Exercise-1

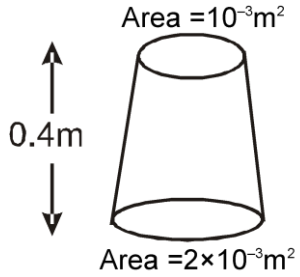
ONLY ONE OPTION CORRECT TYPE

SECTION (A) : MEASUREMENT AND CALCULATION OF PRESSURE

1. The height of a mercury barometer is 75 cm at sea level and 50 cm at the top of a hill. Ratio of density of mercury to that of air is 10^4. The height of the hill is
(1) 250 m (2) 2.5 km (3) 1.25 km (4) 750 m

2. 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
(1) 10m (2) 20m (3) 60m (4) 30m

3. A uniformly tapering vessel is filled with a liquid of density 900 kg/m_3. The force that acts on the base of the vessel due to the liquid is (g = 10 ms $^{-2}$)



(1) 3.6 N (2) 7.2 N (3) 9.0 N (4) 14.4 N

4. The pressure at the bottom of a tank containing a liquid does not depend on
(1) Acceleration due to gravity (2) Height of the liquid column
(3) Area if the bottom surface (4) Nature of the liquid

5. 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
(1) H (2) 2H (3) 7H (4) 8H

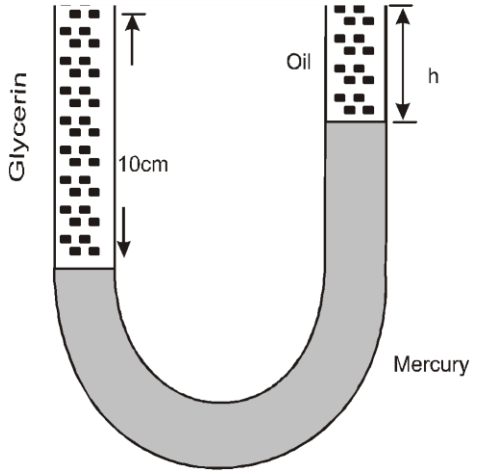
6. The volume of an air bubble become three times as it rises from the bottom of a lake to its surface. Assuming atmospheric pressure to be 75 cm of Hg an density of water to be 1/10 of the density of mercury, the depth of the lake is
(1) 5m (2) 10m (3) 15m (4) 20m

7. The value of g at a place decreases by 2%.The barometric height of mercury
(1) Increases by 2% (2) Decreases by 2%
(3) Remains unchanged (4) Sometimes increases and sometimes decreases

8. A barometer kept in a stationary elevator reads 76 cm. If the elevator starts accelerating up the reading will be
(1) Zero (2) Equal to 76 cm (3) More then 76 cm (4) Less then 76 cm

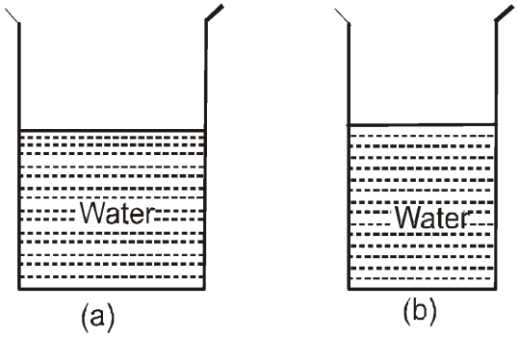
9. A beaker containing a liquid is kept inside a big closed jar. If the air inside the jar is continuously pumped out, the pressure in the liquid near the bottom of the liquid will
(1) Increases (2) Decreases
(3) Remain constant (4) First decrease and then increase

10. A vertical U-tube of uniform inner cross section contains mercury in both sides of its arms. A glycerin (density =1.3g/cm$_3$)column of length 10cm is introduced into one of its arms. Oil of density 0.8 gm/cm$_3$ is poured into the other arm until the upper surfaces of the oil and glycerin are in the same horizontal level. Find the length of the oil column, Density of mercury = 13.6 g/cm$_3$



(1) 10.4cm (2) 8.2 cm (3) 7.2cm (4) 9.6cm

11. From the adjacent figure, the correct observation is

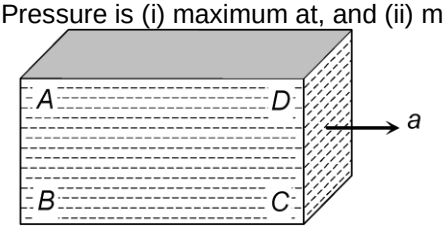


(1) The pressure on the bottom of tank (a) is greater than at the bottom of (b).
(2) The pressure on the bottom of the tank (a) is smaller than at the bottom of (b)
(3) The pressure depend on the shape of the container
(4) The pressure on the bottom of (a) and (b) is the same

12. Air is blown through a hole a closed pipe containing liquid. Then the pressure will
(1) Increase on sides (2) Increase downwards
(3) Increase in all direction (4) Never increases

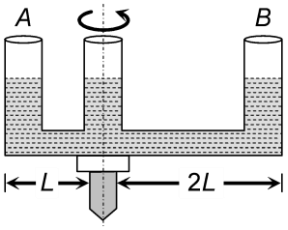
13. Radius of an air bubble at the bottom of the lake is r and it becomes 2r when the air bubbles rises to the top surface of the lake. If P cm water be the atmospheric pressure, then the depth of the lake is
(1) 2p (2) 8p (3) 4p (4) 7p

14. A closed rectangular tank is completely filled with water and is accelerated horizontally with an acceleration a towards right. Pressure is (i) maximum at, and (ii) minimum at



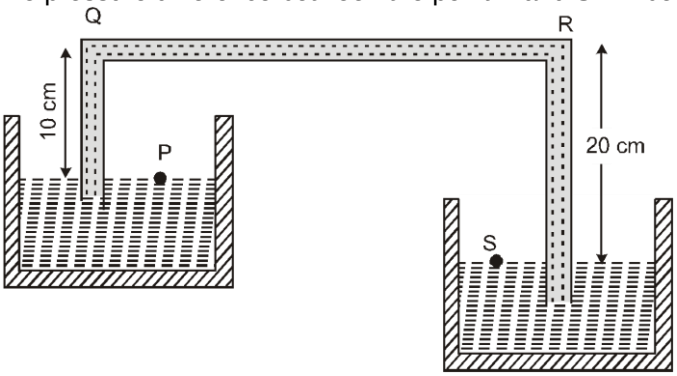
(1) (i) B (ii) D (2) (i) C (ii) D (3) (i) B (ii) C (4) (i) B (ii) A

15. 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 **[AIIMS 2005]**



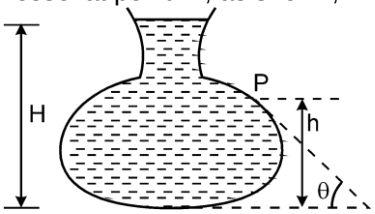
(1) Water levels in both sections A and B go up
(2) Water level in Section A goes up and that in B comes down
(3) Water level in Section A comes down and that in B it goes up
(4) Water levels remains same in both sections

