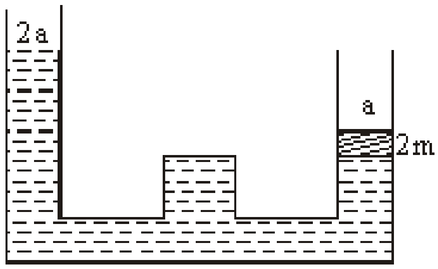
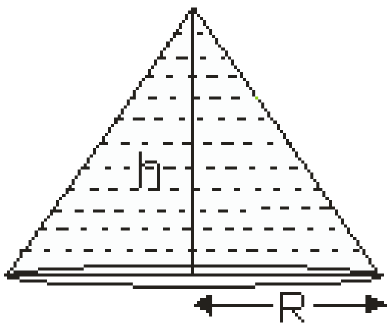
SUB: PHYSICS

1. In the adjoining figure the cross-sectional area of smaller tube is a and the larger tube is 2a. A block of mass 2 m is kept in the smaller tube have same base area a as that of the tube. The difference between water levels of the two tubes are (density of water is $\rho$and in $P_0$is atmospheric pressure)



1)$\frac{P_0}{\rho g}+\frac{m}{a\rho}$ 2)$\frac{P_0}{\rho g}+\frac{m}{2a\rho}$ 3)$\frac{2m}{a\rho}$ 4)$\frac{m}{a\rho}$

2. A liquid of density $\rho$is filled in a conical vessel as shown in the fig. with a very small hole at the top Force exerted by the liquid on the curved side wall is (Neglect atmospheric pressure)

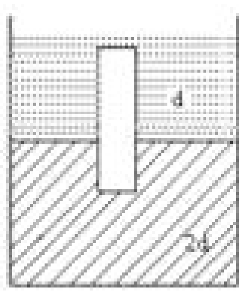


1)$\frac{2}{3}\pi R^2\rho gh$ 2)$\frac{1}{3}\pi R^2\rho gh$ 3)$\pi R^2\rho gh$ 4) 0

3. A vessel contains oil (density $= 0.8 g/cm^3$) over mercury (density $= 13.6 g/cm^3$) A homogeneous sphere floats with half its volume immersed in mercury and the other half in oil. The density of the material of the sphere in g/cm^3 is:

1) 3.3 2) 6.4 3) 7.2 4) 12.8

4. A homogenous solid cylinder of length L cross-sectional area A is immersed in such a way 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:

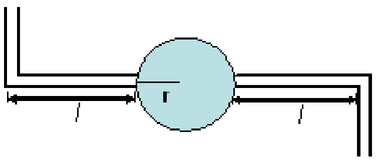


1) $\frac{5}{4}d$ 2) $\frac{4}{5}d$ 3) $4d$ 4) $\frac{d}{5}$

5. A metal ball of density 7800 kg/m^3 is suspected to have a large number of inner cavities. It weighs 9.8 kg when weighed directly on a balance in air and 1.5 kg less when immersed in water. The fraction of volumes of the cavities in the metal ball is approximately

1) 20% 2) 30% 3) 16% 4) 11%

6. Figure shows the top view of a cylindrical can mounted on a turn table. The cylindrical can is filled with water. At a depth h bellow the water surface are two horizontal tubes of length l and cross sectional area a, with right angled bends at their ends. If ρ is the density of water, find the torque exerted on the system as the water jet emerges from the tubes.



1) $4\rho gh(r+l)a$ 2) $4\rho ghra$ 3) $4\rho ghla$ 4) Zero

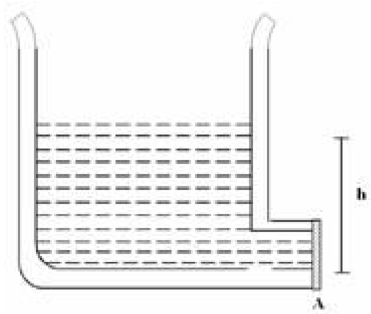
7. A cylindrical vessel filled with water up to the height H becomes empty in time $t_0$due to a small hole at the bottom of the vessel. If the water is filled in the same vessel to a height 4H. The time taken to empty the cylinder will be

1) $8t_0$ 2) $4t_0$ 3) $2t_0$ 4) t_0

8. A liquid is kept in a vertical cylindrical vessel which is rotated along its axis. The liquid rises at the sides. If the radius of vessel is *r* and the speed of revolution is *n* rotation/sec, find the difference in height of liquid at the centre of vessel and its sides.

