

YAKEEN NEET 2.0

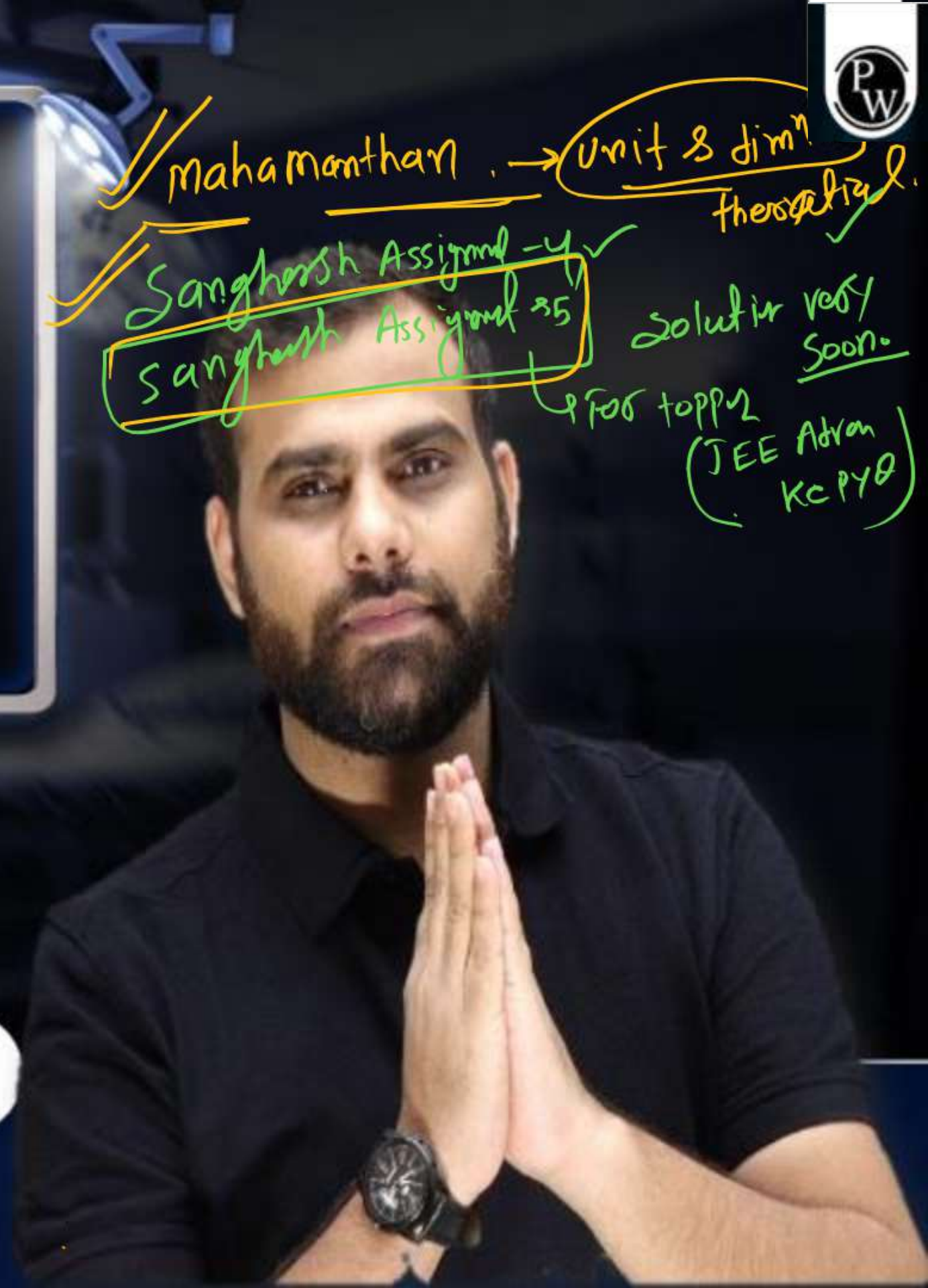
2026

Motion in a Straight Line

Physics

Lecture - 02

By- Manish Raj (MR Sir)





Topics to be covered

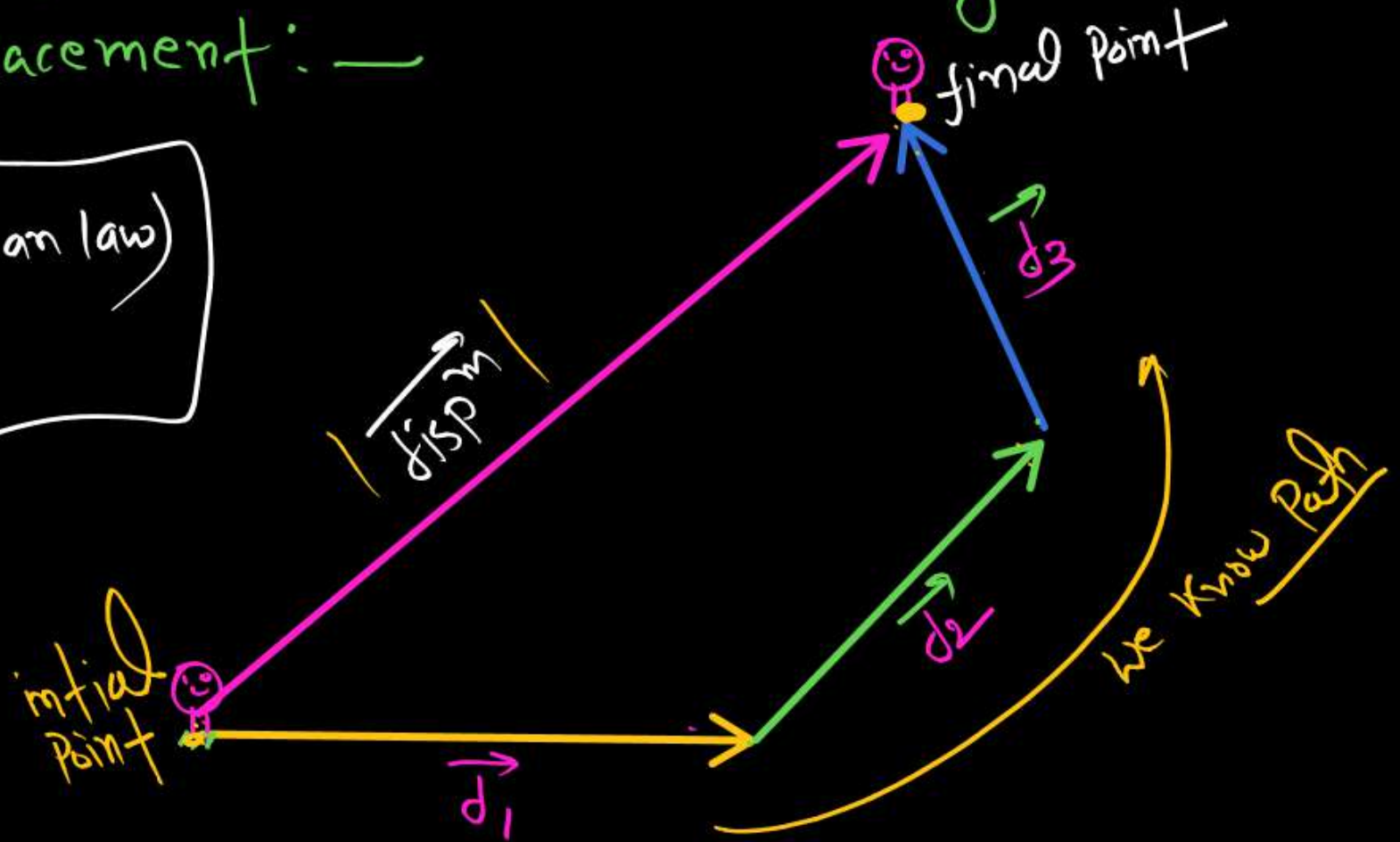


 H/W

Ph.D. on displacement and distance.

(Q) Ramlal moves a length \vec{d}_1 , \vec{d}_2 , \vec{d}_3 as shown in figure then find distance & displacement: —

$\text{Disp}^m = \vec{d}_1 + \vec{d}_2 + \vec{d}_3$ (Polygon law)
vector sum



if we have co-ordinates of final position & initial position

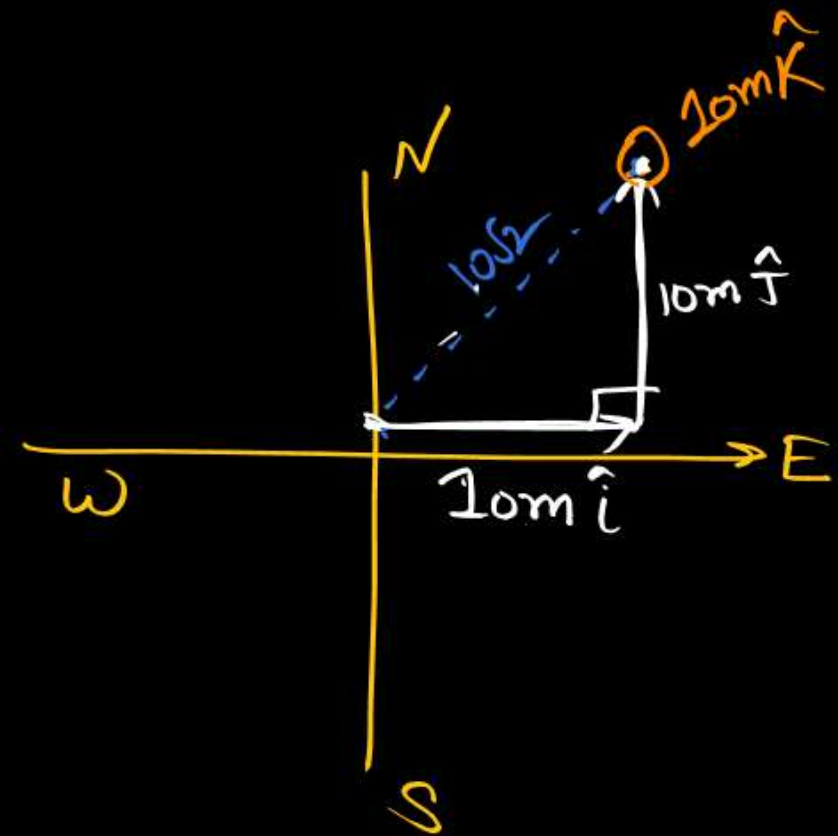
$$\text{disp}^n = \vec{r}_f - \vec{r}_i$$

distance can't be calculated
becau dont know path

Total path length = $|\vec{d}_1| + |\vec{d}_2| + |\vec{d}_3| = \underline{\text{distance}}$

Ram Lal is moving 10m East then 10m North
then climb 10m on Pole then find displacement:-

$$\begin{aligned}\vec{S} &= 10\hat{i} + 10\hat{j} + 10\hat{k} \\ |\vec{S}| &= \sqrt{(10)^2 + (10)^2 + (10)^2} \\ &= \sqrt{300} = 10\sqrt{3} \\ \text{dist}^n &= 10 + 10 + 10 = 30\text{m} \checkmark\end{aligned}$$



