Distance and Displacement.

(1) **Distance:** It is the actual path length covered by a moving particle in a given interval of time.

(i) If a particle starts from A and reach to C through point B as shown in the figure.

Then distance travelled by particle = AB + BC = 7 m

(ii) Distance is a scalar quantity.

- (iii) Dimension: [M⁰L¹T⁰]
- (iv) Unit: meter (S.I.)



(2) **Displacement:** Displacement is the change in position vector i.e., a vector joining initial to final position.

- (i) Displacement is a vector quantity
- (ii) Dimension: $[M^0L^1T^0]$
- (iii) Unit: meter (S.I.)

(iv) In the above figure the displacement of the particle $\overrightarrow{AC} = \overrightarrow{AB} + \overrightarrow{BC}$

 $\Rightarrow |AC| = \sqrt{(AB)^2 + (BC)^2 + 2(AB)(BC)\cos 90^\circ} = 5m$

(v) If $\vec{S}_1, \vec{S}_2, \vec{S}_3, \dots, \vec{S}_n$ are the displacements of a body then the total (net) displacement is the vector sum of the individuals. $\vec{S} = \vec{S}_1 + \vec{S}_2 + \vec{S}_3 + \dots + \vec{S}_n$

(3) Comparison between distance and displacement:

(i) The magnitude of displacement is equal to minimum possible distance between two positions.

- So distance \geq |Displacement|.
- (ii) For a moving particle distance can never be negative or zero while displacement can be.

(Zero displacement means that body after motion has come back to initial position)

i.e., Distance > 0 but Displacement > = or < 0

(iii) For motion between two points displacement is single valued while distance depends on actual path and so can have many values.

(iv) For a moving particle distance can never decrease with time while displacement can. Decrease in displacement with time means body is moving towards the initial position. (v) In general magnitude of displacement is not equal to distance. However, it can be so if the motion is along a straight line without change in direction.

(vi) If \vec{r}_A and \vec{r}_B are the position vectors of particle initially and finally.

Then displacement of the particle

$$\vec{r}_{AB} = \vec{r}_B - \vec{r}_A$$



And s is the distance travelled if the particle has gone through the path APB.