16. A siphon in use is demonstrated in the following figure. The density of the liquid flowing in siphon is 1.5 gm/cc. The pressure difference between the point P and S will be



(1) 10_5 N/m (2) $2 \times 10_5$ N/m (3) Zero (4) Infinity

17. Figure here shown the vertical cross-section of a vessel filled with a liquid of density ρ. The normal thrust per unit area on the walls of the vessel at point. P, as shown, will be

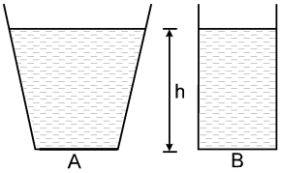


(1) $h\rho g$ (2) $H\rho g$ (3) $(H - h)\rho g$ (4) $(H - h)\rho g \cos\theta$

18. A tank with length 10 m, breadth 8 m and depth 6m is filled with water to the top. If g = 10 m s_{-2} and density of water is 1000 kg m_{-3}, then the thrust on the bottom is
(1) $6 \times 1000 \times 10 \times 80$ N(2) $3 \times 1000 \times 10 \times 48$ N(3) $3 \times 1000 \times 10 \times 60$ N(4) $3 \times 1000 \times 10 \times 80$ N

19. In a hydraulic lift, used at a service station the radius of the large and small piston are in the ratio of 20 : 1. What weight placed on the small piston will be sufficient to lift a car of mass 1500 kg ?
(1) 3.75 kg (2) 37.5 kg (3) 7.5 kg (4) 75 kg.

20. Two vessels A and B of different shapes have the same base area and are filled with water up to the same height h (see figure). The force exerted by water on the base is F_A for vessel A and F_B for vessel B. The respective weights of the water filled in vessels are W_A and W_B. Then



(1) $F_A > F_B$; $W_A > W_B$ (2) $F_A = F_B$; $W_A > W_B$ (3) $F_A = F_B$; $W_A < W_B$ (4) $F_A > F_B$; $W_A = W_B$

21. A hydrogen balloon released on the moon would:

(1) climb up with an acceleration of 9.8 m/s_2 (2) climb up with an acceleration of 9.8 × 6 m/s_2
(3) neither climb nor fall (4) fall with an acceleration of 9.8/6 m/s_2

22. Reason for weightlessness in satellite : **[RPMT 2000]**
(1) zero gravity (2) centre of gravity
(3) zero reaction force on plane of satellite (4) none of these

SECTION (B) : ARCHEMEDIES PRINCIPLE AND FORCE OF BUOYANCY

1. A hemispherical bowl just floats without sinking in a liquid of density 1.2 × 10_3 kg/m_3. If outer diameter and the density of the bowl are 1 m and 2 × 10_4 kgm_3 respectively, then the inner diameter of the bowl will be
(1) 0.94 m (2) 0.97 m (3) 0.98 m (4) 0.99 m

2. In making an alloy, a substance of specific gravity s_1 and mass m_1 is mixed with another substance of specific gravity s_2 and mass m_2 ; then the specific gravity of the alloy is

(1) $\left(\frac{m_1+m_2}{s_1+s_2}\right)$ (2) $\left(\frac{s_1s_2}{m_1+m_2}\right)$ (3) $\frac{m_1+m_2}{\left(\frac{m_1}{s_1}+\frac{m_2}{s_2}\right)}$ (4) $\frac{\left(\frac{m_1}{s_1}+\frac{m_2}{s_2}\right)}{m_1+m_2}$

3. Two solids A and B float in water. It is observed that A floats with half its volume immersed and B floats with 2/3 of its volume immersed. Compare the densities of A and B
(1) 4 :3 (2) 2 :3 (3) 3 :4 (4) 1 :3

4. 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
(1) It will slowly come back to its earlier position position
(2) It will remain submerged, where it is left
(3) It will sink
(4) It will come out violently

5. A rectangular block is 5 cm × 5 cm × 10 cm in size. The block is floating in water with 5 cm side vertical. If it floats with 10 cm side vertical, what change will occur in the level of water ?
(1) No change (2) It will rise
(3) It will fall (4) It may rise or fall depending on the density of block

6. A boat carrying steel balls is floating on the surface of water in a tank. If the ball are thrown into the tank one by one how will it affect the level of water
(1) It will remain unchanged (2) It will rise
(3) It will fall (4) First it will first rise and then fall

7. Two pieces of metal when immersed in a liquid have equal upthrust on them; then
(1) Both pieces must have equal weights (2) Both pieces must have equal densities
(3) Both pieces must have equal volumes (4) Both are floating to the same depth

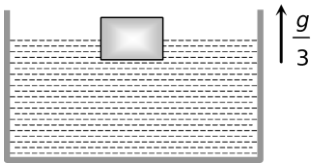
8. A wooden cylinder floats vertically in water with half of its length immersed. The density of wood is
(1) Equal of that of water (2) Half the density of water
(3) Double the density of water (4) The question is incomplete

9. An ice block contains a glass ball when the ice melts with in the water containing, the level of water
(1) Rises (2) Falls
(3) Unchanged (4) First rises and then falls

10. Construction of submarines is based on
(1) Archimedes' principle (2) Bernoulli's theorem
(3) Pascal's law (4) Newton's laws

11. A concrete sphere of radius R has a cavity of radius r which is packed with sawdust. The specific gravities of concrete and sawdust are respectively 2.4 and 0.3 for this sphere to float with its entire volume submerged under water. Ratio of mass of concrete to mass of sawdust will be **[AIIMS 1995]**
(1) 8 (2) 4 (3) 3 (4) Zero

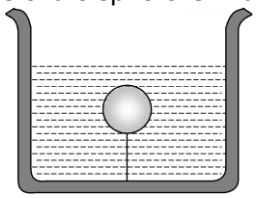
12. A cubical block is floating in a liquid with half of its volume immersed in the liquid. When the whole system accelerates upwards with acceleration of g/3, the fraction of volume immersed in the liquid will be



(1) $\frac{1}{2}$ (2) $\frac{3}{8}$ (3) $\frac{2}{3}$ (4) $\frac{3}{4}$

13. A silver ingot weighing 2.1 kg is held by a string so as 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
(1) 1.6 (2) 1.94 (3) 3.1 (4) 5.25

14. A solid sphere of density η (> 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



(1) $\left(\frac{\eta-1}{\eta}\right)mg$ (2) ηmg (3) $\frac{mg}{\eta-1}$ (4) $(\eta-1)mg$

15. A hollow sphere of volume V is floating on water surface with half immersed in it. What should be the minimum volume of water poured inside the sphere so that the sphere now sinks into the water
(1) V/2 (2) V/3 (3) V/4 (4) V

16. Two solids A and B float in water. It is observed that A floats with half its volume immersed and B floats with 2/3 of its volume immersed. Compare the densities of A and B
(1) 4 : 3 (2) 2 : 3 (3) 3 : 4 (4) 1 : 3

17. 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
(1) $\frac{d_0}{d}$ (2) $\frac{dd_0}{d+d_0}$ (3) $\frac{d-d_0}{d}$ (4) $\frac{dd_0}{d-d_0}$