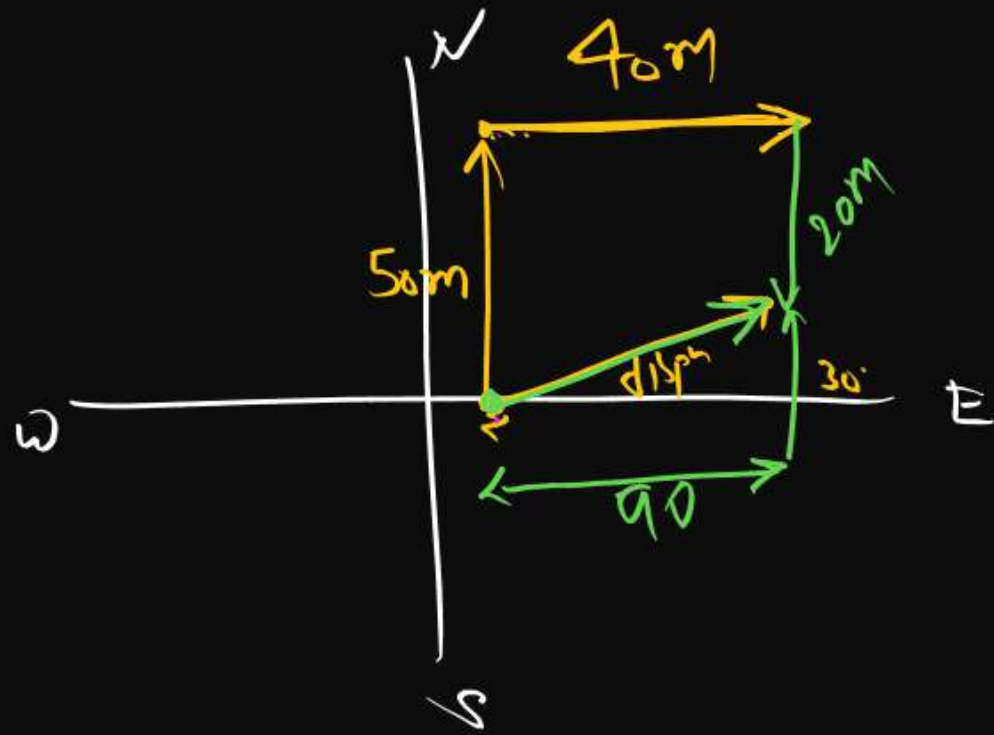
Question

H/W

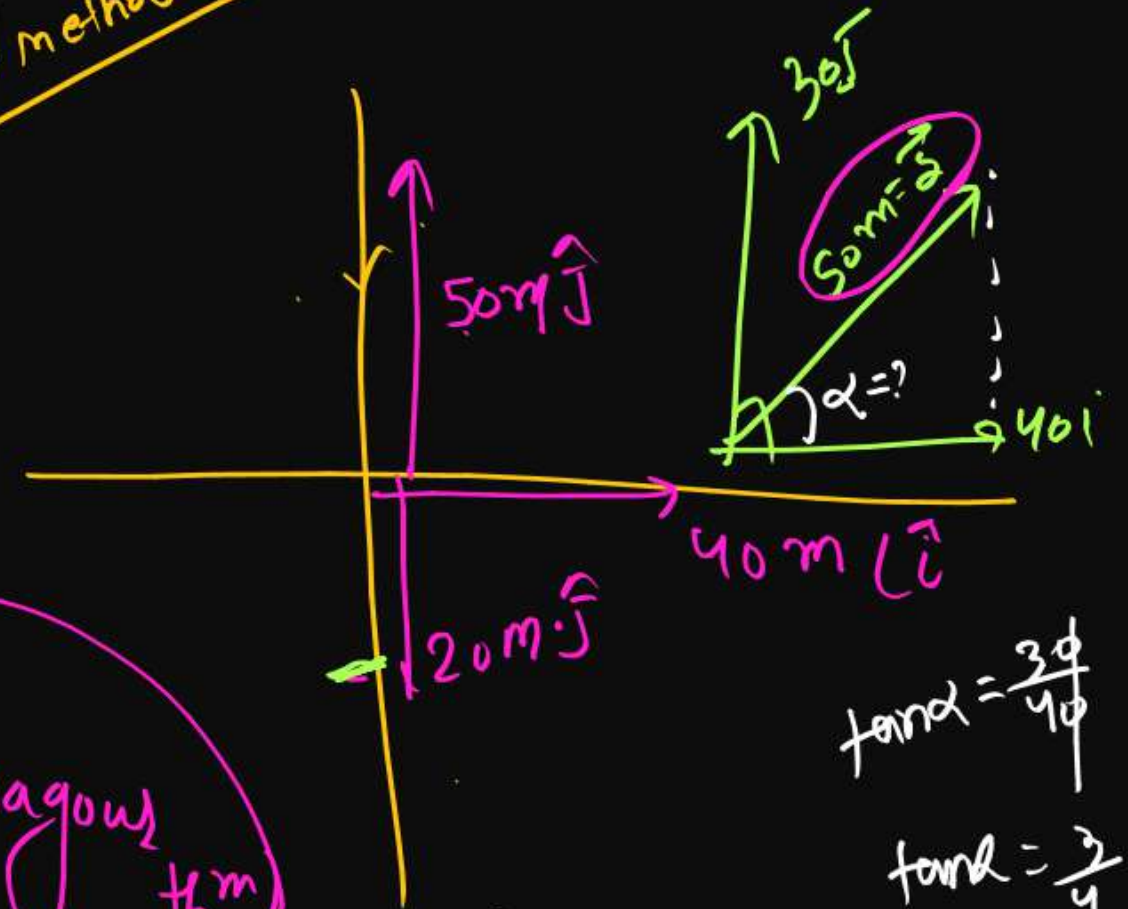


A man has to go 50 m due North, 40 m due East and 20 m due South to reach the field?

- (a) What distance ^{110m} he has to walk to reach the field?
- (b) What is his displacement from his house to the field?



2nd method (mpx)



So Pythagoras thm

$$\tan \alpha = \frac{30}{40}$$

$$\tan \alpha = \frac{3}{4}$$

$$\alpha = 37^\circ$$

Question

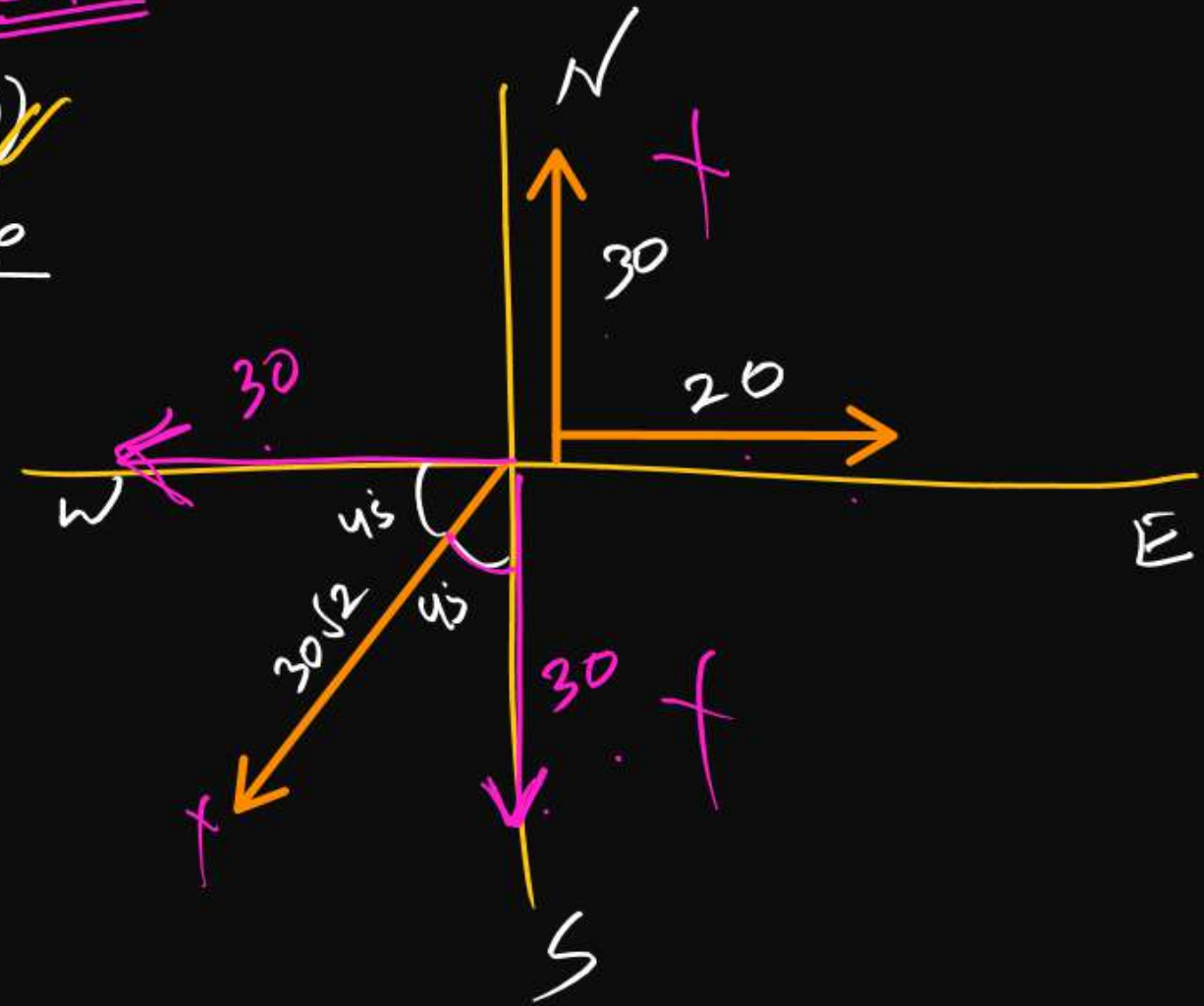
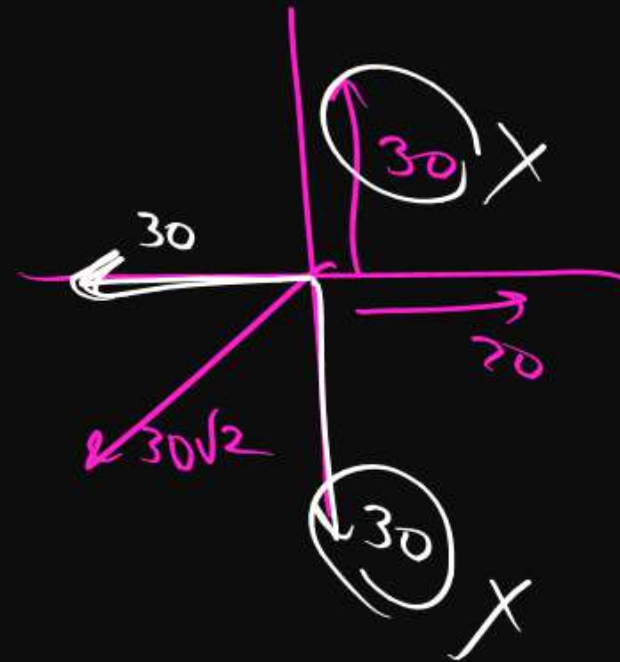
A person moves 30 m north and then 20 towards east and finally $30\sqrt{2}$ m in south-west, then displacement. (IIT-2012)

- 1 10 m North
- 2 10 m South
- 3 10 m West
- 4 Zero

Soln

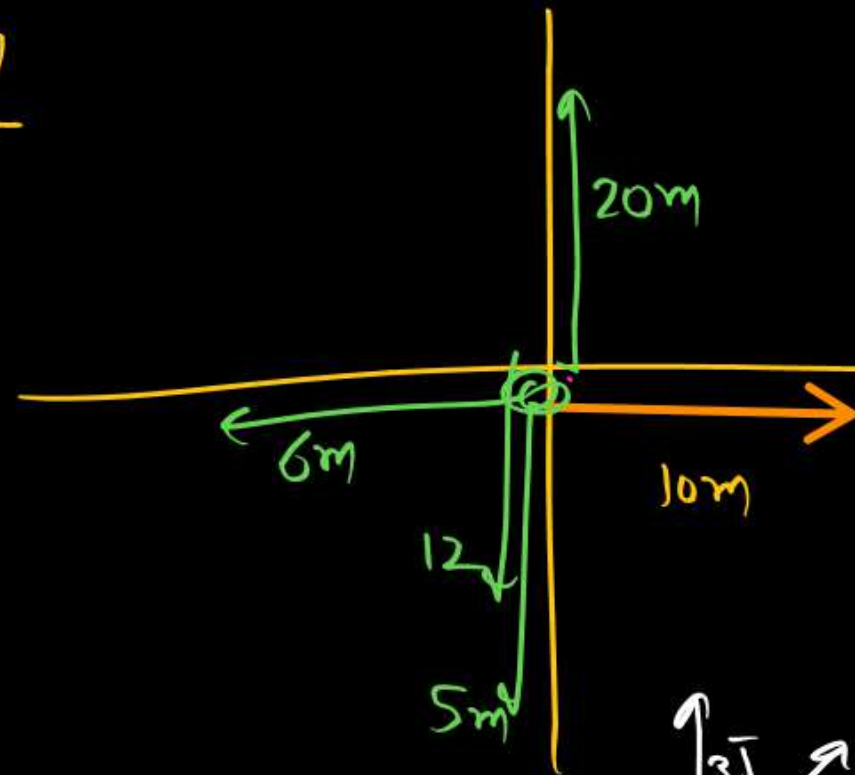
Ans

$$\text{disten} = 30 + 20 + 30\sqrt{2}$$



Q) Kallua moves 10m East then 20m North then 12m South then 6m West then 5m South then find distance and displacement :-

Solⁿ



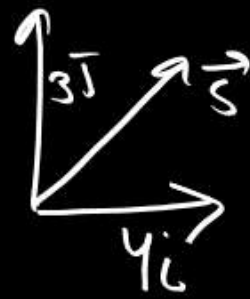
$$d_1 = 10\hat{i}$$

$$d_2 = 20\hat{j}$$

$$d_3 = -12\hat{j}$$

$$d_4 = -6\hat{i}$$

$$d_5 = -5\hat{j}$$



displacement = 5m

$$\vec{d}_{\text{dis}} = \vec{d}_1 + \vec{d}_2 + \vec{d}_3 + \vec{d}_4 + \vec{d}_5$$

$$\vec{d} = 4\hat{i} + 3\hat{j}$$

$$|\vec{d}| = \sqrt{4^2 + 3^2}$$

$$= \sqrt{16 + 9}$$

$$= \sqrt{25} = 5$$

distance = 53m

Question



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

Can't find

$$\vec{r}_i = (2, 6, 9)$$

$$\vec{r}_f = (8, -2, 19)$$

$$(\text{dis}) \vec{s} = (8-2)\hat{i} + (-2-6)\hat{j} + (19-9)\hat{k}$$

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

$$= \sqrt{36 + 64 + 100} = \sqrt{200} \text{ m} \\ = \underline{\underline{10\sqrt{2}}}$$

Question



Object moves from ^{initial} A(2, 3, -4) to B(3, 4, 1) ^{final} to C(5, 7, 1). Find distance and displacement from A to C.