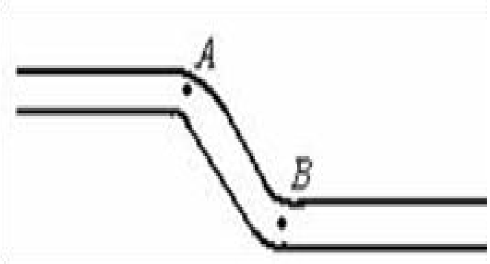
1) $h=\frac{2\pi^2n^2r^2}{g}$ 2) $h=\frac{4\pi^2n^2r^2}{g}$ 3) $h=\frac{2\pi n^2r^2}{g}$ 4) $h=\frac{4\pi n^2r^2}{g}$

9. The small opening near the bottom of the vessel as shown in figure has an area A. A disk is held against the opening to keep the liquid, from running out. Let F_1be the net force on the disk applied by liquid in this case. Now the disk is moved away from the opening at a very short distance. The liquid comes out and strikes the disk inelastically. Let F_2be the force exerted by the liquid in this condition. Then$\frac{F_1}{F_2}$is (neglect atmospheric pressure)



1) $\frac{1}{2}$ 2)1 3) $\frac{2}{1}$ 4) $\frac{1}{4}$

10. In the figure, an ideal liquid flows through the tube, which is of uniform cross-section. The liquid has velocities $V_A$and $V_B$and pressures $P_A$and $P_B$at vertical plane (at points A and B respectively). Which of the following is correct?



1) $V_A = V_B, P_B > P_A$ 2) $V_A = V_B, P_A = P_B$ 3) $P_A = P_B$ 4) $P_A = P_B, V_B > V_A$

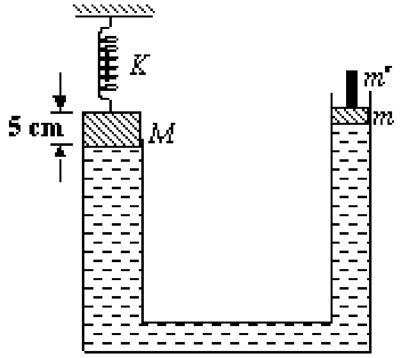
11. A cylindrical container of cross sectional area $100cm^2$is containing water up to a height of 2m. Now a cork of mass 5 kg is put into the container and it floats in equilibrium. If a tiny hole is made on vertical walls very close to base then the velocity of efflux will be (in m/s).(assume that the cork is free to move up and down)

1) $2\sqrt{10}$ 2)5 3) $5\sqrt{2}$ 4)10

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

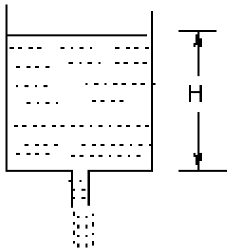
1) $5.0 \times 10^{-4}m^2$ 2) $1.0 \times 10^{-5}m^2$ 3) $5.0 \times 10^{-5}m^2$ 4) $2.0 \times 10^{-5}m^2$

13. For the system shown in the figure, the cylinder on left has a mass (M) of 25 kg and cross sectional area 20 cm^2 and is connected to a spring of spring constant 1400 N/m and is just on the top of the tube. The piston on the right has mass
m (= 5 kg) and cross sectional area 4 cm^2. The minimum mass m^1 to be kept on m so that water spills out from the left is (g = 10 m/s^2) (initially water level in both limbs is same and the compression of spring = 5 cm). (The arrangement on the left side is such that the moment M is lifted slightly water will spill out).



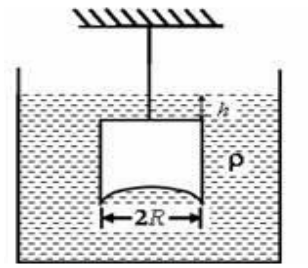
1)1 kg 2) 1.4 kg 3) 0.7 kg 4) 2.5 kg

14. A tank of cross sectional area A_0 is filled with a liquid. A small orifice of area A ($A<<A_0$) is present at the bottom of tank. At a moment the height of liquid in the tank is H, what is acceleration of top layer of liquid at this moment?



