11. Fluid Mechanics – Multiple Choice Questions

1. Pressure and Density

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

2. The pressure on a swimmer 20 m below the surface of water at sea level is

(a) 1.0 atm (b) 2.0 atm

(c) 2.5 atm (d) 3.0 atm

3. A triangular lamina of area A and height h is immersed in a liquid of density ρ in a vertical plane with its base on the surface of the liquid. The thrust on the lamina is

(a) $\frac{1}{2}A\rho gh$ (b) $\frac{1}{3}A\rho gh$

(c) $\frac{1}{6}A\rho gh$ (d) $\frac{2}{3}A\rho gh$

4. Why the dam of water reservoir is thick at the bottom

(a) Quantity of water increases with depth

(b) Density of water increases with depth

(c) Pressure of water increases with depth

(d) Temperature of water increases with depth

5. A body of density d_1 is counterpoised by Mg of weights of density d_2 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) $\frac{M(1-d/d_2)}{(1-d/d_1)}$

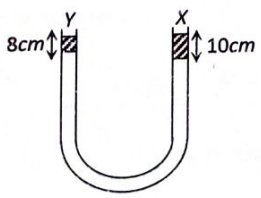
6. A liquid X of density $3.36 g/cm^3$ is poured in a U-tube, which contains Hg. Another liquid Y is poured in left arm with height 8 cm, upper levels of X and Y are same. What is density of Y

(a) 0.8 g/cc

(b) 1.2 g/cc

(c) 1.4 g/cc

(d) 1.6 g/cc



7. The density ρ of water of bulk modulus B at a depth y in the ocean is related to the density at surface ρ_0 by the relation

(a) $\rho=\rho_0\left[1-\frac{\rho_0 gy}{B}\right]$ (b) $\rho=\rho_0\left[1+\frac{\rho_0 gy}{B}\right]$

(c) $\rho=\rho_0\left[1+\frac{B}{\rho_0 hgy}\right]$ (d) $\rho=\rho_0\left[1-\frac{B}{\rho_0 gy}\right]$

8. Three liquids of equal masses are taken in three identical cubical vessels A, B and C. Their densities are ρ_A, ρ_B and ρ_C respectively. But $\rho_A<\rho_B<\rho_C$. The force exerted by the liquid on the base of the cubical vessel is

(a) Maximum in vessel C

(b) Minimum in vessel C

(c) The same in all the vessels

(d) Maximum in vessel A

9. The force acting on a window of area $50cm\times50cm$ of a submarine at a depth of $2000m$ in an ocean, interior of which is maintained at sea level atmospheric pressure is (Density of sea water $=10^3 kg\,m^{-3}$, $g=10ms^{-2}$)

(a) $10^6\,N$ (b) $5\times10^5\,N$

(c) $25\times10^6\,N$ (d) $25\times10^5\,N$

(e) $5\times10^6\,N$

2. Pascal's Law and Archimedes Principle

1. Air is blown through a hole on a closed pipe containing liquid. Then the pressure will

(a) Increase on sides

(b) Increase downwards

(c) Increase in all directions

(d) Never increases

2. An open U-tube contains mercury. When 11.2 cm of water is poured into one of the arms of the tube, how height does the mercury rise in the other arm form its initial level

(a) 0.56 cm (b) 1.35 cm

(c) 0.41 cm (d) 2.32 cm

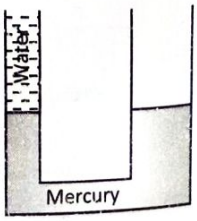
3. A U-tube in which the cross-sectional area of the limb on the left is one quarter, the limb on the right contains mercury (density 13.6 g/cm^3). The level of mercury in the narrow limb is at a distance of 36 cm from the upper end of the tube. What will be the rise in the level of mercury in the right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

(a) 1.2 cm

(b) 2.35 cm

(c) 0.56 cm

(d) 0.8 cm



4. An ice berg of density 900 kg/m^3 is floating in water of density 1000 kg/m^3. The percentage of volume of ice-cube outside the water is

(a) 20% (b) 35%

(c) 10% (d) 25%

5. A log of wood of mass 120 kg floats in water. The weight that can be put on the raft to make it just sink, should be (density of wood=600 kg/m^3)

(a) 80 kg (b) 50 kg

(c) 60 kg (d) 30 kg

6. A piece of wood is floating in water. When the temperature of water rises, the apparent weight of the wood will

(a) Increase (b) Decreases

(c) May increase or decrease (d) Remain same

7. A block of steel of size 5 $cm \times 5\ cm \times 5\ cm$ is weighed in water. If the relative density of steel is 7, its apparent weight is

(a) $6 \times 5 \times 5 \times 5\ gf$

(b) $4 \times 4 \times 4 \times 7\ gf$

(c) $5 \times 5 \times 5 \times 7\ gf$

(d) $4 \times 4 \times 4 \times 6\ gf$

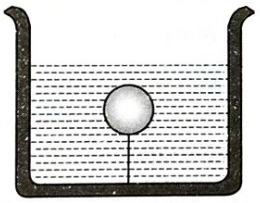
8. A solid sphere of density $\eta\ (>1)$ times lighter than water is suspended in a water tank by a string tied to its base as shown in fig. If the mass of the sphere is m then the tension in the string is given by