mid point

Can't find

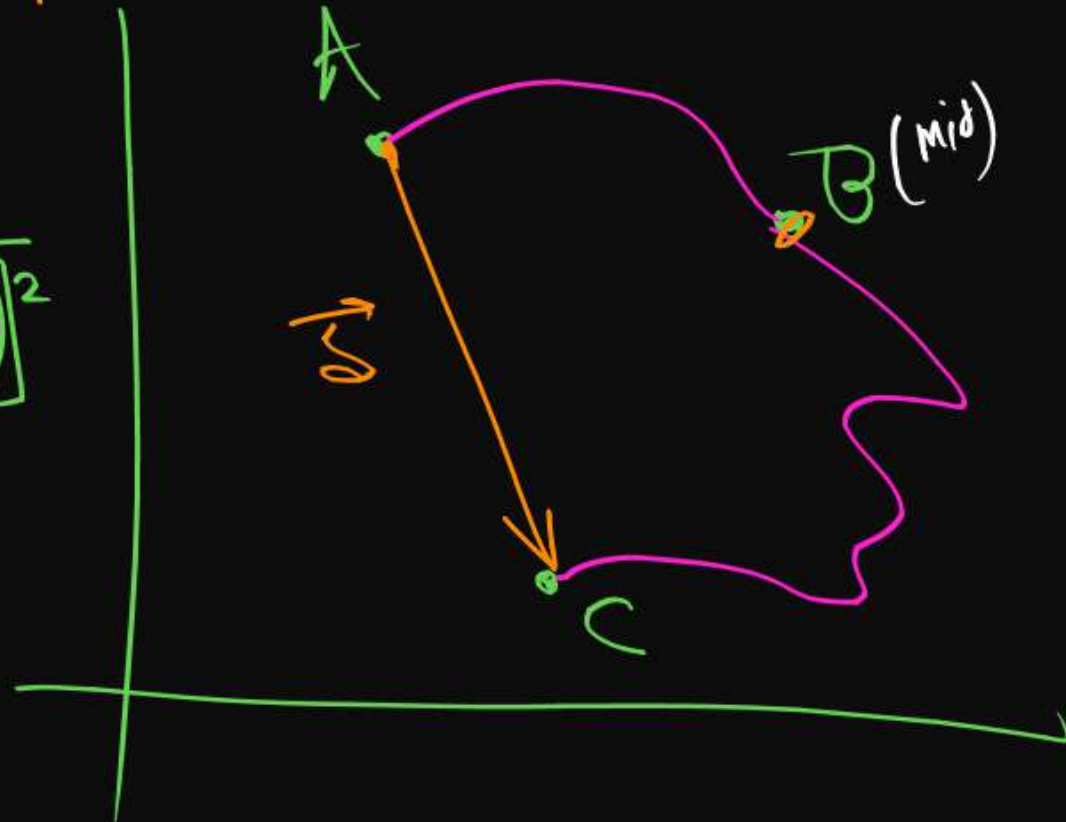
For displacement ignore mid point:-

$$\vec{s} = \sqrt{(5-2)^2 + (7-3)^2 + (1-(-4))^2}$$

$$= \sqrt{3^2 + 4^2 + 5^2}$$

$$= \sqrt{9+16+25}$$

$$= \sqrt{50} = \sqrt{25 \times 2} = 5\sqrt{2} \text{ m}$$



Statement-1: Distance and displacement is different physical quantity.

Statement-2: Distance and displacement have same unit and dimension.

1 Both are wrong

2 Both are correct

3 1st wrong, 2nd correct

4 1st correct, 2nd wrong

{ Fill in the blanks : (may/must/must not/may not)

- A. Distance travelled by object is zero the displacement _____ be non-zero.
- B. Distance travelled by object is not zero then displacement _____ be zero.
- C. Displacement moved is zero then distance _____ or _____ zero
- D. If displacement is not equal to zero then distance _____ equal to zero.

True / False

- A. Particle is moving on straight line, distance is equal to displacement ☐
- B. Displacement independ of choice of frame of reference ☐
- C. For a particle moving on parabolic path distance always grater than displacment ☐
- D. Displacement is not zero; then distance must not be zero ☐
- E. Distance is not equal to zero; then displacement may equal to zero. ☐

Question

M/W

dirⁿ not given



The numerical ratio of displacement to distance is:

magnit^o

- 1 always less than 1
- 2 always greater than 1
- 3 always equal to 1
- 4 ✓✓✓ may be less than 1 or equal to 1

$$\frac{|\text{disp}^m|}{\text{distan}} =$$

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

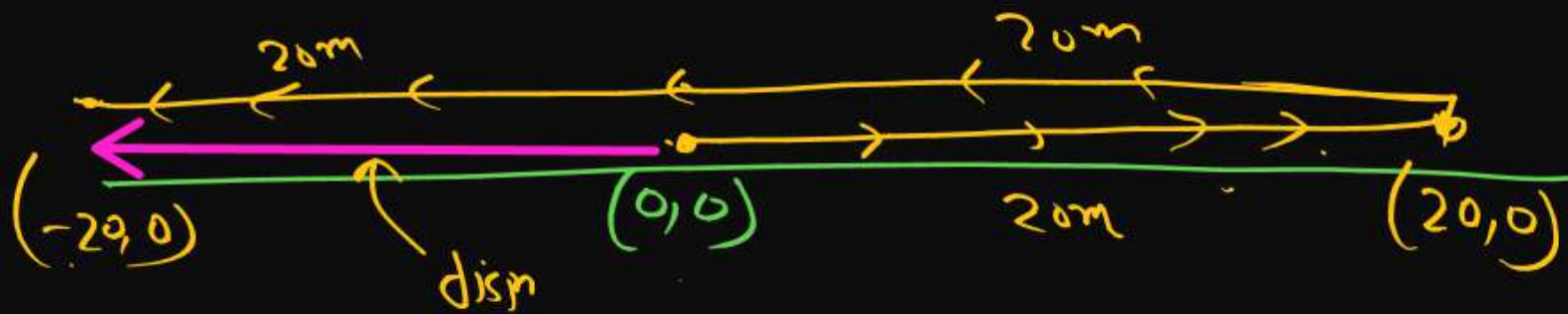
$$\frac{|\text{disp}^m|}{\text{dist}^n} \leq 1$$

Question

H/W (HCV)



A particle starts from the origin, goes along the X-axis to the point (20m, 0) and then returns along the same line to the point (-20 m, 0). Find the distance and displacement of the particle during the trip.



$$\text{dist}^n = 60\text{m}$$

$$\text{disp}^n = -20 - 0$$

$$= -20\text{m}$$

↑
disⁿ



Question

H/w

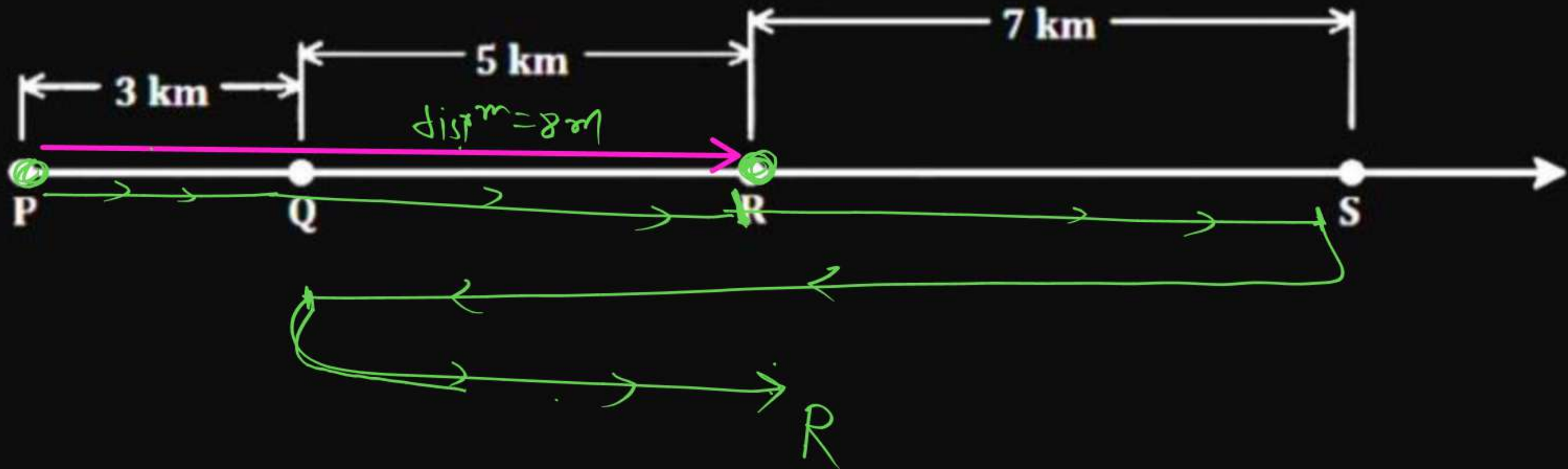


A car moving along in a straight highway from point P to point Q to point R and to point S, then back to point Q and finally to the point R as shown in the figure below.

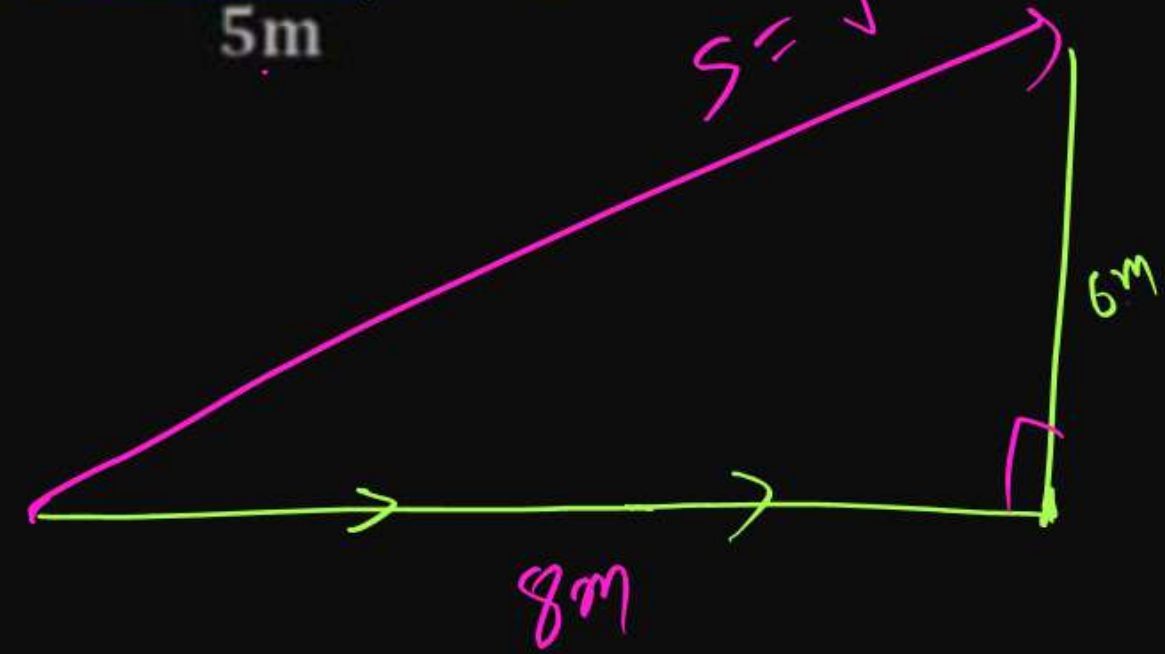
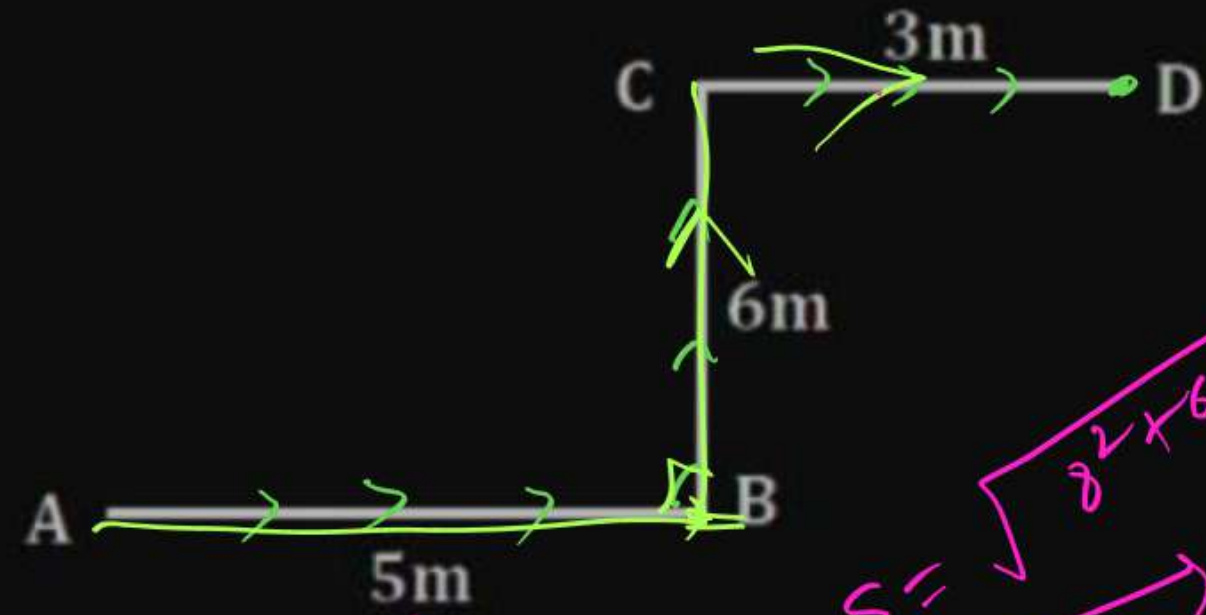
32m

(a) Find the distance travelled by car.

(b) Find the displacement of the car.

