CHAPTER 10

Mechanical Properties of Fluids

TRY YOURSELF — ANSWERS

1. It is due to the fact that, if our weight is supported on a very small area of the sharp edge of the pebble on the road, then it will exert reaction, a large pressure on our feet.

2. Applications based on Pascal's laws are
(i) Hydraulic lift
(ii) Hydraulic brake

3. $P = h\rho g$

$\therefore \quad h_{Hg}\,\rho_{Hg}\,g = h_l\,\rho_l\,g$

or $\quad 76 \times 13.6 = h_e \times 3.4$

or $\quad h_l = \dfrac{76 \times 13.6}{3.4}$

or $\quad h_l = 304$ cm

or $\quad h_l \simeq 3$ m

4. Buoyant force arises because the pressure in the fluid is not uniform and it increases with depth.

5. As it states that the fluid exerts an upward force of buoyancy equal to the weight of the displaced fluid.

Buoyant force $= V_i \sigma g$

6. Buoyant force = loss of weight = 5 N − 2 N = 3 N

7. It depends upon the nature of the fluid as it is proportional to the density of the fluid as $\rho_{\text{Sea water}} > \rho_{\text{Pure water}}$.

8. A body can float if the weight of the liquid displaced by the immersed part of body must be equal to the weight of the body.

9. Large iron ship floats as the weight of water displaced by the ship is greater than the weight of the ship.

10. Archimede's principle does not hold good in this situation as the vessel during free fall is in a condition of weightlessness, where the buoyant force accounting for Archimede's principle does not exists.

11. The greater is the crowding of stream lines at a place, the greater is the velocity of the liquid particles at that place and vice-versa.

12. When water enters into a narrow pipe, the area of cross-section(A) decreases and consequently velocity (v) increased as

$$Av = \text{constant}$$

13. The flow of liquid in which the liquid moves in layers is called laminar flow.

14. A bundle of streamlines forming a tubular region is called a tube of flow.

15. No, the shape of flow of tube cannot change with time in a steady flow.

16. Some applications of Bernoulli's theorem are
(i) Magnus effect
(ii) Sprayer
(iii) Motion of the ping-pong ball
(iv) Aerofoil

17. The depth of the hole below the upper surface of water is

$$h = \frac{H}{4} = \frac{96}{4} = 24 \text{ cm}$$

The height of hole from ground is

$h' = 96 - 24 = 72$ cm

Horizontal range $= 2\sqrt{hh'} = 2\sqrt{24 \times 72}$

$= 48\sqrt{3}$ cm $= 82.22$ cm

18. It is applicable only to incompressible fluids because it does not take into account the elastic energy of the fluids.

19. P.E. $= mgh$

or $\quad \dfrac{\text{P.E.}}{\text{Volume}} = \dfrac{m}{v} gh = \rho gh$

20. $P_1 + \rho g h_1 + \dfrac{1}{2}\rho v_1^2 = P_2 + \rho g h_2 + \dfrac{1}{2}\rho v_2^2$

21. The coefficient of viscosity of liquid decreases with increase in temperature. As a result of it, the hotter liquid flows faster than the colder one.

22. 10 poise = 1 decapoise

1 poiseulle (Pl) = 1 decapoise = 10 poise

23. Viscosity of gas $\times \sqrt{\text{Absolute temperature}}$

$\therefore$ Viscosity of gas increases with increase in temperature.

24. Velocity gradient $= \dfrac{dv}{dx} = \dfrac{8.0 \text{ cm/s}}{0.1 \text{ cm}} = 80$ per second

25. As $F = 6\pi\eta r v$

$$= 6 \times \frac{22}{7} \times (1.8 \times 10^{-5}) \times (0.2 \times 10^{-3}) \times 4 = 2.7 \times 10^{-9} \text{ N}$$

26. Two applications of Stokes' law are
(i) Floatation of clouds.
(ii) Helps in coming down through a parachute.

27. Zero, because when the body attains terminal velocity then the net force acting on the body is zero.

28. The assumptions which are used in the derivation of Poiseuille's formula are as follows :
(i) The flow of the liquid is steady and parallel to the axis of the tube.
(ii) The pressure is constant over any cross-section of the tube.

29. The direction of viscous drag is opposite to the direction of motion of the body.

30. When two capillary tubes are in series combination, the equivalent liquid resistance will be,

$$R_s = R_1 + R_2 = \frac{8\eta l_1}{\pi r_1^4} + \frac{8\eta l_2}{\pi r_2^4}$$

31. Dimensional formula of surface tension is $[M\ L^0\ T^{-2}]$.

32. Surface film is the top most layer of liquid at rest with thickness equal to the molecular range.

33. For mercury, cohesive force is maximum, so surface tension is also maximum.

34. No, the concept of surface tension is only applicable for liquids.

35. Temperature of the drops remain unchanged.

36. The capillaries formed in threads disappear when wax is rubbed on cloth and it becomes water proof.

37. The angle of contact of pure water and glass is zero.

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