

Chapter 10: - GRAVITATION

Part-2:

Thrust and Pressure

Thrust: Force exerted by an object perpendicular to the surface is called thrust.

Pressure: Pressure is defined as thrust or force per unit area on a surface.

- Pressure = Thrust/Area
- SI unit of pressure is Newton/meter² (N/m²).
- SI unit of pressure is called Pascal (Pa).

Factors affecting Pressure

Pressure depends on two factors:

- (i) Force applied
- (ii) Area of surface over which force acts

Since, pressure is indirectly proportional to the surface area of the object, so, pressure increases with a decrease in surface area and decreases with an increase in surface area.

Applications of Pressure in daily life

- The base of high buildings is made wider to spread the weight of the whole building over a large surface area due to which less pressure acts on the ground.
- School bags are provided with broad straps so that the weight of school bags fall over a larger area of the shoulder and produce less pressure hence making it easy to carry.
- The blades of knives are made sharp so that on applying force on it, a large pressure is produced on the very small surface area, thus cutting the object easily.

Pressure in Fluids

- Anything that can flow is called Fluid. Example: liquid and gas.
- Molecules of a fluid move randomly and collide with walls of vessel. Thus, fluids apply pressure on walls.
- Fluids exert pressure in all directions.

Buoyancy & Buoyant Force

- Force applied by the fluid on a solid which is partially or fully submerged in liquid, is called the buoyant force and this phenomenon is named as buoyancy.
- Buoyant force acts in upward direction and it depends on the density of the fluid.

Factors affecting the Buoyant Force:

Magnitude of the buoyant force depends on two factors:

- Volume of the object immersed in liquid
- Density of the liquid

Why does an object sink or float over water?

When an object is immersed in water, it exerts pressure over water due to its weight. At the same time water also exerts upward thrust, i.e., buoyant force over the object.

- If the force exerted by the object is greater than the buoyant force of water, the object sinks in water.
- If the force exerted by the object is less than the buoyant force of water, the object floats over water.

Archimedes' Principle

- It states that when a body is immersed fully or partially in a fluid, it experiences an upward force that is equal to the weight of the fluid displaced by it.

Applications of Archimedes' Principle:

- It is used in designing ships and submarines.
- It is used in determining relative density of substances.
- Hydrometers used to determine the density of liquids, work on this principle.
- Lactometers used to determine purity of milk, are also based on this principle.

It is because of this principle that ship made of iron and steel floats in water whereas a small piece of iron like nail, sinks in it.

Density (ρ)

- The mass per unit volume is called density of an object.
- Density (ρ) = Mass(M)/Volume(V)
- SI unit of density = kg/m³

Relative density

- It is the ratio of the density of a substance to the density of water.

$$\text{Relative density} = \frac{\text{Density of substance}}{\text{Density of water}}$$

- Since relative density is a ratio of similar quantities, it has no unit.

Applications of density

- If an object has density more than that of the liquid, it will float over that liquid.
- If an object has density lower than that of a liquid, it will sink in that liquid.

- When the relative density of a substance is less than 1, it will float in water otherwise it will sink in water.

Try the following questions:

Q1. What is buoyancy and buoyant force? Upon what factors do they depend?

Q2. Why does iron sink in water but floats on mercury?

Q3. Why does a buffalo float on the river but not the man?

Q4. Why does a mug full of water appear lighter inside the water?

Q5. The density of ice is 918kgm^{-3} and that of sea water is $1,030\text{kgm}^{-3}$. An iceberg floats with a portion 224 litres outside water. Find the volume of iceberg.