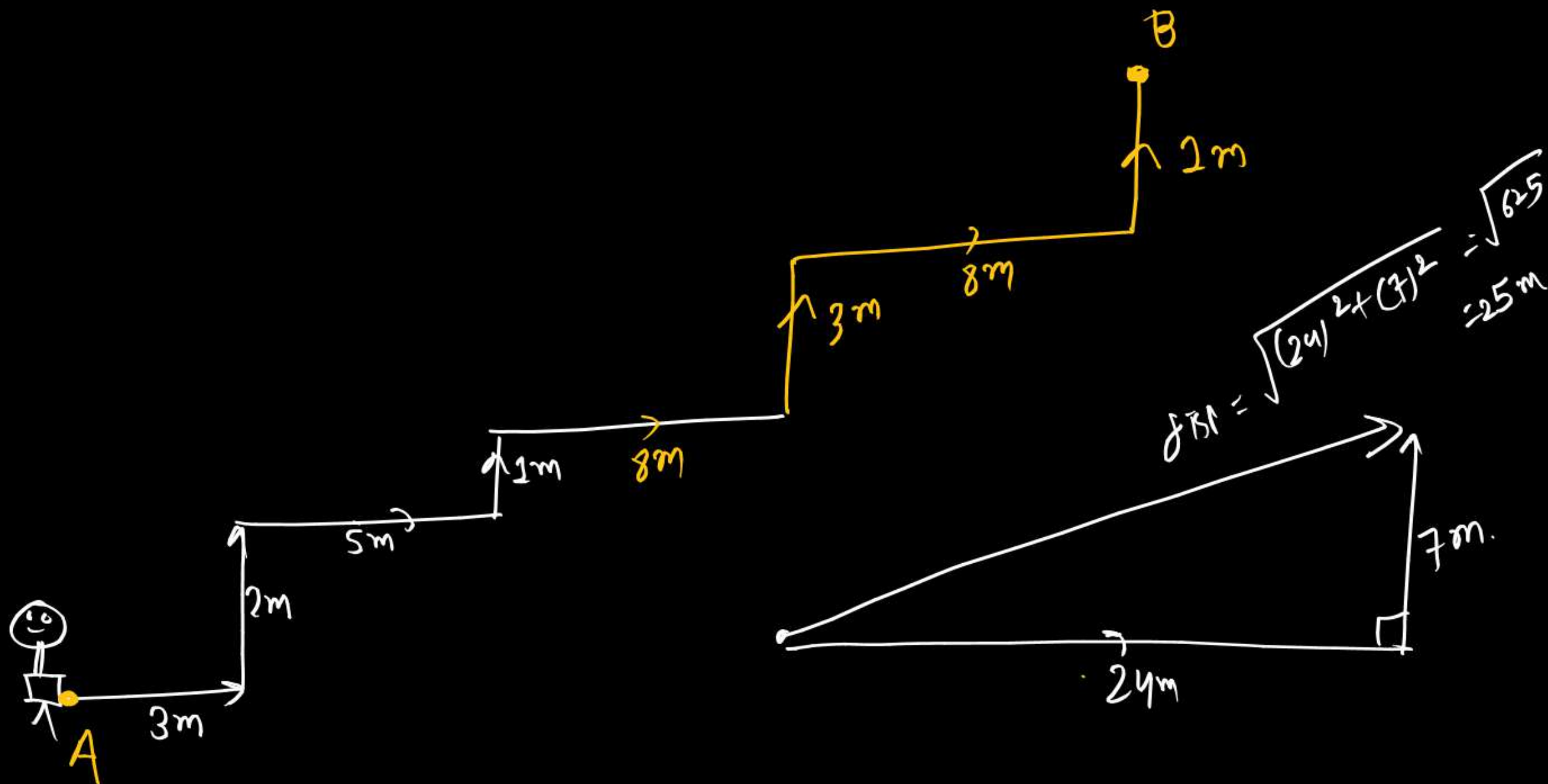


H/w



$$S = \sqrt{8^2 + 6^2} = \sqrt{64 + 36} = \sqrt{100} = \underline{\underline{10m}}$$

Q find disp^m B/w \vec{A} & \vec{B}
Note: \vec{A}



Question



A student moves 10m towards east then 20m south and then $20\sqrt{2}$ north east then find displacement?

Question

HCV (H/W)

$$\angle i = \angle r$$

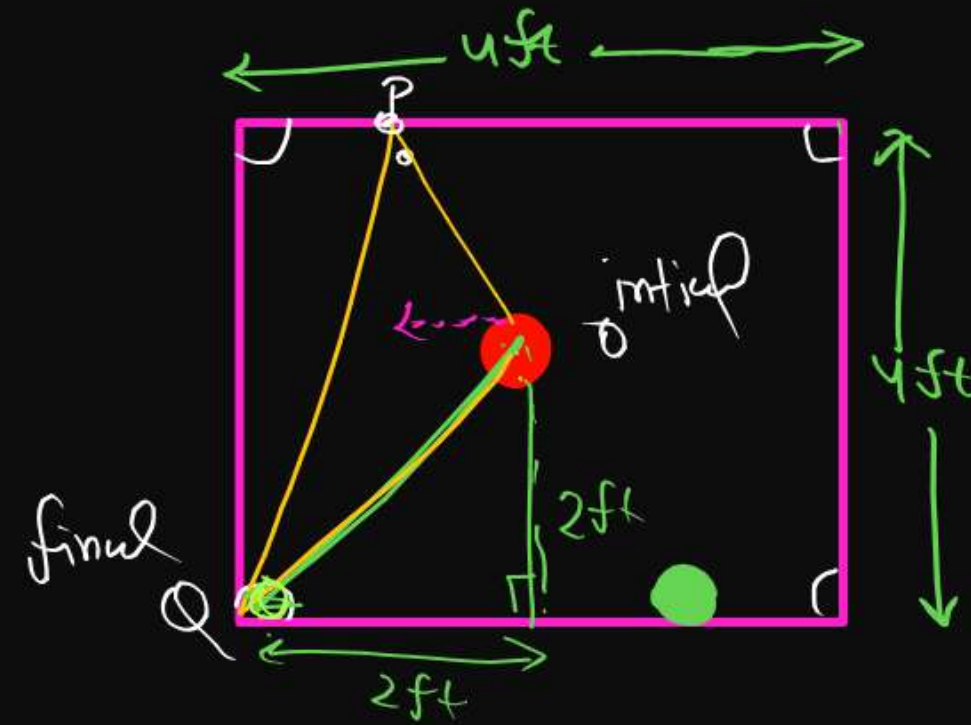


A carrom board (4 ft × 4 ft square) has the queen at the centre. The queen, hit by the striker moves to the front edge, rebounds and goes in the hole behind the striking line. Find the magnitude of displacement of the queen

- (a) From the centre to the front edge
- (b) From the front edge to the hole and
- (c) From the centre to the hole.

easy

$$\begin{aligned} \text{(OP) disp} &= \sqrt{2^2 + 2^2} = \sqrt{8} \text{ m} \\ &= 2\sqrt{2} \text{ m} \end{aligned}$$



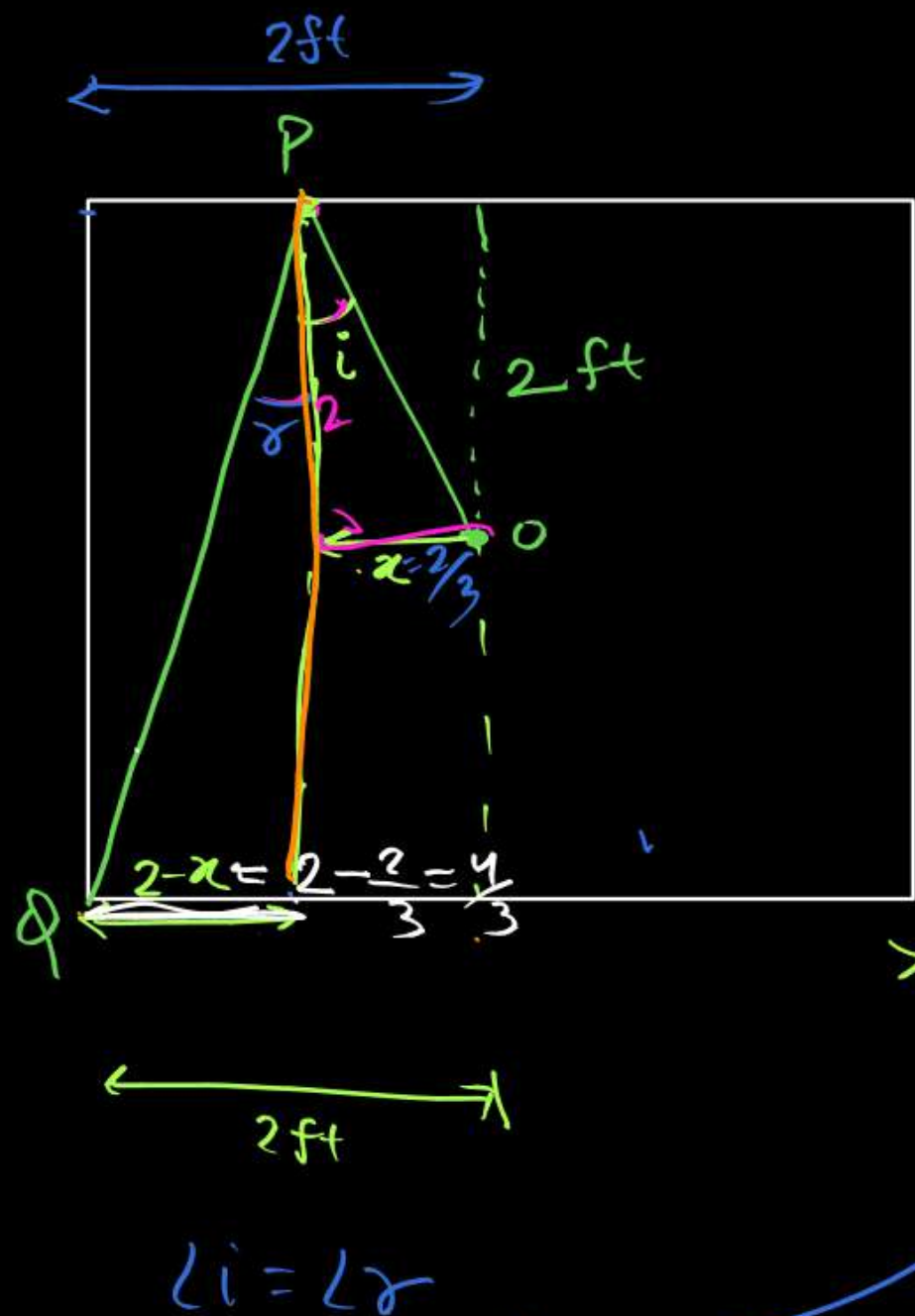
$$PO = \sqrt{4^2 + \left(\frac{4}{3}\right)^2}$$