18. Density of the ice is ρ and that of water is σ. What will be the decreasein volume when a mass M of ice melts.
(1) $\frac{M}{\sigma-\rho}$ (2) $\frac{\sigma-\rho}{M}$ (3) $M\left[\frac{1}{\rho}-\frac{1}{\sigma}\right]$ (4) $\frac{1}{M}\left[\frac{1}{\rho}-\frac{1}{\sigma}\right]$

19. The reading of a spring balance when a block is suspended from it in air is 60 newton. This reading is changed to 40 newton when the block is submerged in water. The specific gravity of the block must be therefore :
(1) 3 (2) 2 (3) 6 (4) 3/2

20. A block of steel of size 5 cm × 5 cm × 5 cm is weighed in water. If the relative density of steel is 7. Its apparent weight is :
(1) 6 × 5 × 5 × 5 gf (2) 4 × 4 × 4 × 7 gf (3) 5 × 5 × 5 × 7 gf (4) 4 × 4 × 4 × 6 gf

21. 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/cc. If the mass of the other is 48 g, its density in g/cc is :
(1) 4/3 (2) 3/2 (3) 3 (4) 5

22. In order that a floating object be in a stable rotation at equilibrium, its centre of buoyancy should be
(1) vertically above its centre of gravity (2) vertically below its centre of gravity

(3) horizontally in line with its centre of gravity (4) may be anywhere

23. A cork is suberged in water by a spring attached to the bottom of a bowl. When the bowl is kept in an elevator moving with acceleration downwards, the length of spring
(1) Increases (2) Decreases (3) Remains unchanged (4) None of these

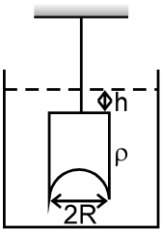
24. A hollow sphere of volume V is floating on water surface with half immersed in it. What should be the minimum volume of water poured inside the sphere so that the sphere now sinks into the water
(1) V / 2 (2) V / 3 (3) V / 4 (4) V

25. An ice block contains a glass ball when the ice melth within the water containing vessel, the level of water **[AFMC 2005]**
(1) Rises (2) Falls
(3) Unchanged (4) First rises and then falls

26. A large ship can float but a steel needle sinks because of **[AFMC 2005]**
(1) Viscostiy (2) Surface tension (3) Density (4) None of these

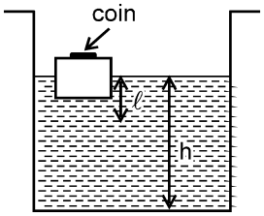
27. An ice berg of density 900 kg/m_3 is floating in water of density 1000 Kg/m_3. The percentage of volume of ice-cube outside the water is **[CPMT 2004]**
(1) 20% (2) 35% (3) 10% (4) 25%

28. 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 : **[I.I.T. 2001, 3/105 Screening]**



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

29. A wooden block with a coin placed on its top, floats in water as shown in figure. The distance and h are shown here. After some time the coin falls into the water. Then : **[I.I.T. 2002, 3/105 Screening]**



(1) ℓ decreases and h increase (2) ℓ increases and h decreases
(3) both ℓ and h increases (4) both ℓ and h decrease

30. If a sphere is inserted in water, then it flows with $\frac{1}{3}$ rd of it outside the water, When it is inserted in an unknown liquid then it flows with $\frac{3}{4}$ th of it outside, then density of unknown liquid is : **[RPMT 2001]**
(1) 4.9 gm/c.c (2) $\frac{9}{4}$ gm/c.c (3) $\frac{8}{3}$ gm/c.c (4) $\frac{3}{8}$ gm/c.c

31. A body of uniform cross-sectional area floats in a liquid of density thrice its value. The fraction of exposed height will be : **[RPMT 2005]**
(1) $\frac{2}{3}$ (2) $\frac{5}{6}$ (3) $\frac{1}{6}$ (4) $\frac{1}{3}$

32. A raft of wood of mass 120 kg floats in water. The weight that can be put on the raft to make it just sing, should be : (d_{raft} = 600 kg/m_3) **[RPMT 2006]**

(1) 80 kg (2) 50 kg (3) 60 kg (4) 30 kg

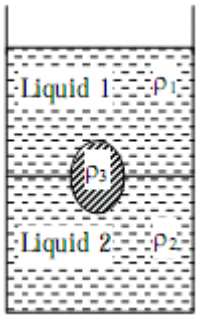
33. A rectangular block of mass m and area of cross section A floats in a liquid of density ρ. If it is given a small vertical displacement from equilibrium it undergoes oscillation with a time period T. Them : **[AIPMT 2006]**

(1) $T \propto \sqrt{\rho}$ (2) $T \propto \frac{1}{\sqrt{A}}$ (3) $T \propto \frac{1}{\rho}$ (4) $T \propto \frac{1}{\sqrt{m}}$

34. The bob of a simple pendulum executes simple harmonic motion in water with a period t, while the period of oscillation of the bob is t_0 in air. Neglecting frictional force of water and given that the density of the bob is (4/3) × 1000 kg/m_3. What relationship between t and t_0 is true? **[AIEEE 2004]**

(1) $t = t_0$ (2) $t = t_0/2$ (3) $t = 2t_0$ (4) $t = 4t_0$

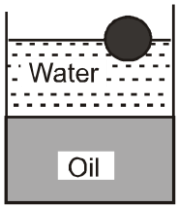
35. A jar is filled with two non-mixing liquids 1 and 2 having densities ρ_1 and ρ_2, respectively. A solid ball, made of a material of density ρ_3, is dropped in the jar. It comes to equilibrium in the position shown in the figure. **[AIEEE 2008, 4/300]**

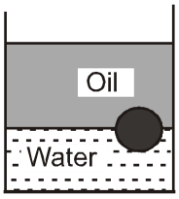


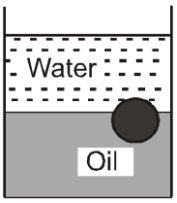
Which of the following is true for ρ_1, ρ_2 and ρ_3 ?