(a) $\left(\frac{\eta-1}{\eta}\right)mg$

(b) ηmg

(c) $\frac{mg}{\eta-1}$

(d) $(\eta-1)mg$



9. An ice block contains a glass ball when the ice melts within the water containing vessel, the level of water

(a) Rises (b) Falls

(c) Unchanged (d) First rises and then falls

10. A wooden piece can float both in mercury (of density 13.6 gm/cc) and in water (of density 1gm/cc). The ratio of mass of mercury displaced to the mass of water displaced is

(a) 1 (b) 13.6

(c) $\frac{1}{13.6}$ (d) $\frac{12.6}{13.6}$

11. Ice pieces are floating in a beaker A containing water and also in a beaker B containing miscible liquid of specific gravity 1.2. When ice melts, the level of

(a) Water increases in A (b) Water decreases in A

(c) Liquid in B decreases (d) Liquid in B increases

(e) Water in A and liquid in B remains unaltered

12. 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

(a) 0.94 m (b) 0.97 m

(c) 0.98 m (d) 0.99 m

13. A sample of metal weighs 210 gm in air, 180 gm in water and 120 gm in liquid. Then relative density (RD) of

(a) Metal is 3 (b) Metal is 7

(c) Liquid is 3 (d) Liquid is $\frac{1}{3}$

14. A ball whose density is $0.4 \times 10^3\ kg/m^3$ falls into water from a height of 9 cm. To what depth does the ball sink

(a) 9 cm (b) 6 cm

(c) 4.5 cm (d) 2.25 cm

15. An aluminium sphere is dipped into water. Which of the following is true?

(a) Buoyancy will be less in water at 0°C than that in water at 4°C

(b) Buoyancy will be more in water at 0°C than that in water at 4°C

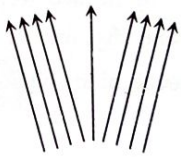
(c) Buoyancy in water at 0°C will be same as that in water at 4°C

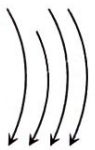
(d) Buoyancy may be more or less in water at 4°C depending on the radius of the sphere

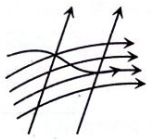
3. Fluid Flow

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

(a) 

(b) 

(c) 

(d) 

2. Along a streamline

(a) The velocity of a fluid particle remains constant

(b) The velocity of all fluid particles crossing a given position is constant

(c) The velocity of all fluid particles at a given instant is constant

(d) The speed of a fluid particle remains constant

3. A liquid is allowed to flow into a tube of truncated cone shape. Identify the correct statement from the following

(a) The speed is high at the wider end and high at the narrow end

(b) The speed is low at the wider end and high at the narrow end

(c) The speed is same at both ends in a stream line flow

(d) The liquid flows with uniform velocity in the tube

4. Water is flowing in a pipe of diameter 4 *cm* with a velocity 3 *m/s*. The water then enters into a tube of diameter 2 *cm*. The velocity of water in the other pipe is

(a) 3 *m/s* (b) 6 *m/s*

(c) 12 *m/s* (d) 8 *m/s*

5. An ideal fluid flows through a pipe of circular cross-section made of two sections with diameters $2.5\,cm$ and $3.75\,cm$. The ratio of the velocities in the two pipes is

(a) $9:4$ (b) $3:2$

(c) $\sqrt{3}:\sqrt{2}$ (d) $\sqrt{2}:\sqrt{3}$

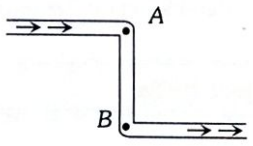
6. In this figure, an ideal liquid flows through the tube, which is of uniform cross-section. The liquid has speed v_A and v_B, and pressure P_A and P_B at points A and B respectively

(a) $v_A = v_B$

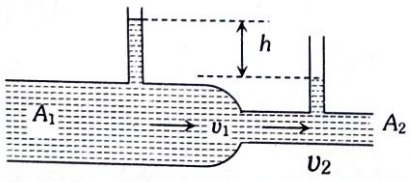
(b) $v_B > v_A$

(c) $P_A = P_B$

(d) $P_B > P_A$



7. A liquid flows through a horizontal tube. The velocities of the liquid in the two sections, which have areas of cross-section A_1 and A_2, are v_1 and v_2 respectively. The difference in the levels of the liquid in the two vertical tubes is h



(a) The volume of the liquid flowing through the tube in unit time is $A_1 v_1$

(b) $v_2 - v_1 = \sqrt{2gh}$

(c) $v_2^2 - v_1^2 = 2gh$

(d) The energy per unit mass of the liquid is the same in both sections of the tube

8. Water containing air bubbles flows without turbulence through a horizontal pipe which has a region of narrow cross – section. In this region the bubbles

