MOTION

INTRODUCTION

When a body does not change its position with time, we can say that the body is at **rest**, while if a body changes its position with time, it is said to be in **motion**.

- An object is said to be a **point object** if it changes its position by distances which are much greater than its size.
- A point or some stationary object with respect to which a body continuously changes its position in the state of motion is known as **origin** or **reference point**.

TYPES OF MOTION

According to Directions

- **One dimensional motion** is the motion of a particle moving along a straight line.
- **Two dimensional motion** A particle moving along a curved path in a plane has 2-dimensional motion.
- **Three dimensional motion** Particle moving randomly in space has 3-dimensional motion.

According to state of motion

Uniform Motion

- A body is said to be in a state of uniform motion if it travels equal distances in equal intervals of time.
- If the time distance graph is a straight line the motion is said to be uniform motion.

Non-uniform motion

- A body has a non-uniform motion if it travels unequal distances in equal intervals of time. **Ex.** a freely falling body.
- Time - distance graph for a body with non-uniform motion is a curved line.

TERMS USED TO DEFINE MOTION

(i) Distance and displacement
(ii) Speed and velocity
(iii) Acceleration

(i) Distance & Displacement

- The path length between the initial and final positions of the particle gives the **distance** covered by the particle.
- The minimum distance between the initial and final positions of a body during that time interval is called **displacement**
- Distance and displacement both are measured in *meter* in m.k.s. system.

Difference between distance and displacement

- Distance travelled is a scalar quantity while displacement is a vector quantity.
- When a body continuously moves in the same straight line and in the same direction then displacement will be equal to the distance travelled. But if the body changes its direction while moving, then the displacement is smaller than the distance travelled.

  $\boxed{\text{Displacement} \leq \text{Distance}}$

- Displacement in any interval of time may be zero, positive or negative where as distance cannot be negative..

Ex.1 A person travels a distance of 5 m towards east, then 4 m towards north and then 2 m towards west.

(i) Calculate the total distance travelled.

(ii) Calculate the resultant displacement.

Sol. (i) Total distance travelled by the person

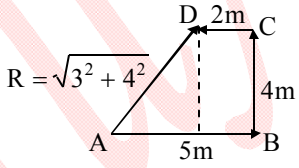
$= 5\text{ m} + 4\text{ m} + 2\text{ m} = 11\text{ m}$

(ii) To calculate the resultant displacement, we choose a convenient scale, where 1 cm represents 1 m. We draw a 5 cm long line AB towards east and then 4 cm long line BC towards north. Finally, a 2 cm long line CD towards west. The resultant displacement is calculated by joining the initial position A to the final position D. We measure AB = 5 cm.

Since 1 cm = 1 m

$\therefore$ 5 cm = 5 m

Hence, the displacement of the person = 5m towards AD.

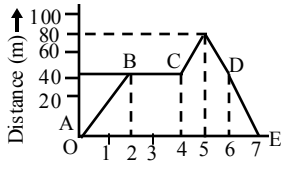


Ex.2 A body is moving in a straight line. Its distances from origin are shown with time in Fig. A, B, C, D and E represent different parts of its motion. Find the following :

(i) Displacement of the body in first 2 seconds.

(ii) Total distance travelled in 7 seconds.

(iii) Displacement in 7 seconds



Displacement-time graph

Sol. (i) Displacement of the body in first 2s = 40m

(ii) From t = 0 to t = 7 s, the body has moved a distance of 80 m from origin and it has again come back to origin. Therefore, the total distance covered = 80 × 2 = 160 m

(iii) Since the body has come back to its initial position, the displacement is zero.