`. Neglect any effect of surface tension.]

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17. Two soap bubbles A and B are kept in a closed chamber where the air is maintained at pressure $8N/m^2$. The radii of bubbles A and B are $2cm$ and $4cm$, respectively. Surface tension of the soap. Water used to make

bubbles is $0.04N/m$. Find the ratio n_B/n_A, where n_A and n_B are the number of moles of air in bubbles A and B respectively. [Neglect the effect of gravity.]

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18. A thin uniform cylindrical shell, closed at both ends, is partially filled with water. It is floating vertically in water in half-submerged state. If ρ_c is the relative density of the material of the shell with respect to water, then the correct statement is that the shell is

A. more than half-filled if ρ_c is less than 0.5

B. more than half-filled if ρ_c is more than 1.0

C. half-filled if ρ_c is more than 0.5

D. less than half-filled if ρ_c is less than 0.5

Answer: A

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MCQ & Solution

1. A bucket water filled upto a height = 15 cm. The bucket is tied to a rope which is passed over a frictionless light pulley and the other end of the rope is tied to a weight of mass which is half of that of the (bucket + water). The water pressure above atmospheric pressure at the bottom is

A. $0.5kPa$

B. $1kPa$

C. $5kPa$

D. None of these

Answer: B

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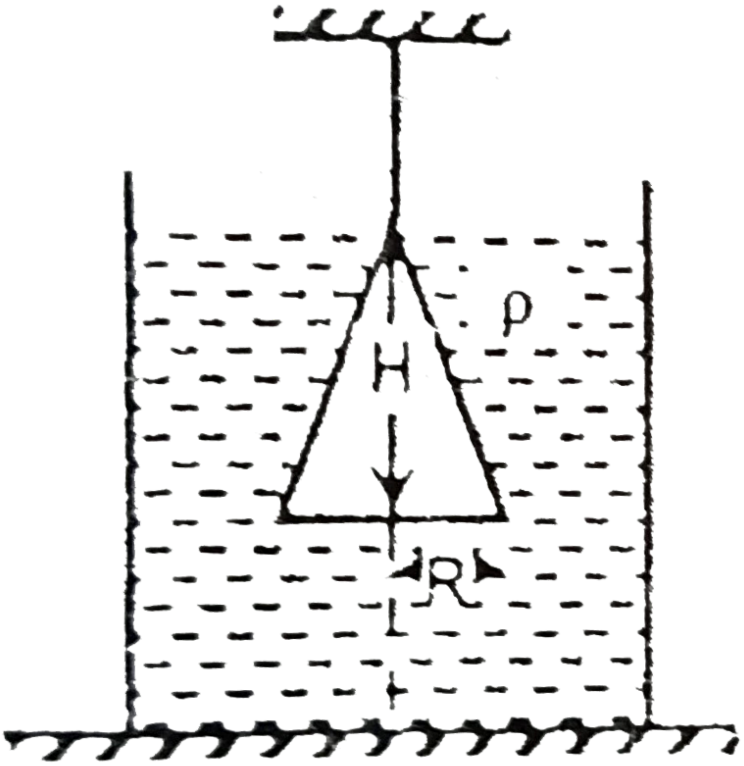
2. A cone of radius R and height H, is hanging inside a liquid of density ρ by means of a string as shown in figure. The force due to the liquid acting

on the slant surface of the cone is



A. $\rho\pi gHR^2$

B. $\pi\rho HR^2$

C. $\frac{4}{3}\pi\rho gHR^2$

D. $\frac{2}{3}\pi\rho gHR^2$

Answer: D

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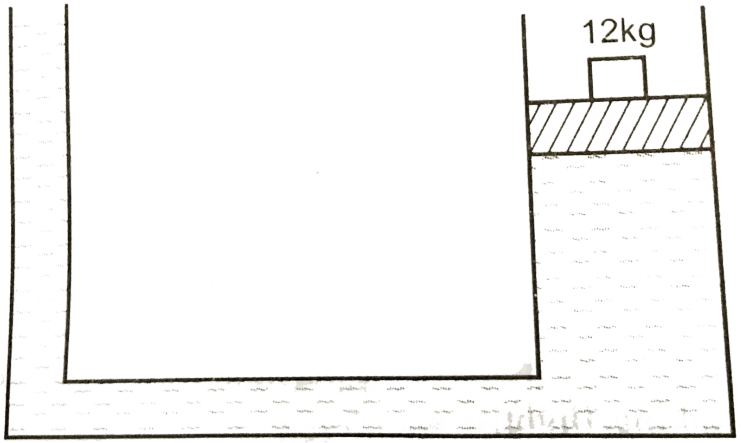
3. The area of cross-section of the wider tube shown in fig., is $800cm^2$. If a mass of 12 kg is placed on the massless piston, what is the difference in the level of water in two tubes.



A. 10 cm

B. 6 cm

C. 15 cm

D. 2 cm

Answer: C

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4. An open cubical tank was initially fully filled with water. When the tank was accelerated on a horizontal plane along one of its side it was found that one thrid of volume of water was spilled out. The acceleration was

A. $g/3$

B. $2g/3$

C. $3g/2$

D. None

Answer: B

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5. Some liquid is filled in a cylindrical vessel of radius R. Let F_1 be the force applied by the liquid on the bottom of the cylinder. Now the same liquid is poured into a vessel of uniform square cross-section of side R.

Let F_2 be the force applied by the liquid on the bottom of this new vessel. (Neglect atmosphere pressure). Then

A. $F_1 = \pi F_2$

B. $F_1 = \frac{F_2}{\pi}$

C. $F_1 = \sqrt{\pi} F_2$

D. $F_1 = F_2$

Answer: D

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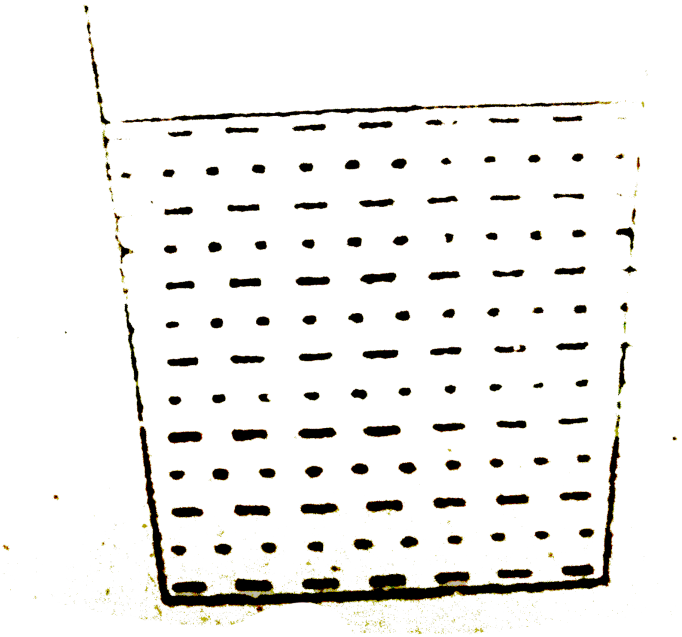
6. A liquid of mass 1 kg is filled in a flask as shown in figure. The force exerted by the flask on the liquid is $\left(g = 10 m / s^2\right)$ [Neglect atmospheric

pressure]:



A. 10 N

B. greater than 10N

C. less than 10N

D. zero

Answer: A

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7. 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. $50cc$

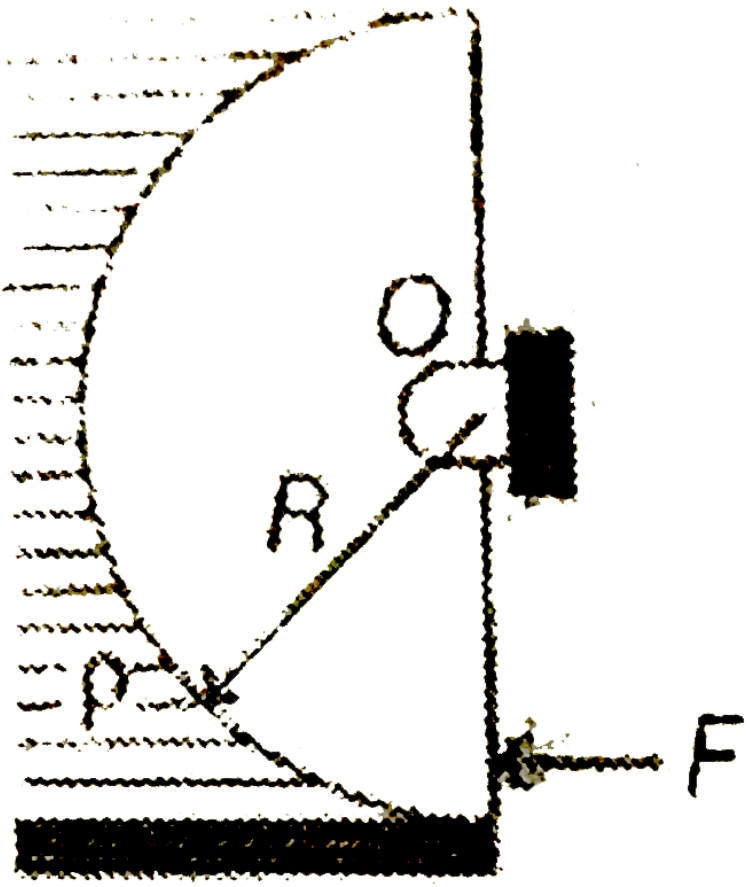
D. $35cc$

Answer: D

Watch Video Solution

8. A light semi cylindrical gate of radius R is pivoted aat its mid point O, of radius R as shown in the figure holding liquid of density ρ. The force F

required to prevent the rotation of the gate is equal to



A. $2\pi R^3 \rho g$

B. $2\rho g R^3 l$

C. $\frac{2R^2 l \rho g}{3}$

D. None of these

Answer: D

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9. The pressure at the bottom of an open tank of water is 3p where p is the atmospheric pressure. If the water is drawn out till the level of water remains one fifth, the pressure at the bottom of the tank will now be