$$= \sqrt{16 + \frac{16}{9}}$$

$$= \sqrt{\frac{144 + 16}{9}}$$

$$= \sqrt{\frac{160}{9}}$$

$$= \sqrt{\frac{4 \times 4}{9}} = \left(\frac{2}{3} \sqrt{40} \right)$$



$$\rightarrow \tan i = \frac{x}{2} = \frac{2-x}{4}$$

$$2x = 2^{-x}$$

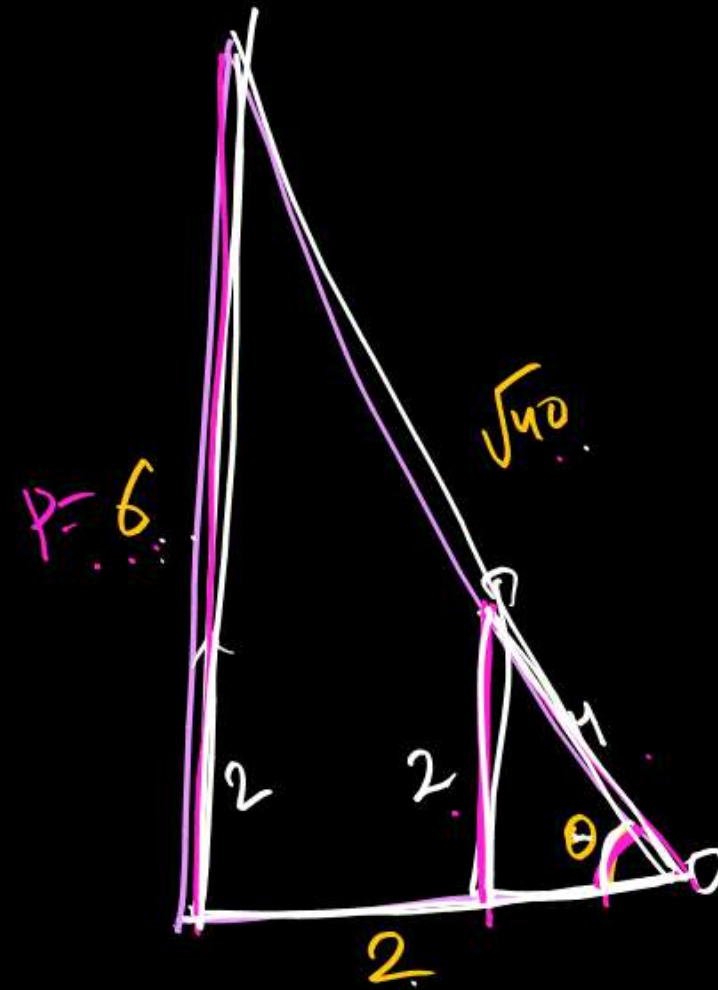
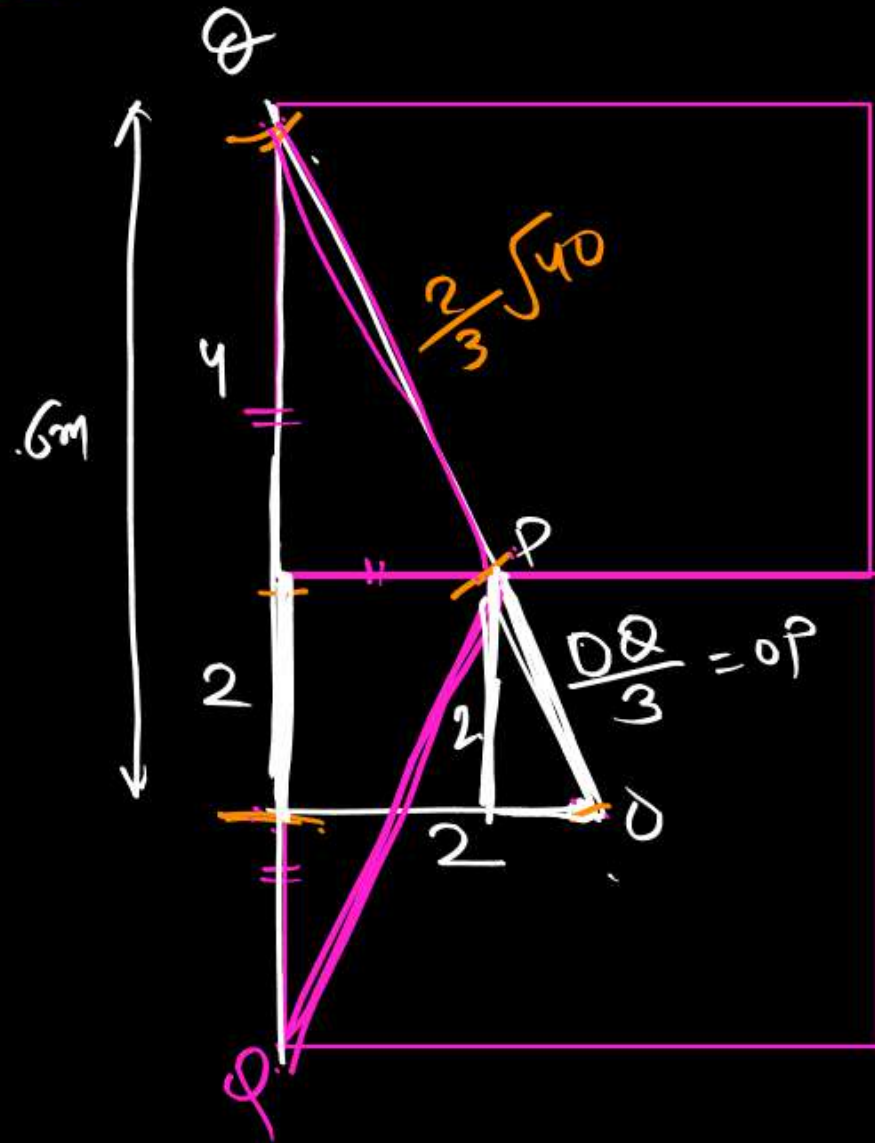
$$3x = 2$$
$$\boxed{x = \frac{2}{3}}$$

$$OP = \sqrt{(2)^2 + (2/3)^2}$$

$$= \sqrt{4 + \frac{4}{9}}$$

$$= \sqrt{\frac{40}{9}} = \frac{1}{3} \sqrt{40} \text{ m}$$

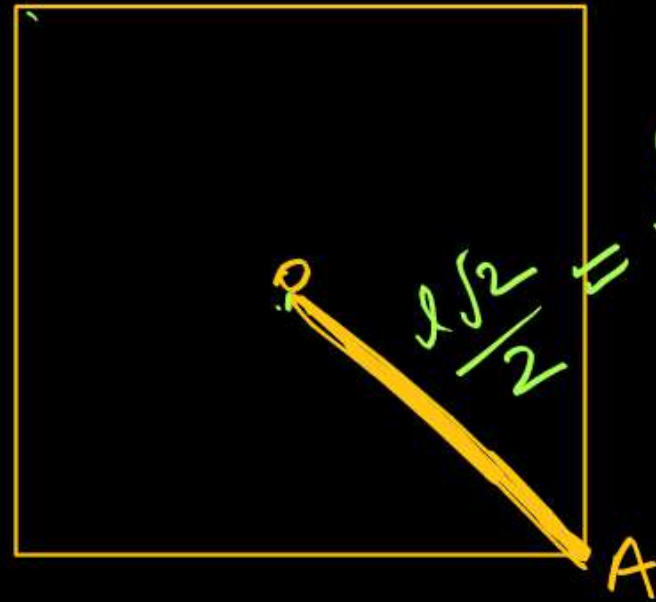
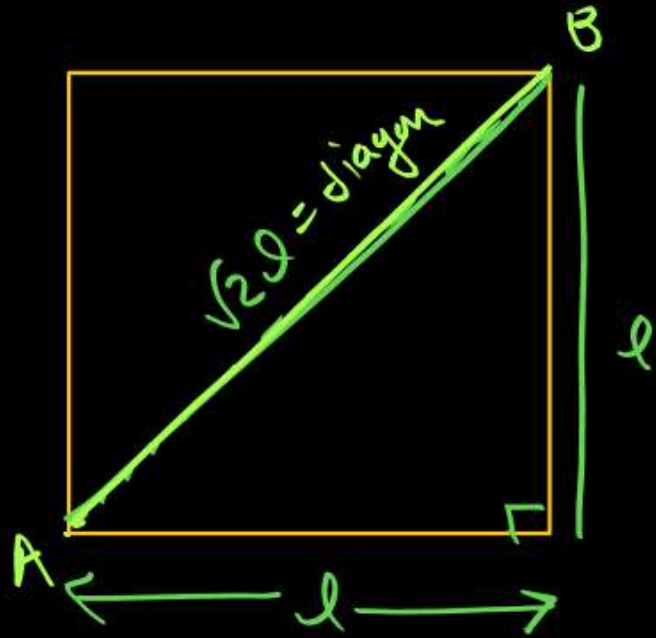
MR^x



$$\sin \theta = \frac{3}{\sqrt{40}} = \frac{2}{\sqrt{11}}$$

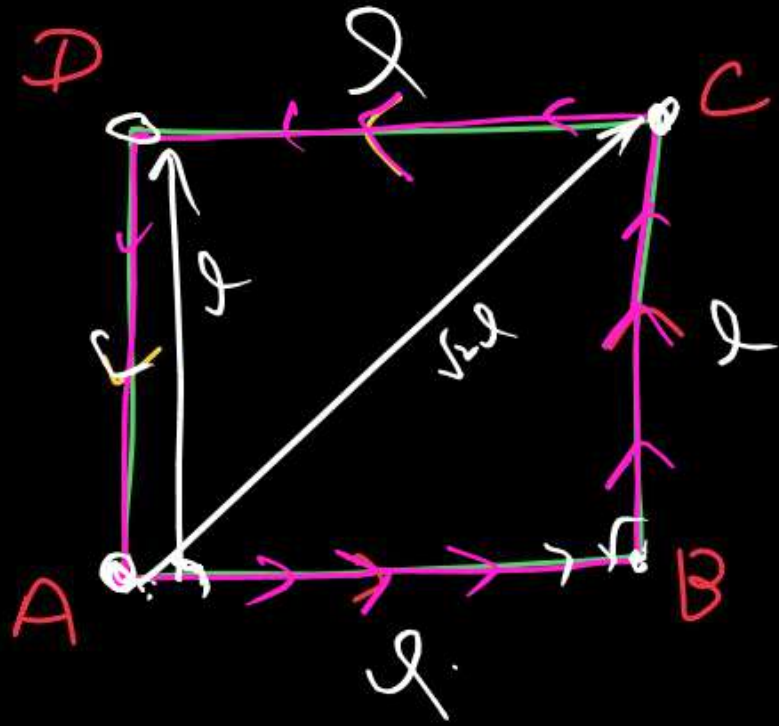
$$\sqrt{11} = \frac{\sqrt{40}}{3}$$

Square of side l

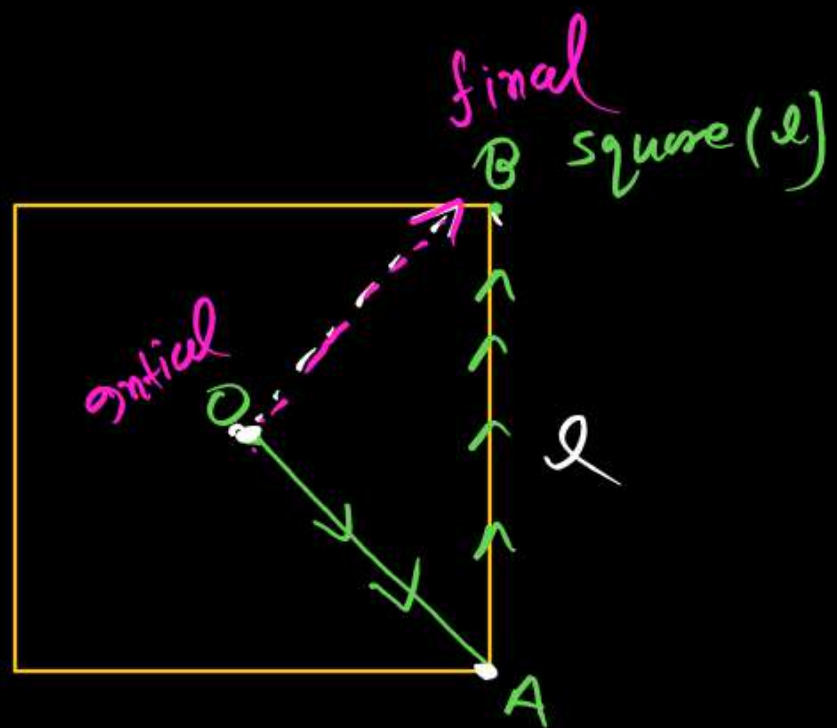


$\frac{l\sqrt{2}}{2} = \frac{l}{\sqrt{2}}$ = distn b/w centre to corners

Q. Object is moving along side of square park then



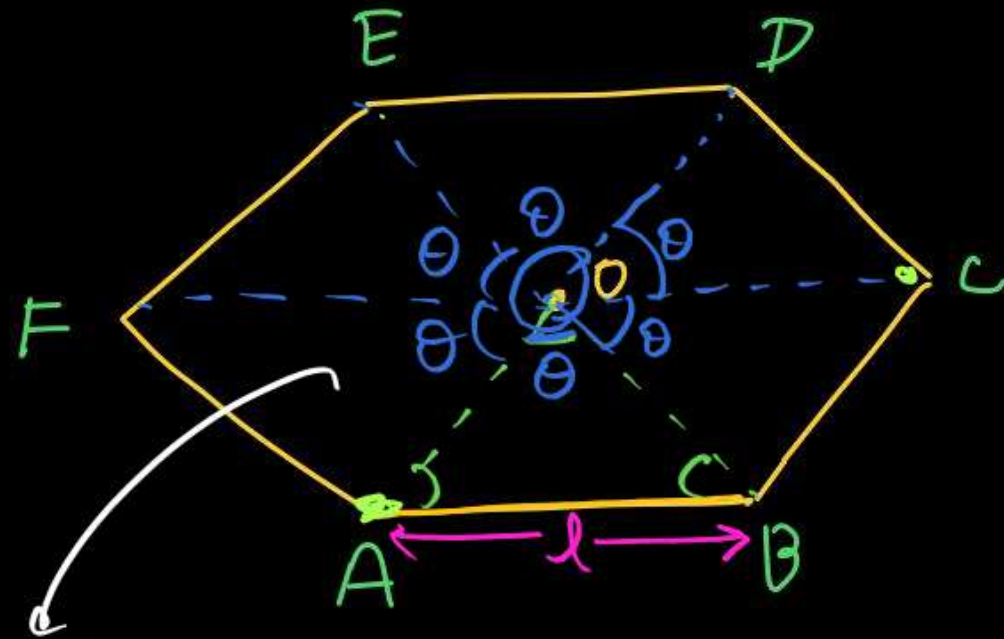
motion	Disp ^m	Distance
$A \rightarrow B$	l	l
$A \rightarrow C$	$\sqrt{2}l$	$2l$
$A \rightarrow D$	l	$3l$
$A \rightarrow A$	0	$4l$



