Gravitation
Summary

- **Gravitational force** is the force that is responsible for the the invisible *ATTRACTION* between objects with masses.
- **Universal law of gravity:** The force of gravitation between 2 objects is directly proportional to the product of their masses and inversely proportional to the square of the distance between them. This force acts along the line joining the center of the masses of the 2 objects.

$$F = G\frac{Mm}{r^2}$$

where,

G = Gravitational constant

M = Mass of object 1

m = mass of object 2

r = Distance between the objects (Center of mass)

- **Freefall:** Any object under the influence of gravity accelerates. Any relatively small object (with respect to the earth) will freefall with an acceleration, g. It does not depend on mass, as the force of gravity is proportional to the mass of the object, but the reaction of any object under the influence of a force is also proportional to its mass and hence the acceleration under gravity is independent of the mass of the object.

  Acceleration due to gravity,

$$g = G\frac{M}{r^2}$$

- g is an inverse function of radius from the center. Therefore, g reduces as altitude increases and it is also greater at the equator than at the poles, as the earth is not a perfect sphere and rather a sphere with flattened top and bottom.
- **Mass vs Weight: Mass** is an intrinsic property of an object which is a constant whereas **weight** is the force experienced by the object under a gravitational field. Weight is proportional to the mass of the object. Mass of an object remains same everywhere, but its weight changes as g changes.

- **Thrust vs pressure: Thrust** is the force acting on an object perpendicular to the surface whereas **pressure** is the thrust acting per unit area.
- **Pressure in fluids:** Fluids (liquids and gases) exert the same amount of pressure on the container walls.
- **Buoyancy:** The upward force, opposing the gravitational force, experienced by an object inside a fluid is called the buoyant force. If this force is enough to balance the gravitational force, then the object will float or else it will sink.
- **Archimedes' Principle:** The buoyant force experienced by an object when immersed in a fluid is equal to the weight of the fluid displaced by the object.
- **Relative Density:** Density of an object is its mass per unit volume, and relative density of an object is its original density with respect to the density of water.