(a) Move with greater speed and are smaller than in the rest of the pipe

(b) Move with greater speed and are larger in size than in the rest of the pipe

(c) Move with lesser speed and are smaller than in the rest of the pipe

(d) Move with lesser speed and are of the same size as in the rest of the pipe

9. The working of an atomizer depends upon

(a) Bernoulli's theorem (b) Boyle's law

(c) Archimedes principle (d) Newton's law of motion

10. According to Bernoulli's equation

$$\frac{P}{\rho g} + h + \frac{1}{2}\frac{v^2}{g} = \text{constant}$$

The terms A, B and C are generally called respectively

(a) Gravitational head, pressure head and velocity head

(b) Gravity, gravitational head and velocity head

(c) Pressure head, gravitational head and velocity head

(d) Gravity, pressure and velocity head

11. Bernoulli's principle is based on the law of conservation of

(a) Angular momentum (b) Linear momentum

(c) Mass (d) Energy

12. A fluid is in stream line flow across of a horizontal pipe of variable area of cross section. For this which of the following statements is correct

(a) The velocity is maximum at the narrowest part of the pipe and pressure is maximum at the widest part of the pipe

(b) Velocity and pressure both are maximum at the narrowest part of the pipe

(c) Velocity and pressure both are maximum at the widest part of the pipe

(d) The velocity is minimum at the narrowest part of the pipe and the pressure is minimum at the widest part of the pipe

13. Choose the correct statement(s) for a cricket ball that is spinning clockwise through air

S1: Streamlines of air are symmetric around the ball.

S2: The velocity of air above the ball relative to it is larger than that below the ball.

S3: The velocity of air above the ball relative to it is smaller than that below the ball.

S4: There is a net upward force on the ball.

(a) S1, S2 and S4 (b) S2 and S4

(c) S4 only (d) S3 only

14. There is a hole in the bottom of tank having water. If total pressure at bottom is 3 *atm* (1 *atm* = $10^5 N/m^2$) then the velocity of water flowing from hole is

(a) $\sqrt{400}\, m/s$ (b) $\sqrt{600}\, m/s$

(c) $\sqrt{60}\, m/s$ (d) None of these

15. A raindrop with radius $1.5\,mm$ falls from a cloud at a height 1200 m from ground. The density of water is $1000\,kg/m^3$ and density of air is $1.2\,kg/m^3$. Assume the drop was spherical throughout the fall and there is no air drag. The impact speed of the drop will be

(a) $27\,km/h$ (b) $550\,km/h$

(c) Zero (d) $129\,km/h$

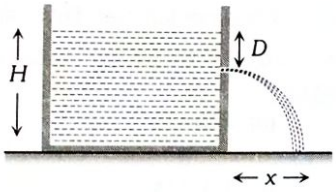
16. A tank is filled with water up to a height H. Water is allowed to come out of a hole P in one of the walls at a dep[illegible] below the surface of water. Express the horizontal distance x in terms of H and D

(a) $x = \sqrt{D(H-D)}$

(b) $x = \sqrt{\frac{D(H-D)}{2}}$

(c) $x = 2\sqrt{D(H-D)}$

(d) $x = 4\sqrt{D(H-D)}$



17. Aerofoils are so designed that the speed of air

(a) On top side is more than on lower side

(b) On top side is less than on lower side

(c) Is same on both sides

(d) Is turbulent

18. A nurse measures the blood pressure of a seated patient to be 190 *mm* of *Hg*

(a) The blood pressure at the patient's feet is less than 190 *mm* of *Hg*

(b) The actual pressure is about 0.25 times the atmospheric pressure

(c) The blood pressure at the patient's neck is more than 190 *mm* of *Hg*

(d) Te actual pressure is about 1.25 times the atmospheric pressure

19. A large tank filled with water to a height 'h' is to be emptied through a small hole at the bottom. The ratio of time 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) $\frac{1}{\sqrt{2}-1}$

20. A sniper fires a rifle bullet into a gasoline tank making a hole 53.0 *m* below the surface of gasoline. The tank was sealed at 3.10 *atm*. The stored gasoline has a density of 660 kgm^{-3}. The velocity with which gasoline begins to shoot out of the hole is

(a) $27.8\,ms^{-1}$ (b) $41.0\,ms^{-1}$

(c) $9.6\,ms^{-1}$ (d) $19.7\,ms^{-1}$

21. A streamlined body falls through air from a height h on the surface of a liquid. If d and $D(D > d)$ represents the densities of the material of the body and liquid respectively, then the time after which the body will be instantaneously at rest, is

(a) $\sqrt{\frac{2h}{g}}$ (b) $\sqrt{\frac{2h}{g}\cdot\frac{D}{d}}$

(c) $\sqrt{\frac{2h}{g}\cdot\frac{d}{D}}$ (d) $\sqrt{\frac{2h}{g}}\left(\frac{d}{D-d}\right)$

22. A manometer connected to a closed tap reads 4.5×10^5 *pascal*. When the tap is opened the reading of the manometer falls to 4×10^5 *pascal*. Then the velocity of flow of water is

(a) 7 ms^{-1} (b) 8 ms^{-1}

(c) 9 ms^{-1} (d) 10 ms^{-1}

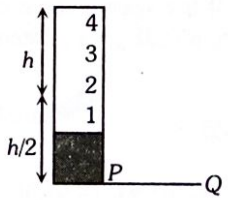
23. A cylinder of height h is filled with water and is kept on a block of height $h/2$. The level of water in the cylinder is kept constant. Four holes numbered 1, 2, 3 and 4 are at the side of the cylinder and at heights 0, $h/4$ and $3h/4$ respectively. When all four holes are opened together, the hole from which water will reach farthest distance on the plane PQ is the hole no.

