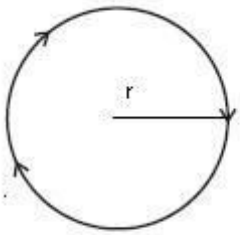
1. Gravitation

- Circular motion: A body is said to be in circular motion when it rotates about a fix point.



speed = v, radius = r,
time to complete 1 rotation = T

$v = 2\pi r/T$

- Uniform circular motion: If the speed of rotation is constant, then the circular motion is uniform.

- **Universal law of Gravitation:**

- Gravitational force of attraction between two masses is directly proportional to the product of their masses and inversely proportional to the square of the distance between them.
  - $F \propto M \times m$ M and m are masses of two bodies.
  - F∝1r2F=GMmr2

$G = 6.673 \times 10^{-11}\ Nm^2\ kg^{-2}$

  - Inverse square law $F \propto \frac{1}{r^2}$
  - Weight is the gravitational force on an object.
  - The weightlessness in outer space happens because the weight of the orbiting body is used to provide the centripetal force required to remain in that particular orbit of rotation. This is the reason why moon doesn't fall down to earth, the gravitational pull of earth on moon is used up in maintaining the centripetal force to keep the moon in its orbit of rotation around the earth

- **Kepler's law of planetary motion**
  - Orbits of planets are elliptical.
  - Planet covers equal area in equal time intervals
  - r3T2=constant

- **Free Fall: A body is said to be free falling if it begins to fall downward towards the earth due to earth's gravity only.**

mg=GMmR2g=GMR2

'g = 9.8 m/s^2' is the acceleration due to gravity, it is the acceleration of a freely falling body.

- **Tips to solve numerical**
  - For upward motion take g = –9.8m/s^2 and final velocity at the highest point as 0.
  - For downward motion take g = 9.8m/s^2 and for a freely falling body take initial velocity as 0.

Equations of motion of an object under the influence of the earth's gravity

for downward motion of the particle

v=u+gts=ut+12gt2v2=u2+2gs

for upward motion of the particle

v=u-gts=ut-12gt2v2=u2-2gs

- **Mass:** It is the amount of matter contained in the body
- **Weight:** It is the force exerted on a body due to the gravitational pull of another body such as the earth, the sun etc.

$$\frac{\text{Weight of the object on the moon}}{\text{Weight of the object on the earth}} = \frac{1}{6}$$

1. Orbital velocity

(i) The velocity of a body in its circular path is known as orbital velocity.

(ii) $v_o = \sqrt{\frac{GM_e}{R}} = \sqrt{Rg}$

2. Escape velocity

(i) The minimum velocity required to project a body to escape from the earth's gravitational field is known as escape velocity.

(ii) $v_e = \sqrt{\frac{2GM_e}{R}} = \sqrt{2Rg}$

(iii) $v_e = \sqrt{2}v_o$

(iv) Escape velocity of earth is 11.2 kms^{-1}.