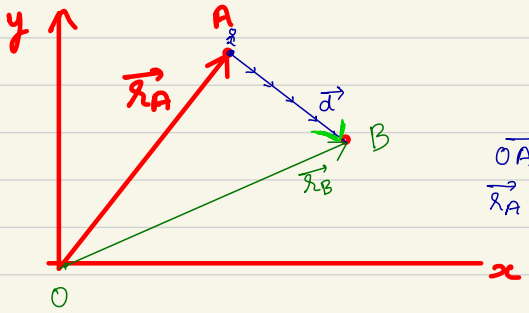

phy

Motion

If a body changes its position with time, it is said to be moving else it is at rest. Motion is always relative to the observer.



$\vec{OA} + \vec{AB} = \vec{OB}$

$\vec{r}_A + \vec{AB} = \vec{r}_B$

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

↓ displacement vector

$\vec{r}_f - \vec{r}_i$ = change in position vector

= **displacement**

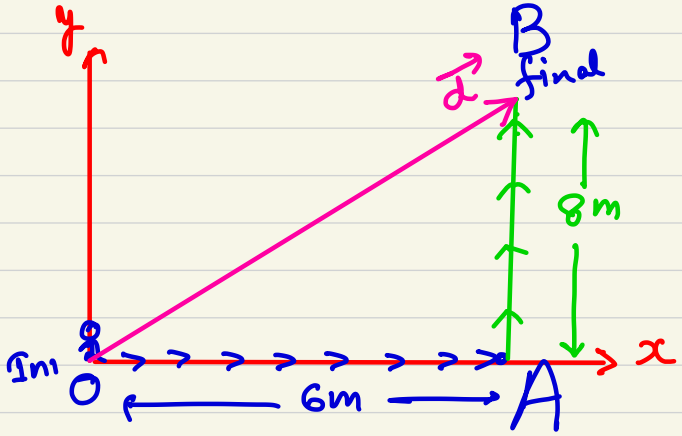
$\vec{r}_B - \vec{r}_A = \vec{d}$ = position vector of B wrt A

P.V. of Q wrt P = $\vec{r}$

DISTANCE AND DISPLACEMENT

Distance ⟶ Actual path travel by particle.

Q # A particle start motion from origin via path O ⟶ A ⟶ B as shown in daigram



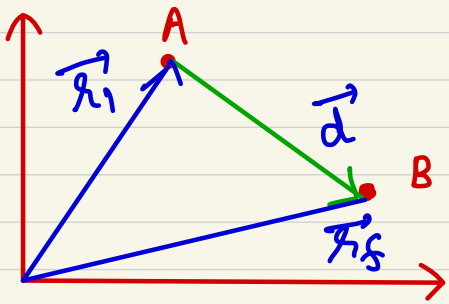
distance = 6+8 = 14 m

displacement = $6\hat{i} + 8\hat{j} = \vec{d}$

$|\vec{d}| = \sqrt{6^2+8^2} = 10$

Displacement

- Vector ✓
- Change in position of particle ✓
- $\vec{d} = \vec{r}_f - \vec{r}_i$
- Shortest distance ..... ✓
- St. line connecting b/w A to B

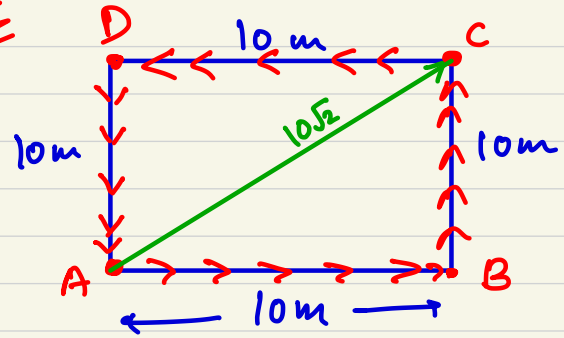


- Independent from path

* |displacement| ≤ distance

Q A particle is moving on square of length 10m along $A \to B \to C \to D \to A$

Sol



	distance	|Displacement|
$A \to B$	10	10
$A \to B \to C$	$10+10 = 20$	$10\sqrt{2}$
$A \to B \to C \to D$	$10+10+10 = 30$	10
$A \to B \to C \to D \to E$	40	0