A. $2P$

B. $(13/5)P$

C. $(8/5)P$

D. $(4/5)P$

Answer: B

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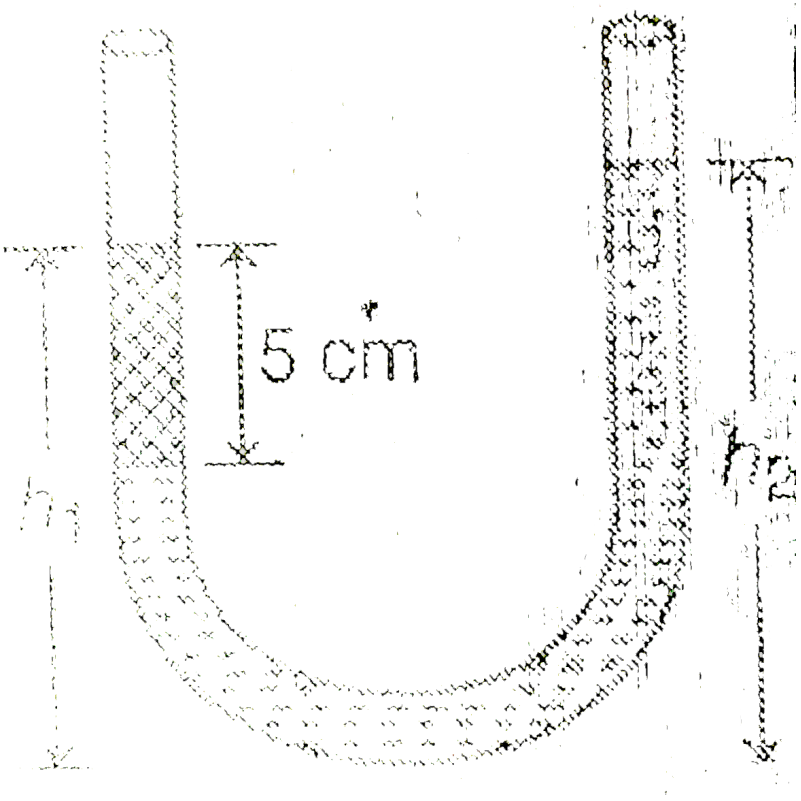
10. An open -ended U-tube of uniform cross-sectional area contains water (density $1.0g/cm^{23}$) standing initially 20 cm from the bottom in each arm. An immiscible liquid of density $4.0g/cm^2$ is added to one arm until a layer 5 cm high forms, as shown in the figure above. What is the ratio h_2/h_1 of the heights of the liquid in the two arms ?



A. $3/1$

B. $5/2$

C. $2/1$

D. $3/2$

Answer: C

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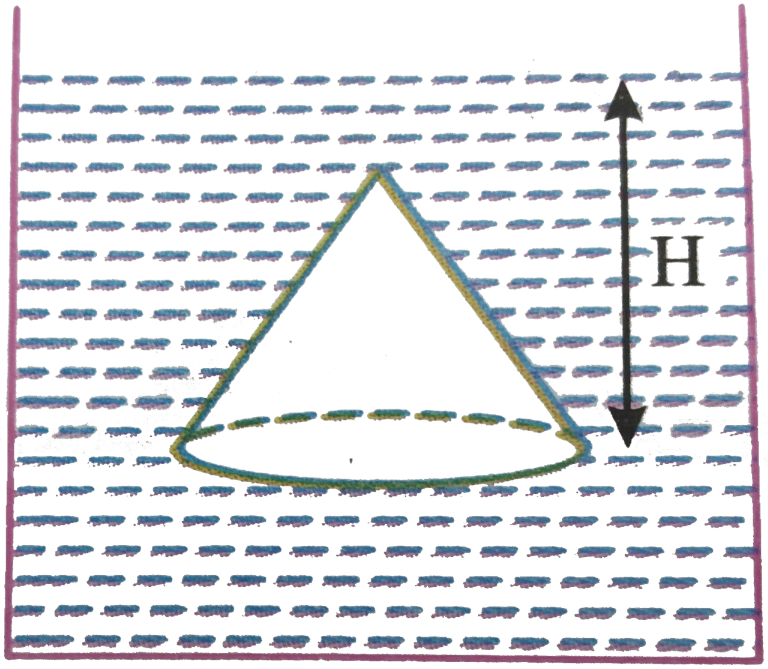

11.

A cone of radius r and height r is under a liquid of density d.its base is

parallel to the free surface of the liquid at a depth H from it as shown.What is the net force due to liquid on its curved surface? (neglect atmospheric pressure)

A. $(2/3)\pi R^2 h\rho g$

B. $(1/3)\pi R^2 h\rho g$

C. $\pi R^2 h\rho g$

D. None

Answer: A

Watch Video Solution

12. Two cubes of side 1.0 msides, one of relative density 0.60 and another of relative density $= 1.15$ are connected by weightless wire and placed in a large tank of water. Under equilibrium the lighter cube will project above the water surface to a height of

A. $50cm$

B. $25cm$

C. $10cm$

D. zero

Answer: B

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13. A cuboidal piece of wood has dimensions a, b and c. its relatively density is d. it is floating in a large body of water such that side a is vertical. It is pushed down a bit and released. The time period of SHM executed by it is

A. $2\pi\sqrt{\frac{abc}{g}}$

B. $2\pi\sqrt{\frac{g}{da}}$

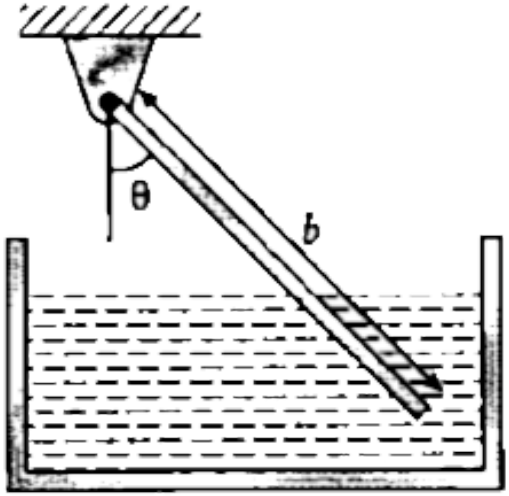
C. $2\pi\sqrt{\frac{bc}{dg}}$

D. $2\pi\sqrt{\frac{da}{g}}$

Answer: D

Watch Video Solution

14. A uniform rod of length b capable of tuning about its end which is out of water, rests inclined to the vertical. If its specific gravity is 5/9, find the length immersed in water.



A. L

B. $\frac{1}{2}L$

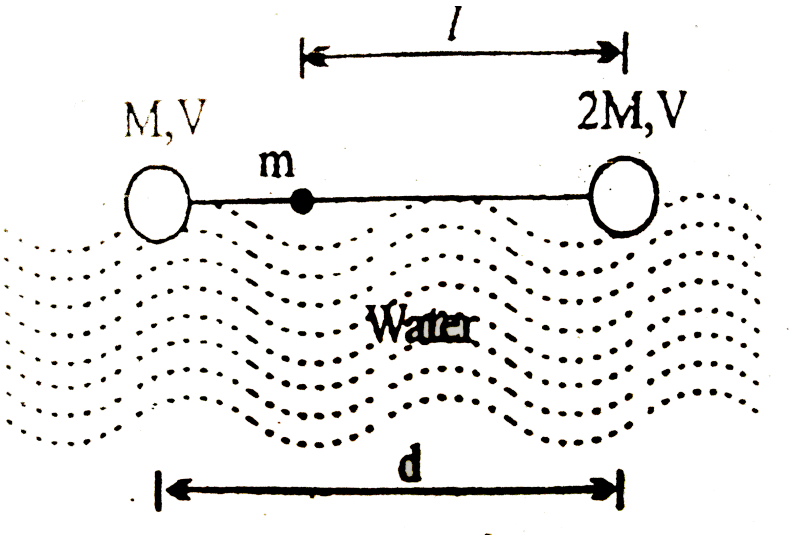
C. $\frac{1}{4}L$

D. 3L

Answer: A

Watch Video Solution

15. A dumbbell is placed in water of density ρ. It is observed that by attaching a mass m to the rod, the dumbbell floats with the rod horizontal on the surface of water and each sphere exactly half submerged as shown in the figure. The volume of the mass m is negligible. The value of length l is



A. $\frac{d(V\rho - 3m)}{2(V\rho - 2m)}$

B. $\frac{d(V\rho - 2m)}{2(V\rho - 3m)}$

C. $\frac{d(V\rho + 2m)}{2(V\rho - 3m)}$

D. $\frac{d(V\rho - 2m)}{2(V\rho + 3m)}$

Answer: B

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16. Two bodies having volumes V and 2V are suspended from the two arms of a common balance and they are found to balance each other. If larger body is immersed in oil (density $d_1 = 0.9gm/cm^3$) and the smaller body is immersed in an unknown liquid, then the balance remain in equilibrium. The density of unknown liquid is given by :

A. $2.4gm/cm^3$

B. $1.8gm/cm^3$

C. $0.45gm/cm^3$

D. $2.7gm/cm^3$

Answer: B

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17. A container of large surface area is filled with liquid of density ρ. A cubical block of side edge a and mass M is floating in it with four-fifth of its volume submerged. If a coin of mass m is placed gently on the top surface of the block is just submerged. M is

A. $4m/5$

B. $m/5$

C. 4m

D. 5m

Answer: C

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18. A boy carries a fish in one hand and a bucket (not full) of water in the other hand. If he places the fish in the bucket, the weight now carried by him (assume that water does not spill).

