ARJUNA NEET BATCH

KINEMATICS

LECTURE - 01

Today's Goal

- Introduction of Kinematics
- frame of reference
- Distance & displacement
- MOKSH

MECHANICS STUDY OF MOTION

KINEMATICS

- **Study of motion without knowing the cause** of motion

speed / distⁿ / disp / velocity

DYNAMICS → Newton Law of Motion

- **Study of cause of motion**

Ex - Inertia/ Force

9th class

Frame of reference – A place from where we take observation

Position – Location of object w.r.t Frame

WHAT IS REST or MOTION ?

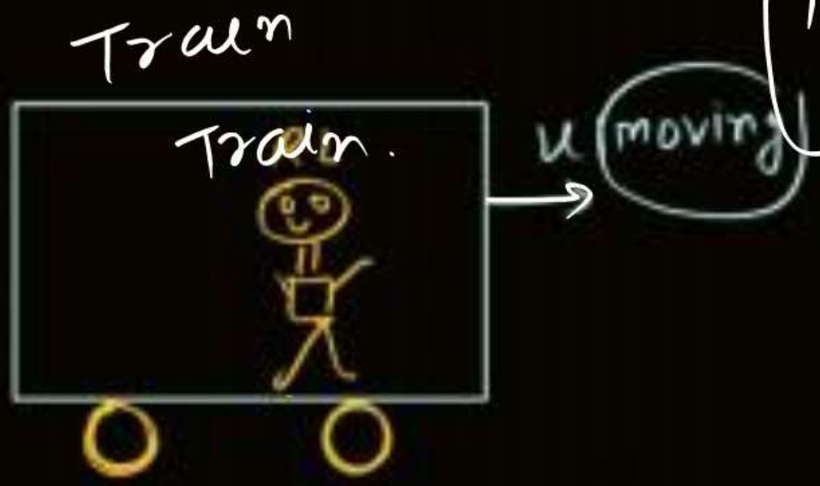
Position

fixed

change

- A body is said to be at rest when there is no change of position with respect to time.
- Motion is change of position with respect to time.

Frame of reference ⇒ A Place from where we take observation / A Person who is taking observation



Train is at rest w.r.t Ramlal

"KOTA is in motion w.r.t Ramlal or Train"

Tree is in motion w.r.t Ramlal or Train.

KOTA is at rest w.r.t Kallu

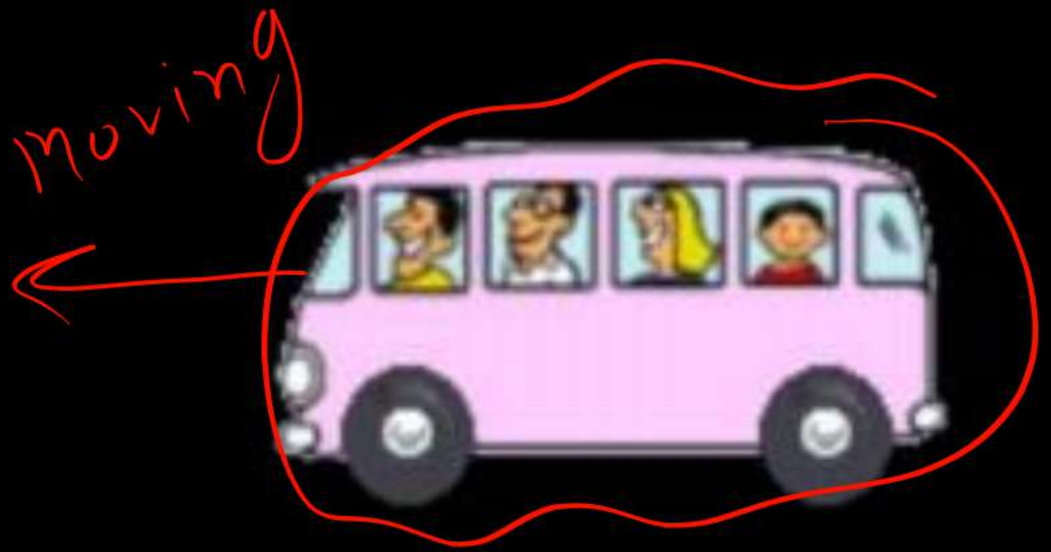
Frame of reference

- Frame of ref^{n} always assume to be at rest.

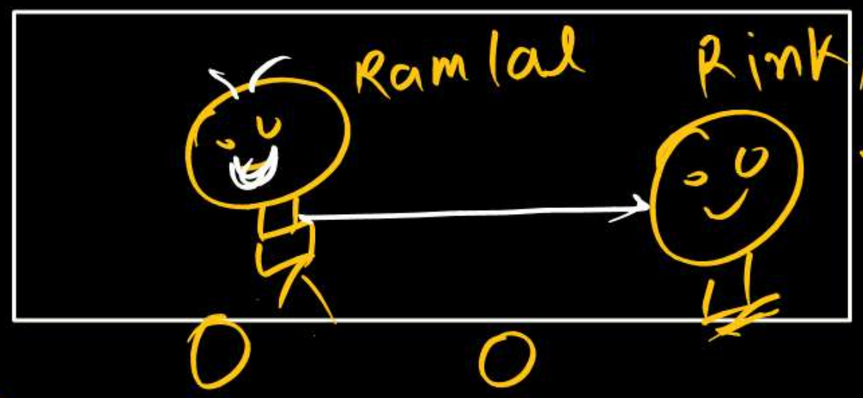
Are The Passengers In The Bus At Rest Or In Motion??

Passengers In The Bus Are At Rest Relative To Each Other.....

Passengers In The Bus Are In Motion Relative To People At Bus Stop



Pinky is in motion or at rest ??



Pinky is at rest w.r.t Ramlal

Pinky is in motion w.r.t Kallu

REST & MOTION ARE RELATIVE TERMS

- Motion of an object is always with respect to some frame of reference.

One frame of reference

Another frame of reference

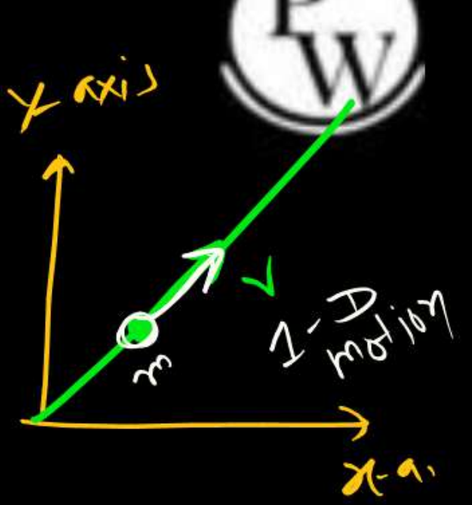
Let us see how the states of motion and rest are related....