(a) 1

(b) 2

(c) 3

(d) 4



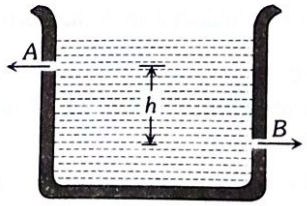
24. There are two identical small holes of area of cross-section a on the opposite sides of a tank containing a liquid of density ρ. The difference in height between the holes is h. Tank is resting on a smooth horizontal surface. Horizontal force which will has to be applied on the tank to keep it in equilibrium is

(a) $gh\rho a$

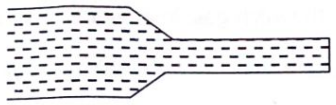
(b) $\frac{2gh}{\rho a}$

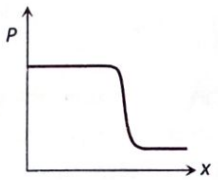
(c) $2\rho agh$

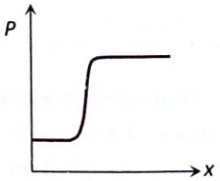
(d) $\frac{\rho gh}{a}$

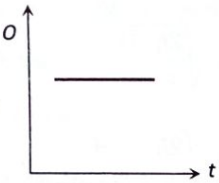


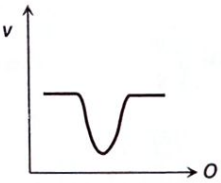
25. Water flows through a frictionless duct with a cross-section varying as shown in fig. Pressure p at points along the axis is represented by



(a) 

(b) 

(c) 

(d) 

26. An aircraft has a mass $4\times10^5\ kg$ with total wing area $500\,m^2$ flying at a speed of 720 *km/h*. The density of air at its height is $1.2\,kg/m^3$. Estimate the fractional increase in air speed on the upper surface of its wings relative to lower surface

(a) 0.04 (b) 0.08

(c) 0.17 (d) 0.32

27. When the temperature increases, the viscosity of

(a) Gases decreases and liquid increases

(b) Gases increases and liquids decreases

(c) Gases and liquids increases

(d) Gases and liquids decreases

28. A square plate of 0.1 *m* side moves parallel to a second plate with a velocity of 0.1 *m/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

29. The water flows from a tap of diameter 1.25 *cm* with a rate of $5\times10^{-5}m^3s^{-1}$. The density and coefficient of viscosity of water are $10^3 kg\ m^{-3}$ and 10^{-3} Pas, respectively. The flow of water is

(a) Steady with Reynolds number 5100

(b) Turbulent with Reynolds number 5100

(c) Steady with Reynolds number 3900

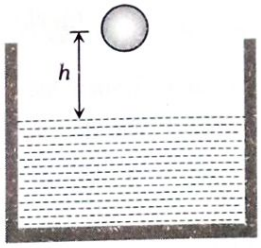
(d) Turbulent with Reynolds number 3900

30. Water is flowing through a very narrow tube. The velocity of water below which the flow remains a streamline flow is known as

(a) Relative velocity (b) Terminal velocity

(c) Critical velocity (d) Particle velocity

31. A ball of radius r and density ρ 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



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

32. The terminal speed attained by an aluminium sphere of radius $1mm$ falling through water at $20°C$ will be close to (Assume laminar flow, specific gravity of $Al = 2.7$ and $\eta_{water} = 8\times10^{-4}$)

(a) $9.2m/s$ (b) $6.9m/s$

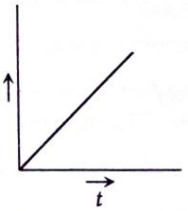
(c) $4.6m/s$ (d) $2.3m/s$

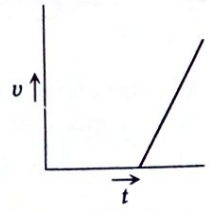
33. Two metal spheres are falling through a liquid of density $2\times10^3\ kg/m^3$ with the same uniform speed. The material density of sphere 1 and sphere 2 are $8\times10^3 kg/m^3$ and $11\times10^3 kg/m^3$ respectively. The ratio of their radii is

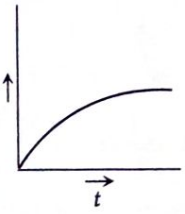
(a) $\frac{11}{8}$ (b) $\sqrt{\frac{11}{8}}$

