

1

Motion

- An object is said to be in motion if it changes its position with the passage of time.
- Rest and motion are relative terms.
- **Scalar Quantity**: A physical quantity defined by its magnitude only.
- **Vector Quantity**: A physical quantity that is defined by its magnitude as well as direction.

2

Distance & Displacement

Distance: The length of the actual path between initial and final positions of a moving object.

- Scalar quantity.
- S.I. unit: metre (m).

Displacement: The shortest distance between the initial position and the final position of the particle.

- Vector quantity.
- S.I. unit: metre (m).

3

Speed

Speed: The distance travelled by a particle per unit time is called speed.

$$\text{Speed} = \frac{\text{Distance}}{\text{time}} \quad \cdot \text{Scalar quantity.} \quad \cdot \text{S.I. unit: metre/second (m/s)}$$

Average speed: The ratio of the total distance travelled by the object to the total time taken.

$$\text{Average speed} = \frac{\text{Total distance travelled}}{\text{Total time taken}}$$

4

Velocity

Velocity: The rate of change of displacement is called velocity.

$$\text{Velocity} = \frac{\text{Displacement}}{\text{time}} \quad \cdot \text{Vector quantity.} \quad \cdot \text{S.I. unit: metre/second (m/s)}$$

Average velocity: It is the ratio of total displacement to the total time taken.

$$\text{Average velocity} = \frac{\text{Total displacement}}{\text{Total time taken}}$$

5

Acceleration

Acceleration : The rate of change of velocity of a moving body with time is called acceleration.

$$\text{Acceleration} = \frac{\text{Change in velocity}}{\text{Time taken for change}} \quad a = \frac{v - u}{t}$$

- In SI system : m/s^2 or ms^{-2} , In CGS system : cm/s^2 or cms^{-2}

6

Equations of uniformly accelerated motion

(i) First equation of motion

$$v = u + at$$

(ii) Second equation of motion

$$s = ut + \frac{1}{2} at^2$$

(iii) Third equation of motion

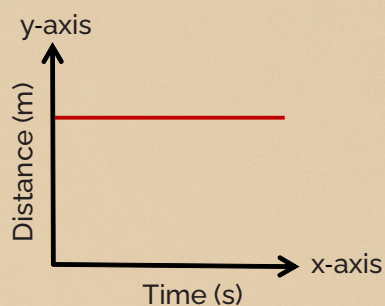
$$v^2 = u^2 + 2as$$

7

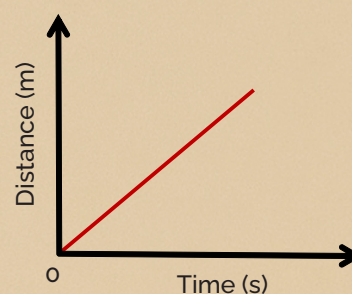
Graphical Representation of Motion

Distance/displacement–time graph

(i) When the body is at rest



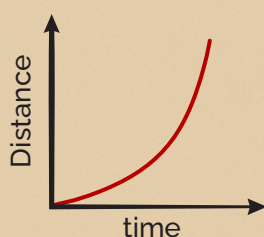
(ii) When the body is in uniform motion



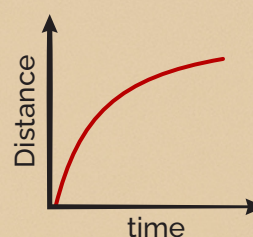
The slope of the distance-time graph gives the speed of the body. The slope of the displacement-time graph gives the velocity of the body.

In a distance-time graph, more the slope of the graph of an object in motion, more will be its speed and vice-versa.

(iii) When the body is in non-uniform motion



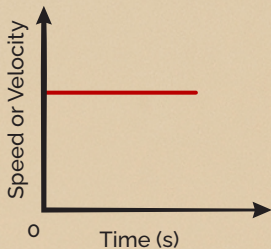
s-t graph of an accelerated motion
(speed increasing with time)



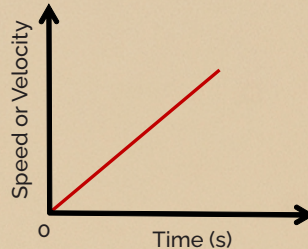
s-t graph of a retarded motion
(speed decreasing with time)

Speed/Velocity-time graph

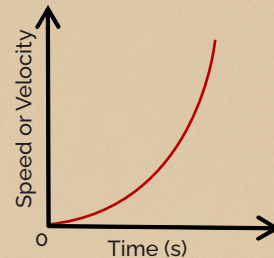
(i) When the body is in uniform motion



(ii) When the body is moving with a uniform acceleration.



(iii) When the body is moving with a non-uniform acceleration.

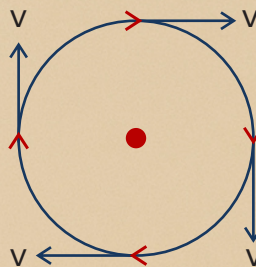


- (i) The slope of the speed/velocity-time graph gives the acceleration of the body.
- (ii) Area enclosed under a speed-time graph or velocity time graph gives the distance covered by the body.

Circular Motion

Circular Motion

- When a particle moves along a circular path, its motion is called 'circular motion'.



Circular motion of a particle

- Circular motion is always accelerated motion. The direction of velocity of the particle changes continuously due to the change in the direction of motion.
- If a particle takes t seconds to go one around the circular path of radius r , the speed is given by

$$v = \frac{2\pi r}{t}$$