- Rest and motion are relative terms. They are not absolute. A body can be at rest or in motion with respect to reference frame.
- There is no object in Universe which is perfectly at rest.
- A man in a moving train is at rest with respect to a co-passenger, but he is in motion with respect to a man outside the train.

MOTION IN ONE DIMENSION

Types of Motion :

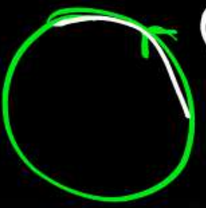
- Motion in a straight line



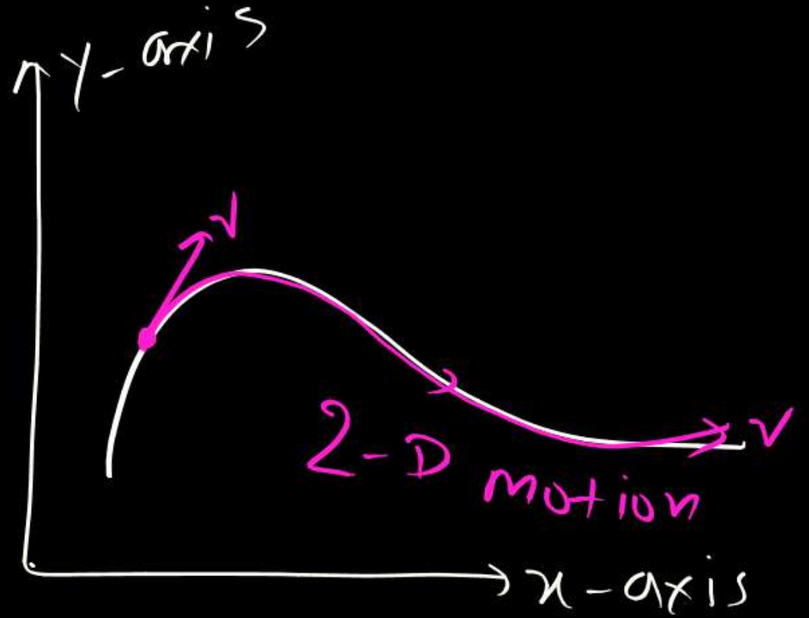
- Motion in two dimensions
  - Motion in a plane.

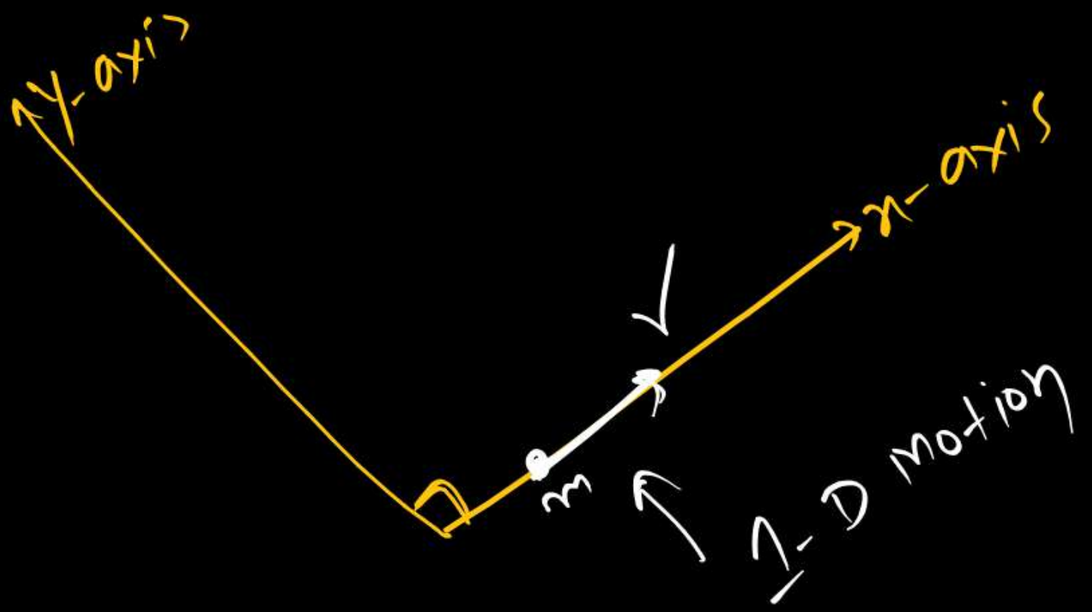
Ex- Circular motion (2-D)

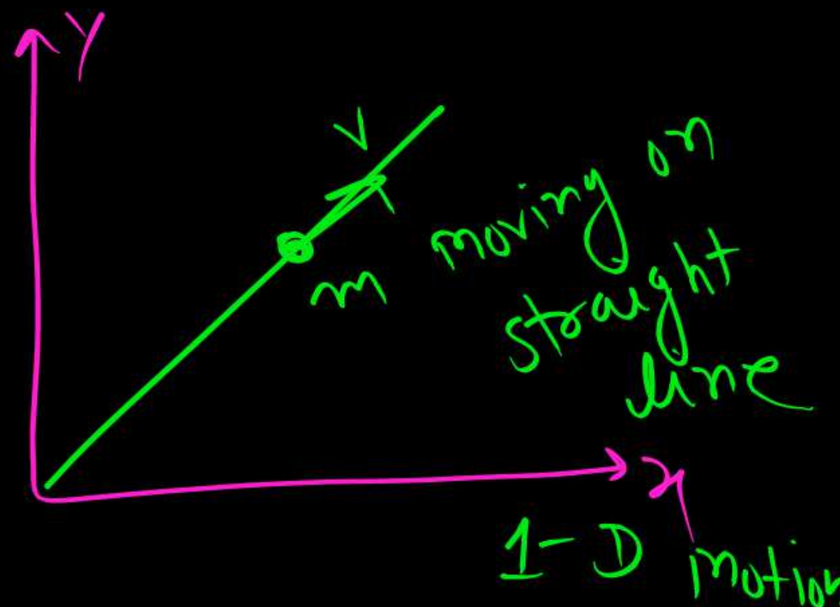
Projectile Motion

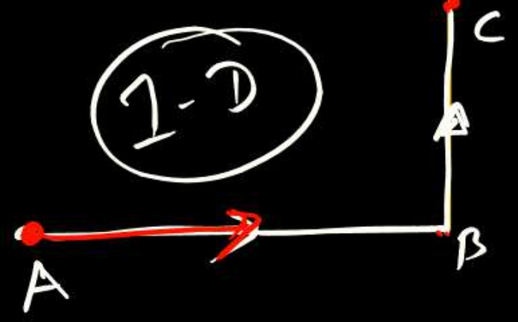


- Motion in three dimensions
  - Motion in a space.....


Y-axis
v
2-D motion
v
x-axis


Y-axis
x-axis
v
m
1-D motion


Y
v
m moving on straight line
X
1-D motion



Rectilinear motion need not be one dimensional necessarily.