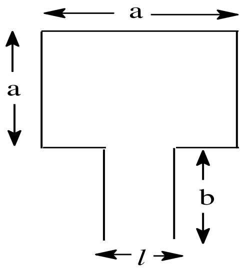
1) g 2) $\frac{A}{A_0}g$ 3) $\left(\frac{A}{A_0}\right)^2 g$ 4) depends on H

15. 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 side walls of the cylinder by the liquid is :



1) Zero 2) $Mg - V\rho g$ 3) $Mg - \pi R^2 h\rho g$ 4) $\rho g(V + \pi R^2 h)$

16. A light open rigid wire frame floats on the surface of water as shown in figure. What force will act on the frame, immediately after some soap solution is dropped inside it? $\alpha_1 and \alpha_2$ are the surface tensions of water and soap respectively ($\alpha_1 > \alpha_2$).



1) Zero
2) $(\alpha_1 - \alpha_2)l$
3) $(\alpha_1 + \alpha_2)(4a + 2b - l)$
4) $(\alpha_1 - \alpha_2)(4a + 2b - l)$

17. One end of a glass capillary tube with a radius 'r' is immersed into water to a depth of 'h'. The surface tension of water is 'S' and the atmospheric pressure is 'P_0'. What pressure is required to blow an air bubble out of the lower end of the tube? Density of water is 'ρ'.

1) $P_0 - \rho gh + \frac{2s}{r}$
2) $P_0 + \rho gh + \frac{2s}{r}$
3) $P_0 + \rho gh - \frac{2s}{r}$
4) $P_0 - \rho gh - \frac{2s}{r}$

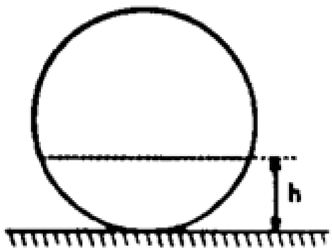
18. A glass rod of diameter $d_1 = 1.5mm$ is inserted symmetrically into a glass capillary with inside diameter $d_2 = 2mm$. Then the whole arrangement is vertically oriented and brought in contact with the surface of water. Surface tension and density of water are 0.075 N/m and $10^3 Kg/m^3$ respectively. The height through which the water will rise in the capillary is ($g = 10m/s^2$)

1) 12 cm
2) 3 cm
3) 6 cm
4) 36 cm

19. An air bubble inside a liquid of surface tension 1.0 x $10^{-3} Nm^{-1}$ grows from a radius of 1.0 x 10^{-5}m to 1.0 x 10^{-4}m in 6μs. The average rate of change of the pressure inside the bubble is

1) $2x10^7$ Nm$^{-2}s^{-1}$
2) $3x10^7$ Nm$^{-2}s^{-1}$
3) $4x10^7$ Nm$^{-2}s^{-1}$
4) $6x10^7$ Nm$^{-2}s^{-1}$

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

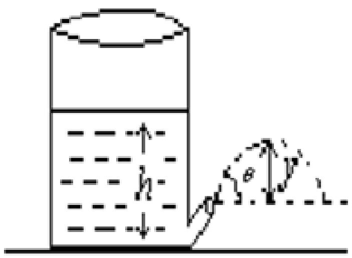


1) 0 2) $cos^{-1}\left(\frac{R-h}{R}\right)$ 3) $cos^{-1}\left(\frac{h-R}{R}\right)$ 4) $sin^{-1}\left(\frac{R-h}{R}\right)$

21. A long glass capillary tube of uniform bore of diameter 1 mm with both ends open is filled completely with water and then held vertically in air. If the surface tension of water is $0.075 N/m$, the length of the water column remaining in the glass tube is $(g = 10 m/s^2)$

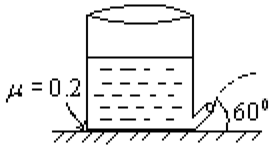
1) zero 2) 1.5 cm 3) 3.0 cm 4) 6.0 cm

22. Figure shows a stream of fluid emerging from a tube in the base of an open fixed tank. The expression of 'y' (Maximum height travelled by jet of water) is



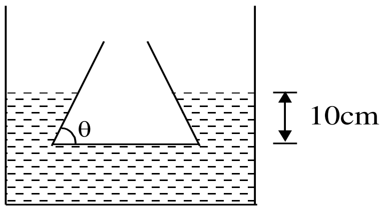
1) h 2) $h\, sin^2 \theta$ 3) $h\, cos^2 \theta$ 4) $\frac{h}{sin^2 \theta}$