A. is less than before

B. is more than before

C. is the same as before

D. depends upon his speed

Answer: C

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19. A cork of density $0.5gcm^{-3}$ floats on a calm swimming pool. The fraction of the cork's volume which is under water is

A. $0\ \%$

B. $25\ \%$

C. $10\ \%$

D. $50\ \%$

Answer: D

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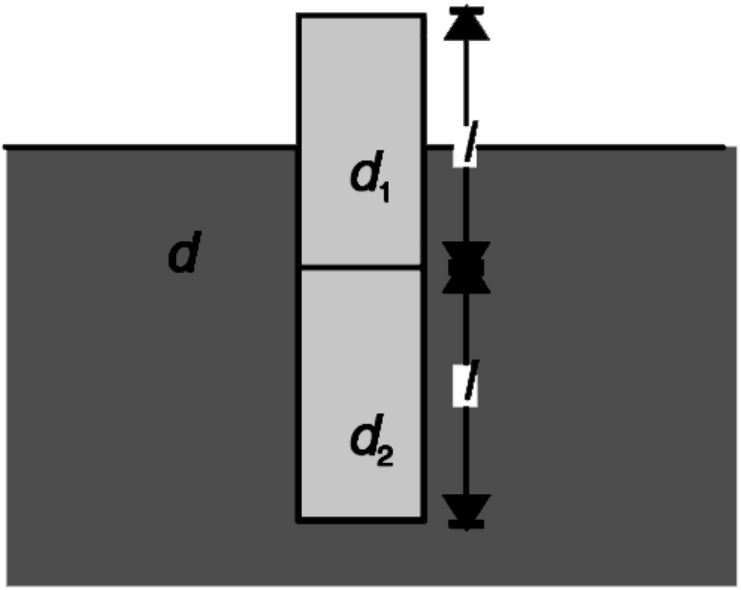
20. A cylindrical block of length 2l is made of two different materials. The upper half has density d_1 and and lower half, which is heavier, has density d_2 the block is floating in a liquid of unknown density d with $\frac{l}{2}$ of its length outside the liquid.

(a) Find d

(b) Show that $d > \frac{4d_1}{3}$



A. $d_1 > \frac{3}{4}d$

B. $\frac{d}{2} > d_1$

C. $\frac{d}{4} > d_1$

D. $d < d_1$

Answer: A

Watch Video Solution

21. The frequency of a sonometer wire is f . When the weight producting the tensions are completely. Immersed in water the frequency becomes $f/2$ and on immersing the weight in acertain liquid the fequency becomes $f/3$. The specific gravity of the liquid is

A. $4/3$

B. $16/9$

C. $15/12$

D. $32/27$

Answer: D

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22. 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. 8m

B. 2m

C. 6m

D. 4m

Answer: A

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23. A small wooden ball of density ρ is immersed in water of density σ to depth h and then released. The height H above the surface of water up to which the ball will jump out of water is

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

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

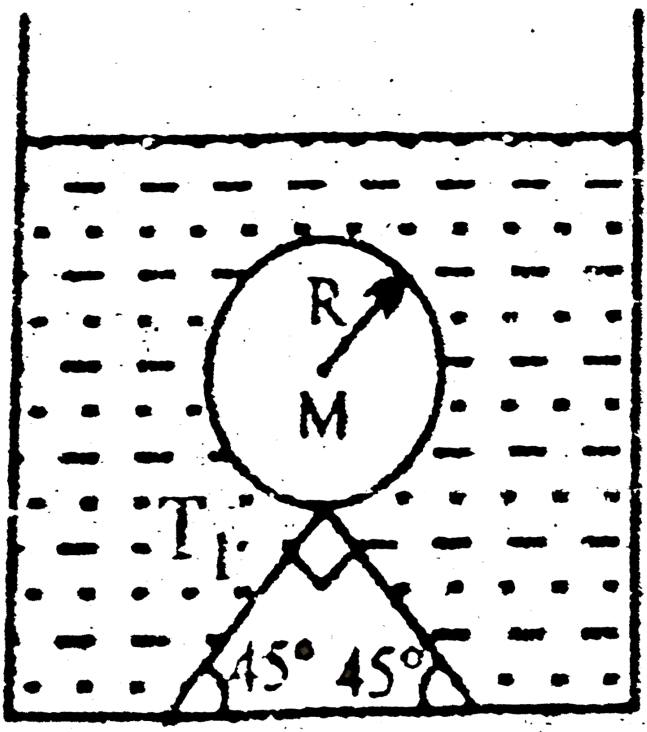
C. h

D. zero

Answer: B

Watch Video Solution

24. A hollow sphere of mass M and radius r is immersed in a tank of water (denstiy ρ_w). The sphere would float if it were set free. The sphere is tied to the bottom of the tank by two wires which makes angle 45° with the horizontal as shown in the figure. The tension T_1 in the wire is :



A. $\frac{\frac{4}{3}\pi R^3 \rho_w g - Mg}{\sqrt{2}}$

B. $\frac{2}{3}\pi R^3\rho_w g - Mg$

C. $\frac{\frac{4}{3}\pi R^3\rho_w g - Mg}{2}$

D. $\frac{4}{3}\pi R^3\rho_w g + Mg$

Answer: A

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25. A sphere of radius R and made of material of relative density σ has a concentric cavit of radius r. It just floats when placed in a tank full of water. The value of the ratio R/r will be

A. $\left(\frac{\sigma}{\sigma-1}\right)^{1/3}$

B. $\left(\frac{\sigma-1}{\sigma}\right)^{1/3}$

C. $\left(\frac{\sigma+1}{\sigma}\right)^{1/3}$

D. $\left(\frac{\sigma-1}{\sigma+1}\right)^{1/3}$

Answer: A

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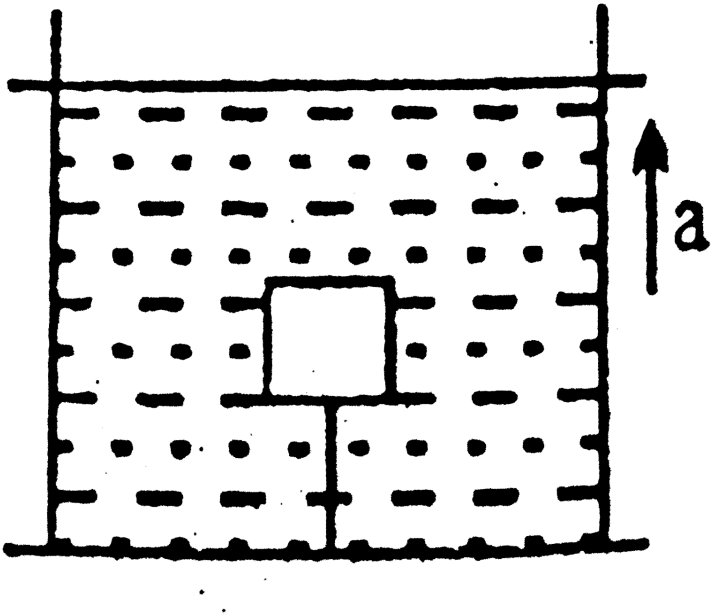
26. A body having volume V and density ρ is attached to the bottom of a container as shown. Density of the liquid is $d(>\rho)$. Container has a constant upward acceleration a. Tension in the string is



A. $V[Dg-\rho(g+a)]$

B. $V(g+a)(d-\rho)$

C. $V(d-\rho)g$

D. none

Answer: B

Watch Video Solution

27. A beaker containing water is placed on the platform of a spring balance. The balance reads $1.5kg$. A stone of mass $0.5kg$ and density $10^4 kg/m^3$ is immersed in water without touching the walls of the beaker. What will be the balance reading now?

A. $2kg$

B. $2.5kg$

C. $1kg$

D. $3kg$

Answer: B

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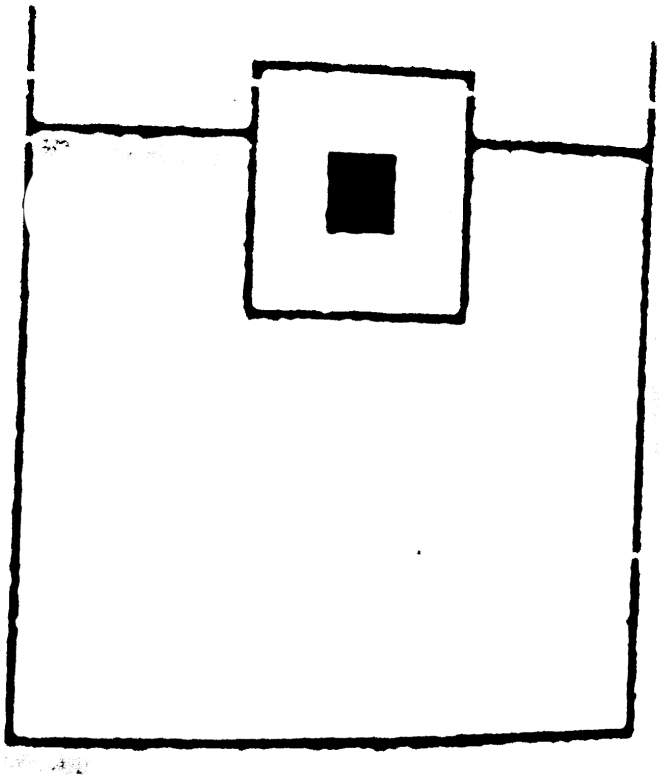
28. There is a metal cube inside a block of ice which is floating on the surface of water. The ice melts completely and metal falls in the water. Water level in the container



A. Rises

B. Falls

C. Remains same

D. Nothing can be concluded

Answer: B

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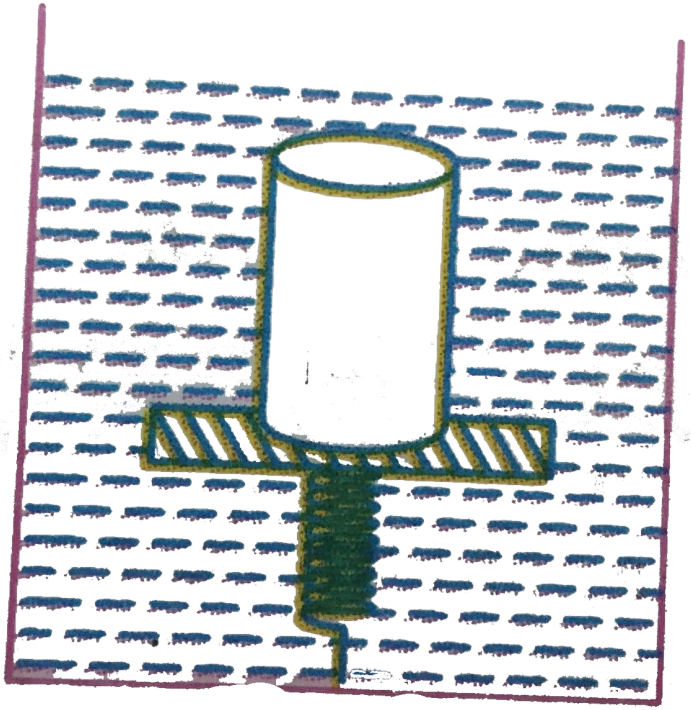

29.

