Direction (Q. Nos. 1-13) *This section contains 13 multiple choice questions. Each question has four choices (a), (b), (c) and (d), out of which ONLY ONE is correct.*

1 A vertical narrow glass tube of uniform cross-section, closed at one end has air filled in it upto 40 cm of height, with a column of mercury of height 10 cm above it. If the tube is gradually inclined in the vertical plane and brought to a position making an angle of 60° with the vertical, then new length of air column entrapped within the tube is (atmospheric pressure = 76 cm of Hg)

a. 45.47 cm

b. 43.47 cm

c. 42.47 cm

d. 44.47 cm

2 The press plunger of a Bramah (hydraulic) press is $5 \, m^2$ in cross-section and is employed to lift a load of mass 500 kg. What minimum force will be required to be applied on the pump plunger if its cross-sectional area is $200 \, cm^2$?

a. 39.2 N

b. 9.8 N

c. 29.4 N

d. 19.6 N

3 To what height (h) should a cylindrical vessel of radius (R) be filled with a homogeneous liquid to make the force with which the liquid presses on the curved side wall of the vessel equal to the force exerted by the liquid on the bottom of the vessel?

a. $h = R$

b. $h = \sqrt{2}R$

c. $h = \dfrac{R}{2}$

d. $h = 2R$

4 Water is contained in a rectangular tank, at rest, to a height H. Which of the following graphs best represents the variation of hydrostatic thrust F per unit width of the side of the vessel (width is measured perpendicular to paper) on the area measured from the top of a level, at a height y from the bottom level?
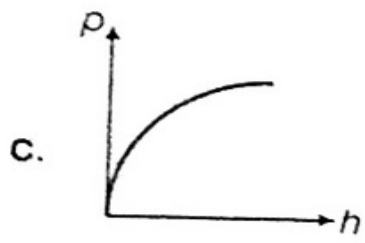

a.

b.

c.

d.

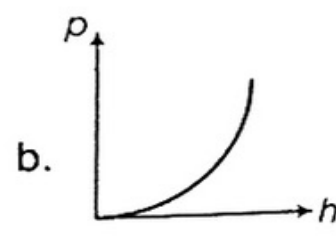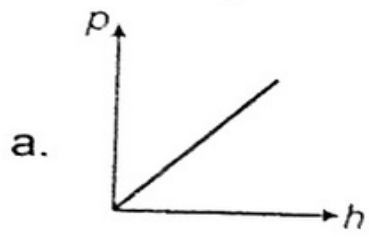**5** A vessel contains non-homogeneous liquid whose density ρ increases linearly with depth h. Which of the following graphs best depicts the variation of liquid pressure p with depth h?

a.

b.

c.

d.
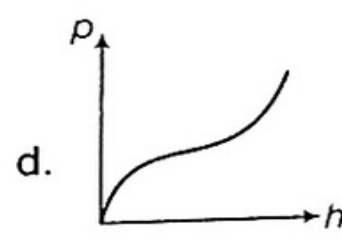
6 A U-tube of length L (see figure) contains liquid and is vertical. It is mounted on a horizontal turn table rotating with an angular speed ω about one of its arms as shown in the figure. The difference in heights (h) between the liquid columns in two vertical arms is
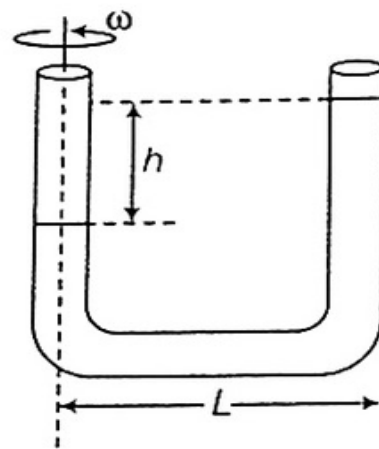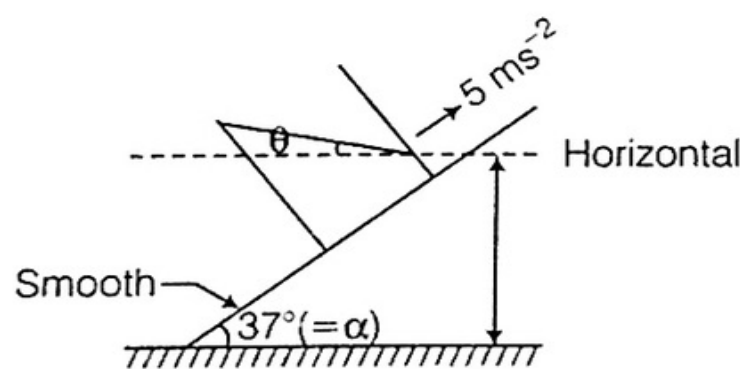