Rectilinear motion can be any straight line in any direction

But, it is always possible that rectilinear motion be treated as one dimensional motion

Distance

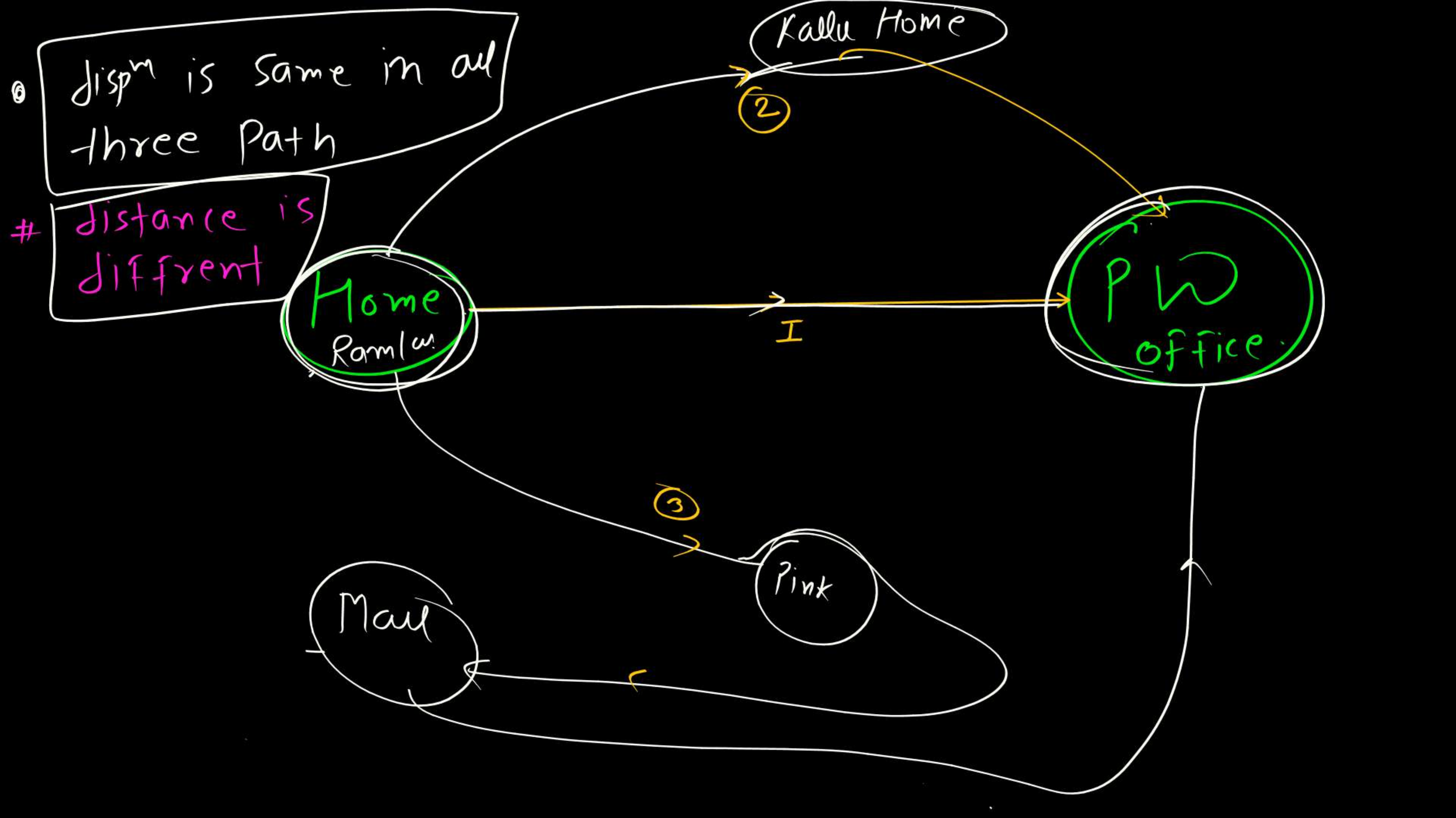
How far

- Total Path length.
- distance depend's upon Path taken.
- distance can't decrease with time.
- dist^n is Scalar
- dist^n is always +ve.

Displacement

How far & where

- Shotest length b/w initial and final Position.
- Length of straight line b/w initial & final Position.
- disp^m does not depends upon Path taken only depends upon initial and final Position.
- disp^m can decrease.
- disp^m may be +ve, -ve & zero


@ dispm is same in all three Path
# distance is diffrent
Kallu Home
2
Home
Ramlal
I
PW
office
3
Pintu
Mail

$|disp^m|_{compt\ life} = zero$ *

$|dist^n|_{compt\ life} = \underline{infinite}$

PATH LENGTH AND DISPLACEMENT

Path length :

Total distance travelled by an object from initial to final position.

Displacement :

Shortest distance between initial and final position.

HOME (H)

Ram Lal

COLLEGE (C)

(M)

$\therefore$ disp

Path length = $D_{HC} + D_{CM}$

Displacement = D_{HM}

PATH LENGTH = DISPLACEMENT

Ram lal is moving without change in direction

H

Initial position

Ram lal.