Cylindrical block of area of cross-section A and of material of density ρ is placed in a liquid of density one third of density of block. The block compress in the spring is one-third of the length of the block. if acceleration due to gravity is g, the spring constant of the spring is

A. ρAg

B. $2\rho Ag$

C. $2\rho Ag/3$

D. $\rho Ag/3$

Answer: B

Watch Video Solution

30. A jet of water with cross section of $6cm^2$ strikes a wall at an angle of 60° to the normal and rebounds elastically from the wall without losing energy. If the velocity of the water in the jet is $12m/s$, the force acting on the wall is

A. $0.864Nt$

B. $86.4Nt$

C. $72Nt$

D. $7.2Nt$

Answer: B

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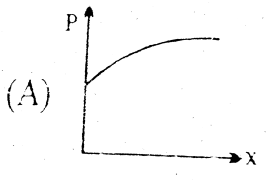
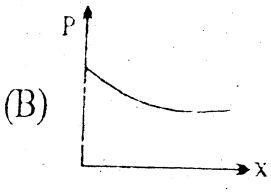
31. The cross sectional area of a horizontal tube increases along its length linearly, as we move in the direction of flow. The variation of pressure, as we move along its length in the direction of flow (x-direction), is best depicted by which of the following graphs.

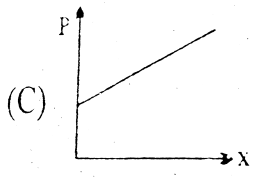
A.

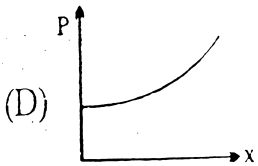


B.



C.





D.

Answer: A

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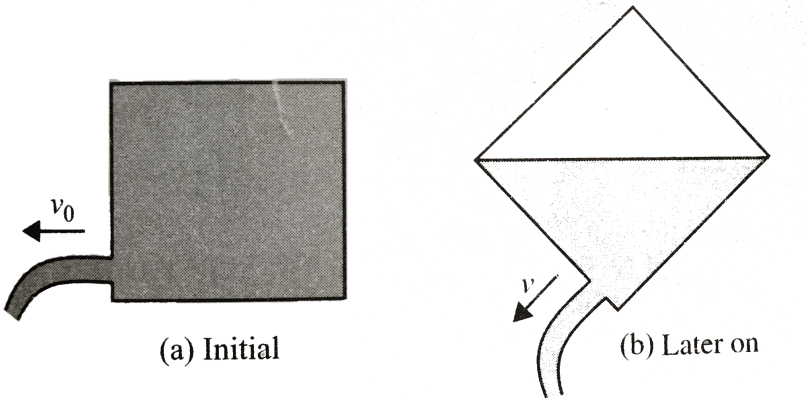
32. A square box of water has a small hole located the bottom corners. When the box is full and sitting on a level surface, complete opening of the hole results in a flow of water with a speed v_0 as shown in Fig. (a). when the box is still half empty, it is tilted by 45° so that hole is at the lowest point. Now the water will flow out with a speed of



A. V_0

B. $V_0/2$

C. $V_0/\sqrt{2}$

D. $V_0/.^4\sqrt{2}$

Answer: D

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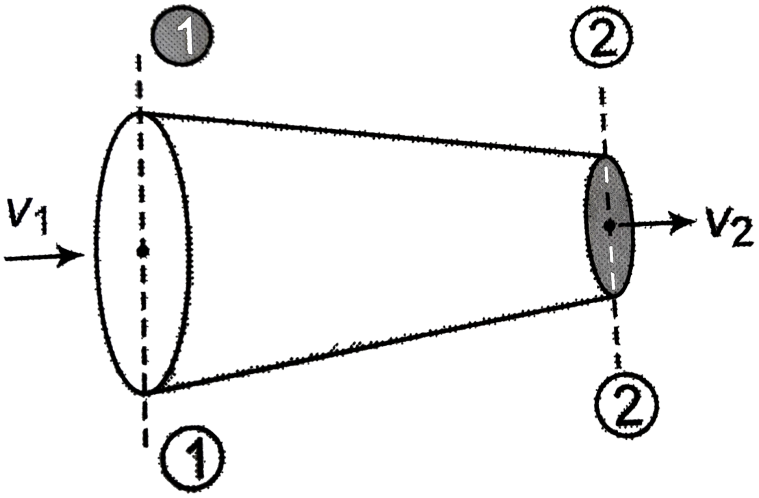
33. Water is flowing steadily through a horizontal pipe of non-uniform cross-section. If the pressure of water is $4 \times 10^4 N/m^2$ at a point where cross-section is $0.02m^2$ and velocity of flow is $2m/s$. What is the pressure

at a point where cross-section reduces to $0.01m^2$?



A. $1.4 \times 10^4 N/m^2$

B. $3.4 \times 10^4 N/m^2$

C. $2.4 \times 10^{-4} N/m^2$

D. none of these

Answer: B

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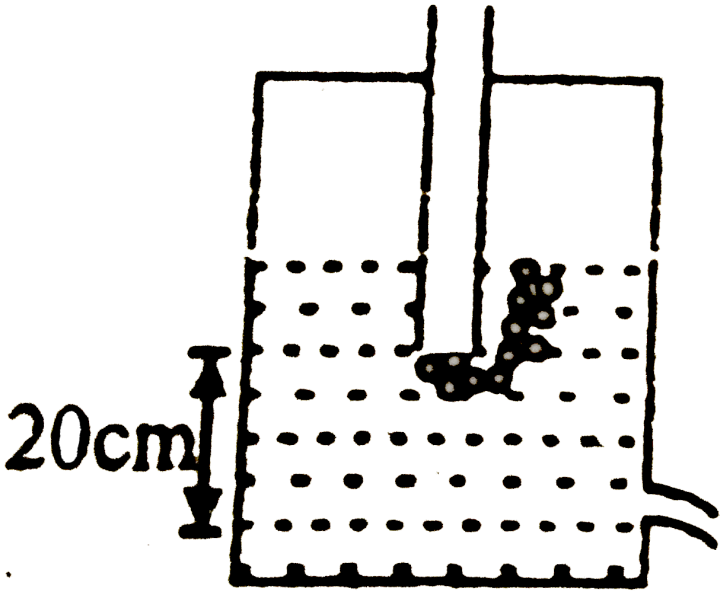
34. A tube is attached as shown in closed vessel containing water. The velocity of water coming out from a small hole is :



A. $\sqrt{2}m/s$

B. $2m/s$

C. depends on pressure of air inside vessel

D. None of these

Answer: B

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35. A large tank is filled with water to a height H. A small hole is made at the base of the tank. It takes T_1 time to decrease the height of water to $\frac{H}{\eta}(\eta > 1)$, and it takes T_2 times to take out the rest of water. If $T_1 = T_2$, then the value of η is

A. 2

B. 3

C. 4

D. $2\sqrt{2}$

Answer: C

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36. In the case of a fluid, Bernoulli's theorem expresses the application of the principle of conservation of :

A. linear momentum

B. energy

C. mass

D. angular momentum

Answer: B

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37. Fountains usually seen in gardens are generated by a wide pipe with an enclosure at one end having many small holes. Consider one such fountain which is produced by a pipe of internal diameter 2 cm in which water flows at a rate $3ms^{-1}$. The enclosure has 100 holes each of diameter 0.05 cm. The velocity of water coming out of the hole ids $\left(\text{in}ms^{-1}\right)$:

A. 0.48

B. 96

C. 24

D. 48

Answer: D

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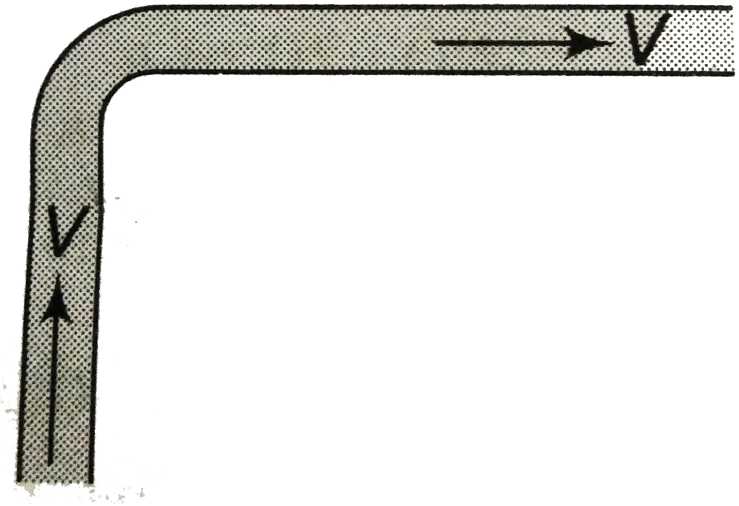
38. A fire hydrant delivers water of density ρ at a volume are L. The water travels vertically upward through the hydrant and then does 90° turn to emerge horizontally at speed V. The pipe and nozzle have uniform cross-section through out. The force exerted by the water on the corner of the hydrant is



A. ρVL

B. zero

C. $2\rho VL$

D. $\sqrt{2}\rho VL$

Answer: D

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39. A vertical tank, open at the top, is filled with a liquid and rests on a smooth horizontal surface. A small hole is opened at the centre of one side of the tank. The area of cross-section of the tank is N times the area of the hole, where N is a large number. Neglect mass of the tank itself. The initial acceleration of the tank is

A. $\frac{g}{2N}$

B. $\frac{g}{\sqrt{2N}}$

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

D. $\frac{g}{2\sqrt{N}}$

Answer: C

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40. Two water pipes P and Q having diameters $2 \times 10^{-2} m$ and $4 \times 10^{-2} m$, respectively, are joined in series with the main supply line of water. The velocity of water flowing in pipe P is

A. 4 times that of Q

B. 2 times that of Q

C. $1/2$ times of that Q

D. $1/4$ times that of Q

Answer: A

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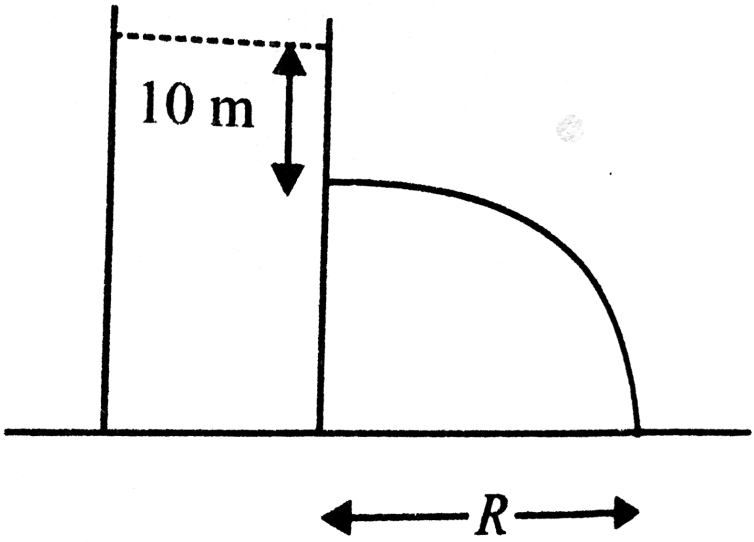
41. The range of water flowing out of a small hole made at a depth $10m$ below water surface in a large tank is R. Find the extra pressure (in atm) applied on the water surface so that range becomes $2R$. Take $1atm = 10^5 Pa$.