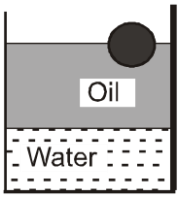
(1) $\rho_1 > \rho_3 > \rho_2$ (2) $\rho_1 < \rho_2 < \rho_3$ (3) $\rho_1 < \rho_3 < \rho_2$ (4) $\rho_3 < \rho_1 < \rho_2$

36. 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? **[AIEEE 2010, 4/144]]**

(1) 

(2) 

(3) 

(4) 

37. A block of volume V and of density σ_b is placed in liquid of density σ_l ($\sigma_l > \sigma_b$), then block is moved upward upto a height h and it is still in liquid. The increase in gravitational potential energy of the system is :

(1) σ_b Vgh (2) $(\sigma_b + \sigma_l)$Vgh (3) $(\sigma_b - \sigma_l)$Vgh (4) none of these

38. A metallic sphere floats (just sink) in an immiscible mixture of water ($\rho_w = 10^3$ kg/m^3) and a liquid ($\rho_L = 13.5 \times 10^3$) with (1/5)th portion by volume in the liquid. The density of the metal is :

(1) 4.5×10^3 kg/m^3 (2) 4.0×10^3 kg/m^3 (3) 3.5×10^3 kg/m^3 (4) 1.9×10^3 kg/m^3

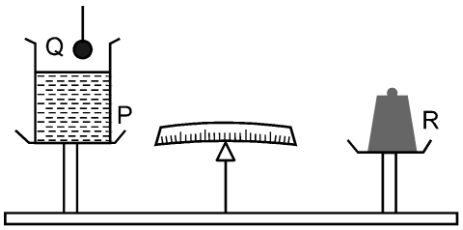
39. Three liquids of densities d, 2d and 3d are mixed in equal volumes. Then the density of the mixture is

(1) d (2) 2d (3) 3d (4) 5d

40. Three liquids of densities d, 2d and 3d are mixed in equal proportions of weights. The relative density of the mixture is

(1) $\frac{11d}{7}$ (2) $\frac{18d}{11}$ (3) $\frac{13d}{9}$ (4) $\frac{23d}{18}$

41. Figure shows a weigh-bridge, with a beaker P with water on one pan and a balancing weight R on the other. A solid ball Q is hanging with a thread outside water. It has volume 40 cm^3 and weighs 80 g. If this solid is lowered to sink fully in water, but not touching the beaker anywhere, the balancing weight R' will be



(1) same as R (2) 40 g less than R (3) 40 g more than R (4) 80 g more than R

SECTION (C) : CONTINUITY EQUATION AND BERNOULLI THEOREM & THEIR APPLICATION

1. In which one of the following cases will the liquid flow in a pipe be most streamlined **[Pb. CET 2005]**
(1) Liquid of high viscosity and high density flowing through a pipe of small radius
(2) Liquid of high viscosity and low density flowing through a pipe of small radius
(3) Liquid of low viscosity and low density flowing through a pipe of large radius
(4) Liquid of low viscosity and high density flowing through a pipe of large radius

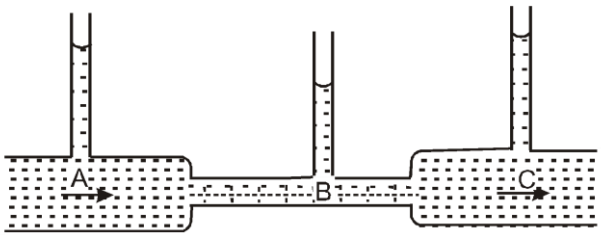
2. Two water pipes of diameters 2 cm and 4 cm are connected with the main supply line. The velocity of flow of water in the pipe of 2 cm diameter is

(1) 4 time that in the other pipe (2) $\frac{1}{4}$ time that in the other pipe
(3) 2 time that in the other pipe (4) $\frac{1}{2}$ time that in the other pipe

3. Water enters through end A with speed υ_1 and leaves through end B with speed υ_2 of a cylindrical tube AB. The tube is always completely filled with water. In case I tube is horizontal and in case II it is vertical with end A upwards and in case III it is vertical with end B upwards. We have $\upsilon_1 = \upsilon_2$ for
(1) Case I (2) Case II (3) Case III (4) Each case

4. Water is moving with a speed of 5.18 ms^{-1} through a pipe with a cross-sectional area of 4.20 cm^2. The water gradually descends 9.66 m as the pipe increase in area to 7.60 cm^2. The speed of flow at the lower level is
(1) 3.0 ms^{-1} (2) 5.7 ms^{-1} (3) 3.82 ms^{-1} (4) 2.86 ms^{-1}

5. In the following flg. Is shown the flow of liquid through a horizontal pipe. 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 2 cm, 1 cm and 2cm. It can be said that the



(1) Height of the liquid in the tube A is maximum
(2) Height of the liquid in the tubes A and B is the same
(3) Height of the liquid in all three tubes is the same
(4) Height of the liquid in the tubes A and C is the same

6. Air is steaming past a horizontal air plane wing such that its speed in 120 m/s over the upper surface and 90 m/s at the lower surface. If the density of air is 1.3 kg per $metre^3$ and the wing is 10 m long and has an average width of 2 m, then the difference of the pressure on the two sides of the wing of
(1) 4095.0 Pascal (2) 409.50 Pascal (3) 40.950 Pascal (4) 4.0950 Pascal

7. 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
(1) 10 (2) 20 (3) 25.5 (4) 5

8. 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

(1) $\sqrt{400}$ m/s (2) $\sqrt{600}$ m/s (3) $\sqrt{60}$ m/s (4) None of these

9. In a turbulent flow, the velocity of the liquid molecules in contact with the walls of the tube is

(1) Zero (2) Maximum

(3) Equal to critical velocity (4) May have any value

10. Water is flowing through a tube of non-uniform cross-section ratio of the radius at entry and exit end of the pipe is 3 : 2. Then the ratio of velocities at entry and exit of liquid is

(1) 4 : 9 (2) 9 : 4 (3) 8 : 27 (4) 1 : 1

11. Water is flowing through a horizontal pipe of non-uniform cross-section. At the extreme narrow portion of the pipe, the water will have

(1) Maximum speed and least pressure (2) Maximum pressure and least speed

(3) Both pressure and speed maximum (4) Both pressure and speed least

12. A liquid flows in a tube from left to right as shown in figure. A_1 and A_2 are the cross-section of the portions of the tube as shown. Then the ratio of speeds v_1 / v_2 will be

(1) A_1 / A_2 (2) A_2 / A_1 (3) $\sqrt{A_2}$ / $\sqrt{A_1}$ (4) $\sqrt{A_1}$ / $\sqrt{A_2}$

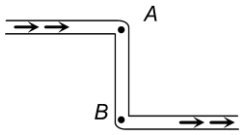
13. A large tank filled with water to a height 'h' is to be emptied through a small hole at the bottom. The ratio of time taken for the level of water to fall from h to $\frac{h}{2}$ and from $\frac{h}{2}$ to zero is **[EAMCET (Engg.) 2003]**

(1) $\sqrt{2}$ (2) $\frac{1}{\sqrt{2}}$ (3) $\sqrt{2}-1$ (4) $\frac{1}{\sqrt{2}-1}$

14. 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 **[MP PMT 1997]**

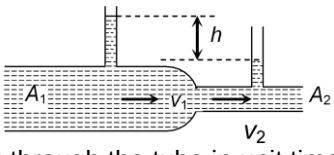
(1) t (2) 4t (3) 2 t (4) t/4

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



(1) $v_A = v_B$ (2) $v_B > v_A$ (3) $P_A = P_B$ (4) $P_B > P_A$

16. 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



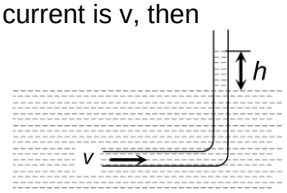
(1) The volume of the liquid flowing through the tube in unit time is A_1v_1

