CLASS IX
PHYSICS
CHAPTER 6 - MOTION

NOTES

Reference Point : It is a fixed point needed to describe the position of an object relative to it.

- The position of an object is described by stating
  - a fixed reference point called the origin (o)
  - its distance from the reference point
  - its direction from the reference point
- If a body does not change its position with time w.r.t. some fixed reference point in its surrounding it is said to be at rest.
- If the body changes its position with time w.r.t. some fixed reference point in its surrounding it is said to be in motion.
- Motion of a body along a straight line is the simplest type of motion.

Scalar Quantities : These are quantities that have magnitudes only but require no direction to specify it. Examples are distance travelled and speed.

- **Vector quantities:** These are quantities that have magnitudes as well as directions and obey the "Vector Addition Rules". Examples are displacement and velocity.
- The actual length of the path covered by a moving body is the distance travelled by it. It is always positive. It is a scalar quantity.
- The change in position of a body as it moves from one position (initial) to another (final) position is called its displacement. It may be positive, negative or zero. It is a vector quantity.

Uniform motion : The motion of a body is said to be uniform if it covers equal distances in equal intervals of time e.g. Motion of the hands of a clock.

Non-uniform motion : The motion of a body is said to be non-uniform if it covers unequal distances in equal intervals of time e.g. Almost all types of motion of bodies around us.

- **Speed (v) :** Distance travelled by a body per unit time is called speed. Mathematically, it is defined as follows:

$$v = \frac{s}{t}$$

where s is the distance travelled and t is the time. The S.I unit of speed is ms^{-1}. It is a scalar quantity.

- **Velocity ($\vec{v}$) :** Displacement of a body per unit time is called velocity. Mathematically, it is defined as follows:

$$\vec{v} = \frac{\vec{s}}{t}$$

where $\vec{s}$ is the displacement and t is the time. The S.I unit of velocity is ms^{-1}. It is a vector quantity.

- **Acceleration ($\vec{a}$) :** It is the rate of change of velocity of a body. Mathematically, it is defined as follows:

$$\vec{a} = \frac{\vec{v} - \vec{u}}{t}$$

where $\vec{u}$ is the initial velocity, $\vec{v}$ is the final velocity and t is the time interval. The S.I unit of acceleration is ms^{-2}. It is a vector quantity.

- Positive acceleration occurs when $\vec{v} > \vec{u}$ whereas negative acceleration occurs when $\vec{u} > \vec{v}$.
- **Uniformly accelerated motion :** When a body moves in a circular path of fixed radius without changing the magnitude of its velocity, it is also said to be in uniformly accelerated motion. When the velocity of a body travelling along a straight line increases or decreases by equal amounts in equal intervals of time, then it is said to be a uniformly accelerated motion. For example, a freely falling body.
- **Non-uniformly accelerated motion :** When the velocity of a body travelling along a straight line increases or decreases by unequal amounts in equal intervals of time, then it is said to be a non-uniformly accelerated motion. For example, a car moving in a crowded road.

- **Distance-time graph**: It is a graph that shows the variation of distance with time. Slope of the distance time graph gives the speed. Different types of distance- time graphs are shown below.

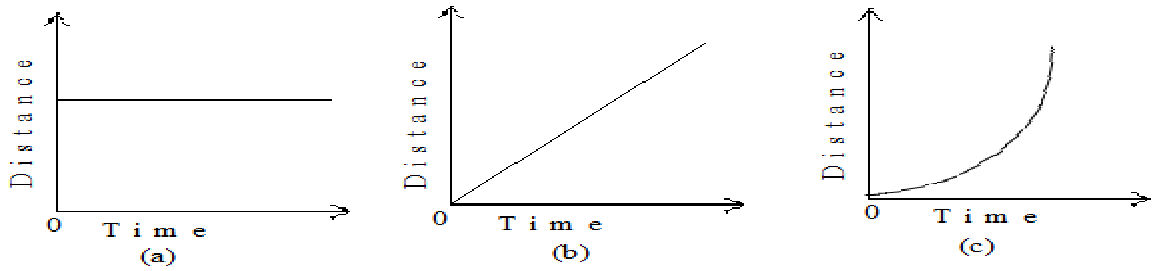

Fig. Distance-time graphs for

(a) a body at rest

(b) a body moving with uniform speed

(c) a non-uniform motion

- **Velocity-time graph :** It is a graph that shows the variation of velocity with time. Area under the velocity-time graph gives the magnitude of the displacement. Different types of Velocity-time graphs are shown below.

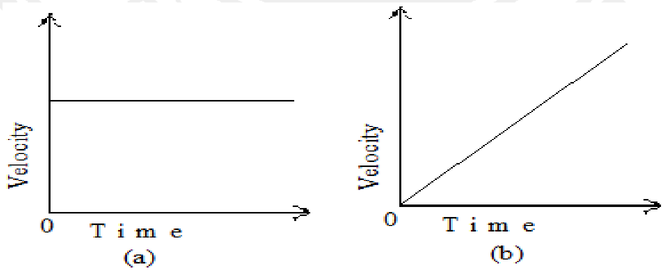

Fig. 6.2

Fig. Velocity-time graph for

(a) a body moving with uniform motion

(c) a uniformly accelerated motion

- **Equations of motion for a uniformly accelerated motion**

$$v = u + a\,t$$

$$s = u\,t + \frac{1}{2}\,at^2$$

$$v^2 = u^2 + 2\,a\,s$$

Where u = magnitude of initial velocity, v = magnitude of final velocity, a = magnitude of acceleration, s = magnitude of displacement and t is the time.

- **Uniform circular motion :** It is the motion of a body along a circular path with a constant speed. The direction of the body changes at every point along the circular path. Therefore, there is change in the velocity and hence is a uniformly accelerated motion.