$$|\text{disp}^m|_{OB} = \frac{l}{\sqrt{2}}$$

$$(\text{distam})_{OB} = \frac{l}{\sqrt{2}} + l$$

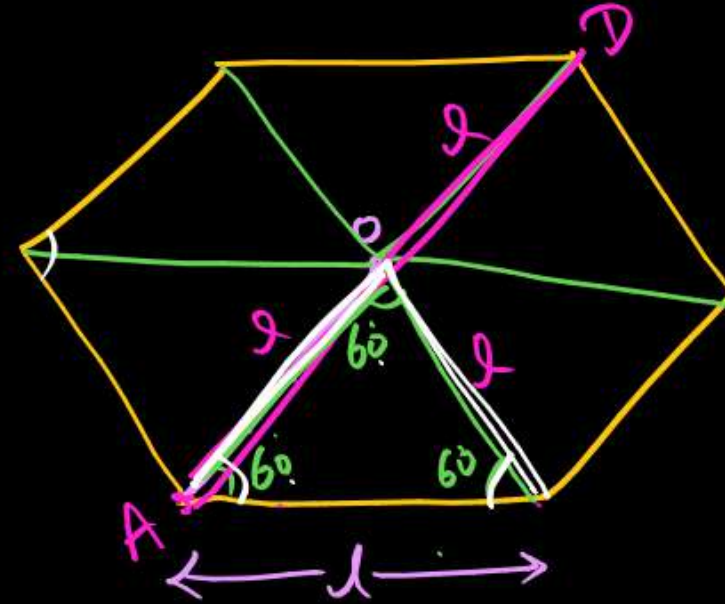
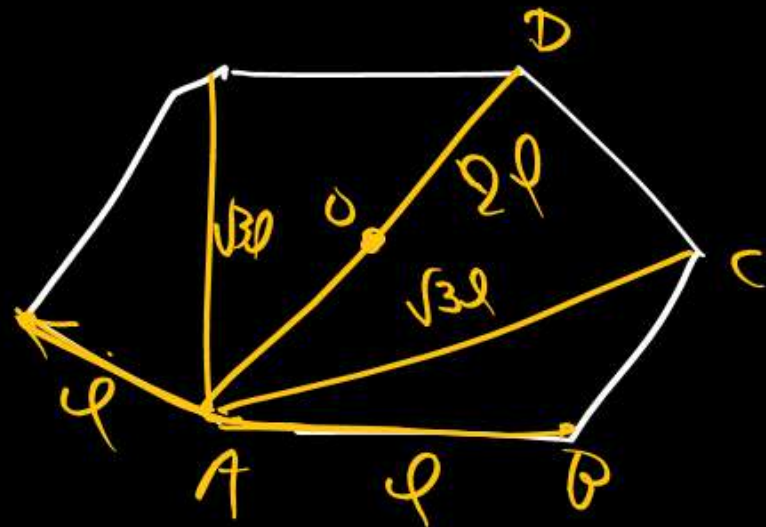
hexagonal of side a , find AO ,
 AD , AC



$$6\theta = 360^\circ$$

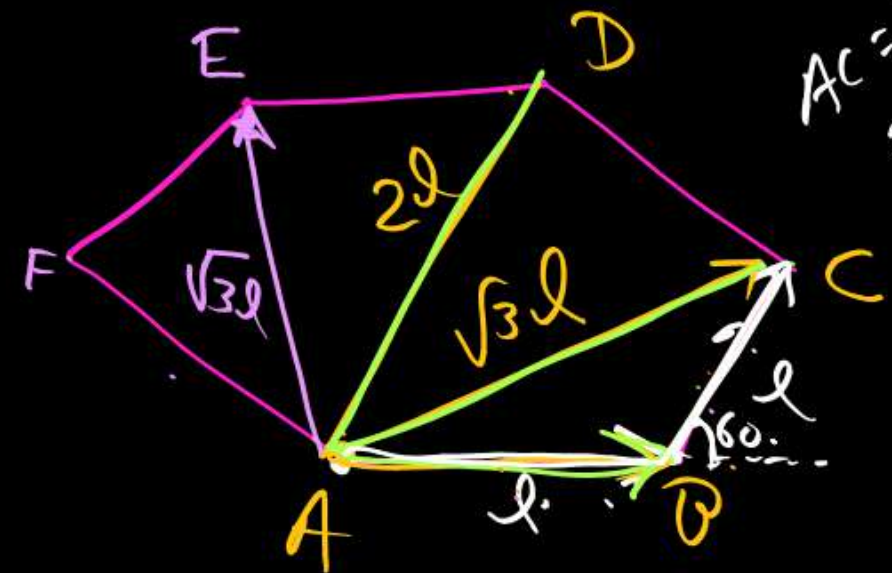
$$\theta = 60^\circ$$

6-equilateral Triangle
in one Hexagonal



$$AD = 2a$$

$$AO = a$$



$$AC = 2a \cos\left(\frac{60^\circ}{2}\right)$$

$$= 2a \cos 30^\circ$$

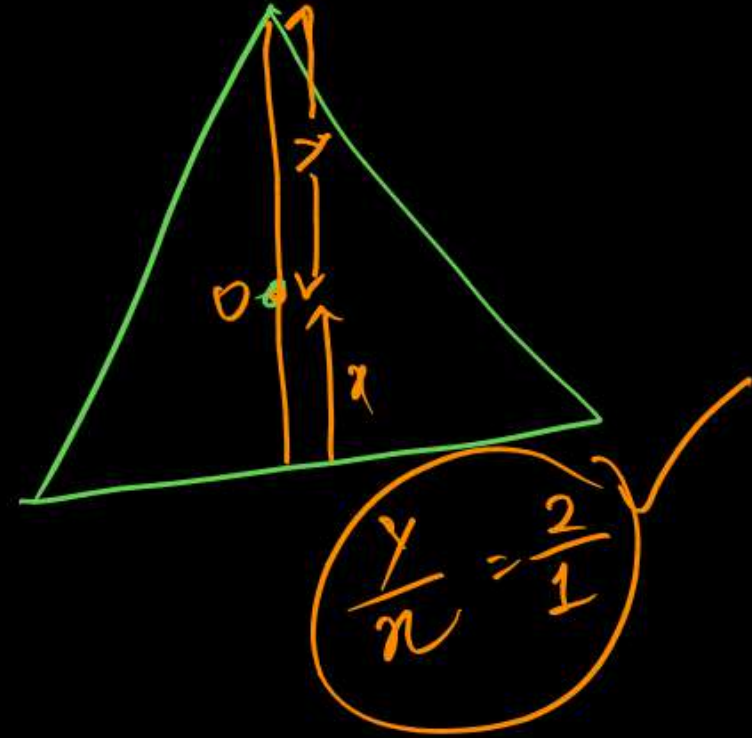
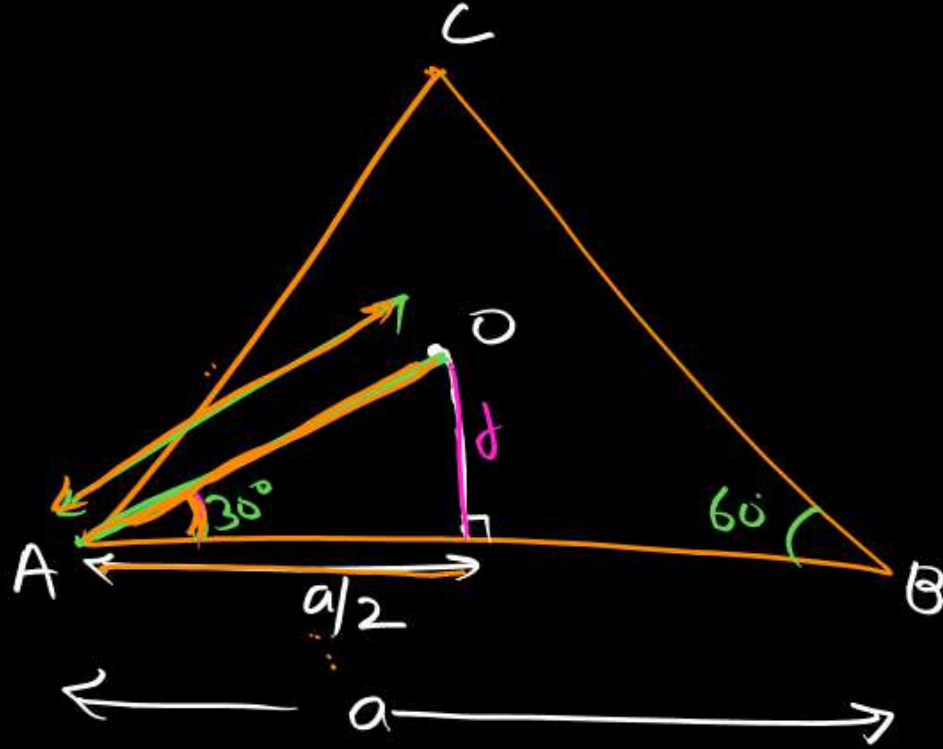
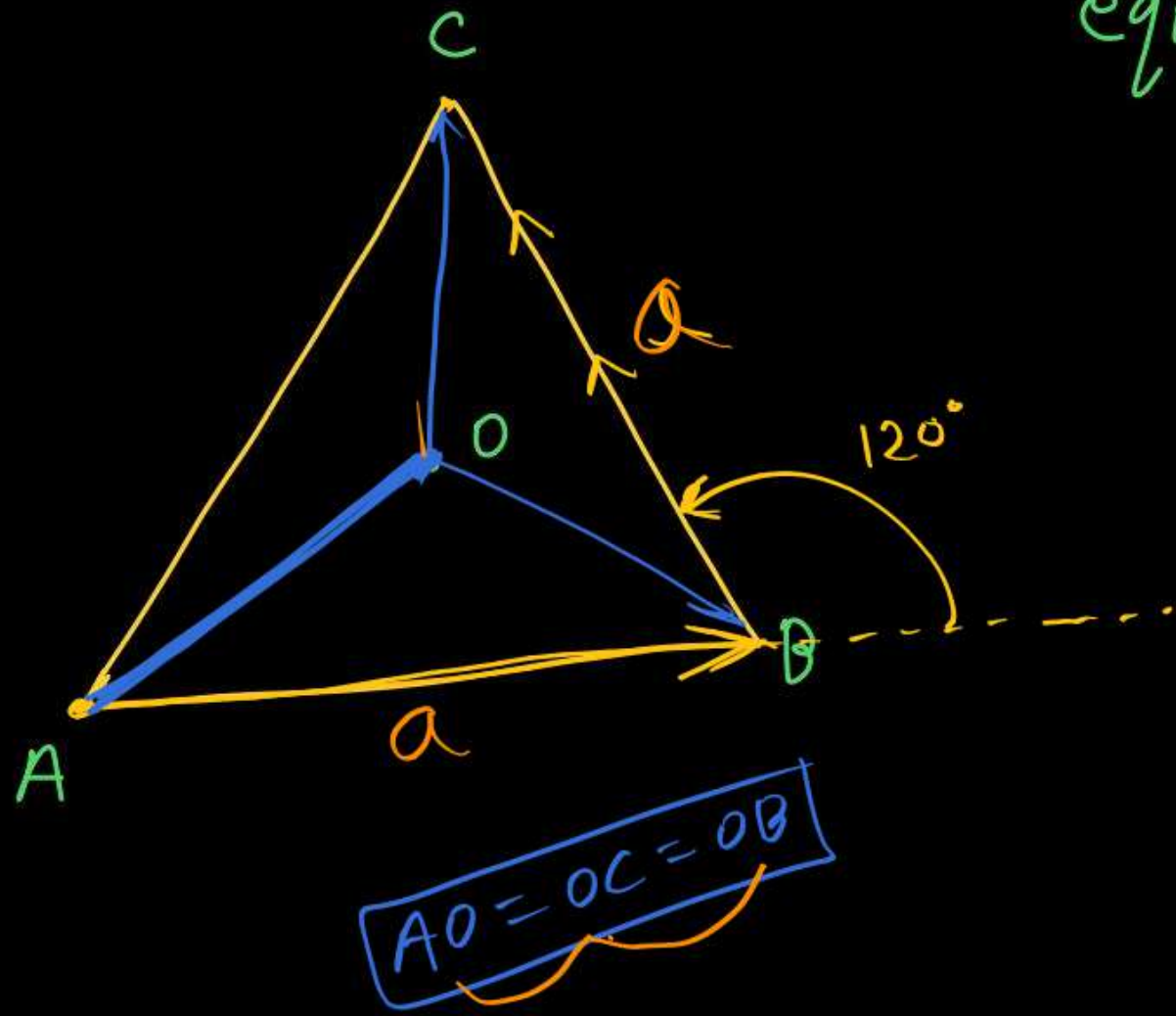
$$= 2a \cdot \frac{\sqrt{3}}{2}$$

$$= \sqrt{3}a$$



Motion	Distance	Displacement
$A \rightarrow B$	l	l
$A \rightarrow C$	$2l$	$\sqrt{3}l$
$A \rightarrow D$	$3l$	$2l$
$A \rightarrow E$	$4l$	$\sqrt{3}l$
$A \rightarrow F$	$5l$	l
$A \rightarrow A$	$6l$	0

equilateral triangle of side a :- find 'oc'