M

Final position

Ram lal is moving without change in direction

$$\text{Path length} = D_{HM}$$

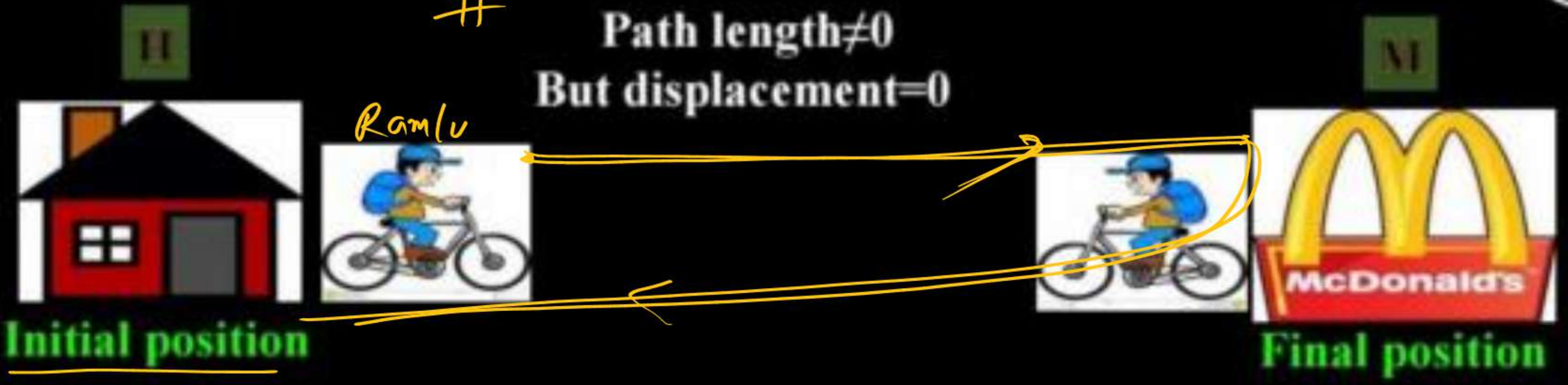
$$\text{Displacement} = D_{HM}$$

$$\text{Path length} = \text{displacement}$$

#

Path length≠0

But displacement=0

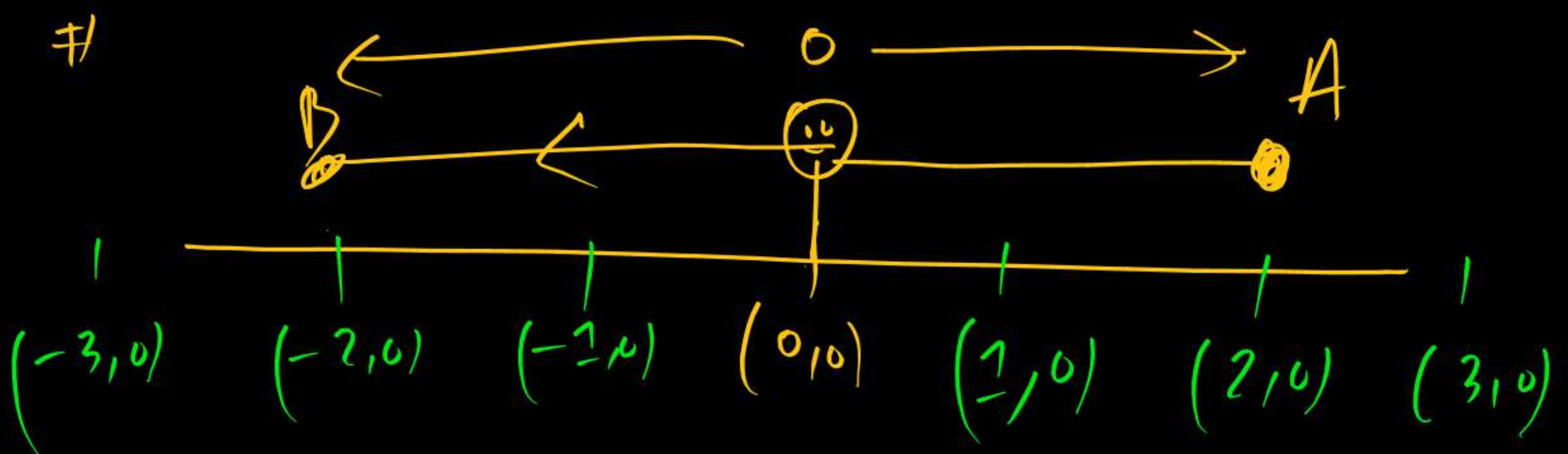


→ Path length = $D_{HM} + D_{MH}$

Displacement = 0

" Initial and final Position of Ramlal is Same"

Initial and final Position of Ramlal is Same.
then displ^{n} becn zero.



dist^n = कितना चला (Path का length)

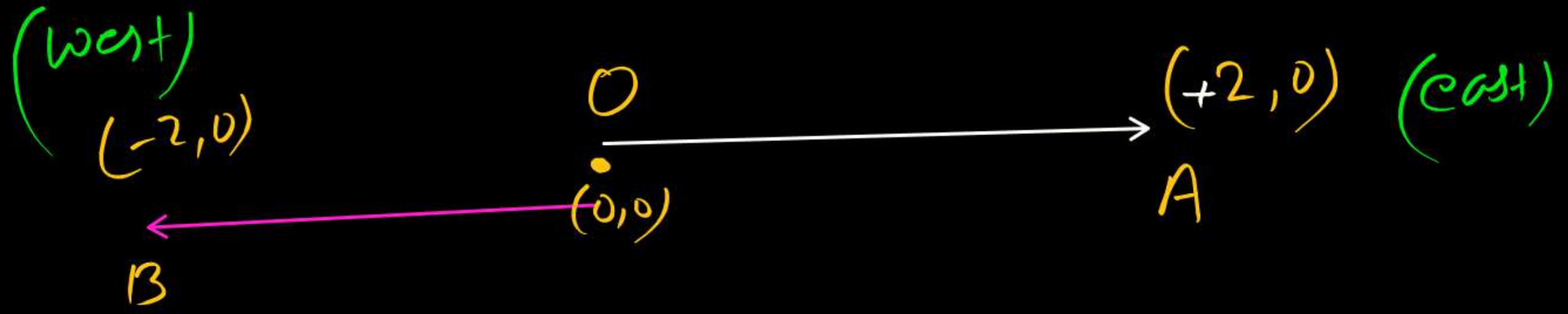
distance is always +ve

$\begin{bmatrix} O \to A \\ O \to B \end{bmatrix}$ ⟶ dist^n = 2m

disp^m is diff^n in both case because Final Position is diff^n

O → A ⇒ +ve 2m

O → B = -2m



distance does not have direction (scalar) does not have dirⁿ.

displacment have direction. (vector) ⇓ which have direction

- **The magnitude of displacement may or may not be equal to the path length travelled by an object.**

- **The magnitude of the displacement for a complete motion may be zero but the corresponding path length is not zero.**

Q

Correct statement among the following is...

(a) When displacement is zero, distance travelled is not zero. ✗

(b) When displacement is zero, distance travelled is also zero. ✗

(c) When distance is zero, displacement is not zero. ✗

(d) Distance travelled and displacement are always equal. ✗

Not moving

(A)

$disp^m = 0$

$disp^r = 0$

(C)

$disp^n = 0$

object चला ही नहीं गा

The numerical ratio of displacement to distance is...

(a) always less than 1 (b) always greater than 1

(c) always equal to 1 (d) may be less than 1 or equal to 1

$$\frac{\text{disp}^n}{\text{dist}^n} \leq 1$$

Case-1 ⟶ Object is moving without change in dirⁿ.

$$\text{dist}^n = |\text{disp}^m|$$

Case-2 ⟶⟵ Object is moving with change in direction.

$$\text{dist}^n > |\text{disp}^m|$$

$|\text{disp}^m| = \text{dist}^n$ Never Possible

The total distance travelled by an object from initial to final position is known as ...

(a) speed

(b) path length

(c) displacement

(d) distance

Which of the following option is correct for motion in 1-D .