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

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

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

17. An L-shaped glass tube is just immersed in flowing water such that its opening is pointing against flowing water. If the speed of water current is v, then



(1) The water in the tube rises to height $\frac{v^2}{2g}$ (2) The water in the tube rises to height $\frac{g}{2v^2}$

(3) The water in the tube does not rise at all (4) None of these

18. 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

(1) $\sqrt{\frac{2h}{g}}$ (2) $\sqrt{\frac{2h}{g}\cdot\frac{D}{d}}$ (3) $\sqrt{\frac{2h}{g}\cdot\frac{d}{D}}$ (4) $\sqrt{\frac{2h}{g}}\left(\frac{d}{D-d}\right)$

19. 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 time to take out the rest of water. If $T_1 = T_2$, then the value of η is

(1) 2 (2) 3 (3) 4 (4) $2\sqrt{2}$

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

(1) mass (2) momentum (3) energy (4) none of these

21. Action of paint-gun is based on:

(1) Bernoulli's principle (2) Boyle's law

(3) Faraday's law (4) Archimedee's principle

22. Bernoulli's equation is applicable to points:

(1) in a steadily flowing liquid

(2) in a stream line

(3) in a straight line perpendicular to a stream line

(4) for ideal lequid stream line flow on a stream line

23. Bernoulli's equation is based upon:

(1) isochoric process (2) isobaric process (3) isothermal process (4) adiabatic process

24. The horizontal flow of fluid depends upon

(1) pressure difference (2) amount of fluid (3) density of fluid (4) all the above

25. In steady horizontal flow:

(1) the pressure is greatest where the speed is least

(2) the pressure is independent of speed

(3) the pressure is least where the speed is least

(4) (a) and (c) are correct

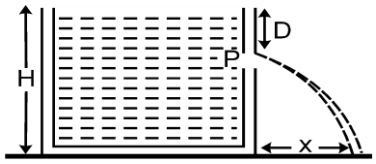
26. In a laminar flow the velocity of the liquid in contact with the wals of the tube is

(1) Zero (2) Maximum
(3) In between zero and maximum (4) Equal to critical velocity

27. In a turbulent flow, the velocity of the liquid molecules in contact with the walls of the tube is –
(1) Zero (2) Maximum
(3) Equal to critical velocity (4) May have any value

28. The Reynolds number of a flow is the ratio of
(1) Gravity to viscous force (2) Gravity force to pressure force
(3) Inertia forces to viscous force (4) Viscous forces to pressure forces

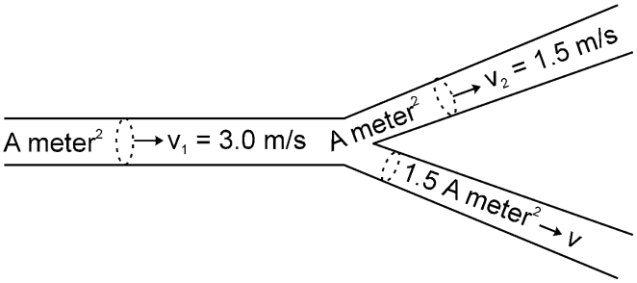
29. A tank is filled with water up to height H. Water is allowed to come out of a hole P in one of the walls at a depth D below the surface of water. Express the horizontal distance x in terms of H and D :



(1) $x = \sqrt{D(H-D)}$ (2) $x = \sqrt{\frac{D(H-D)}{2}}$ (3) $x = 2\sqrt{D(H-D)}$ (4) $x = 4\sqrt{D(H-D)}$

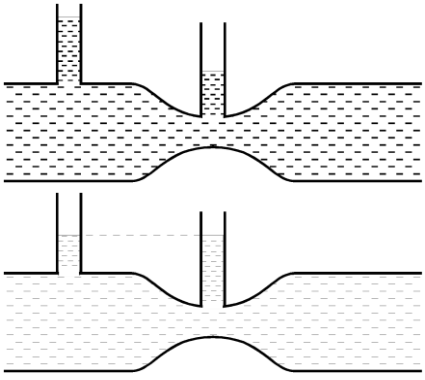
30. A fixed cylindrical vessel is filled with water up to height H. A hole is bored in the wall at a depth h from the free surface of water. For maximum horizontal range h is equal to :
(1) H (2) 3H/4 (3) H/2 (4) H/4

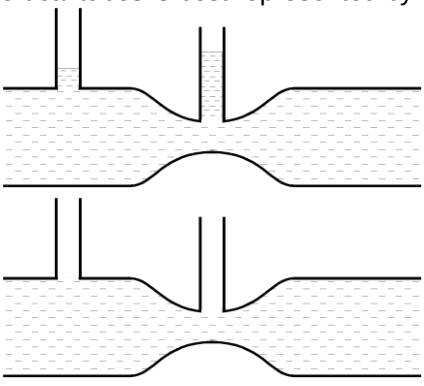
31. An incompressible liquid flows through a horizontal tube as shown in the figure. Then the velocity ' v ' of the fluid is :



(1) 3.0 m/s (2) 1.5 m/s (3) 1.0 m/s (4) 2.25 m/s

32. For a fluid which is flowing steadily, the level in the vertical tubes is best represented by

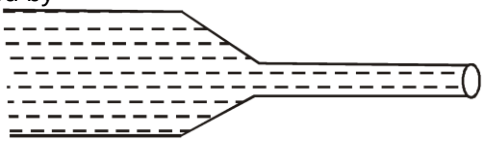
(1) 

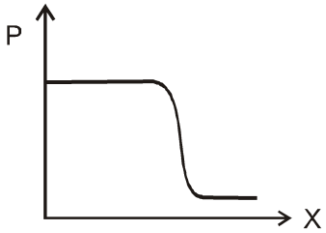
(2) 

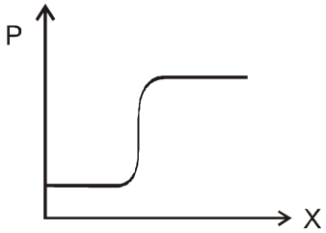
(3)

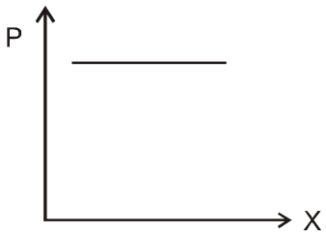
(4)

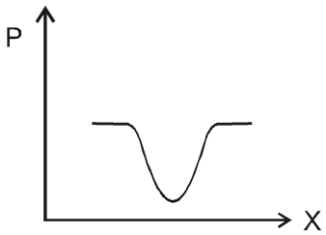
33. Water flows through a frictionless duct with a cross-section varying as shown in fig. Pressure p at points along the axis is represented by



(1) 

(2) 

(3) 

(4) 

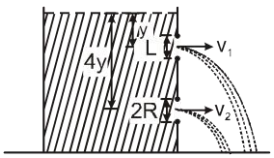
34. Air is blown through a hole on a closed pipe containing liquid. Then the pressure will :
(1) Increase on sides (2) Increase downwards
(3) Increase in all directions (4) Never increases

