Class 9th

PHYSICS

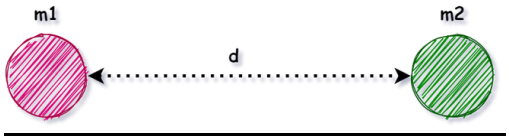
GRAVITATION

Centripetal Force

- A force that acts on a body moving in a circular path and is directed towards the centre around which the body is moving.
- Motion of the moon around the Earth and Motion of Planets around the Sun is due to centripetal force.

Universal Law of Gravitation

- Every object in this universe attracts every other object with a force which is directly proportional to the product of their masses and inversely proportional to the square of distance between them.



$$F = G\frac{m_1 m_2}{r^2}$$

- "G" is called the Universal Gravitational Constant.
- G = 6.67 x 10^{-11} Nm^2/kg^2

Importance of Universal Law of Gravitation

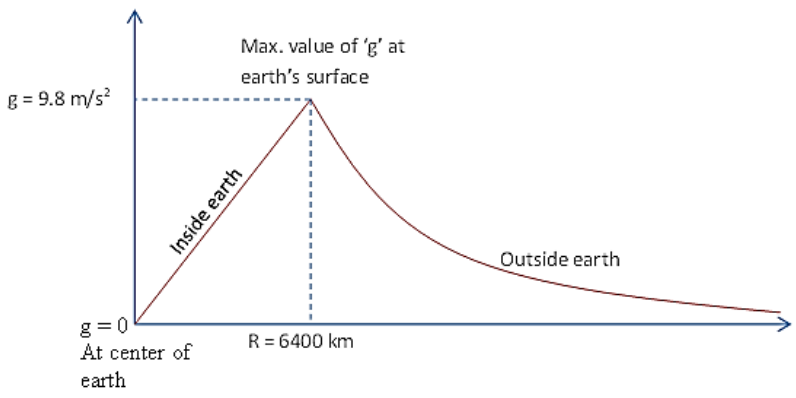
1. Gravitational Force binds us to the earth.
2. It is the reason for the motion of the moon around the earth and planets around the sun.
3. It causes tides due to the moon and the Sun.

Free Fall

- Whenever objects fall towards the earth under gravitational force alone, we say that the objects are in free fall.
- The acceleration of an object under free fall is called **acceleration due to gravity.**
- The acceleration due to gravity is denoted by "g".
- Value of g = 9.8 m/s^2
- Value of "g" is independent of the mass of the object.

Variation of g

- The value of "g" increases as we move from equator to poles.
- The value of "g" decreases as we move above the surface of the earth.



Motion Under Gravity

For solving equations of motion of an object under free fall , replace "a" by "g" and "s" by "h".

$v = u + gt$

$h = ut + \frac{1}{2} gt^2$

$v^2 = u^2 + 2gh$

Kepler's law of Planetary motion:

- **Law of orbits:** According to Kepler's first law, "All the planets revolve around the sun in elliptical orbits having the sun at one of the foci".
- **Law of areas:** The radius vector drawn from the sun to the planet sweeps out equal areas in equal intervals of time".
- **Law of periods:** According to Kepler's law of periods, "The square of the time period of revolution of a planet around the sun in an elliptical orbit is directly proportional to the cube of its semi-major axis".

Mass and Weight

- Mass is the quantity of matter contained in a body. Mass is constant everywhere.
- The force of attraction of the Earth on the object is known as weight of the object. Weight varies from place to place.
- $W = mg$
- Weight of an object on moon = ⅙ x Weight of an object on Earth.

Thrust and Pressure

- The force acting perpendicular to a surface is called thrust.
- The thrust acting per unit area is called pressure.
- Pressure = Force / Area
- Unit of Pressure = Pascal or N/m^2

Buoyant Force

- The upward force exerted by the fluid on an object immersed fully or partially immersed in it is called buoyant force.
- This phenomenon is called buoyancy.

$F_b = \rho gV$

Where:

F_b is the buoyant force

ρ is the density of the fluid

g is the gravitational acceleration

V is the volume of the fluid displaced

Why do objects float and sink in water?

- Object will float if the density of liquid is more than the density of the object.
- Object will sink if the density of liquid is less than the density of the object.

Archimedes Principle

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

- In designing ships and submarines.
- In designing lactometers.
- In designing hydrometers.

Relative Density

It is often convenient to express the density of a substance in comparison with that of water. The relative density of a substance is the ratio of its density to that of water.