23. Water is filled to a height of 20cm in the container which contains 5lit of water as shown in the figure. A small orifice of area $10^{-2}m^2$ is made at the bottom of the vertical wall of container the ejected water is directed as shown in figure. Assuming that the mass of container is negligible, the acceleration of the container is



1) zero 2) $3.7ms^{-2}$ 3) $0.64ms^{-2}$ 4) $7ms^{-2}$

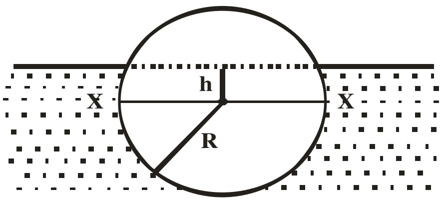
24. A conical flask of mass 10 kg and base area as 10^3 cm^2 is floating in liquid of relative density 1.2, as shown in the figure. The force that liquid exerts on curved surface of conical flask will be
(Given g = 10 m/s^2) neglect atmospheric pressure.



1) 20 N downward direction 2) 40 N in downward direction

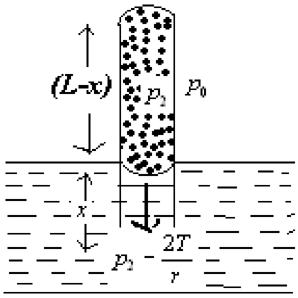
3) Can be determined only if θ is given 4) 20 N in upward direction

25. A solid sphere of radius 'R' floats in a liquid of density 'σ' such that its diameter x-x is below distance 'h' from free surface as shown. The density of sphere is ρ. If $2h = R$ then the value of $\frac{\sigma}{\rho}$ is



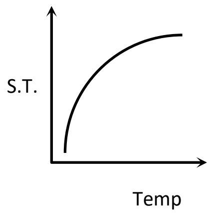
1) $\frac{21}{33}$ 2) $\frac{27}{32}$ 3) $\frac{32}{27}$ 4) $\frac{33}{21}$

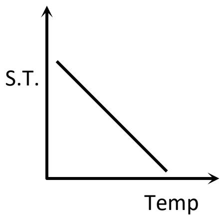
26. A glass capillary sealed at the upper end is of length 0.11 m and internal diameter $2 \times 10^{-5} m$ containing air atmospheric pressure. The tube is immersed vertically into a liquid of surface tension 5.06×10^{-2} N/m. To what length has the capillary to be immersed so that the liquid level inside and outside the capillary becomes the same? (angle of contact = 0^0)

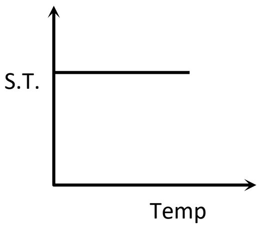


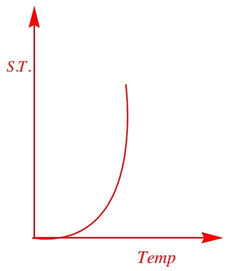
1) 1cm 2) 2cm 3) 3cm 4) 4cm

27. Which graph represents the variation of surface tension with temperature over small temperature ranges for water

1) 

2) 

3) 

4) 

28. A suction cup is attached a smooth metal ceiling. Assume absolute vacuum inside the cup. The maximum weight that can be supported by the suction cup is dependent on (Mark the most appropriate option)

1) Its area of contact with the ceiling   2) The air pressure outside the cup

3) Both 1 and 2   4) Neither 1 nor 2

29. A large rock is tied to a balloon filled with air. Both are placed in lake. As the balloon sinks assuming no surface tension no viscosity. The magnitude of the net force on the balloon +air +rock

1) Increases   2) Remains the same

3) Decreases   4) varies in an unpredictable manner.

30. A long capillary tube of radius r is put in contact with the surface of (perfectly) wetting liquid of very low viscosity and densityρ. The maximum height h the liquid can reach inside the capillary is (Here height is measured above the level of the liquid outside the capillary. The surface tension of the liquid and acceleration due to gravity are denoted by σ and g respectively)

1) $h = \frac{2\sigma}{\rho g r}$ 2) $h = \frac{4\sigma}{\rho g r}$ 3) $\frac{2\sigma}{\rho g r} < h < \frac{4\sigma}{\rho g r}$ 4) $h = \frac{\pi}{\rho g r}$