(A) distance = | disp^{m} |

(B) distance > | disp^{m} |

(C) distance ≥ | disp^{m} |

(D) distance < | disp^{m} |

A ⟶ Wrong

direction may change

(B) → wrong

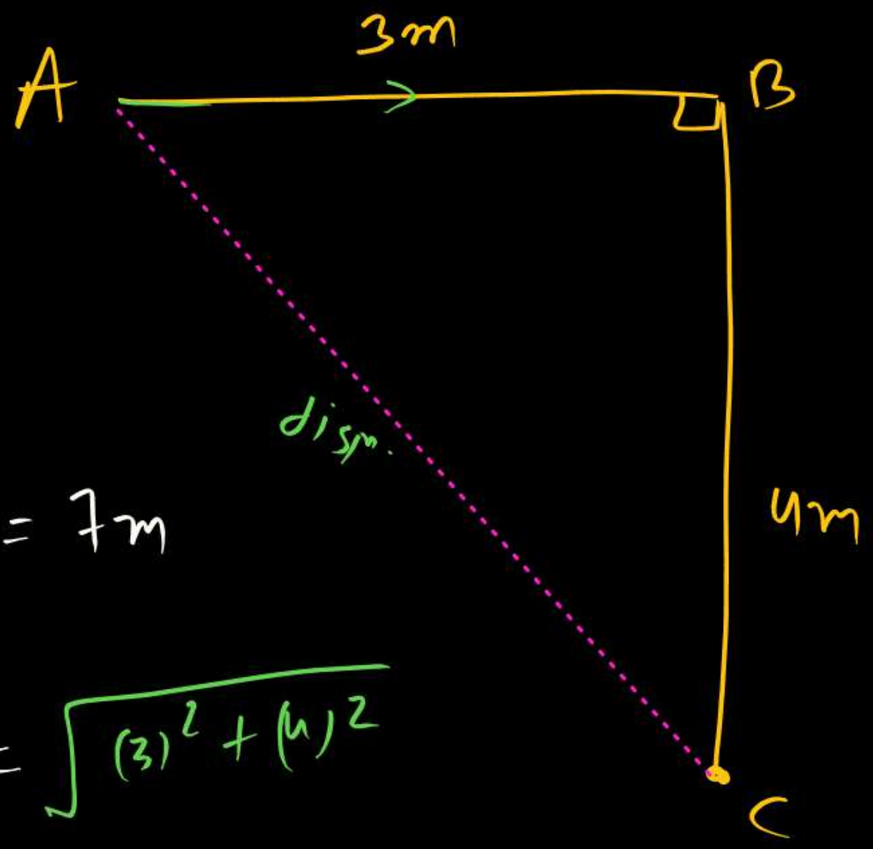
When dir^{n} must be changing

(C) Correct

becaus in 1-D information of direction is not given in question.

Object is moving in 1-D with change in direction.

$\Longrightarrow$ $dist^n = |disp^m|$

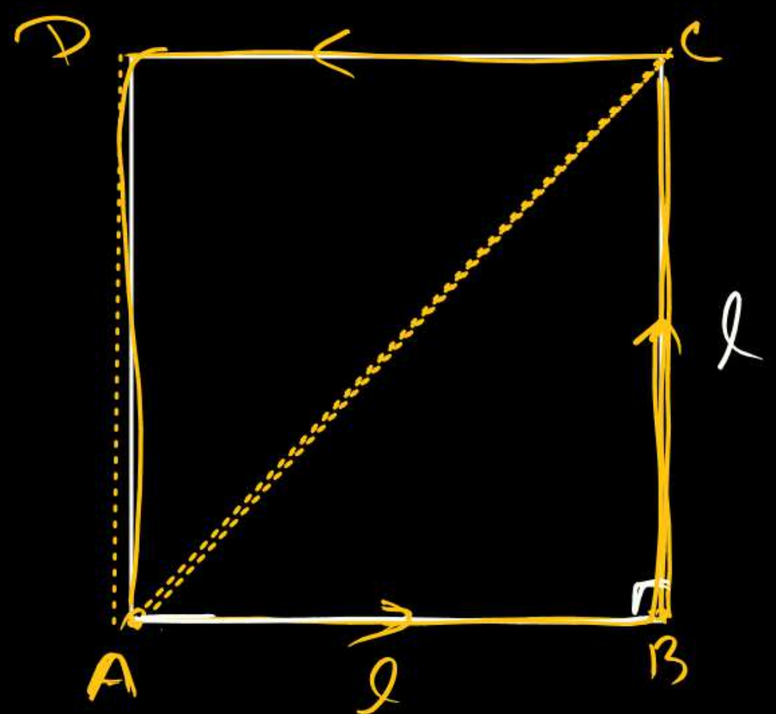


$dist^n = 7m$

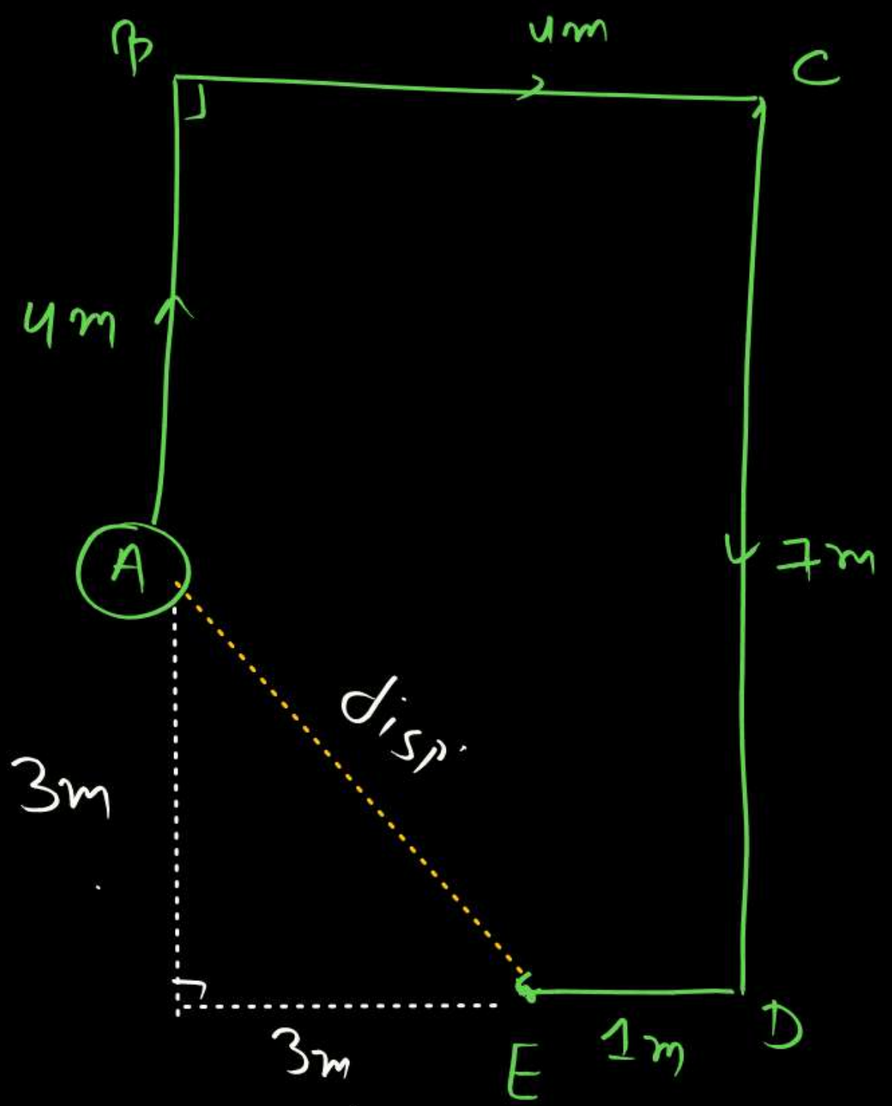
$|disp^{ment}| = \sqrt{(3)^2 + (4)^2}$

$= 5m$

Ram lal is Moving on Square Park.