A. 9 atm

B. 4 atm

C. 5 atm

D. 3 atm

Answer: D

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42. A sufficiently long closed organ pipe has a small hole at its bottom . Initially , the pipe is empty . Water is poured into the pipe at a constant rate . The fundamental frequency of the air column in the pipe

A. continuosly increasing

B. first increases and them become constant

C. continuously decreases

D. first decreases and them become constant

Answer: B

Watch Video Solution

43. A water barrel stands on a table of height h. If a small holes is punched in the side of the barrel at its base, it is found that the resultant

stream of water strikes the ground at a horizontal distance R from the table. What is the depth of water in the barrel?

A. $\frac{R}{2}$

B. $\frac{R^2}{4h}$

C. $\frac{R^2}{h}$

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

Answer: B

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44. A cyclinderical vessel of cross-sectional area $1000cm^2$, fitted with a frictonless piston of mass $10kg$, and filled with water completely. A small hole of cross-sectional area $10mm^2$ is opened at a point $50cm$ deep from the lower surface of the piston. The velocity of efflux from the hole will be

A. $10.5m/s$

B. $3.4m/s$

C. $0.8m/s$

D. $0.2m/s$

Answer: B

Watch Video Solution

45. A rectangular tank is placed on a horizontal ground and is filled with water to a height H above the base. A small hole is made on one vertical side at a depth D below the level of the water in the tank. The distance x from the bottom of the tank at which the water jet from the tank will hit the ground is

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

B. $2\sqrt{DH}$

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

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

Answer: A

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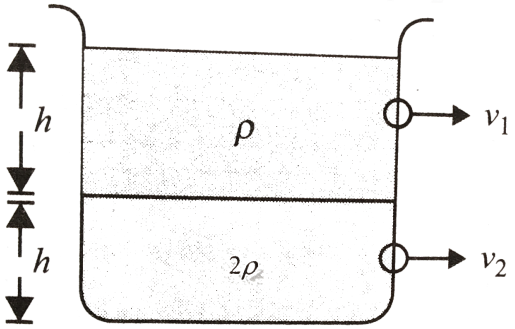
46. Equal volume of two immiscible liquids of densities ρ and 2ρ are filled in a vessel as shown in the figure. Two small holes are punched at depths $h/2$ and $3h/2$ from the surface of lighter liquid. If v_1 and v_2 are the velocities of efflux at these two holes, then v_1/v_2 is



A. $\frac{1}{2\sqrt{2}}$

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

C. $\frac{1}{4}$

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

Answer: D

Watch Video Solution

47. 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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48. A cylindrical vessel filled with water upto a height of $2m$ stands on horizontal plane. The side wall of the vessel has a pugged circular hole touching the bottom. If the minimum diameter of the hole so that the vessel begins to move on the floor if the plug is removed is $\frac{x}{10\sqrt{\pi}}$ meter then x will be (if the coefficient of frication between the bottom of the vessel and the plane is 0.4 and total mass of water plus vessel is $100kg$.)

A. $\sqrt{\frac{2\mu M}{\pi\rho H}}$

B. $\sqrt{\frac{\mu M}{2\pi\rho H}}$

C. $\sqrt{\frac{\mu M}{\rho H}}$

D. none

Answer: A

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49. Which of the following is not an assumption for an ideal fluid flow for which Bernoulli's principle is valid

A. Steady flow

B. Incompressible

C. Viscous

D. Irrotational

Answer: C

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50. A Newtonian fluid fills the clearance between a shaft and a sleeve. When a force of $800N$ is applied to the shaft, parallel to the sleeve, the shaft attains a speed of $1.5cm/\sec$. If a force of $2.4kN$ is applied instead, the shaft would move with a speed of

A. $1.5cm/\sec$

B. $13.5cm/\sec$

C. $4.5cm/\sec$

D. None

Answer: C

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51. A solid metallic sphere of radius r is allowed to fall freely through air. If the frictional resistance due to air is proportional to the cross-sectional area and to the square of the velocity, then the terminal velocity of the sphere is proportional to which of the following ?

A. r^2

B. r

C. $r^{3/2}$

D. $r^{1/2}$

Answer: D

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52. Two drops of same radius are falling through air with steady velocity of $v \quad cm/s$. If the two drops coalesce, what would be the terminal velocity ?

A. $4v$

B. $(4)^{1/3}v$

C. $2v$

D. $64v$

Answer: B

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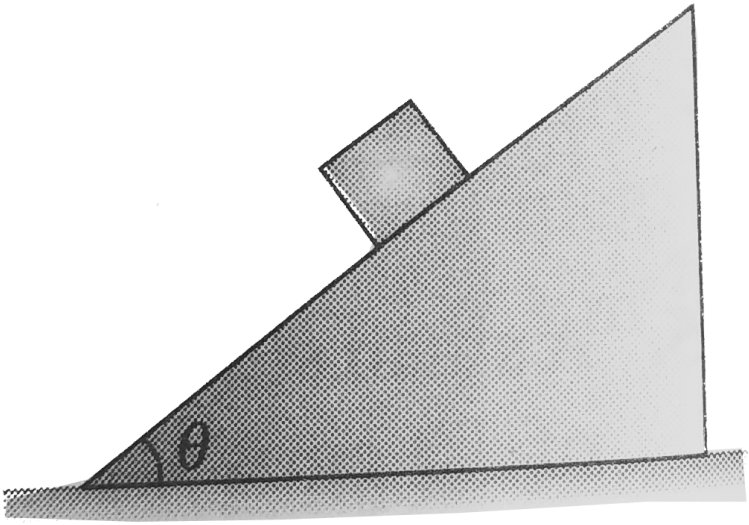


53.

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 viscous fluid of thickness t between the plane and the block. Then the coefficient of viscosity of the thin film will be: (Acceleration due to gravity is g)

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

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

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

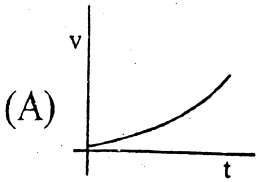
D. none of these

Answer: A

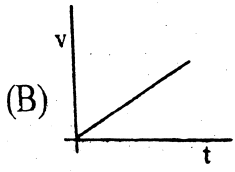
Watch Video Solution

54. Which of the following graphs best represents the motion of a raindrop?

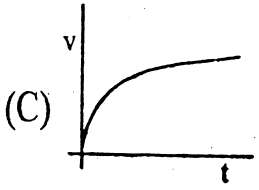
A.



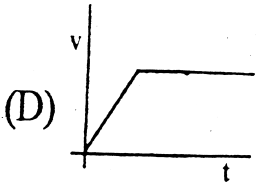
B.



C.



D.



Answer: C

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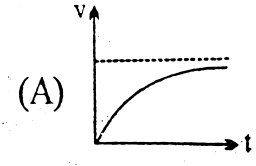
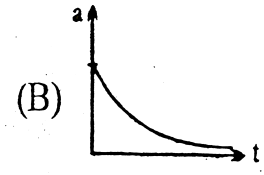
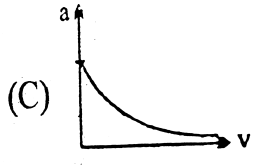
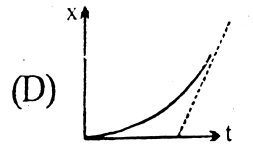
55. Which of the following is the incorrect graph for a sphere falling in a viscous liquid?

A. 

B. 

C. 

D. 

Answer: C

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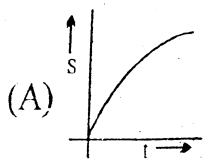
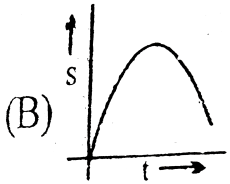
56. The displacement of a ball falling rest in a viscous medium is platted against time. Choose a possible option

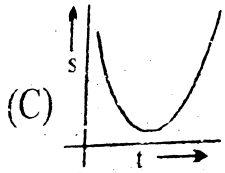
A.



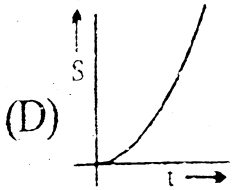
B.



C.



D.



Answer: D

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57. There is a 1mm thick layer of glycerine between a flat plate of area $100cm^2$ and and a big plate. If te coefficient of viscosity of glycerine is $1.0kg/m-\sec$, then how much force is required to move the plate with a velocity of 7 cm/sec.