35. The Working of an atomizer depends upon **[AFMC 2005; MP PMT 1992]**
(1) Bernoulli's theorem (2) Boyle's law
(3) Archimedes principle (4) Newton's law of motion

36. A cylinder of height 20m is completely filled with water. The velocity of efflux of water (in ms^{-1}) through a small hole on the side wall of the cylinder near its bottom, is : **[AIEEE 2002, 4/300]**
(1) 10 (2) 20 (3) 25.5 (4) 5

37. An application of Bernoulli's equation for fluid flow is found in **[IIT–JEE (Screening) 1994]**
(1) Dynamic lift of an aeroplane (2) Viscosity meter
(3) Capillary rise (4) Hydraulic press

38. 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 radius R, is equal to : **[JEE - 2000, 2/105]**



(1) $\frac{L}{\sqrt{2\pi}}$ (2) $2\pi L$ (3) L (4) $\frac{L}{2\pi}$

39. 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) ($g = 10\ m/s_2$)
[I.I.T. 2005 Screening , 3/60]
(1) 50 (2) 51 (3) 48 (4) 51.5

40. **STATEMENT -1** **[JEE-2008' 3/162]**
The stream of water flowing at high speed from a garden hose pipe tends to spread like a fountain when held vertically up, but tends to narrow down when held vertically down.
and
STATEMENT -2

In any steady flow of an incompressible fluid, the volume flow rate of the fluid remains constant.

(1) STATEMENT -1 is True, STATEMENT -2 is True; STATEMENT -2 is a correct explanation for STATEMENT -1

(2) STATEMENT -1 is True, STATEMENT -2 is True; STATEMENT -2 is NOT a correct explanation for STATEMENT -1

(3) STATEMENT -1 is True, STATEMENT -2 is False

(4) STATEMENT -1 is False, STATEMENT -2 is True.

41. Water is flowing inside a tube of an uniform radius ratio of radius of entry and exit terminals of the tube is 3 : 2. Then the ratio of velocities at entry and exit terminals will be : **[RPMT 2001]**

(1) 4 : 9 (2) 9 : 4 (3) 8 : 27 (4) 1 : 1

42. At what speed, the velocity head of water is equal to pressure head of 40 cm of hg ? **[RPMT 2007]**

(1) 10.3 m/s (2) 2.8 m/s (3) 5.6 m/s (4) 8.4 m/s

43. A hole is in the bottom of the tank having water. If total pressure at the bottom is 3 atm (1 atm = 10_5 Nm_{-2}), then velocity of water flowing from hole is : **[RPMT 2007]**

(1) $\sqrt{400}$ ms_{-1} (2) $\sqrt{600}$ ms_{-1} (3) $\sqrt{60}$ ms_{-1} (4) none of these

44. The velocity of water flowing in a non-uniform tube is 20 cm/s at a point where the tube radius is 0.2 cm. The velocity at another point, where the radius is 0.1 cm is: **[RPMT-2011]**

(1) 80 cm/s (2) 40 cm/s (3) 20 cm/s (4) 5 cm/s

45. Water is poured in a vessel at a constant rate $\beta m_3/s$. There is a small hole of area α at the bottom of the vessel. The maximum level of water in the vessel is proportional to **[RPMT-2014]**

(1) β / α (2) β_2 / α (3) β_2 / α_2 (4) α_2 / β_2

46. A manometer connected to a closed tap reads 3.5×10^5 N/m^2, When the value is opened, the reading of manometer falls to 3.0×10^5 N/m^2, then velocity of flow of water is

(1) 100 m/s (2) 10 m/s (3) 1 m/s (4) $10\sqrt{10}$ m/s

47. According to Bernoulli's equation $\frac{P}{pg} + h\frac{1}{2}\frac{\upsilon}{g}$ = Constant

The terms A, B, and C are generally called respectively :

(1) Gravitational head, pressure head and velocity head

(2) Gravity, gravitational head and velocity head

(3) Pressure head, gravitational head and velocity head

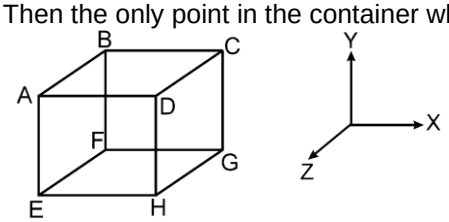
(4) Gravity, Pressure and velocity head

Exercise-2

ONLY ONE OPTION CORRECT TYPE

1. The weight of sphere in air is 50g. Its weight is 40 g in a liquid, at temperature 20°C. When temperature increases to 70°C,it weight becomes 45 g. Find **[AIPMT-2008]**
(i) the ratio of densities of liquid at given two temperatures,
(ii) the coefficient of cubical expansion of liquid assuming the there is no expansion of the volume of sphere.

2. The cubical container ABCDEFGH which is completely filled with an ideal (nonviscous and incompressible) fluid, moves in a gravity free space with a acceleration of $a = a_0 (\hat{i} - \hat{j} + \hat{k})$ where a_0 is a positive constant. Then the only point in the container where pressure is maximum, is

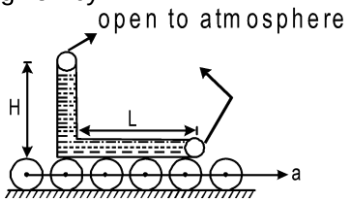


(1) B (2) C (3) E (4) F

3. In previous question pressure will be minimum at point –
(1) A (2) B (3) H (4) F

4. A cylindrical tank of height 0.4 m is open at the top and has a diameter 0.16 m. Water is filled in it up to a height of 0.16 m. how long it will take to empty the tank through a hole of radius 5×10^{-3} m in its bottom. **[Roorkee 1990]**
(1) 46.26 sec. (2) 4.6 sec. (3) 462.6 sec. (4) .46 sec.

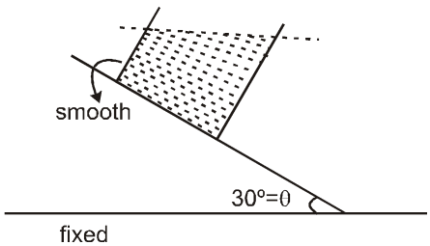
5. A narrow tube completely filled with a liquid is lying on a series of cylinders as shown in figure. Assuming no sliding between any surfaces, the value of acceleration of the cylinders for which liquid will not come out of the tube from anywhere is given by



(1) $\frac{gH}{2L}$ (2) $\frac{gH}{L}$ (3) $\frac{2gH}{L}$ (4) $\frac{gH}{\sqrt{2}L}$

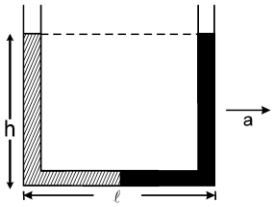
6. A liquid is kept in a cylindrical vessel which is rotated along its axis. The liquid rises at the sides. If the radius of the vessel is 0.05 m and the speed of rotation is 2 rev/s, The difference in the height of the liquid at the centre of the vessel and its sides will be ($\pi^2 = 10$) : **[REE 1987]**
(1) 3 cm (2) 2 cm (3) 3/2 cm (4) 2/3 cm

7. A container of liquid release from the rest, on a smooth inclined plane as shown in the figure. Length of at the inclined plane is sufficient, and assume liquid finally equilibrium. Finally liquid surface makes an angle with horizontal.