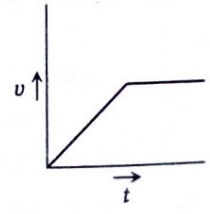
(c) $\frac{3}{2}$ (d) $\sqrt{\frac{3}{2}}$

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

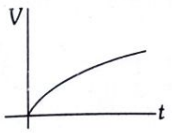
(a) 

(b) 

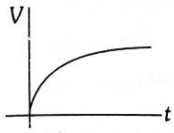
(c) 

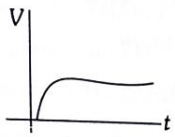
(d) 

35. A particle released from rest is falling through a thick fluid under gravity. The fluid exerts a resistive force on the particle proportional to the square of its speed. Which one of the following graphs best depicts the variation of is speed v with time t

(a) 

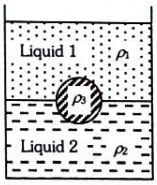
(b) 

(c) 

(d) 

4. IIT-JEE/AIEEE

1. A jar is filled with two non-mixing liquids 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 comes to equilibrium in the position shown in the figure. Which of the following is true for ρ_1, ρ_2 and ρ_3 **[2010]**



(a) $\rho_1 > \rho_3 > \rho_2$

(b) $\rho_1 > \rho_2 > \rho_3$

(c) $\rho_1 < \rho_3 < \rho_2$

(d) $\rho_3 < \rho_1 < \rho_2$

2. 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 **[2012]**

(a) More than half filled if ρ_c is less then 0.5

(b) More than half filled if ρ_c is less then 1.0

(c) Half filled if ρ_c is less than 0.5

(d) Less than half filled if ρ_c is less than 0.5

3. An open glass tube is immersed in mercury in such a way that a length of 8 *cm* extends above the mercury level. The open end of the tube is then closed and sealed and the tube is raised vertically up by additional 46 *cm*. What will be length of the air column above mercury in the tube now (Atmospheric pressure = 76 *cm* of *Hg*) **[2014]**

(a) 16 *cm* (b) 22 *cm*

(c) 38 *cm* (d) 6 *cm*

4. 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 **[1982]**

(a) Zero

(b) Equal to the weight of the liquid displaced

(c) Equal to the weight of the body in air

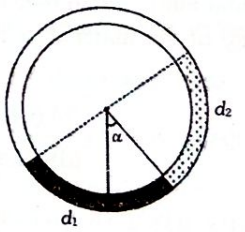
(d) Equal to the weight of the immersed portion of the body

5. A spherical solid ball 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 force on the ball that is proportional to the square of its speed v, i.e., $F_{viscous} = -kv^2$ $(k > 0)$. The terminal speed of the ball is **[2008]**

(a) $\frac{Vg\rho_1}{k}$ (b) $\sqrt{\frac{Vg\rho_1}{k}}$

(c) $\frac{Vg(\rho_1 - \rho_2)}{k}$ (d) $\sqrt{\frac{Vg(\rho_1 - \rho_2)}{k}}$

6. There is a circular tube in a vertical plane. Two liquids which do not mix and of densities d_1 and d_2 are filled in the tube. Each liquid subtends 90° angle at centre. Radius joining their interface makes an angle α with vertical. Ratio $\frac{d_1}{d_2}$ is **[2014]**



(a) $\frac{1+\sin\alpha}{1-\sin\alpha}$ (b) $\frac{1+\cos\alpha}{1-\cos\alpha}$

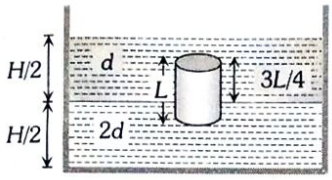
(c) $\frac{1+\tan\alpha}{1-\tan\alpha}$ (d) $\frac{1+\sin\alpha}{1-\cos\alpha}$

7. A uniform cylinder of length L and mass M having cross - sectional area A is suspended, with its length vertical, from a fixed point by a massless spring such that it is half submerged in a liquid of density σ at equilibrium position. The extension x_0 of the spring when it is in equilibrium is **[2013]**

(a) $\frac{Mg}{k}$ (b) $\frac{Mg}{k}\left(1-\frac{LA\sigma}{M}\right)$

(c) $\frac{Mg}{k}\left(1-\frac{LA\sigma}{2M}\right)$ (d) $\frac{Mg}{k}\left(1+\frac{LA\sigma}{M}\right)$

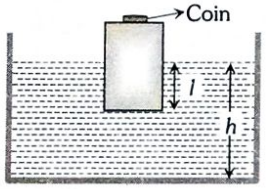
8. A homogeneous solid cylinder of length $L\,(L < H/2)$. Cross-sectional area $A/5$ is immersed such that it floats with its axis vertical at the liquid-liquid interface with length $L/4$ in the denser liquid as shown in the fig. The lower density liquid is open to atmosphere having pressure P_0. Then density of solid is given by **[1995]**



(a) $\frac{5}{4}d$ (b) $\frac{4}{5}d$

(c) d (d) $\frac{d}{5}$

9. A wooden block, with a coin placed on its top, floats in water as shown in fig. the distance l and h are shown there. After some time the coin falls into the water. Then **[2002]**