A. $3.5N$

B. $0.7N$

C. $1.4N$

D. None

Answer: B

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58. A container, whose bottom has round holes with diamter $0.1mm$ is filled with water. The maximum height in cm upto which water can be

filled without leakage will be what? Surface tension $= 75 \times 10^{-3} N/m$ and $g = 10 m/s^2$

A. $20 cm$

B. $40 cm$

C. $30 cm$

D. $60 cm$

Answer: C

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59. If two soap bubbles of different radii are connected by a tube

A. air flows from the bigger bubble to the smaller bubble till the sizes become equal

B. air flows from bigger bubble to the smaller bubble till the sizes are interchanged

C. air flows from the smaller bubble to the bigger

D. there is no flow of air.

Answer: C

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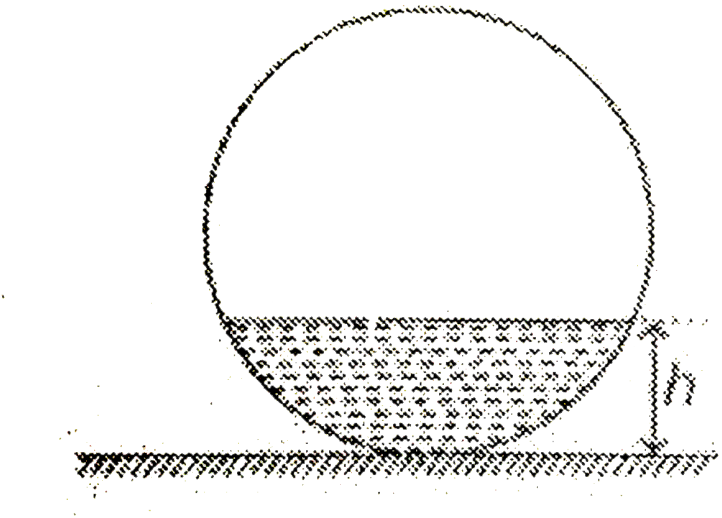
60. A liquid is filled in a spherical container of radius R up to a height h. At this position the liquid surface at the end is also horizontal. The contact angle is



A. 0

B. $\cos^{-1}\left(\frac{R-h}{R}\right)$

C. $\cos^{-1}\left(\frac{h-R}{R}\right)$

D. $\sin^{-1}\left(\frac{R-h}{R}\right)$

Answer: B

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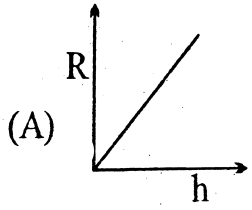
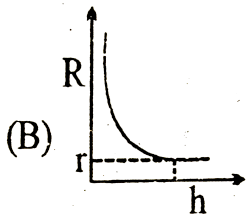
61. A capillary tube of radius r is placed in a liquid I the angle of contact is θ , the radius of curvature R of the meniscus in the capillary is

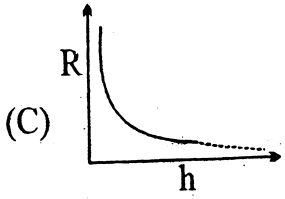
A.



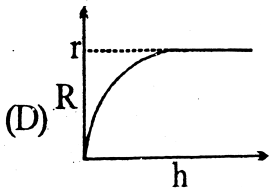
B.



C.



D.



Answer: B

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62. A beaker filled with water, is accelerated at a rate a $\frac{m}{s^2}$ in forward direction. The surface of water shall make an angle

A. $\tan^{-1}(a/g)$ backwards

B. $\tan^{-1}(a/g)$ forwards

C. $\cot^{-1}(g/a)$ backwards

D. $\cot^{-1}(g/a)$ forwards

Answer: A::C

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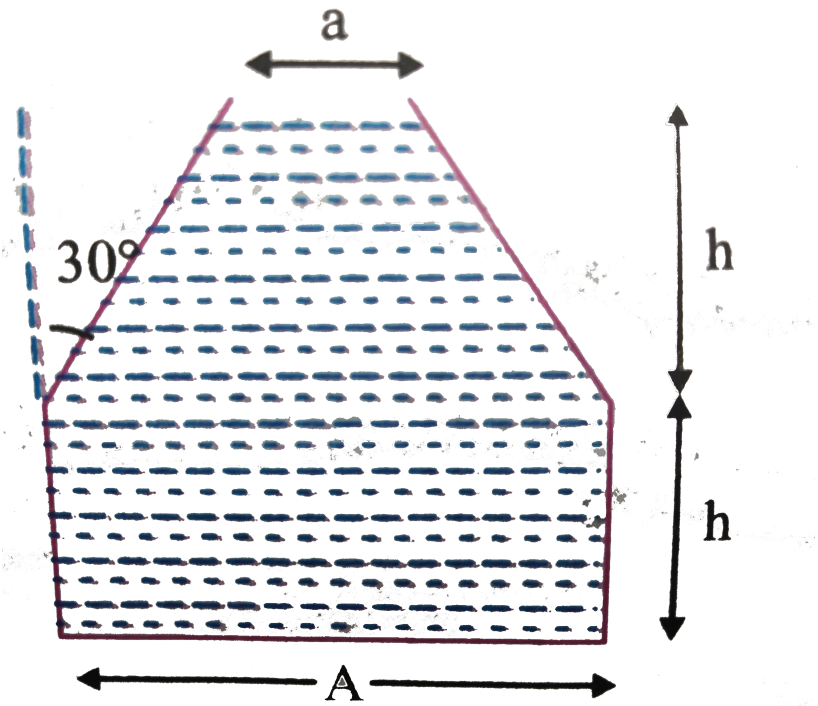

63.

The vessel shown in the figure has two sections. The lower part is a rectangular vessel with area of cross-section A and height h. The upper part is a conical vessel of height h with base area A and top area a and the walls of the vessel are inclined at an angle 30° with he vertical.A

liquid of density ρ fills both the sections upto a height 2h. Neglect atmospheric pressure.

A. The force F exerted by the liquid on the base of the vessel is $2h\rho g.\ \frac{(A+a)}{2}$

B. the pressure P at the base of the vessel is $2h\rho g.\ \frac{A}{a}$

C. the weight of the liquid W is greater than the force exerted by the liquid on the base

D. the walls of the vessel exert a downward force $(F-W)$ on the liquid.

Answer: D

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64. A cubical block of wood of $10cm$ and mass $0.92kg$ floats on a tank of water with oil or rel. density 0.6. Thickness of oil is $4cm$ above water. When the block attains equilibrium with four of its sides edges verical:

A. $1cm$ of it will be above the free surface of oil.

B. $5cm$ of it will be under water.

C. $2cm$ of it will be above the common surface of oil and water.

D. $8cm$ of it will be under water.

Answer: C::D

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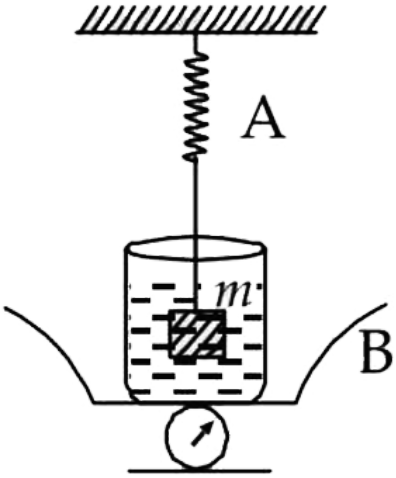
65. The spring balance A reads 2 kg with a block m suspended from it. A balance B reads 5kg when a beaker with liquid is put on the pan of the balance. The two balances are now so arranged that the hanging mass in

inside the liquid in the beaker as shown in the figure. In this situation:



A. the balance A will read more than $2kg$

B. the balance B will read more than $5kg$

C. the balance A will read less than $2kg$ and B will read more than $5kg$

D. the balance A and B will read $2kg$ and $5kg$ repectively

Answer: B::C

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66. When an air bubble rise from the bottom of a deep lake to a point just below the water surface, the pressure of air inside the bubble

A. is greater than the pressure outside it

B. is less than the pressure outside it

C. increases as the bubble moves up

D. decreases as the bubble moves up

Answer: A::D

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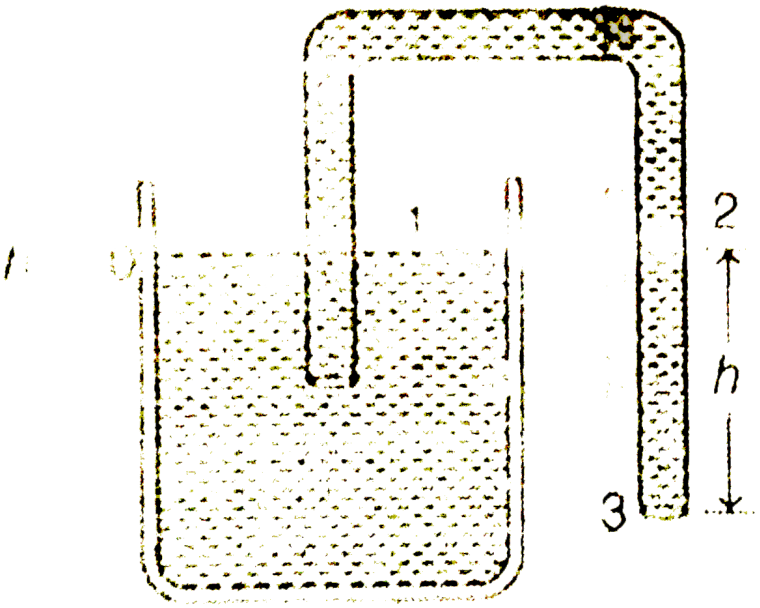
67. Figure shows a siphon. Choose the wrong statement.



(p_0 = atmospheric pressure)

A. Siphon works when $h_3 > 0$

B. Pressure at point 2 is $P_2 = P_0 - \rho g h_3$

C. Pressure at point 3 is P_0

D. None of these

Answer: D

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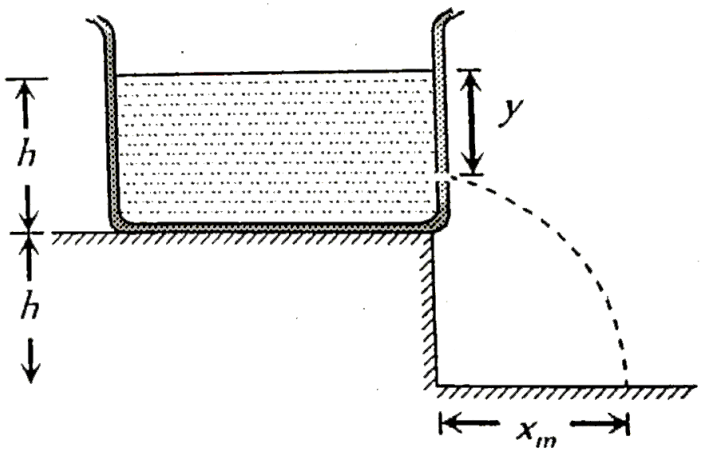
68. A tank is filled upto a height h with a liquid and is placed on a platform of height h from the ground. To get maximum range x_m a small hole is punched at a distance of y from the free surface of the liquid. Then



A. $x_m = 2h$

B. $x_m = 1.5h$

C. $y = h$

D. $y = 0.75h$

Answer: A::C

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69. A horizontal jet of water coming out of a pipe of area of cross-section $20cm^2$ hits a vertical wall with a velocity of $10ms^{-1}$ and rebounds with the same speed. The force exerted by water on the wall is .