(1) 60° (2) 45° (3) 30° (4) None of these

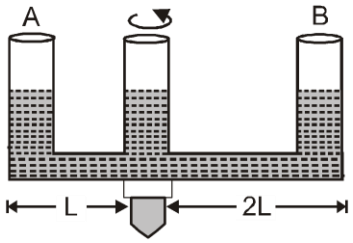
8. A U-tube of base length "l" filled with same volume of two liquids of densities ρ and 2ρ is moving with an acceleration "a" on the horizontal plane. If the height difference between the two surfaces (open to atmosphere) becomes zero, then the height h is given by:



(1) $\frac{a}{2g}\ell$ (2) $\frac{3a}{2g}\ell$ (3) $\frac{a}{g}\ell$ (4) $\frac{2a}{3g}\ell$

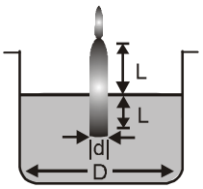
9. A given shaped glass tube having uniform cross section is filled with water and is mounted on a rotatable shaft as shown in figure. If the tube is rotated with a constant angular velocity ω then:

[AIIMS 2005]



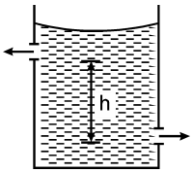
(1) Water levels in both sections A and B go up
(2) Water level in Section A goes up and that in B comes down
(3) Water level in Section A comes down and that in B it goes up
(4) Water levels remains same in both sections

10. 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 2cm/hour then the top of the candle will **[AIIMS 2005]**



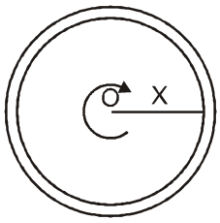
(1) Remain at the same height (2) Fall at the rate of 1 cm/hour
(3) Fall at the rate of 2 cm/hour (4) Go up the rate of 1 cm/hour

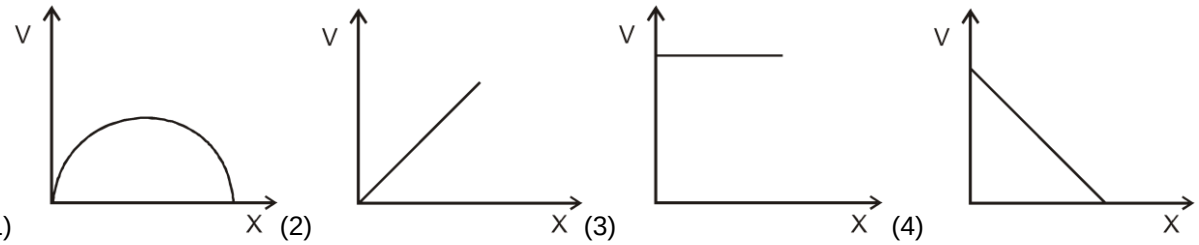
11. There are two identical small holes on the opposite sides of a tank containing a liquid. The tank is open at the top. The difference in height between the two holes is h. As the liquid comes out of the two holes, the tank will experience a net horizontal force proportional to:



(1) $h^{1/2}$ (2) h (3) $h^{3/2}$ (4) h^2

12. 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 υ with which the liquid is crossing points at a distance X from O along a radius XO would look like





Exercise-3

PART - I : NEET / AIPMT QUESTION (PREVIOUS YEARS)

1. 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 direction of the force will be : (P_{air} = 1.2 kg / m_3) **[AIPMT-2015]**

(1) 4.8 x 10_5 N, upwards (2) 2.4 x 10_5 N, upwards

(3) 2.4 x 10_5 N, downwards (4) 4.8 x 10_5 N, downwards

2. 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 ×10_3 kg/m_3 and g = 10m/s_2 then the power of heart in watt is :

[AIPMT-2015]

(1) 2.35 (2) 3.0 (3) 1.50 (4) 1.70

3. 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 :

[AIPMT-2015]

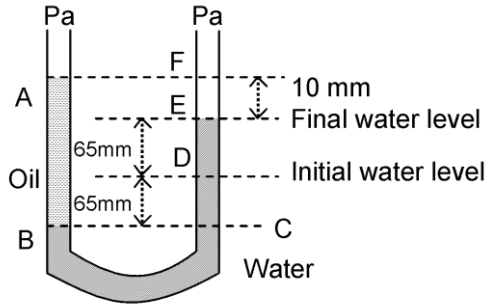
(1) $\frac{VR^2}{nr^2}$ (2) $\frac{VR^2}{n^3r^2}$ (3) $\frac{V^2R}{nr}$ (4) $\frac{VR^2}{n^2r^2}$

4. Two non-mixing liquids of densities ρ and nρ (n > 1) are put in 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 **[AIPMT_2016]**

(1) {1 + (n – 1)p}ρ (2) {1 + (n + 1)p}ρ (3) {2+(n + 1)p}ρ (4) {2 + (n – 1)p}ρ

5. 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 :

[NEET 2017]



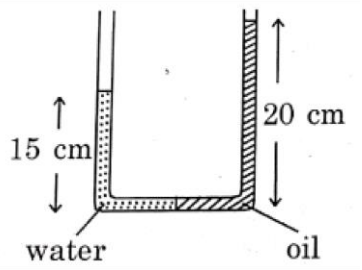
(1) 650 kg m^{-3} (2) 425 kg m^{-3} (3) 800 kg m^{-3} (4) 928 kg m^{-3}

6. A small hole of area of cross-section 2 mm^2 present near the bottom of a fully filled open tank of height 2 m. Taking g = 10 m/s^2, the rate of flow of water through the open hole would be nearly

[NEET 2019]

(1) 6.4×10^{-6} m^3/s (2) 12.6×10^{-6} m^3/s (3) 8.9×10^{-6} m^3/s (4) 2.23×10^{-6} m^3/s

7. In a u-tube as shown in the figure water and oil are in the left side and right side of the tube respectively. The heights from the bottom for water and oil columns are 15 cm and 20 cm respectively. The density of the oil is: [take ρ_{water} = 1000 kg/m^3] **[NEET_2019-II]**



(1) 1200 kg/m^3 (2) 750 kg/m^3 (3) 1000 kg/m^3 (4) 1333 kg/m^3

PART - II : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

1. Water is flowing continuously from a tap having an internal diameter 8×10^{-3} m. The water velocity as it leaves the tap is 0.4 ms^{-1}. The diameter of the water stream at a distance 2×10^{-1} m below the tap is close to : **[AIEEE - 2011, 4/120, –1]**