(a) l decreases and h increases

(b) l increases and h decreases

(c) Both l and h increase

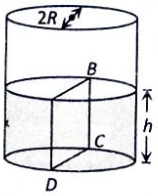
(d) Both l and h decrease

10. A vessel contains oil (density = 0.8 gm/cm^3) over mercury (density = 13.6 gm/cm^3). A homogeneous sphere floats with half of its volume immersed in mercury and the other half in oil. The density of the material of the sphere in gm/cm^3 is **[1988]**

(a) 3.3 (b) 6.4

(c) 7.2 (d) 12.8

11. Water is filled up to a height h in a beaker of radius R as shown in the figure. The density of water is ρ, the surface tension of water is T and the atmospheric pressure is P_0. Consider a vertical section $ABCD$ of the water column through a diameter of the beaker. The force on water on one side of this section by water on the other side of this section has magnitude **[2007]**



(a) $|2P_0Rh+\pi R^2\rho gh - 2RT|$ (b) $|2P_0Rh+R\rho gh^2 - 2RT|$

(c) $|P_0\pi R^2+R\rho gh^2 - 2RT|$ (d) $|P_0\pi R^2+ R\rho gh^2 +2RT|$

12. A cylindrical vessel of height 500 mm 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 200 mm. Find the fall in height (in mm) of water level due to opening of the orifice. **[2009]**

[Take atmospheric pressure $=1.0\times10^5\ N/m^2$, density of water $=1000\ kg/m^3$ and $g=10\ m/s^2$. Neglect any effect of surface tension]

(a) 5 mm (b) 6 mm

(c) 2 mm (d) 1 mm

13. Water is flowing continuously from a tap having an internal diameter $8\times10^{-3}m$. The water velocity as it leaves the tap is $0.4\,ms^{-1}$. The diameter of the water stream at a distance $2\times10^{-1}m$ below the tap is close to **[2011]**

(a) $5.0\times10^{-3}m$ (b) $7.5\times10^{-3}m$

(c) $9.6\times10^{-3}m$ (d) $3.6\times10^{-3}m$

14. An application of Bernoulli's equation for fluid flow is found in **[1994]**

(a) Dynamic lift of an aeroplane

(b) Viscosity meter

(c) Capillary rise

(d) Hydraulic press

15. A cylinder of height 20 m is completely filled with water. The velocity of efflux of water (in m/s) through a small hole on the side wall of the cylinder near its bottom is **[2002]**

(a) 10 (b) 20

(c) 25.5 (d) 5

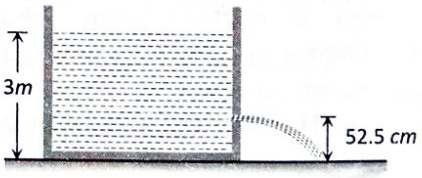
16. Water is filled in a cylindrical container to a height of 3m. The ratio of the cross-sectional area of the orifice and the beaker is 0.1. The square of the speed of the liquid coming out from the orifice is (g = 10 m/s^2) **[2005]**

(a) 50 m^2/s^2

(b) 50.5 m^2/s^2

(c) 51 m^2/s^2

(d) 52 m^2/s^2



17. 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 the holes are the same. Then R is equal to **[2000]**

(a) $2\pi L$ (b) $\frac{L}{\sqrt{2\pi}}$

(c) L (d) $\frac{L}{2\pi}$

18. A block of ice floats on a liquid of density 1.2 in a beaker then level of liquid when ice completely melt **[1994]**

(a) Remains same (b) Rises

(c) Lowers (d) (a), (b) or (c)

19. Spherical ball of radius 'r' is falling in a viscous fluid of viscosity 'η' with a velocity 'v'. The retarding viscous force acting on the spherical ball is **[2004]**

(a) Inversely proportional to 'r' but directly 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'

20. If the terminal speed of a sphere of gold (density = 19.5 kg/m^3) is 0.2 m/s in a viscous liquid (density = 1.5 kg/m^3), find the terminal speed of a sphere of silver (density = 10.5 kg/m^3) of the same size in the same liquid **[2006]**

(a) 0.133 m/s (b) 0.1 m/s

(c) 0.2 m/s (d) 0.4 m/s

5. NEET/AIPMT

1. The heart of man pumps 5 litres of through the arteries per minute at a pressure of 150 mm of mercury. If the density of mercury be $13.6\times10^3 kg/m^3$ and $g=10 m/s^2$ the power of heart in watt is **[2015]**

(a) 2.35 (b) 3.0

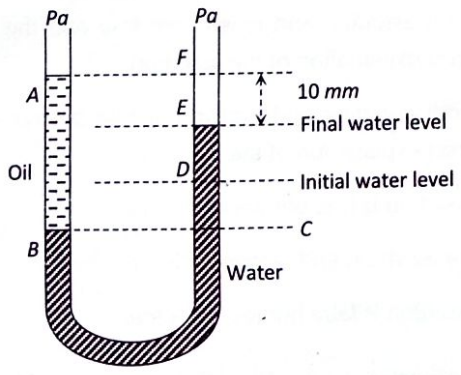
(c) 1.50 (d) 1.70

2. The value of coefficient of volume expansion of glycerine is $5\times10^{-4}K^{-1}$. The fractional charge in the density of glycerine for a rise of 40°C in its temperature is **[2015]**