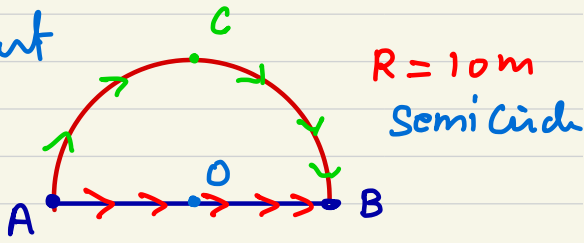
$$|\text{displacement}| \leq \text{distance}$$

Particle move from 'A' to 'B' in two different

Q. . path.

①

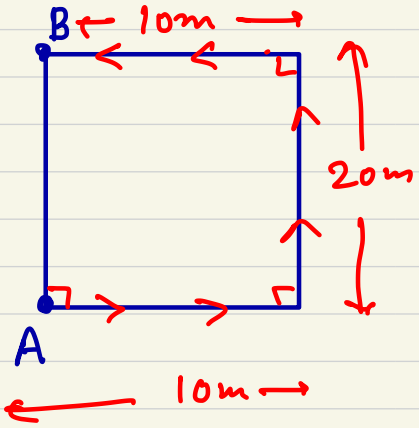
	Distance	Displacement
A → B directly	2R = 20	20
A → C → B	πR	20



②

distance = 10 + 20 + 10
= 40

displacent = 20



Rectangle

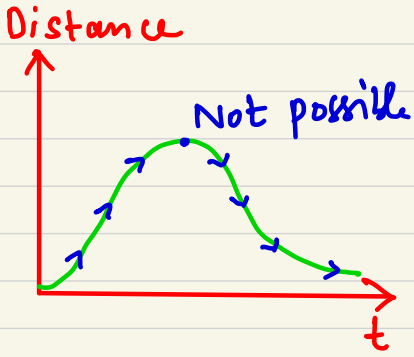
- Distance is a scalar while displacement is a vector.
- Distance depends on path while displacement is independent of path but depends only on final and initial position.
- For a moving body, distance can't have zero or negative values but displacement may be +ive, –ive or zero.
- For a moving/stationary object distance can't be decreasing.
- If motion is in straight line without change in direction then
  distance = |displacement| i.e. magnitude of displacement.
- Magnitude of displacement may be equal or less than distance but never greater than distance.
  distance $\geq$ |displacement|

Displacement in terms of position vector

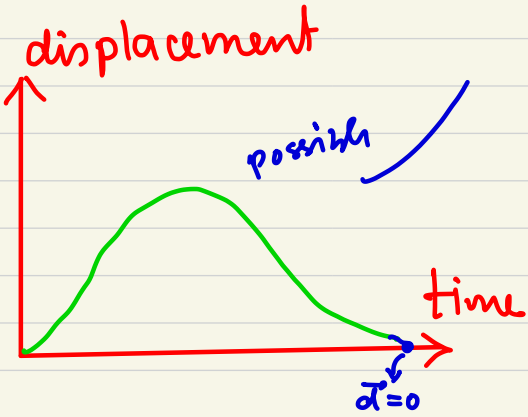
distance ≥ 0

Which of the following graph is not possible

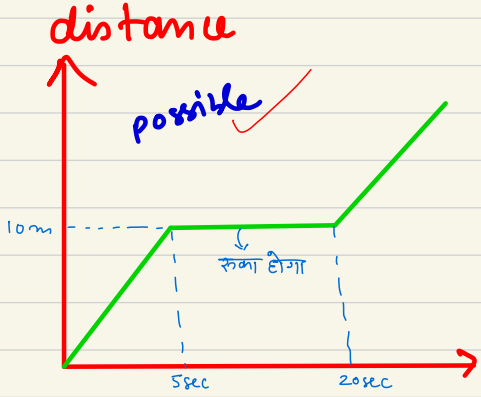
(1)



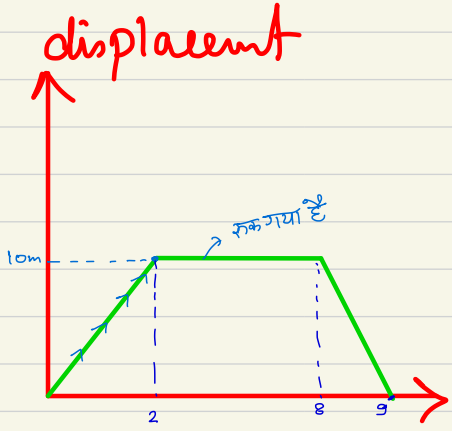
(2)