A. the thrust exerted by the water on the wall will be doubled

B. the thrust exerted by the water on the wall will be four times

C. the energy lost per second by water strikeup the wall will also be four times

D. the energy lost per second by water striking the wall be increased eight times.

Answer: B::D

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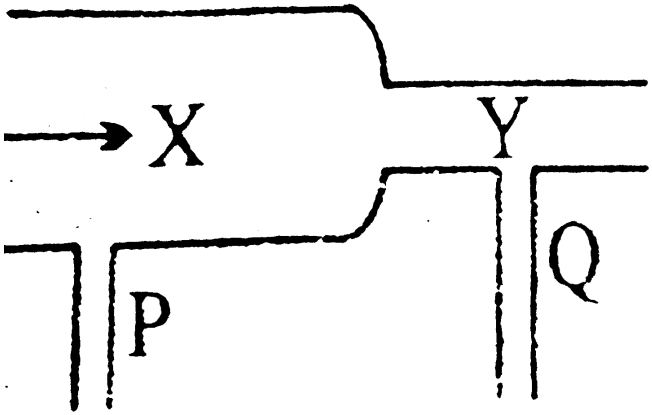
70. A steady flow of water passes along a horizontal tube from a wide section X to the narrower section Y, see figure. Manometers are placed at P and Q at the sections. Which of the statement A,B,C,D, E is most correct?



A. water velocity at X is greater than at Y

B. the manometer at P shows lower pressure than at Q

C. kinetic energy per m^3 of water at X=kinetic energy per m^3 at Y

D. the manometer at P shows greater pressure than at Y

Answer: D

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71. Some question (Assertion-Reason type) are given below. Each question contains STATEMENT-1(Assertion) and STATEMENT-2(Reason) . Each question has 4 choices (A),(B),(C) and (D) out of which ONLY ONE is correct. So select the correct choice :

STATEMENT-1

If a body is floating in a liquid, the density of liquid is always greater than the density of solid.

STATEMENT-2

Surface tension is the property of liquid surface.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

Answer: D

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72. Some question (Assertion-Reason type) are given below. Each question contains STATEMENT-1(Assertion) and STATEMENT-2(Reason) . Each question has 4 choices (A),(B),(C) and (D) out of which ONLY ONE is correct. So select the correct choice :

STATEMENT-1

Viscosity of liquid increases rapidly with the rise of temperature.

STATEMENT-2

Viscosity of liquid is the property of liquid by virtue of which it opposes the relative motion amongst its different layers.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

Answer: D

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73. Some question (Assertion-Reason type) are given below. Each question contains STATEMENT-1(Assertion) and STATEMENT-2(Reason) . Each question has 4 choices (A),(B),(C) and (D) out of which ONLY ONE is correct. So select the correct choice :

STATEMENT-1

Falling raindrops acquire a terminal velocity.

STATEMENT-2

A constant force in the direction of motion and a velocity dependent force opposite to the direction of motion, always result in the acquisition of terminal velocity.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

Answer: A

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74. Some question (Assertion-Reason type) are given below. Each question contains STATEMENT-1(Assertion) and STATEMENT-2(Reason) . Each question has 4 choices (A),(B),(C) and (D) out of which ONLY ONE is correct. So select the correct choice :

STATEMENT-1

In the steady flow of an ideal fluid, the velocity at any point is same for different fluid particles.

STATEMENT-2

Steady fluid flow is the unaccelerated fluid flow.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

Answer: C

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75. Some questions (Assertion-Reason Type) are given below. Each question contains Statement I (Assertion) and statement II(reason). Each question has 4 choices (a),(b),(c) and (d) out of which only one is correct. So select the correct choise.

a. Statement I is True, Statement II is True,Statement II is a correct explanation for Statement I

b. Statement I is True, Statement II is True, Statement II is NOT a correct

ecplanation for Statement I

c. Statement I is True, Statement II is False .

d. Statement I is false, Statement II is True.

2. Statement:I Though light of a single frequency (monochromatic light) is incident on a metal, the energies of emitted photoelectrons are different.

Statement II: The energy of electrons just after they absorb photons incident on the metal surface may be lost in collision with other atoms in the metal before the electron is ejected out of the metal.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

Answer: D

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76. Some question (Assertion-Reason type) are given below. Each question contains STATEMENT-1(Assertion) and STATEMENT-2(Reason) . Each question has 4 choices (A),(B),(C) and (D) out of which ONLY ONE is correct. So select the correct choice :

STATEMENT-1

1kg of cotton fibre will weight less lens in air when made more fluffy.

STATEMENT-2

Weight of air in cotton will cancel out with the force of extra buoyancy acting on it.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

Answer: D

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77. Some question (Assertion-Reason type) are given below. Each question contains STATEMENT-1(Assertion) and STATEMENT-2(Reason) . Each question has 4 choices (A),(B),(C) and (D) out of which ONLY ONE is correct. So select the correct choice :

STATEMENT-1

Steel is more elastic than rubber.

STATEMENT-2

When same deformation is produced in two identical bodies of these material greater restoring force develops in the steel body.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

Answer: A

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78. Some question (Assertion-Reason type) are given below. Each question contains STATEMENT-1(Assertion) and STATEMENT-2(Reason) . Each question has 4 choices (A),(B),(C) and (D) out of which ONLY ONE is correct. So select the correct choice :

STATEMENT-1

Two identical beakers contains water to the same level. A wooden block is floating in one of the beakers. The total weight of both beakers is same.

STATEMENT-2

Volume of the displaced water is equal to the volume of the block.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

Answer: C

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79. Some question (Assertion-Reason type) are given below. Each question contains STATEMENT-1(Assertion) and STATEMENT-2(Reason) . Each question has 4 choices (A),(B),(C) and (D) out of which ONLY ONE is correct. So select the correct choice :

STATEMENT-1

A rain drop after falling through a certain distance attains a constant velocity.

STATEMENT-2

The viscous force for spherical body is proportional to its speed. Hence

after falling through a certain distance viscous drag and buoyant forces balance the gravitational force.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

Answer: A

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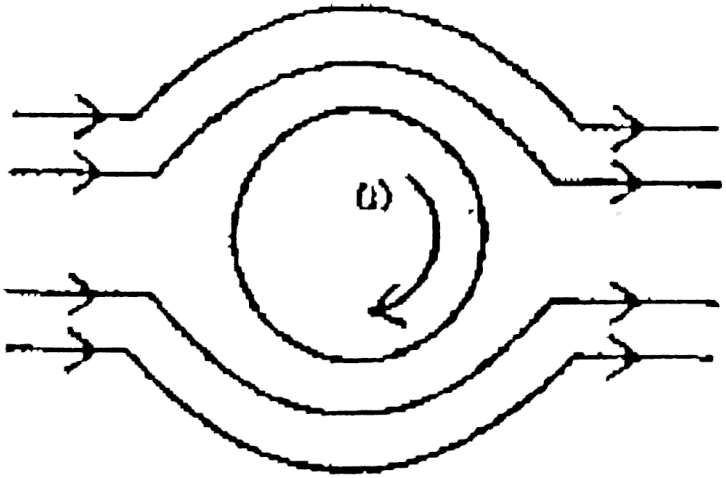
80. Statement-1: As wind flows left to right and a ball is spinned as shown, there will be a lift of the ball.

Statement-2: Decrease in velocity of air below the ball, increases the

pressure more than that above the ball.



A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

Answer: A

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81. Some question (Assertion-Reason type) are given below. Each question contains STATEMENT-1(Assertion) and STATEMENT-2(Reason) . Each question has 4 choices (A),(B),(C) and (D) out of which ONLY ONE is correct. So select the correct choice :

STATEMENT-1 : Ratio of normal stress to volumetric strain is bulk modulus of given gas.

STATEMENT-2 : Compressibility is the reciprocal of bulk modulus.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

Answer: B

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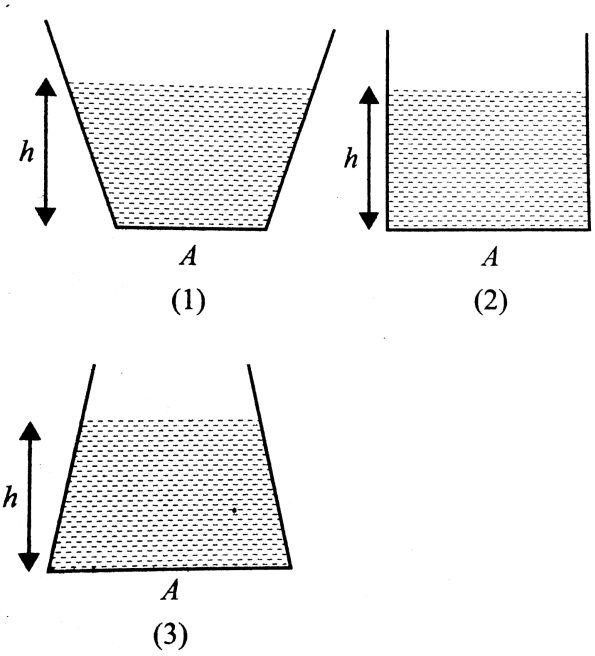
82. Statement I: In the three cases shown in the figure, force exerted by liquid on three vessels is the same.

Statement II: Pressure at the bottom in each case is same.