(1) 5.0×10^{-3} m (2) 7.5×10^{-3} m (3) 9.6×10^{-3} m (4) 3.6×10^{-3} m

2. A wooden cube (density of wood 'd') of side 'ℓ' floats in a liquid of density 'ρ' with its upper and lower surfaces horizontal. If the cube is pushed slightly down and released, it performs simple harmonic motion of period 'T'. Then, 'T' is equal to : **[AIEEE 2011, 11 May; 4, –1]**

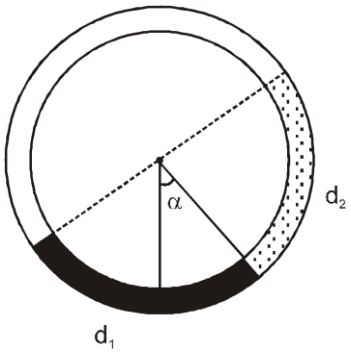
(1) $2\pi\sqrt{\frac{\ell d}{\rho g}}$ (2) $2\pi\sqrt{\frac{\ell\rho}{dg}}$ (3) $2\pi\sqrt{\frac{\ell d}{(\rho - d)g}}$ (4) $2\pi\sqrt{\frac{\ell\rho}{(\rho - d)g}}$

3. 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 : (Here k is spring constant)

[JEE-MAINS_2013, 4/120, -1]

(1) $\frac{Mg}{k}$ (2) $\frac{Mg}{k}\left(1-\frac{LA\sigma}{M}\right)$ (3) $\frac{Mg}{k}\left(1-\frac{LA\sigma}{2M}\right)$ (4) $\frac{Mg}{k}\left(1+\frac{LA\sigma}{M}\right)$

4. 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 subtands 90° angle at centre. Radius joining their interface makes an angle α with vertical. Ratio $\frac{d_1}{d_2}$ is : **[JEE-Mains 2014]**



(1) $\frac{1+\sin\alpha}{1-\sin\alpha}$ (2) $\frac{1+\cos\alpha}{1-\cos\alpha}$ (3) $\frac{1+\tan\alpha}{1-\tan\alpha}$ (4) $\frac{1+\sin\alpha}{1-\cos\alpha}$

5. The top of a water tank is open to air and its water level is maintained. It is giving out 0.74 m^3 / min. water per minute through a circular opening of 2 cm radius in its wall. The depth of the centre of the opening from the level of water in the tank is close to : **[JEE-Mains 2019]**

(1) 2.9 m (2) 9.6 m (3) 4.8 m (4) 6.0 m

6. A cylindrical plastic bottle of negligible mass is filled with 310 ml of water and left floating in a pond with still water. If pressed downward slightly and released, it starts performing simple harmonic motion at angular frequency ω. If the radius of the bottle is 2.5 cm then ω is close to : (density of water = 10^3 kg/m^3)

[JEE-Mains 2019]

(1) 5.00 rad s^{-1} (2) 3.70 rad s^{-1} (3) 2.50 rad s^{-1} (4) 1.25 rad s^{-1}

7. A liquid of density ρ is coming out of a hose pipe of radius a with horizontal speed v and hits a mesh. 50% of the liquid passes through the mesh unaffected. 25% looses all of its momentum and 25% comes back with the same speed. The resultant pressure on the mesh will be : **[JEE-Mains 2019]**

(1) $\frac{1}{2}\rho v^2$ (2) $\frac{1}{4}\rho v^2$ (3) $\frac{3}{4}\rho v^2$ (4) ρv^2

8. A load of mass M kg is suspended from a steel wire of length 2 m and radius 1.0 mm in Searle's apparatus experiment. The increase in length produced in the wire is 4.0 mm. Now the load is fully immersed in a liquid of relative density 2. The relative density of the material of load is 8.

The new value of increase in length of the steel wire is : **[JEE-Mains 2019]**

(1) 3.0 mm (2) zero (3) 5.0 mm (4) 4.0

Answers

EXERCISE - 1

PART – I

SECTION (A)

1.	(2)	**2.**	(2)	**3.**	(2)	**4.**	(3)	**5.**	(3)	**6.**	(3)	**7.**	(1)
8.	(4)	**9.**	(2)	**10.**	(4)	**11.**	(4)	**12.**	(4)	**13.**	(4)	**14.**	(1)
15.	(1)	**16.**	(3)	**17.**	(3)	**18.**	(1)	**19.**	(1)	**20.**	(2)	**21.**	(4)
22.	(3)												

SECTION (B)

1.	(3)	**2.**	(3)	**3.**	(3)	**4.**	(2)	**5.**	(1)	**6.**	(3)	**7.**	(3)
8.	(2)	**9.**	(2)	**10.**	(1)	**11.**	(2)	**12.**	(1)	**13.**	(2)	**14.**	(4)
15.	(1)	**16.**	(3)	**17.**	(3)	**18.**	(3)	**19.**	(1)	**20.**	(1)	**21.**	(3)
22.	(1)	**23.**	(2)	**24.**	(1)	**25.**	(2)	**26.**	(4)	**27.**	(3)	**28.**	(4)
29.	(4)	**30.**	(3)	**31.**	(1)	**32.**	(1)	**33.**	(2)	**34.**	(3)	**35.**	(3)
36.	(2)	**37.**	(3)	**38.**	(3)	**39.**	(2)	**40.**	(2)	**41.**	(3)		

SECTION (C)

1.	(2)	**2.**	(1)	**3.**	(4)	**4.**	(4)	**5.**	(4)	**6.**	(1)	**7.**	(2)
8.	(1)	**9.**	(4)	**10.**	(1)	**11.**	(1)	**12.**	(2)	**13.**	(3)	**14.**	(3)
15.	(1,4)	**16.**	(1,3,4)	**17.**	(1)	**18.**	(4)	**19.**	(3)	**20.**	(3)	**21.**	(1)
22.	(4)	**23.**	(3)	**24.**	(1)	**25.**	(1)	**26.**	(1)	**27.**	(4)	**28.**	(3)
29.	(3)	**30.**	(3)	**31.**	(3)	**32.**	(1)	**33.**	(1)	**34.**	(3)	**35.**	(1)
36.	(2)	**37.**	(1)	**38.**	(1)	**39.**	(1)	**40.**	(1)	**41.**	(1)	**42.**	(1)
43.	(1)	**44.**	(1)	**45.**	(3)	**46.**	(2)	**47.**	(3)				

EXERCISE - 2

1. (i) $\frac{\rho_1}{\rho_2} = \frac{2}{1}$ the ratio of densities of liquid at given two temperatures, (ii) $\frac{1}{(70-20)} = 0.02/°C$

2.	(1)	**3.**	(3)	**4.**	(1)	**5.**	(1)	**6.**	(2)	**7.**	(3)	**8.**	(2)
9.	(1)	**10.**	(2)	**11.**	(2)	**12.**	(4)						

EXERCISE - 3

PART – I

1.	(2)	**2.**	(4)	**3.**	(1)	**4.**	(1)	**5.**	(4)	**6.**	(2)	**7.**	(2)

PART – II

1.	(4)	**2.**	(1)	**3.**	(3)	**4.**	(3)	**5.**	(3)	**6.**	(4)	**7.**	(3)
8.	(1)												