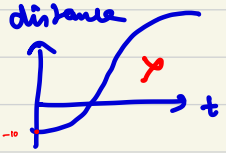
(3)

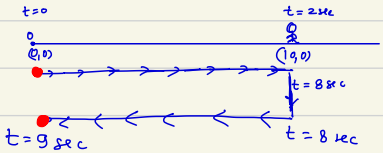


(4)



(5)

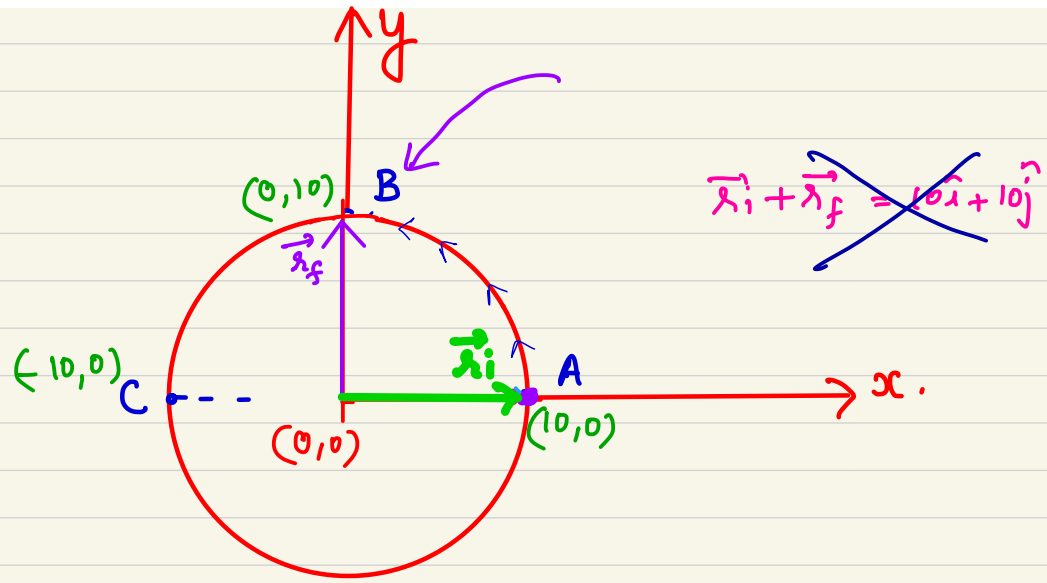




displacement = 0 ($t=0 \rightarrow t=9$ sec)

distance = $10 + 0 + 10 = 20$

x. A particle goes along a quadrant from A to B of a circle radius 10m as shown in fig. Find the direction and magnitude of displacement and distance along path AB.



(1)

$A \to B$, distance $= \frac{2\pi R}{4}$

displacement $= AB = R\sqrt{2}$

$\vec{d} = \vec{r}_f - \vec{r}_i$

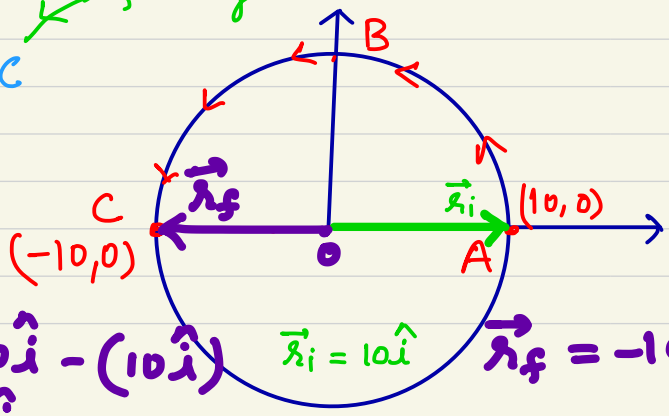
$= 10\hat{j} - 10\hat{i}$

(2)

finally

$A \to B \to C$

distance $= \pi R$



displacement $= -10\hat{i} - (10\hat{i})$

$= -20\hat{i}$