$$\textcircled{+} \cos 30^\circ = \frac{a}{2AO}$$

$$\frac{\sqrt{3}}{2} = \frac{a}{2AO}$$

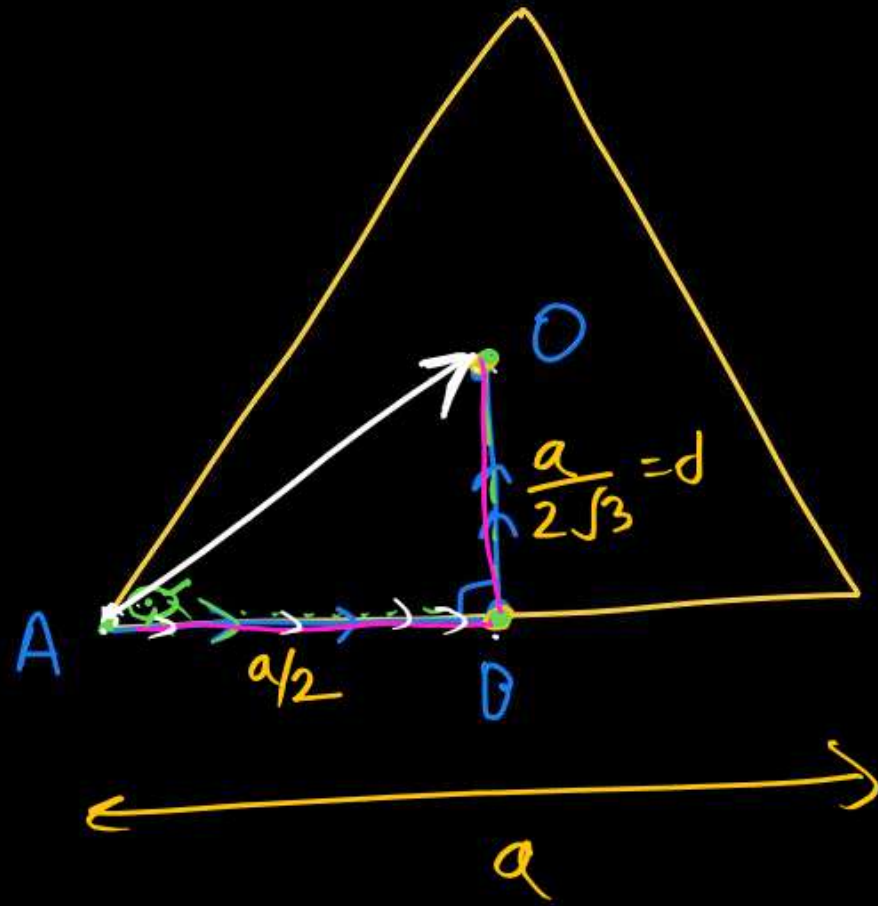
$$AO = \frac{a}{\sqrt{3}}$$

$$\tan 30^\circ = \frac{d}{a/2}$$

$$\frac{1}{\sqrt{3}} = \frac{d}{(a/2)}$$

$$d = \frac{a}{2\sqrt{3}}$$

double

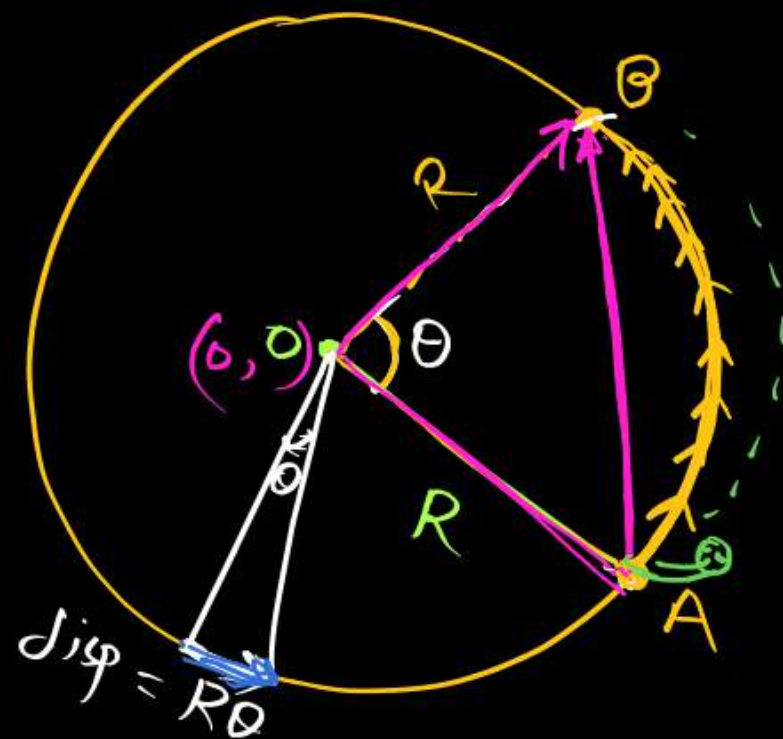


(17) Object moves from $A \rightarrow B \rightarrow O$ on given equilateral Triangle then find

$$(\text{distance})_{AO} = \frac{a}{2} + \frac{a}{2\sqrt{3}} \quad \checkmark$$

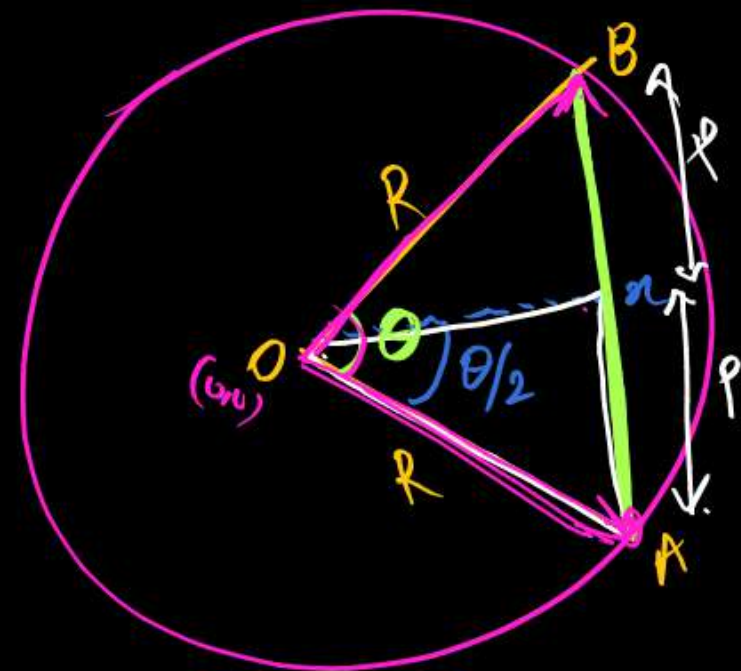
$$(\text{displacement})_{AO} = \frac{a}{\sqrt{3}} \quad \checkmark$$

circle



$$\text{Arc}(AB) = R\theta$$

distance = Arc = $R\theta$



$$\sin(\theta/2) = \frac{p}{R}$$

$$p = R \sin(\theta/2)$$

* $AB = 2p = 2R \sin(\theta/2)$

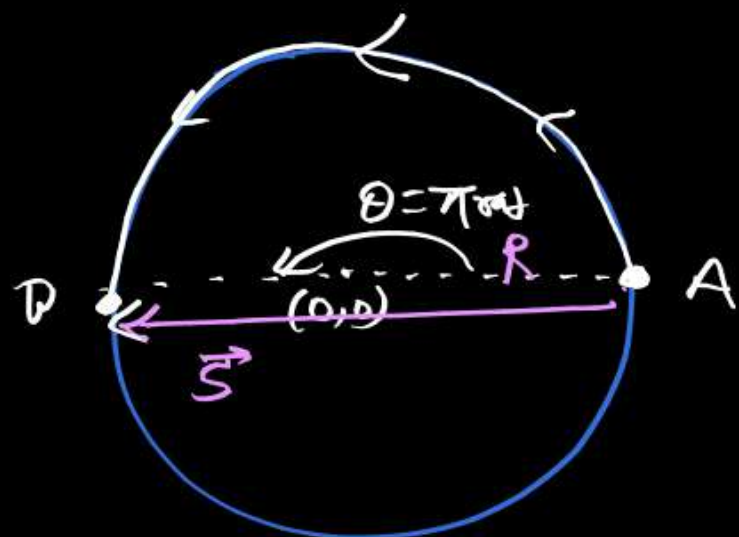
(disp^m)_{A→B} = $2R \sin(\theta/2)$

if Angle is very small

$$\text{disp}^m = 2R \sin(\theta/2)$$

$$\theta \rightarrow \text{small} = 2R \frac{\theta}{2}$$

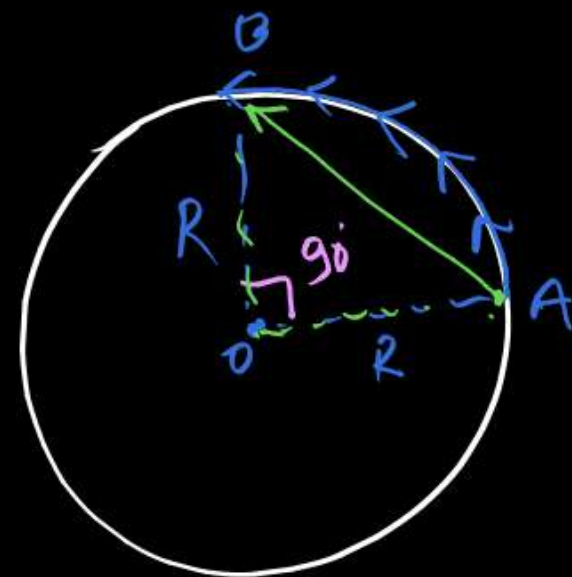
$\text{disp}^m = R\theta$



$$\text{distance} = R\theta = R\pi$$

$$\text{disp}^m = 2R$$

$$\begin{aligned} \text{Disp} &= 2R \sin(\theta/2) \\ &= 2R \sin(\pi/2) \\ &= 2R \end{aligned}$$



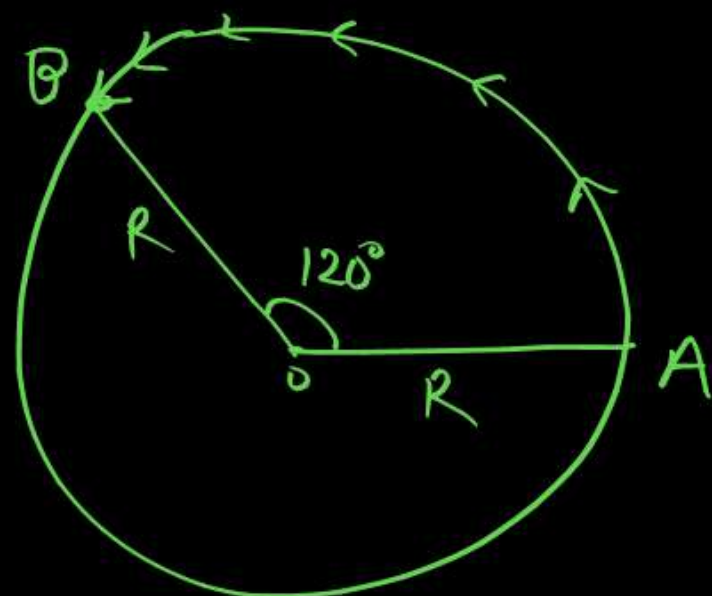
$$|\text{dist}^n|_{AB} = R\theta = \frac{R\pi}{2}$$

