# Daily Practice Problems

## PHYSICS

### Physics - Fluid

**1.** A 10 cm side cube weighing 5N is immersed in a liquid of relative density 0.8 contained in a rectangular tank of cross section a area 15cm x 15cm. If the tank contained liquid to a height of 8 cm before the immersion, the level of the liquid surface is :

(A) $\frac{100}{9}$ cm (B) $\frac{97}{9}$ cm

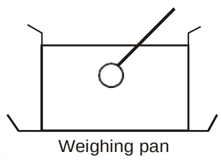
(C) 10 cm (D) 11 cm

**2.** 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 1 m and $2 \times 10^4$ kg/m$^3$ respectively, then the inner diameter of the bowl will be (outer surface is in contact with the liquid) :

(A) 0.94 m (B) 0.97 m

(C) 0.98 m (D) 0.99 m

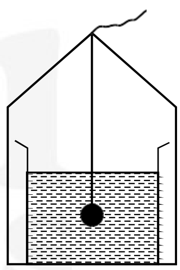
**3.** A vessel with water is placed on a weighing pan and it reads 600 g. Now a ball of mass 40 g and density 0.80 g cm$^{-3}$ is sunk into the water with a pin of negligible volume, as shown in figure keeping it sunk. The weighing pan will show a reading




(A) 600 g (B) 550 g

(C) 650 g (D) 632 g

**4.** A beaker with a liquid of density 1.4 g cm$^{-3}$ is in balance over one pan of a weighing machine. If a solid of mass 10 g and density 8 g cm$^{-3}$ is now hung from the top of that pan with a thread and sinking fully in the liquid without touching the bottom, the extra weight to be put on the other pan for balance will be:



(A) 10.0 g

(B) 8.25 g

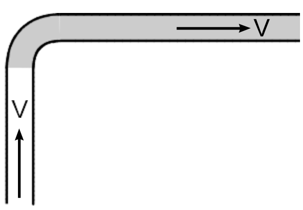
(C) 11.75 g

(D) – 1.75 g

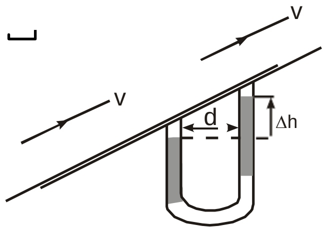
**5.** The time period of a simple pendulum is T. The pendulum is oscillated with its bob immersed in a liquid of density $\sigma$. If the density of the bob is $\rho$ and viscous effect is neglected, the time period of the pendulum in this case will be

(A) $\left(\frac{\rho}{\rho-\sigma}\right)^{1/2}T$ (B) $\left(\frac{\sigma}{\rho-\sigma}\right)^{1/2}$ (C) $\left(\frac{\rho}{\sigma}\right)^{1/2}T$

(D) $\left(\frac{\sigma}{\rho}\right)^{1/2}T$



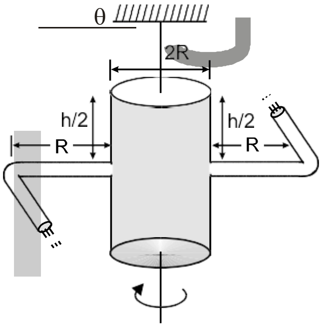
**6.** A fire hydrant delivers water of density ρ at a volume rate L. The water travels vertically upward through the hydrant and then does $90^0$ turn to emerge horizontally at speed V. The pipe and nozzle have uniform cross-section throughout. The force exerted by the water on the corner of the hydrant is




(A) ρVL (B) zero

(C) 2ρVL (D) $\sqrt{2}$

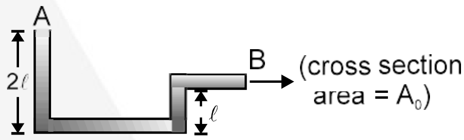
**7.** A mercury manometer is connected as shown in the figure. The difference in height Δh is: (symbols have usual meaning) ($\rho_{Hg} >> \rho$ )




(A) $\frac{\rho\, d \cot\theta}{\rho_{Hg}}$ (B) $\frac{\rho\, d \tan\theta}{\rho_{Hg}}$

(C) $\frac{\rho\, d \sin\theta}{\rho_{Hg}}$ (D) none of these

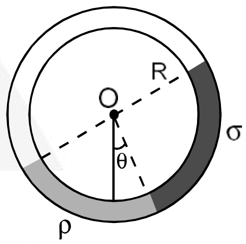
**8.** A cylindrical container of radius ' R ' and height ' h ' is completely filled with a liquid. Two horizontal L shaped pipes of small cross-section area ' a ' are connected to the cylinder as shown in the figure. Now the two pipes are opened and fluid starts coming out of the pipes horizontally in opposite directions. Then the torque due to ejected liquid on the system is:




(A) 4 a g h ρ R (B) 8 a g h ρ R

(C) 2 a g h ρ R (D) none of these

**9.** A tube in vertical plane is shown in figure. It is filled with a liquid of density ρand its end B is closed. Then the force exerted by the fluid on the tube at end B will be : [Neglect atmospheric pressure and assume the radius of the tube to be negligible in comparison to ℓ]



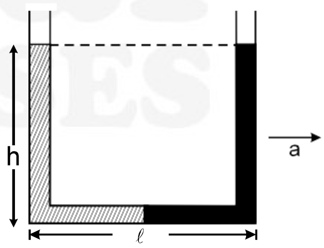

(A) 0 (B) $\rho g \ell A_0$

(C) $2\rho g \ell A_0$ (D) Cannot be determined

**10.** A small uniform tube is bent into a circular tube of radius R and kept in the vertical plane. Equal volumes of two liquids of densities ρ and σ (ρ > σ) fill half of the tube as shown. θ is the angle which the radius passing through the interface makes with the vertical.

(A) $\theta = \tan^{-1}\left(\frac{\rho-\sigma}{\rho+\sigma}\right)$ (B) $\theta = \tan^{-1}\left(\frac{\sigma-\rho}{\sigma+\rho}\right)$

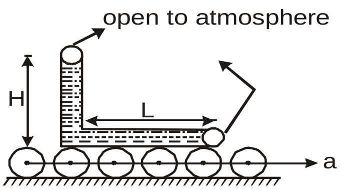
(C) $\theta = \tan^{-1}\left(\frac{\rho}{\rho+\sigma}\right)$ (D) $\theta = \tan^{-1}\left(\frac{\rho}{\rho-\sigma}\right)$




**11.** A U-tube of base length "l" filled with same volume of two liquids of densities ρ and 2ρ is moving with an acceleration "a" on the horizontal plane. If the height difference between the two surfaces (open to atmosphere) becomes zero, then the height h is given by:

(A) $\frac{a}{2g}\ell$ (B) $\frac{3a}{2g}\ell$ (C) $\frac{a}{g}\ell$ (D) $\frac{2a}{3g}\ell$

**12.** You are studying for an exam on the eight floor of your luxurious apartment building. You look out from the window and notice that one of your neighbours is giving a party on the ground-floor terrace and has placed a huge punch bowl full of an interesting looking beverage (specific gravity 1) directly below your window. You quickly string together 80 drinking straws to form a giant straw that can reach the punch bowl 80 feet below. You dip the straw into the punch and begin to suck. When you use a single drinking straw to drink something, it takes you 0.1 seconds to raise the liquid to your lips. But when you use this giant drinking straw,




(A) you find that you can't raise the liquid to your lips no matter how hard you try.
(B) it takes you 8 seconds (80 times 0.1 second) to raise the liquid to your lips.
(C) it takes you 800 seconds (80 divided by 0.1 second) to raise the liquid to your lips.
(D) it takes you 640 seconds (80 times 80 times 0.1 second) to raise the liquid to your lips.

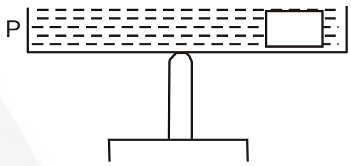
**13.** A narrow tube completely filled with a liquid is lying on a series of cylinders as shown in figure. Assuming no sliding between any surfaces, the value of acceleration of the cylinders for which liquid will not come out of the tube from anywhere is given by

(A) $\frac{gH}{2L}$ (B) $\frac{gH}{L}$ (C) $\frac{2gH}{L}$ (D) $\frac{gH}{\sqrt{2L}}$

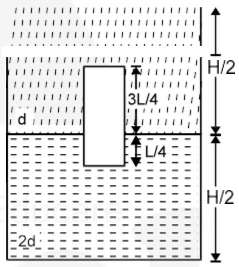
**14.** A piece of cork of mass m and density $\rho$ is completely immersed in a liquid of density $\rho_0$, where $\rho_0 > \rho$. It is attached to the bottom of the vessel containing the liquid by a light string. The whole system moves up with an acceleration = a. The tension in the string is

(A) $m(g + a)\left(1 - \frac{\rho_0}{\rho}\right)$ (B) $m(g + a)\left(\frac{\rho_0}{\rho} - 1\right)$

(C) $mg\left(\frac{\rho_0}{\rho} - 1\right)$ (D) $m(g - a)\left(\frac{\rho_0}{\rho} - 1\right)$

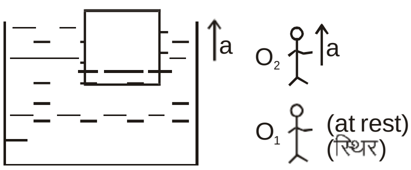



**15.** An open pan P filled with water (density $\rho_w$) is placed on a vertical rod, maintaining equilibrium. A block of density $\rho$ is placed on one side of the pan as shown. Water depth is more than height of the block.
(A) Equilibrium will be maintained only if $\rho < \rho_w$.
(B) Equilibrium will be maintained only if $\rho \le \rho_w$.
(C) Equilibrium will be maintained for all relations between $\rho$ and $\rho_w$
(D) Equilibrium will not be maintained in all cases.