Motion	distⁿ	|Dispⁿ|
$A \rightarrow B$	l	l
$A \rightarrow C$	$2l$	$\sqrt{2}l$
$A \rightarrow D$	$3l$	l
$A \rightarrow B \rightarrow C \rightarrow D \rightarrow A$ ↵	$4l$	0



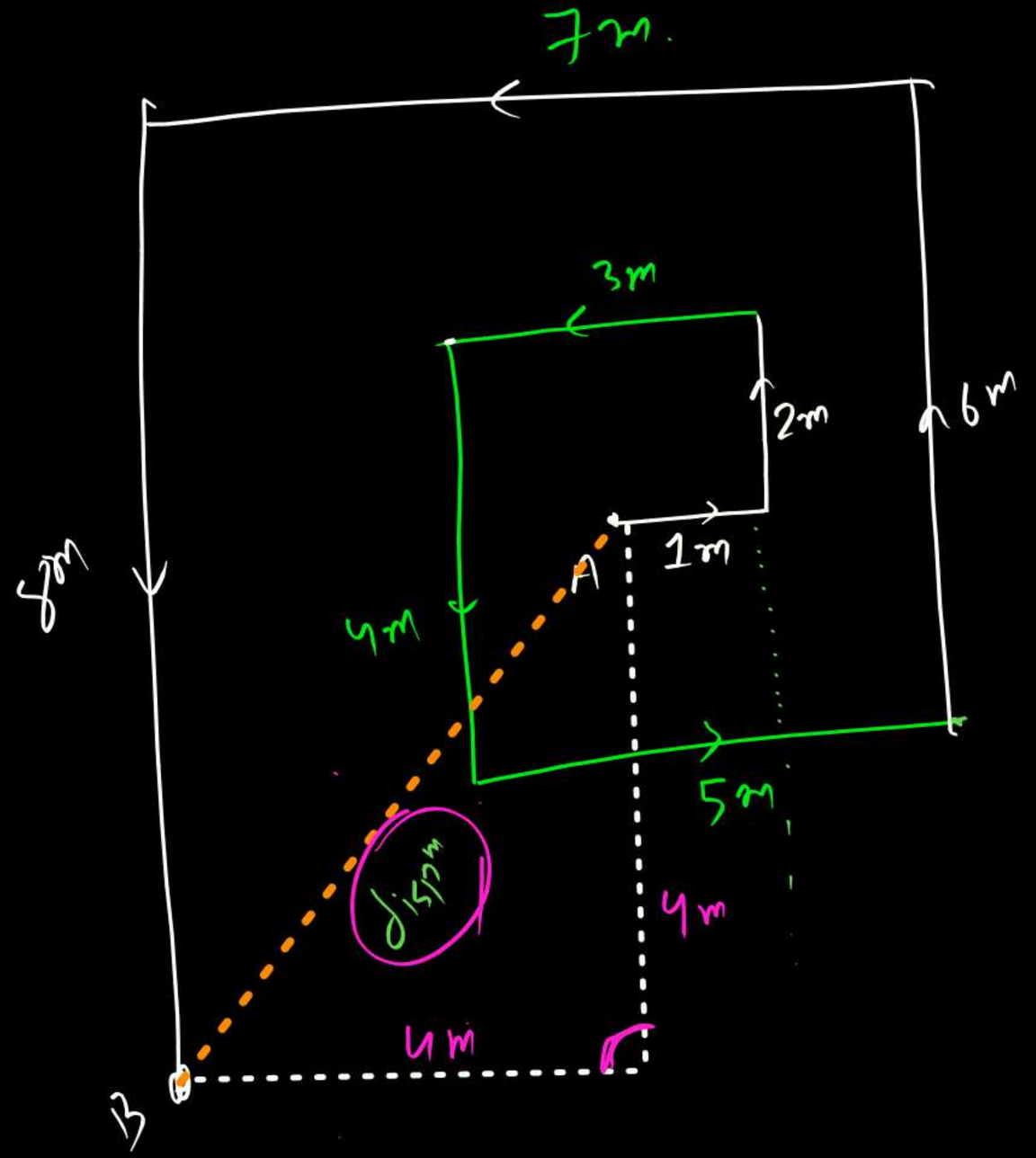
$$\text{dist}^n = 4+4+7+1 = 16\,m$$

$$\text{disp}^m = \sqrt{(3)^2 + (3)^2}$$

$$= \sqrt{18}$$

$$= 3\sqrt{2}\ m.$$

IMR*



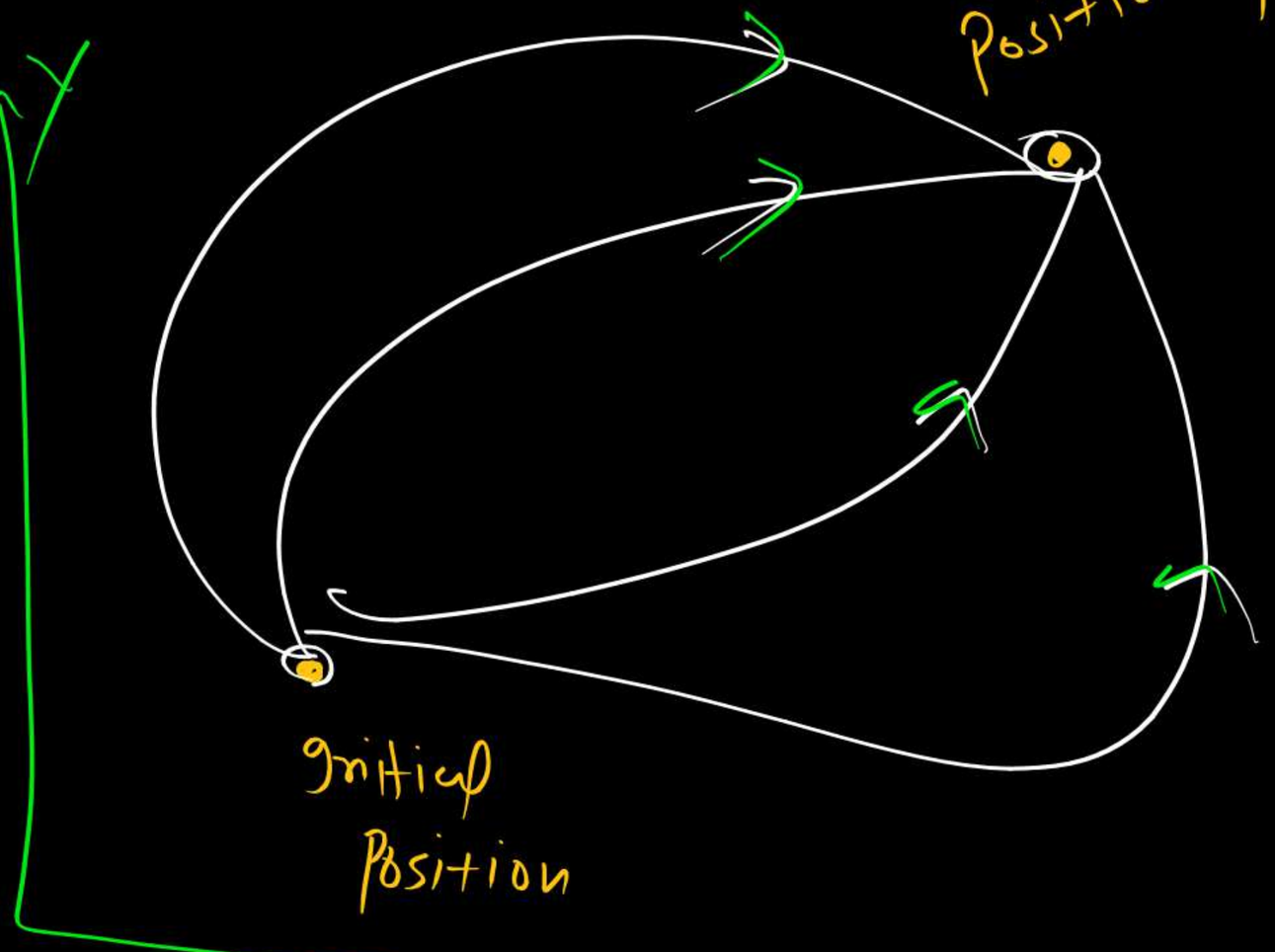
dist^n = total Path length

= 36m

disp^m = $\sqrt{(4)^2 + (4)^2}$

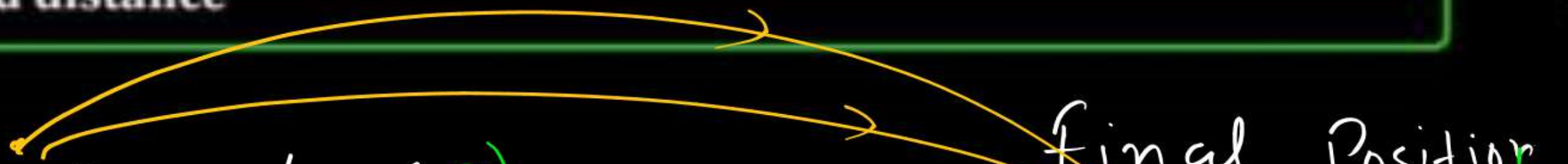
= $4\sqrt{2}$

dist^{n} b/w any two fixed Point is not a single value (not unique) because it depend upon Path.