A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

Answer: D

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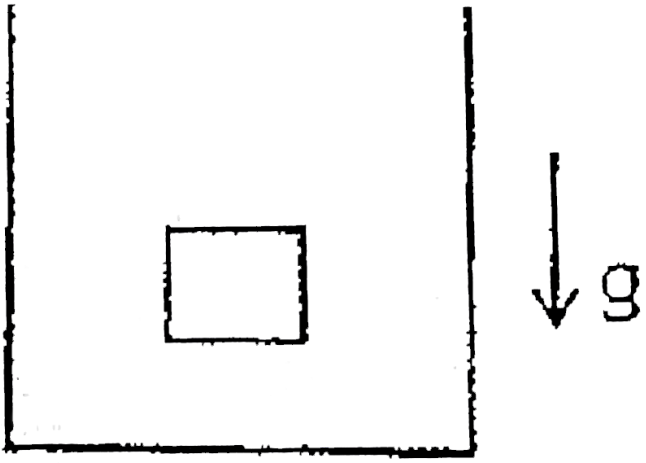
83. Statement-1: A block is immersed in a liquid inside a beaker which is falling freely buoyant force acting on block is zero.

Statement-2: In case of freely falling liquid there is no pressure difference

between any two points.



A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

Answer: A

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84. Some question (Assertion-Reason type) are given below. Each question contains STATEMENT-1(Assertion) and STATEMENT-2(Reason) . Each question has 4 choices (A),(B),(C) and (D) out of which ONLY ONE is correct. So select the correct choice :

STATEMENT-1 : The velocity increase, when water flowing in broader pipe enter a narrow pipe.

STATEMENT-2 : According to equation of continuity, product of area and velocity is constant.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

Answer: A

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85. Some question (Assertion-Reason type) are given below. Each question contains STATEMENT-1(Assertion) and STATEMENT-2(Reason) . Each question has 4 choices (A),(B),(C) and (D) out of which ONLY ONE is correct. So select the correct choice :

STATEMENT-1 : Pascal's Law is the working principle of a hydraulic lift.

STATEMENT-2 : Pressure is equal to thrust acting per unit area.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

Answer: B

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86. Some question (Assertion-Reason type) are given below. Each question contains STATEMENT-1(Assertion) and STATEMENT-2(Reason) . Each question has 4 choices (A),(B),(C) and (D) out of which ONLY ONE is correct. So select the correct choice :

STATEMENT-1 : Two row boats moving parallel to one another are pulled towards one another.

STATEMENT-2 : When the boats are close to each other, the velocity of water between them increases and pressure falls according to Bernoull's theorem.

A. Statement-1 is True, Statement-2 is True, Statement-2 is a correct explanation for Statement-1.

B. Statement-1 is True, Statement-2 is True, Statement-2 is NOT a correct explanation for Statement-1.

C. Statement-1 is True, Statement-2 is False.

D. Statement-1 is False, Statement-2 is True.

Answer: A

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PYQS AIEEE

1. A cylinder of height 20m is completely filled with water. The velocity of effux of water $\left(\in ms^{-1} \right)$ through a small hole on the side wall of the cylinder near its bottom is

A. 10

B. 20

C. 25.5

D. 5

Answer: B

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2. Spherical balls of radius 'R' are falling in a viscous fluid of viscosity $'\eta'$ with a velocity 'v'. The retarding viscous force acting on the spherical ball is

A. directly proportional to R but inversely proportional to v

B. directly proportional to both radius R and velocity v

C. inversely proportional to both radius R and velocity v

D. inversely proportional to R but directly proportional to velocity v

Answer: B

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3. If two soap bubbles of different radii are connected by a tube

A. air flows from the bigger bubble to the smaller bubble till the sizes become equal

B. air flows from bigger bubble to the smaller bubble till the sizes are interchanged

C. air flows from the smaller bubble to the bigger

D. there is no flow of air.

Answer: C

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4. A 20cm long capillary tube is dipped in water. The water rises up to 8cm. If the entire arrangement is put in a freely falling elevator the length of water column in the capillary tube will be

A. 8cm

B. 10cm

C. 4cm

D. 20cm

Answer: D

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5. If the terminal speed of a sphere of gold (density $= 19.5kg/m^3$) is $0.2m/s$ in a viscous liquid (density $= 1.5kg/m^3$), find the terminal speed of a sphere of silver (density $= 10.5kg/m^3$) of the same size in the same liquid

A. $0.4ms^{-1}$

B. $0.133ms^{-1}$

C. $0.1ms^{-1}$

D. $0.2ms^{-1}$

Answer: C

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6. A spherical solild of volume V is made of a material of density ρ_1. It is falling through a liquid of density $\rho_2(\rho_2 < \rho_1)$. Assume that the liquid applies a viscous froce on the ball that is proportional ti the its speed v, i.e., $F_{viscous} = -kv^2(k > 0)$. The terminal speed of the ball is

A. $\sqrt{\frac{Vg(\rho_1 - \rho_2)}{k}}$

B. $\frac{Vg\rho_1}{k}$

C. $\sqrt{\frac{Vg\rho_1}{k}}$

D. $\frac{Vg(\rho_1 - \rho_2)}{k}$

Answer: A

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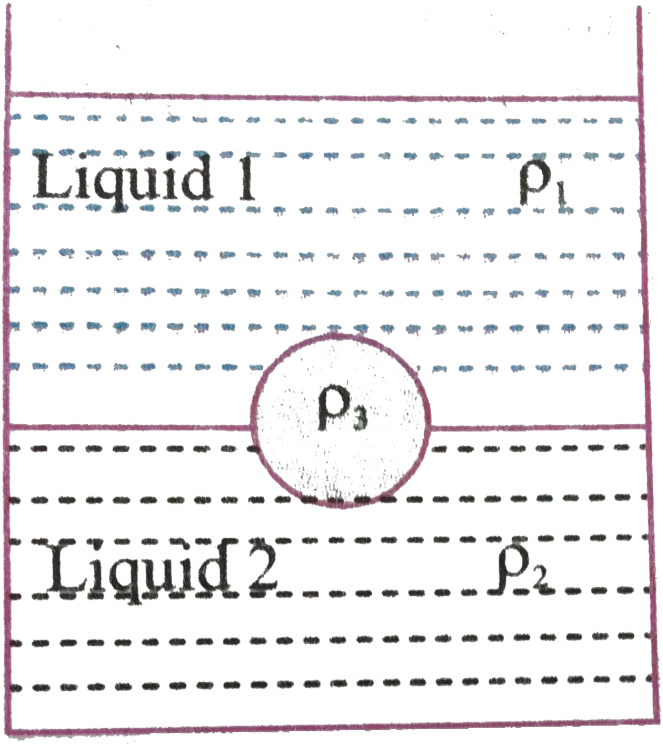

7.

A jar filled with two non-mixing liquid 1 and 2 having densities ρ_1 and ρ_2 respectively. A solid ball, made of a material of density ρ_3 is dropped in the jar. It come to equilibrium in the position shown in the figure. Which of the following is true for ρ_1, ρ_2 and ρ_3?

A. $\rho_3 < \rho_1 < \rho_2$

B. $\rho_1 > \rho_3 > \rho_2$

C. $\rho_1 > \rho_2 > \rho_3$

D. $\rho_1 < \rho_3 < \rho_2$

Answer: D

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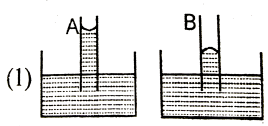
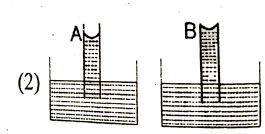
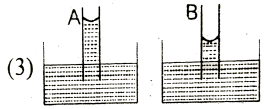
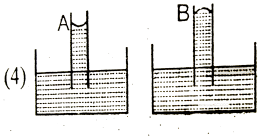
8. A capillary tube (A) is dipped in water. Another identical tube (B) is dipped in a soap-water solution. Which of the following shows the relative nature of the liquid columns in the two tubes?

A. 

B. 

C. 

D. 

Answer: C

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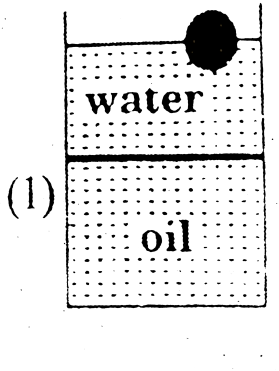
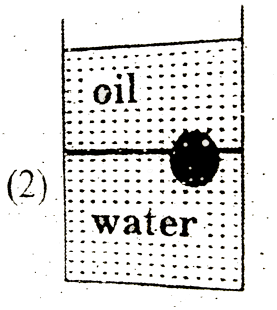
9. A ball is made of a material of density ρ where $\rho_{oil} < \rho < \rho_{water}$ with ρ_{oil} and ρ_{water} representing the densities of oil and water, respectively. The oil and water are immiscible. If the above ball is in equilibrium in a mixture of this oil and water, which of the following pictures represents its equilibrium position?

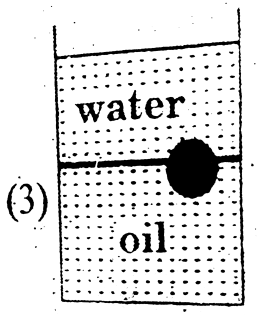
A.



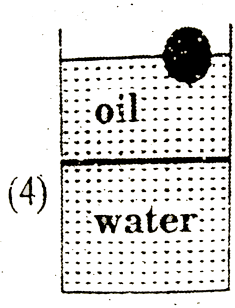
B.



C.



D.



Answer: B

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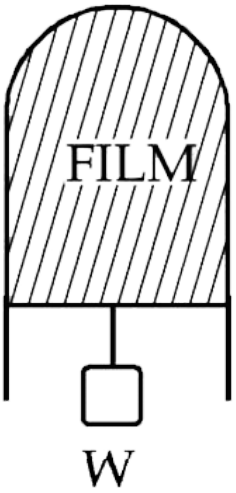
10. A thin liquid film formed between a U-shaped wire and a light slider supports a weight of $1.5 \times 10^{-2} N$ (see figure). The length of the slider is 30cm and its weight negligible. The surface tension of the liquid film is



A. $0.0125 Nm.1$

B. $0.1 Nm.1$

C. $0.05 Nm.1$

D. $0.025 Nm.1$

Answer: D

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