**16.** The centre of buoyancy of a floating object is
(A) at the centre of gravity of the object.
(B) at the centre of gravity of the submerged part of the object.
(C) at the centre of gravity of the remaining part outside the fluid of the object.
(D) at the centre of gravity of the fluid displaced by the submerged part of the object.

**17.** A container of a large uniform cross-sectional area A resting on a horizontal surface holds two immiscible, non-viscous and incompressible liquids of densities ' d ' and ' 2 d ' each of height (1/2)H as shown. The smaller density liquid is open to atmosphere. A homogeneous solid cylinder of length L $\left(< \frac{1}{2}H\right)$ cross-sectional area (1/5) A is immersed such that it floats with its axis vertical to the liquid-liquid interface with length (1/4) L in denser liquid. If D is the density of the solid cylinder then :




(A) $D = \frac{3d}{2}$ (B) $D = \frac{d}{2}$ (C) $D = \frac{2d}{3}$ (D) $D = \frac{5d}{4}$

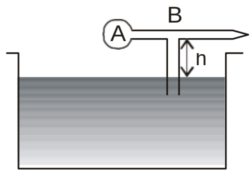
**18.** A vessel contains oil (density = 0.8 gm/cm$^3$) over mercury (density = 13.6 gm/cm$^3$). A uniform sphere floats with half its volume immersed in mercury and the other half in oil. The density of the material of sphere in gm/cm$^3$ is:

(A) 3.3 (B) 6.4 (C) 7.2 (D) 12.8

**19.** A block is partially immersed in a liquid and the vessel is accelerating upwards with an acceleration "a". The block is observed by two observers $O_1$ and $O_2$, one at rest and the other accelerating with an acceleration "a" upward. The total buoyant force on the block is :

(A) same for $O_1$ and $O_2$ (B) greater for $O_1$ than $O_2$

(C) greater for $O_2$ than $O_1$ (D) data is not sufficient



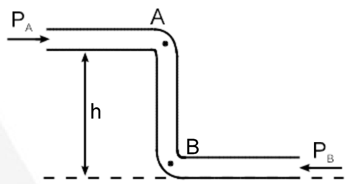

**20.** There is a hole of area A at the bottom of cylindrical vessel. Water is filled up to a height h and water flows out in t second. If water is filled to a height 4h, it will flow out in time equal to

(A) t (B) 4t (C) 2t (D) t/4

**21.** A cylindrical vessel of 92 cm height is kept filled up to the brim. It has four holes 1,2,3,4 which are respectively at heights of 20 cm, 30 cm, 46 cm and 80 cm from the horizontal floor. The water falling at the maximum horizontal distance from the vessel comes from :

(A) hole no.4 (B) hole no.3

(C) hole no.2 (D) hole no.1




**22.** A light cylindrical vessel is kept on a horizontal surface. Its base area is A. A hole of cross sectional area a is made just at its bottom side. The minimum coefficient of friction necessary for preventing the sliding of the vessel due to the impact force of the emerging liquid is (a << A)

(A) varying (B) a/A

(C) 2a/A (D) None of these

**23.** The figure shows a model of perfume atomizer. When the bulb A is compressed, air flows through the narrow tube consequently pressure at the position of the vertical tube reduce. The liquid (perfume) rise in through the vertical tube and emerges through the end. If the excess pressure applied to the bulb in this process be $\Delta p$ then the minimum speed of air in the tube to lift the perfume is ($\rho_a$ is density of air and $\rho$ is density of perfume).

(A) $\sqrt{\frac{2[\Delta p+\rho gh]}{\rho_a}}$ (B) $\sqrt{\frac{2[\Delta p-\rho gh]}{\rho_a}}$ (C) $\sqrt{\frac{\Delta p+\rho gh}{\rho_a}}$ (D) None of these



**24.** Figure shows an ideal fluid flowing through a uniform cross-sectional tube in the vertical tube with liquid velocities $v_A$ & $v_B$ and pressure $P_A$ & $P_B$. Knowing that tube offers no resistance to fluid flow following is true.

