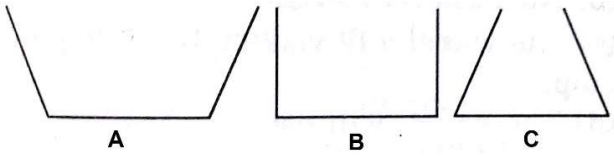
Chapter- 10

Mechanical Properties of Fluids

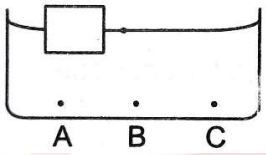
Multiple Choice Questions Type (1 Mark)

1. The three vessels have the same base area. Equal volumes of a liquid are poured in the three vessels. The Force on the base will be



   a) maximum in vessel A
   b) maximum in vessel B
   c) maximum in vessel C
   d) equal in all the vessels

2. A wooden object floats in water kept in a beaker. The object is near a side of the beaker. Let P_1, P_2, P_3 be the pressures at the three points A, B, and C of the bottom.



   a) $P_1 = P_2 = P_3$
   b) $P_1 < P_2 < P_3$
   c) $P_1 > P_2 > P_3$
   d) $P_2 = P_3$ P_1

3. In a streamline flow,
   a) the speed of a particle always remains the same
   b) the velocity of a particle always remains the same
   c) the kinetic energies of all the particles arriving at a given point are the same
   d) the moments of all the particles arriving at a given point are the same
4. Water is flowing in streamline motion through a tube with its axis horizontal. Consider two points A and B in the tube at the same horizontal level.
   a) The pressures at A and B are equal for any shape of the tube
   b) The pressures are never equal
   c) The pressures are equal if the tube has a uniform cross-section
   d) The pressures may be equal even if the tube has a non-uniform cross-section.
5. There is a small hole near the bottom of an open tank filled with a liquid. The speed of the water ejected does not depend on
   a) area of the hole
   b) the density of the liquid
   c) height of the liquid from the hole
   d) acceleration due to gravity.

Very Short Answer Type Questions (1 Mark)

6. Define pressure. State its S.I unit and specify its direction.
7. Name the law that involves the transmission of fluid pressure.
8. What do you mean by streamline or the steady flow of liquid?
9. What is the acceleration of a body falling freely through viscous liquid after it has acquired terminal velocity?
10. Write the difference between friction and viscosity.
11. What are the factors on which critical velocity depends?
12. Define surface tension?
13. How surface tension is related to surface energy?
14. What is the origin of surface tension?
15. On which side of the meniscus the pressure is more?
16. What are the limitations of Bernoulli's equation?
17. Small raindrops fall slower than bigger drops through the air. Why?
18. Find the excess of pressure inside the soap bubble of diameter 1.2mm. The surface tension of the soap solution is 18dyne/cm.
19. What is the pressure inside a drop of mercury of radius 3mm at room temperature? The surface tension of mercury at that temperature (200C) is 0.465 X N/m. The atmospheric pressure is 1.01 X 105p.a. Also given the excess pressure inside the drop.
20. Show that surface energy is equal to surface tension.
21. An ice piece floats in a glass of water. How does the level change when the whole of ice melts?
22. A hydraulic automobile is designed to lift cars with a maximum mass of 3000kg. The area of cross-section of the piston carrying the load is 425cm2. What maximum pressure would the small piston has to bear?

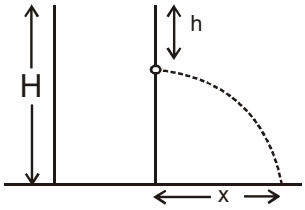
Short Answer Type Questions (2 Marks)

23. What is meant by Reynolds's number? Write about its physical significance.
24. What do you understand by the angle of contact? On what factors does it depend.
25. The flow of blood in a large artery of anesthetized dog is diverted through a venturimeter. The wider part of the meter has a cross-sectional area equal to that of the artery A = $8mm^2$. The narrower part has an area 'a' = $4mm^2$. The pressure drop in the artery is 24 Pa. What is the speed of the blood in the artery if the density of blood is 1.06 X $10^3 kgm^{-3}$.

Short Answer Type Questions (3 Marks)

26. Obtain an expression for the pressure exerted by liquid column
27. Derive an expression for the excess of pressure inside a liquid drop.
28. Derive an expression for the excess of pressure inside a soap bubble.

29. Derive an expression for the critical velocity for the viscous liquid of the co-efficient of viscosity η and density ρ flowing through a pipe of diameter D.
30. What is the principle of venturimeter? Derive an expression for the rate of flow of liquid through it.
31. Derive the equation of continuity for the steady flow of incompressible liquid.
32. 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 depth 'h' below the surface of the water as shown in the figure below.



Express the horizontal distance 'x' in terms of H and h.
33. State & prove Stoke's law.
34. A metal block of area 0.10 m^2 is connected to a 0.01kg mass via a string that passes over an ideal pulley (considered massless & frictionless) as shown in fig. A liquid with a film thickness of 0.3mm is placed between the block and the table. when released the block moves to the right with a constant speed of 0.085ms-1. Find the coefficient of viscosity of the liquid.
35. The flow rate of water from a tap of diameter 1.25cm is 0.45L/min. The coefficient of viscosity of water is 10^{-3} Pa s. After, sometime the flow rate is increased to 3L/min. Characterize the flow for both the flow rates.
36. What is the excess pressure inside a bubble of soap solution of radius 500mm, given that the surface tension of soap solution at the temperature (20^0 C) is 2.50 X 10^{-2} Nm^{-1}? If an air bubble of the same dimension were formed at depth of 40cm inside a container containing the soap solution (relative density 1.20). What would be the pressure inside the bubble? (1 atm pressure is 1.01 X 10^5Pa)
37. Water rises to a height of 4.8cm in a certain capillary tube. When the same tube is dipped in some another liquid it falls by 12.5cm. Compare the surface tension of water and liquid. The density of the liquid is 9.6gm/cc and the angle of contact is 120^0.
38. Oil is poured to calm the seawater. Explain why?
39. State and prove Torricelli's theorem
40. Water flows in a pipe of varying cross-section kept horizontally. The mercury stands 12cm at a point where the velocity of flow is 25 cm/s. Find the pressure at another point where the velocity is 100 cm/s
41. 64 droplets of water, each of radius r coalesce to form a big drop. If a small droplet in viscous media falls with terminal velocity 5cm/s then what is the velocity of a big drop?
42. What is the principle of hydraulic pressure?
43. The blotting paper absorbs the ink. State the principle in which this phenomenon is based.

Long Answer Type Questions (5 Marks)

44. Derive the ascent formula. What happens if the capillary tube is of insufficient height?

45. State and prove Bernoulli's theorem.
46. Derive an expression for terminal velocity acquired by a spherical body falling in viscous media under gravity.