a. $\dfrac{\omega^2 L^2}{2g}$

b. $\dfrac{\omega^2 L^2}{g}$

c. $\dfrac{2\omega^2 L^2}{g}$

d. $\dfrac{\omega^2 L^2}{g}$

7 On a smooth inclined plane (with angle of inclination $\alpha = 37°$), a vessel containing liquid is being pushed upwards with an acceleration $5\,\text{ms}^{-2}$. If $g = 10\,\text{ms}^{-2}$, then angle (θ) that the liquid surface makes with the horizontal is (Given, $\sin 37° = \dfrac{3}{5}$)

a. $37°$

b. $53°$

c. $\tan^{-1}\left(\dfrac{4}{13}\right)$
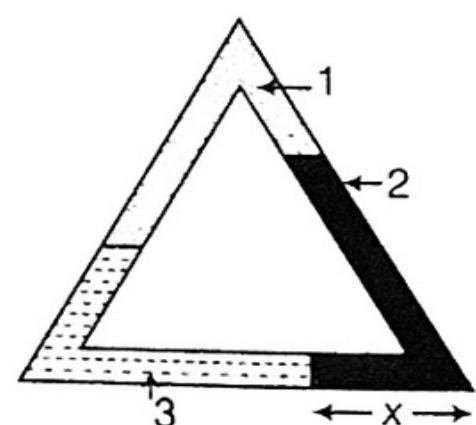
d. $\tan^{-1}\left(\dfrac{5}{13}\right)$

8 A closed tube in the form of an equilateral triangle of side l contains equal volumes of three liquids which do not mix and is placed vertically with its lowest side horizontal. Find the value of x (see figure), if the densities of liquids marked 1, 2 and 3 are in arithmetic progression in increasing order.

a. $\dfrac{l}{3}$

b. $\dfrac{2l}{3}$

c. $\dfrac{l}{2}$

d. $\dfrac{3l}{4}$

6 A hollow sphere of inner diameter and outer diameter of 12 cm and 16 cm respectively floats half submerged in water. The specific gravity of material of the sphere is

a. 8.65

b. 6.85

c. 0.865

d. 0.685

7 A small steel ball of mass m is attached to the bottom surface of a wooden cube of mass 200 g. Find the value of m that will just allow the block to float in water. Specific gravity of wood is 0.8 and that of steel is 7.8.

a. 59.3 g

b. 57.3 g

c. 56.3 g

d. 58.3 g

8 In the above problem, what is the value of m, if the ball is attached to the top surface of the cube, floating with upper surface of cube just immersed in water?

a. 60 g

b. 50 g

c. 55 g

d. 65 g

9 A cubical block of side a is floating in a fixed and closed cylindrical container of radius $2a$ kept on the ground. Density of the block is ρ, whereas density of the liquid is 2ρ. Container is made up of conducting wall, so that the temperature remains constant. A piston is mounted in the cylinder which can move inside the cylinder without friction. If piston oscillates with a large amplitude A, then
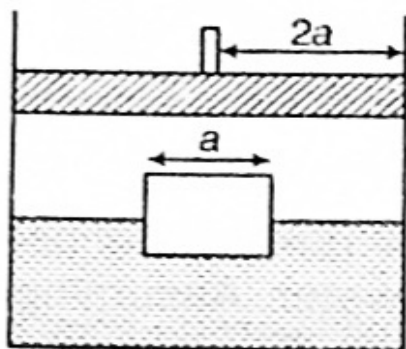
a. the cube will remain stationary

b. the cube will oscillate with very small amplitude in opposite phase with piston

c. the cube will oscillate with very small amplitude in same phase with piston

d. the cube will oscillate with amplitude A

10 A cubical wooden block of side L and relative density 0.5 is floating on the surface of water as shown in the figure. A string is attached by a pulley to it as shown in figure. The graph of tension T in the string versus distance d of the bottom of the block from the free surface of water, when the end A of the rope is slowly being pulled up will be (block is moving very slowly)

a.

b.

c.

d.