CHAPTER NO. 6 (FLUID DYNAMICS)

Question 6.1:- Explain what do you understand by the term viscosity?

Answer:- The frictional effect between different layers of a flowing fluid is called viscosity. It determines how much force is required to slide one layer of fluid over another layer.

Substances which do not flow easily have large coefficients of viscosity such as honey and tar. Substances which flow easily like water and gases have small coefficients of viscosity.

Question 6.2:- What is meant by drag force? What are the factors upon which drag force acting upon a small sphere of radius r, moving down through a liquid, depends?

Answer:- Any object moving through a fluid experiences a retarding force (a force which opposes the motion of object) is called drag force. Its relation id given by Stoke's law for spherical objects moving slowly through a fluid as $F_D = 6\pi\eta rv$.

For spherical objects, it depends on the following factors:-

i. It depends directly on coefficient of viscosity i.e. nature of the fluid.
ii. It depends directly on radius of the spherical object.
iii. It depends directly on velocity of the spherical object.

Question 6.3:- Why fog droplets appear to be suspended in air?

Answer:- The terminal velocity of spherical object moving in a fluid of density ρ is given as $v_t = \frac{2\rho g r^2}{9\eta}$. It depends upon square of the radius of spherical objects. Fog droplets are very small in size, therefore, their terminal velocity is very small and they appear to be suspended in air.

Question 6.4:- Explain the difference between laminar flow and turbulent flow.

Answer:- <u>Laminar Flow</u>:- If every particle passes that passes a particular point, moves exactly along the same path, as followed by the particles which passed that points earlier, the flow is said to streamline or laminar.

<u>Turbulent Flow</u>:- The irregular or unsteady flow of the fluid is called turbulent flow.

Question 6.5:- State Bernoulli's relation for a liquid in motion and describe some of its applications.

Answer:- The sum of pressure, kinetic energy per unit volume and potential energy per unit volume at any point during steady flow of a non-viscous and incompressible fluid is constant. Mathematically, $P + \frac{1}{2}\rho v^2 + \rho gh = \text{Constant}$.

Bernoulli's equation has very wide applications. Some of which are given as:-

i. Measurement of the speed of fluids using Venturi meter.
ii. Working principle of chimney of a kitchen is based on Bernoulli's equation.
iii. Swing of a cricket ball.
iv. Working of carburetor of a car engine.
v. Lift of an aeroplane.
vi. Measurement of blood pressure using Sphygmomanometer.

Question 6.6:- A person is standing near a fast moving train. Is it any danger that he will fall towards it?

Answer:- Yes, he is in danger of falling towards the train as a consequence of Bernoulli's principle. When a fast moving train passes by a person standing on platform, the streamlines of air between the person and the train becomes close due to high speed and pressure becomes low. On the other side of the person, streamlines are farther apart due to low speed and pressure is high. A force acts on the person from high pressure towards low pressure i.e. he will tend to fall towards the train.

Question 6.7:- Identify the correct answer. What do you infer from Bernoulli's theorem?

Answer:- (i) Where the speed of the fluid is high the pressure will be low. **(Correct)**

(ii) Where the speed of the fluid is high the pressure is also high.

(iii) This theorem is valid only for turbulent flow of the liquid.

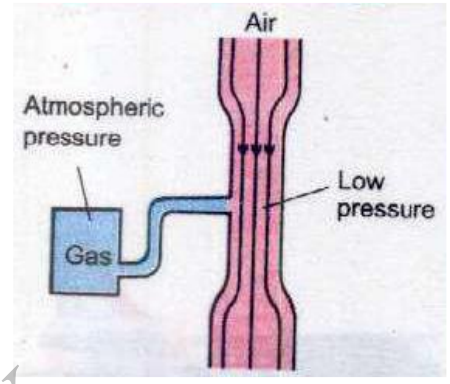
Question 6.8:- Two row boats moving parallel in the same direction are pulled towards each other. Explain.

Answer:- According to Bernoulli's theorem, where the speed of the fluid is high, the pressure will be low. When two row boats are moving parallel to each other, the streamlines of water between them are forces closer due to high speed and as a result pressure decreases. The pressure of water on other sides of boats is high due to low speed of water streamlines. Hence, boats are forced close to each other due to this pressure difference.

Question 6.9:- Explain, how the swing is produced in a fast moving cricket ball.

Answer:- When a bowler balls the cricket ball, the speed of streamlines of air on one side (shinny side) becomes high and pressure decreases. On the other side (rough side), the speed of air is low and pressure is high. Thus, a force acts on the ball from high pressure towards low pressure and causes the ball to swing.

Question 6.10:- Explain the working of a carburetor of a motorcar using by Bernoulli's equation.



Answer:- The carburetor of a car engine uses a Venturi duct to feed the correct mix of air and petrol to the cylinders. Air is drawn trough the duct and along a pipe to the cylinders. A tiny inlet at the side of duct is fed with petrol. The air through the duct moves very fast, creating low pressure in the duct, which draws petrol vapour into the air stream.

Question 6.11:- For which position will the maximum blood pressure in the body have the smallest value. (a) Standing up right (b) Sitting (c) Lying horizontally (d) Standing on one's head?

Answer:- The maximum blood pressure in the body have the smallest value when body is lying horizontally.

Question 6.12:- In an orbiting space station, would the blood pressure in major arteries in the leg ever be greater than the blood pressure in major arteries in the neck?

Answer:- In an orbiting space station, blood pressure in major arteries in the leg will be equal to blood pressure in major arteries of the neck as the situation of weightlessness exists in orbiting space stations.