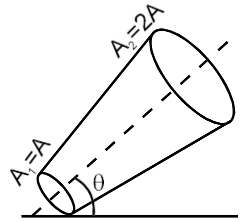
(A) $P_B > P_A$ (B) $P_B < P_A$ (C) $P_A = P_B$ (D) none of these

**25.** Bernoulli's equation can be written in the following different forms (column A). Column B lists certain units each of which pertains to one of the possible forms of the equation. Match the unit associated with each of the equations :

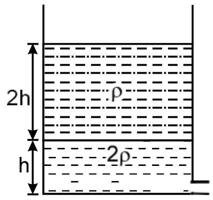
| Column A | Column B |
| --- | --- |
| (a) $\frac{v^2}{2g}+\frac{p}{\rho g}+z$ = constant | (i) Total energy per unit mass |
| (b) $\frac{\rho V^2}{2}+P+\rho gz$ = constant | (ii) Total energy per unit weight |
| (c) $\frac{V^2}{2}+\frac{P}{\rho}+gz$ = constant | (iii) Total energy per unit volume |

(A) a–(i), b–(ii), c–(iii) (B) a–(iii), b–(i), c–(iii)

(C) a–(ii), b–(iii), c–(i) (D) a–(iii), b–(iii), c–(i)



**26.** A large open tank has two small holes in the wall. One is a square hole of side 'L' at a depth '4y' from the top and the other is a circular hole of radius 'R' at a depth 'y' 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:



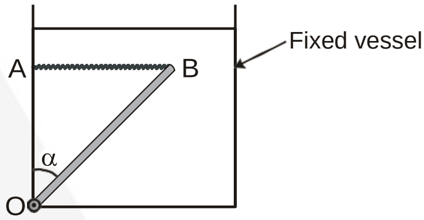

(A) $\frac{L}{\sqrt{2\pi}}$ (B) $2\pi L$ (C) $\sqrt{\frac{2}{\pi}} \, . \, L$

(D) $\frac{L}{2\pi}$

**27.** A portion of a tube is shown in the figure. Fluid is flowing from cross-section area $A_1$ to $A_2$. The two cross-sections are at distance ' $l$ ' from each other. The velocity of the fluid at section $A_2$ is $\sqrt{\frac{g\ell}{2}}$. If the pressures at $A_1$ & $A_2$ are same, then the angle made by the tube with the horizontal will be:

(A) 37° (B) $\sin^{-1}\frac{3}{4}$ (C) 53° (D) none of these

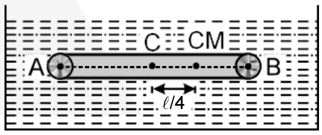
**28.** The velocity of the liquid coming out of a small hole of a vessel containing two different liquids of densities $2\rho$ and $\rho$ as shown in figure is




(A) $\sqrt{6gh}$ (B) $2\sqrt{gh}$ (C) $2\sqrt{2gh}$

(D) $\sqrt{gh}$

**29.** There is a small hole in the bottom of a fixed container containing a liquid upto height 'h'. The top of the liquid as well as the hole at the bottom are exposed to atmosphere. As the liquid comes out of the hole. (Area of the hole is 'a' and that of the top surface is 'A') :




(A) the top surface of the liquid accelerates with acceleration = g

(B) the top surface of the liquid accelerates with acceleration $= g\frac{a^2}{A^2}$

(C) the top surface of the liquid retards with retardation $= g\frac{a}{A}$

(D) the top surface of the liquid retards with retardation $= \frac{ga^2}{A^2}$



**30.** A uniform rod OB of length 1m, cross-sectional area 0.012 $m^2$ and relative density 2.0 is free to rotate about O in vertical plane. The rod is held with a horizontal string AB which can withstand a maximum tension of 45 N. The rod and string system is kept in water as shown in figure. The maximum value of angle $\alpha$ which the rod can make with vertical without breaking the string is

(A) 45° (B) 37° (C) 53° (D) 60°

(A) $\frac{\pi\rho g\ell^2 r^2}{I}$ (B) $\frac{\pi\rho g\ell^2 r^2}{4I}$ (C) $\frac{\pi\rho g\ell^2 r^2}{2I}$ (D) $\frac{3\pi\rho g\ell^2 r^2}{4I}$

# ANSWER KEY

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|---|---|---|---|---|---|---|---|---|---|---|
| **Que.** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
| **Ans.** | B | C | C | A | A | D | B | A | B | A |
| **Que.** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** |
| **Ans.** | B | A | A | B | B | D | D | C | A | C |
| **Que.** | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** |
| **Ans.** | B | C | A | A | C | C | B | B | D | B |