(a) 0.020 (b) 0.025

(c) 0.010 (d) 0.015

3. A U tube with both ends open to the atmosphere, is partially filled with water. Oil, which is immiscible with water, is poured into one side until it stands at a distance of 10 mm above the water level on the other side. Meanwhile the water rises by 65 mm from its original level (see diagram). The density of the oil is **[2017]**



(a) $650 kg\,m^{-3}$ (b) $425 kg\,m^{-3}$

(c) $800 kg\,m^{-3}$ (d) $928 kg\,m^{-3}$

4. Two bodies are in equilibrium when suspended in water from the arms of a balance. The mass of one body is 36 g and its density is 9 g/cm^3. If the mass of the other is 48 g, its density in g/cm^3 is **[1994]**

(a) $\frac{4}{3}$ (b) $\frac{3}{2}$

(c) 3 (d) 5

5. Two non-mixing liquids of densities ρ and $n\rho(n>1)$ are put in a container. The height of each liquid is h. A solid cylinder of length L and density d is put in this container. The cylinder floats with its axis vertical and length $pL(p<1)$ in the denser liquid. The density d is equal to **[2016]**

(a) $\{1+(n+1)p\}\rho$ (b) $\{(2+(n+1)p\}\rho$

(c) $\{2+(n-1)p\}\rho$ (d) $\{1+(n-1)p\}\rho$

6. The cylindrical tube of a spray pump has radius, R, one end of which has n fine holes, each of radius r. If the speed of the liquid in the tube is V, the speed of the ejection of the liquid through the holes is **[2015]**

(a) $\frac{VR^2}{nr^2}$ (b) $\frac{VR^2}{n^3r^2}$

(c) $\frac{V^2R}{nr}$ (d) $\frac{VR^2}{n^2r^2}$

7. Velocity of water in a river is **[1988]**

(a) Same everywhere

(b) More in the middle and less near its banks

(c) Less in the middle and more near its banks

(d) Increase from one bank to other bank

8. A wind with speed $40 m/s$ blows parallel to the roof of a house. The area of the roof is $250 m^2$. Assuming that the pressure inside the house is atmospheric pressure, the force exerted by the wind on the roof and the direction of the force will be: ($P_{air}=1.2 kg/m^3$) **[2015]**

(a) $4.8\times10^5 N$, upwards (b) $2.4\times10^5 N$, upwards

(c) $2.4\times10^5 N$, downwards (d) $4.8\times10^5 N$, downwards

9. A small sphere of radius 'r' falls from rest in a viscous liquid. As a result, heat is produced due to viscous force. The rate of production of heat when the sphere attains its terminal velocity, is proportional to **[2018]**

(a) r^3 (b) r^2

(c) r^5 (d) r^4

6. AIIMS

1. By sucking through a straw, a student can reduce the pressure in his lungs to 750 *mm* of *Hg* (density = 13.6 gm/cm^3). Using the straw, he can drink water from a glass up to a maximum depth of **[2006]**

(a) 10 *cm* (b) 75 *cm*

(c) 13.6 *cm* (d) 1.36 *cm*

2. When a large bubble rises from the bottom of a lake to the surface. Its radius doubles. If atmospheric pressure is equal to that of column of water height H, then the depth of lake is **[1995]**

(a) H (b) $2H$

(c) $7H$ (d) $8H$

3. A body is just floating on the surface of a liquid. The density of the body is same as that of the liquid. The body is slightly pushed down. What will happen to the body **[1980]**

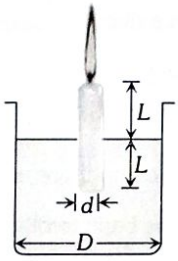
(a) It will slowly come back to its earlier position

(b) It will remain submerged, where it is left

(c) It will sink

(d) It will come out violently

4. A candle of diameter d is floating on a liquid in a cylindrical container of diameter D ($D>>d$) as shown in figure. If it is burning at the rate of 2*cm/hour* then the top of the candle will **[2005]**



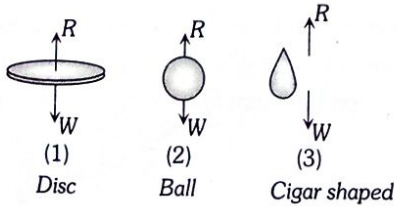
(a) Remain at the same height

(b) Fall at the rate of 1 *cm/hour*

(c) Fall at the rate of 2 *cm/hour*

(d) Go up the rate of 1*cm/hour*

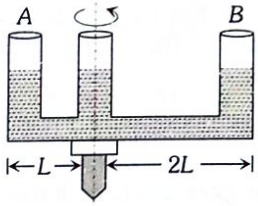
5. When a body falls in air, the resistance of air depends to a great extent on the shape of the body, 3 different shapes are given. Identify the combination of air resistances which truly represents the physical situation. (The cross sectional areas are the same). **[2007]**