disp^{m} b/w any two fixed Point is unique value does not depend on Path.

If initial position of object (2, 6, 9) and final position (8, –2, 19) then find displacement and distance



Find

(i) dist^n ⟶ Can't be calculated.

(ii) * disp^m = Shortest length $= \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2 + (z_2-z_1)^2}$

$= \sqrt{(8-2)^2 + (-2-6)^2 + (19-9)^2}$

$= \sqrt{(6)^2 + (8)^2 + (10)^2} = \sqrt{200} = 10\sqrt{2}$ m

Object moves 6 m in east then 8 m in north and 10 m in vertically upward, then find displacement.

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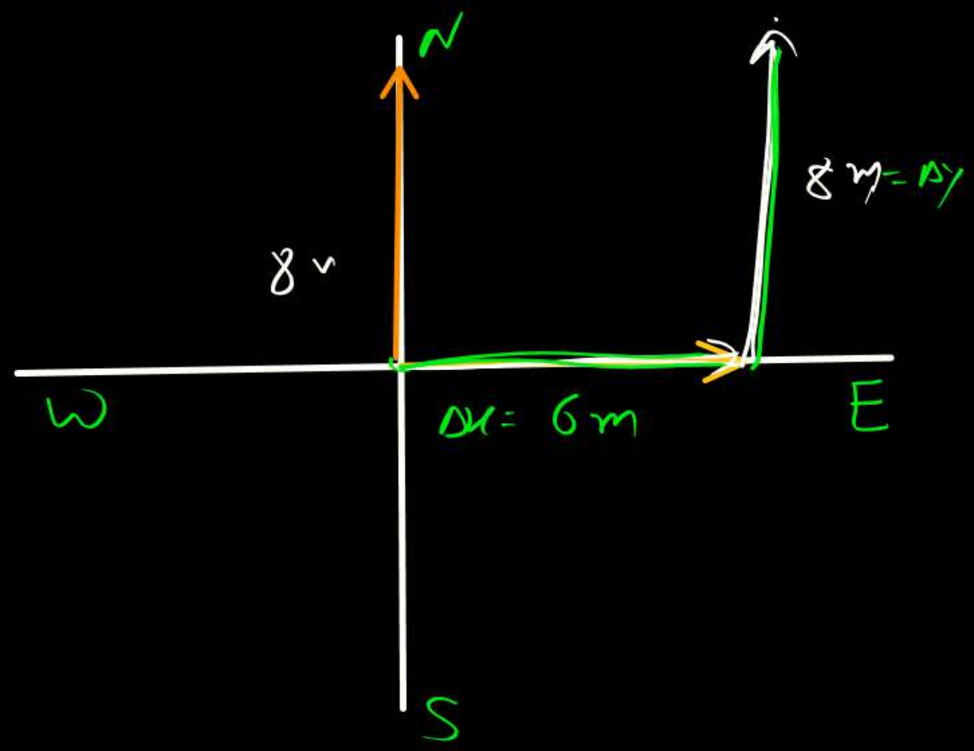
$\text{disp}^n \text{ in } x = 6m$

