

Physical Quantities and Measurements

Density:

- It is mass per unit volume of a substance.
- **Unit: Relative density** g/cm^3 or kg/m^3
- **Relative density** = Density of the substance/Density of the water

Variation in density of gases and liquids with temperature:

- When temperature increases in case of a solid the volume does not change much so the density is not altered much.
- When temperature increases in case of a gases and liquids the volume does not change much so the density is not altered much.
- **Density of a substance-** mass per unit volume. It is expressed as

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

The SI unit of density is kg/m^3 .

- If density of body $>$ density of fluid, then the body will sink in the fluid.
- If density of body $<$ density of fluid, then the body will float in the fluid.

(Density of cork) $<$ (density of water), so cork floats.

(Density of iron) $>$ (Density water), so iron sinks.

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

Relative Density of a Solid Substance by Archimedes' Principle

$$\text{R.D.} = \frac{W_1}{W_1 - W_2}$$

where W_1 is the weight of the body in air and W_2 is the weight of the body in water.

(1) Relative density of a solid denser than water and insoluble in it

$$\text{R.D.} = \frac{\text{Weight of solid in air}}{\text{Loss in weight of solid in water}} = \frac{W_1}{W_1 - W_2} \quad \text{R.D.} = \frac{\text{Weight of solid in air}}{\text{Loss in weight of solid in water}} = \frac{W_1}{W_1 - W_2}$$

(2) Relative density of a solid denser than water and soluble in it

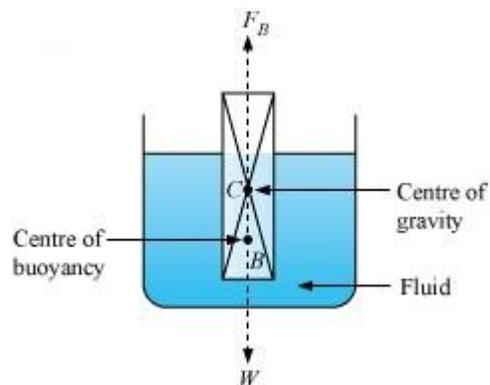
$$\text{R.D.} = \frac{\text{Weight of solid in air}}{\text{Loss in weight of solid in liquid}} \times \text{R.D. of liquid} \quad \text{R.D.} = \frac{\text{Weight of solid in air}}{\text{Loss in weight of solid in liquid}} \times \text{R.D. of liquid}$$

Relative Density of a Liquid Substance by Archimedes' Principle

If a solid is immersed in a liquid or water, it displaces the liquid or water equal to its own volume.

$$\text{R.D.} = \frac{\text{Weight of a liquid displaced by a body}}{\text{Weight of water displaced by the same body}} = \frac{\text{Weight of the body in air} - \text{Weight of the body in liquid}}{\text{Weight of the body in air} - \text{Weight of the body in water}} = \frac{W_1 - W_2}{W_1 - W_3} \quad \text{R.D.} = \frac{W_1 - W_2}{W_1 - W_3}$$

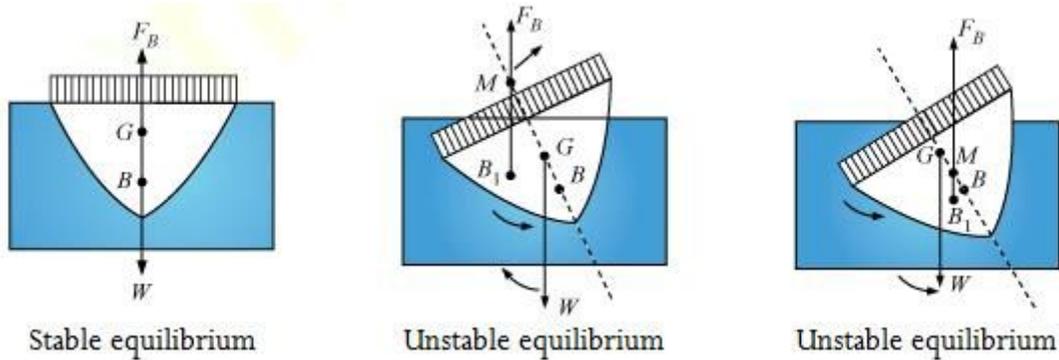
Floatation:



1. When weight of a body is more than buoyant force, the body will drown.
2. When weight of a body is just equal to the weight of fluid displaced, the body will just float.

3. When weight of body is less than fluid displaced, the body will not drown in water. Even if a force is applied on it to drown, it will come up as soon as the force is removed.

Stability of a floating body



Applications of law of floatation:

1. Floatation of iron ship
2. Floatation of fish
3. Floatation of submarine
4. Floatation of balloons
5. Floatation in sea water
6. Floatation of icebergs

Hydrometer— Device used for measuring the densities of liquids directly