(a) $1 < 2 < 3$ (b) $2 < 3 < 1$

(c) $3 < 2 < 1$ (d) $3 < 1 < 2$

6. A given shaped glass tube having uniform cross section is filled with water and is mounted on a rotatable shaft as shown in figure. If the tube is rotated with a constant angular velocity ω then **[2005]**



(a) Water levels in both sections A and B go up

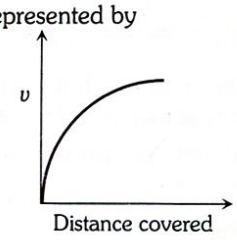
(b) Water level in Section A goes up and that in B comes down

(c) Water level in Section A comes down and that in B it goes up

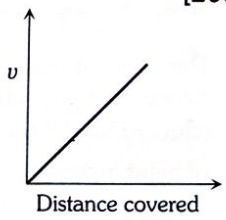
(d) Water levels remains same in both sections

7. A lead shot of 1*mm* diameter falls through a long column of glycerine. The variation of its velocity v. with distance covered is represented by **[2003]**

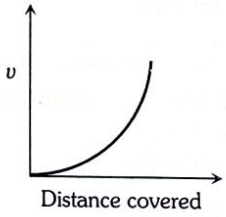
(a)



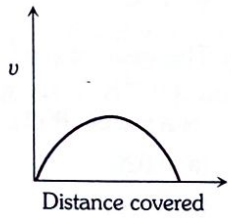
(b)



(c)



(d)



7. Assertion & Reason

Read the assertion and reason carefully to mark the correct option out of the options given below:

(a) If both assertion and reason are true and the reason is the correct explanation of the assertion.

(b) If both assertion and reason are true but reason is not the correct explanation of the assertion.

(c) If assertion is true but reason is false.

(d) If the assertion and reason both are false.

(e) If assertion is false but reason is true.

1. Assertion : Pascal's law is the working principle of a hydraulic lift.

Reason : Pressure is equal to thrust per unit area.

2. Assertion : Hydrostatic pressure is a vector quantity.

   Reason : Pressure is force divided by area, and force is a vector quantity.

3. Assertion : A piece of ice floats in water, the level of water remains unchanged when the ice melts completely.

   Reason : According to Archimedes's principle, the loss in weight of the body in the liquid is equal to the weight of the liquid displaced by the immersed part of the body.

4. Assertion : A bubble comes from the bottom of a lake to the top.

   Reason : Its radius increases.

5. Assertion : The shape of an automobile is so designed that its front resembles the stream line pattern of the fluid through which it moves.

   Reason : The resistance offered by the fluid is maximum.

6. Assertion : A fluid flowing out of a small hole in a vessel apply a backward thrust on the vessel.

   Reason : According to equation of continuity, the product of area and velocity remain constant.

7. Assertion : In taking into account the fact that any object which floats must have an average density less than that of water, during world war I, a number of cargo vessels are made of concrete.

   Reason : Concrete cargo vessels were filled with air.

8. Assertion : A thin stainless steel needle can lay floating on a still water surface.

   Reason : Any object floats when the buoyancy force balances the weight of the object.

9. Assertion : Sudden fall of pressure at a place indicates storm.

   Reason : Air flows from higher pressure to lower pressure.

10. Assertion : A rain drop after falling through some height attains a constant velocity.

    Reason : At constant velocity, the viscous drag is just equal to its weight.

11. Assertion : Railway tracks are laid on small sized wooden sleepers.

    Reason : Small sized wooden sleepers are used so that rails exert more pressure on the railway track. Due to which rail does not leave the track.

11. Fluid Mechanics – Answers & Keys

1. Pressure and Density

1	c	2	b	3	b	4	c	5	d
6	a	7	b	8	c	9	e		

2. Pascal's Law and Archimedes Principle

1	c	2	c	3	c	4	c	5	a
6	d	7	a	8	d	9	c	10	a
11	d	12	c	13	bc	14	b	15	a

3. Fluid Flow

1	d	2	b	3	b	4	c	5	a
6	ad	7	acd	8	b	9	a	10	c
11	d	12	a	13	b	14	a	15	b
16	c	17	a	18	d	19	c	20	b
21	d	22	d	23	c	24	c	25	a
26	c	27	b	28	d	29	b	30	c
31	c	32	c	33	d	34	c	35	a

4. IIT-JEE/AIEEE

1	c	2	a	3	a	4	a	5	d
6	c	7	c	8	a	9	d	10	c
11	b	12	b	13	d	14	a	15	b
16	a	17	b	18	a	19	b	20	b

5. NEET/AIPMT

1	d	2	a	3	d	4	c	5	d
6	a	7	b	8	b	9	c		

6. AIIMS

1	c	2	c	3	b	4	b	5	c
6	a	7	a						

7. Assertion and Reason

1	b	2	e	3	a	4	b	5	c
6	a	7	a	8	c	9	a	10	a
11	d								