$\text{disp}^n \text{ in } Y = 8m$

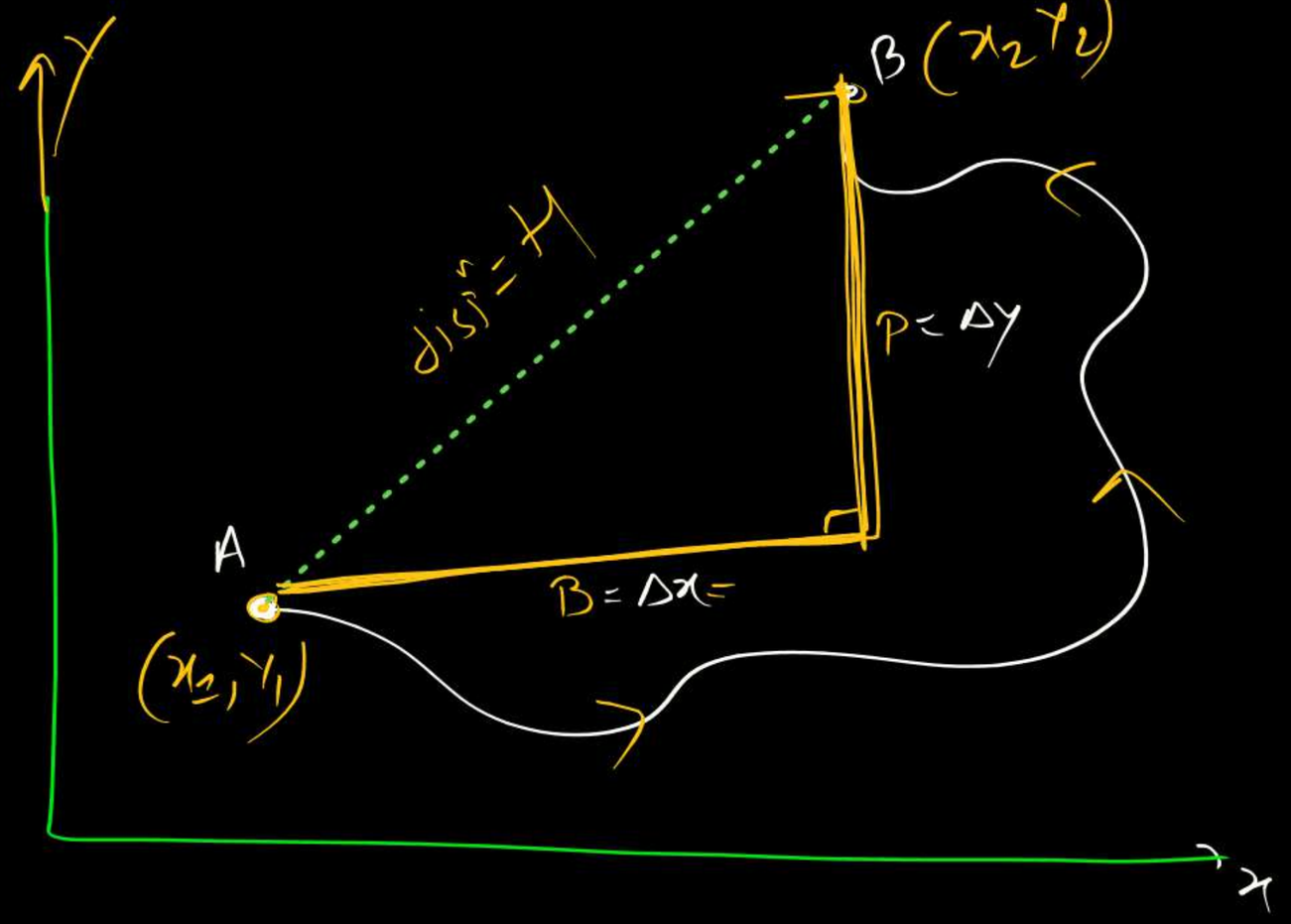
$\text{disp}^n \text{ in } z = 10m.$



$$\text{Disp}^n = \sqrt{(\Delta x)^2 + (\Delta y)^2 + (\Delta z)^2}$$

$$= \sqrt{(6)^2 + (8)^2 + (10)^2}$$

$$= 10\sqrt{2}$$



+1 $\quad disp = \sqrt{(\Delta x)^2 + (\Delta y)^2} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$disp = \sqrt{(\Delta x)^2 + (\Delta y)^2 + (\Delta z)^2}$

disⁿ

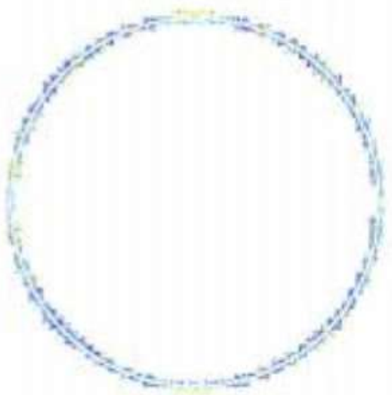
- total Path length.
- Can't decrease with time
- always Incre with time.
- Can't be -ve
- Depends upon Path taken.
- (Scalar)

displacement

- Shotest Path length b/w gnitial and final Position.
- Can decrese with time
- may be +ve, -ve, zero
- vector (disⁿ)
- Does not depends on Path taken.

Object moves 30m in north then 20m in east and then $30\sqrt{2}$ m south west then find displacement.

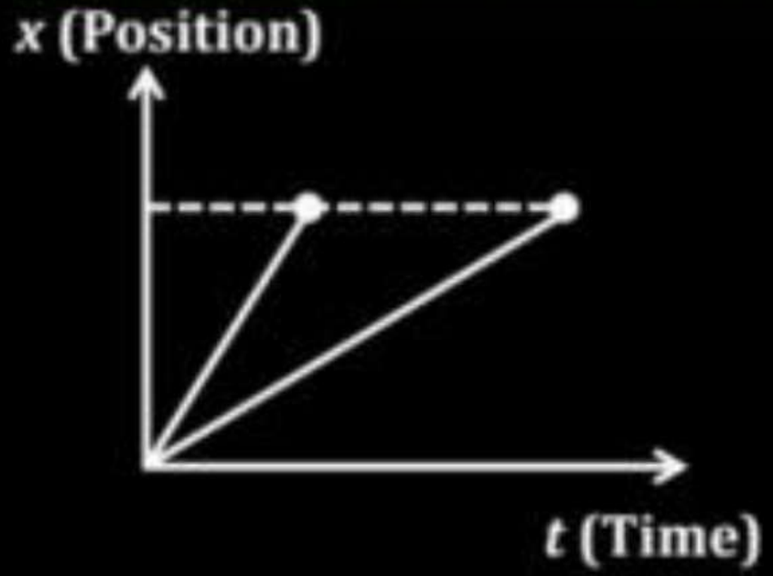
Distance and displacement on circular path–



If position of object is $x = t^2 + 2t + y$ then find displacement in

(i) 4 sec

(ii) 4^{th} sec



Position of object is given as $x = t^2 + 2t - 4$

then find (i) displacement in 2-sec (ii) Position at $t = 2s$