$$|\text{disp}|_{AB} = 2R \sin\left(\frac{90}{2}\right)$$

$$= 2R \sin 45^\circ$$

$$= 2R \times \frac{1}{\sqrt{2}}$$

$$= \sqrt{2}R \quad \checkmark$$



$$\text{dist}^n =$$

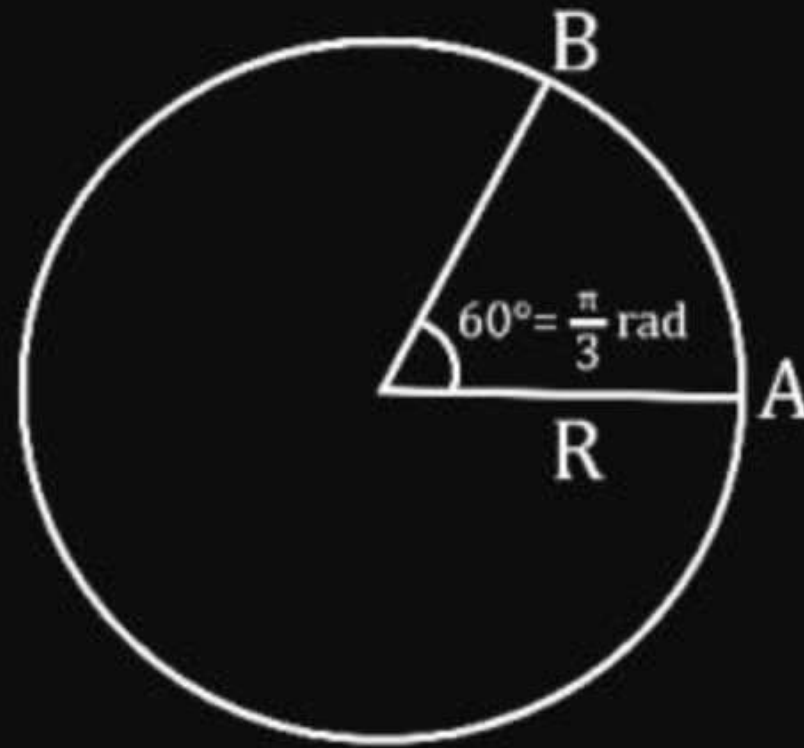
$$\text{dis} =$$

H/w

Question

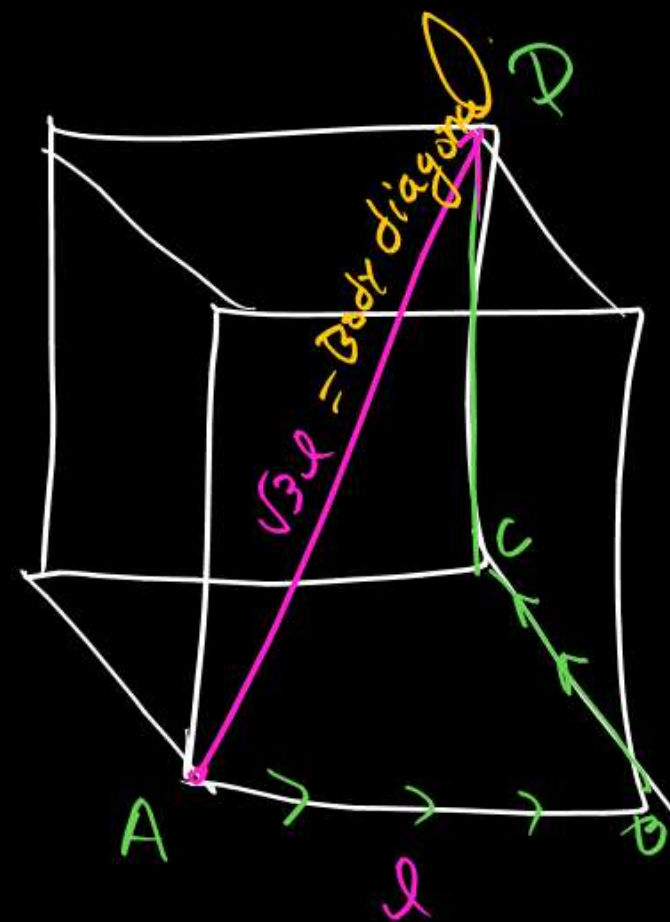
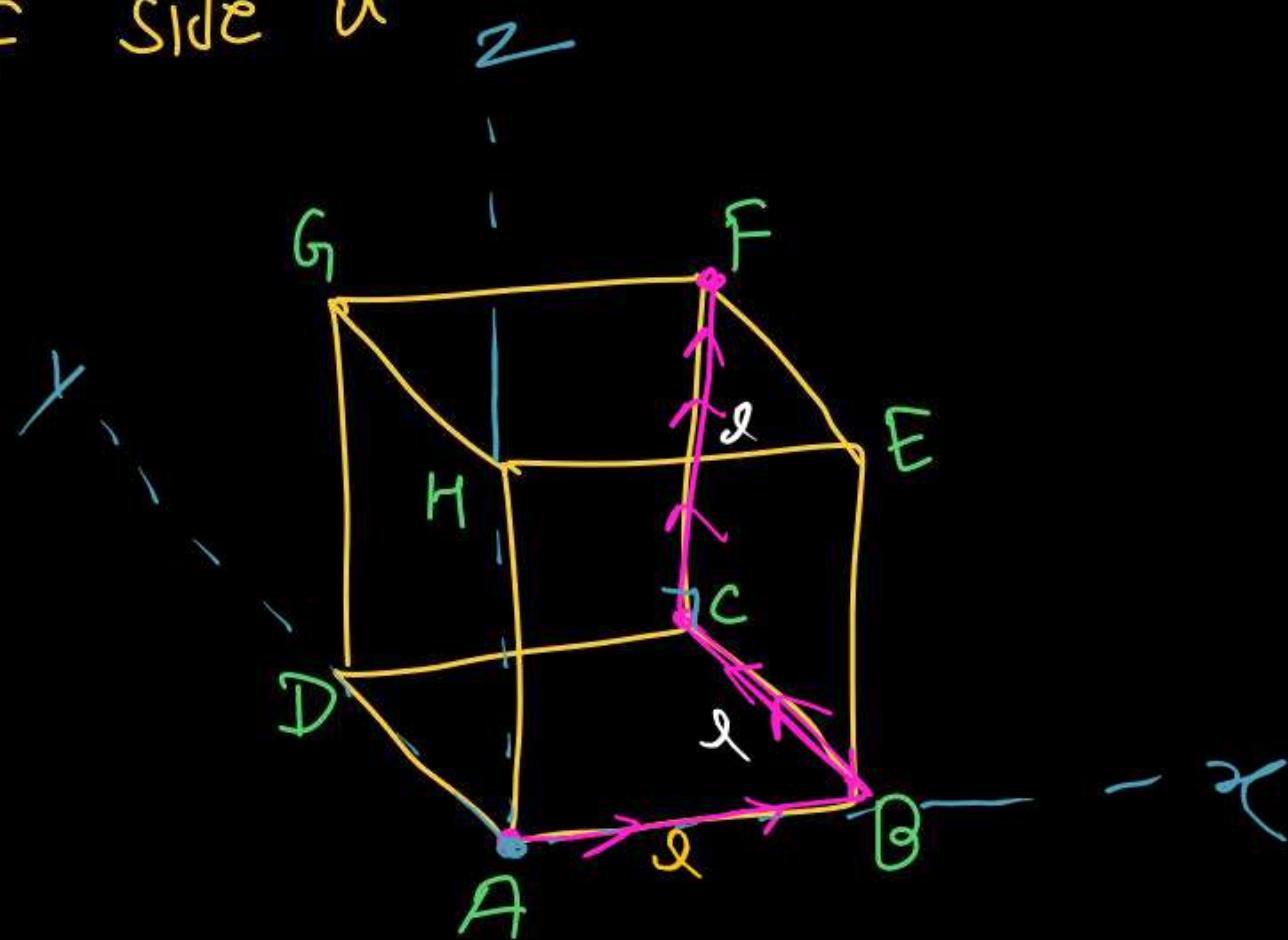


Object moves on a circular path by angle 60° then find ratio of distance to displacement.



H/w

Cube of side a



⑧ $dist^n = 3a$

⑧ $disp^m = a\hat{i} + a\hat{j} + a\hat{k}$
 $|disp| = \sqrt{3}a$

Question

H/W



A butterfly start flying from a corner of the cubical room of side l and reaches to the opposite corner of the room. Find its displacement.

Question

#12



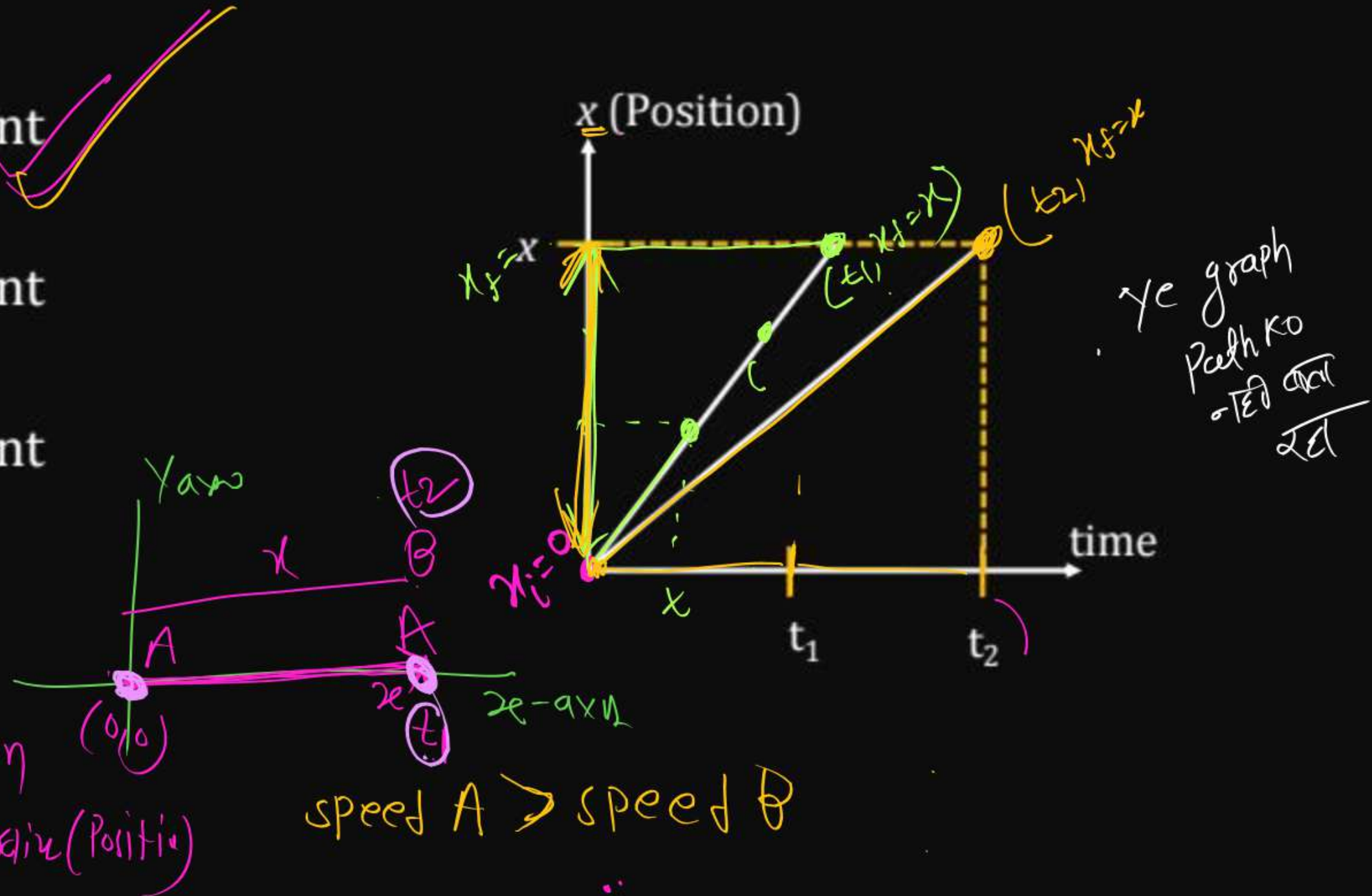
An ant start moving from a corner of the solid cubical room and want to reach opposite of body diagonal find minimum distance moved by ant.

Question

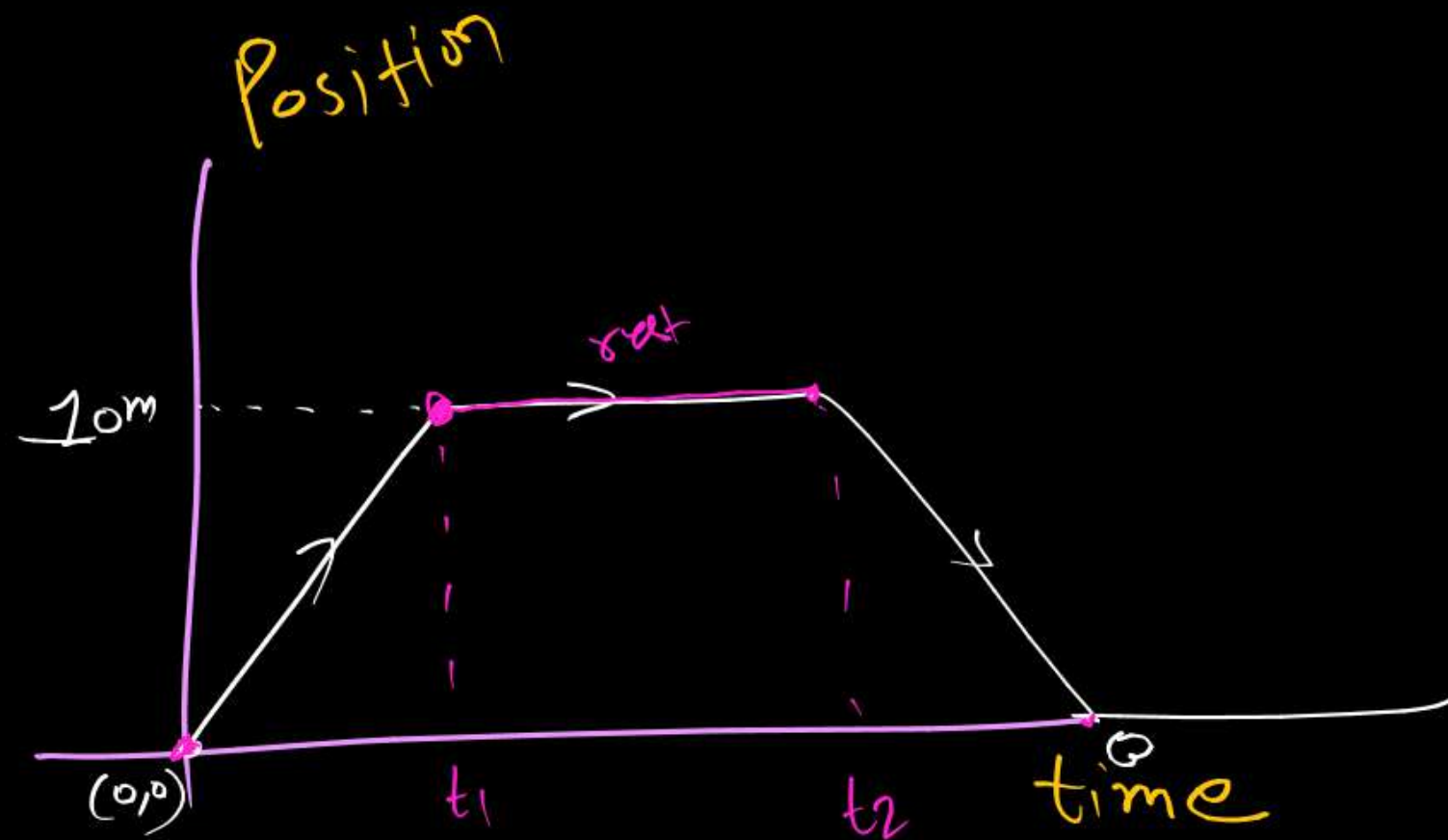


① Position-time graph for two man are moving along x-axis as shown; then find correct relation between

- ① ^{60%} displacement = displacement ✓
- ② ~~displacement > displacement~~
- ③ displacement < displacement
- ④ None of these

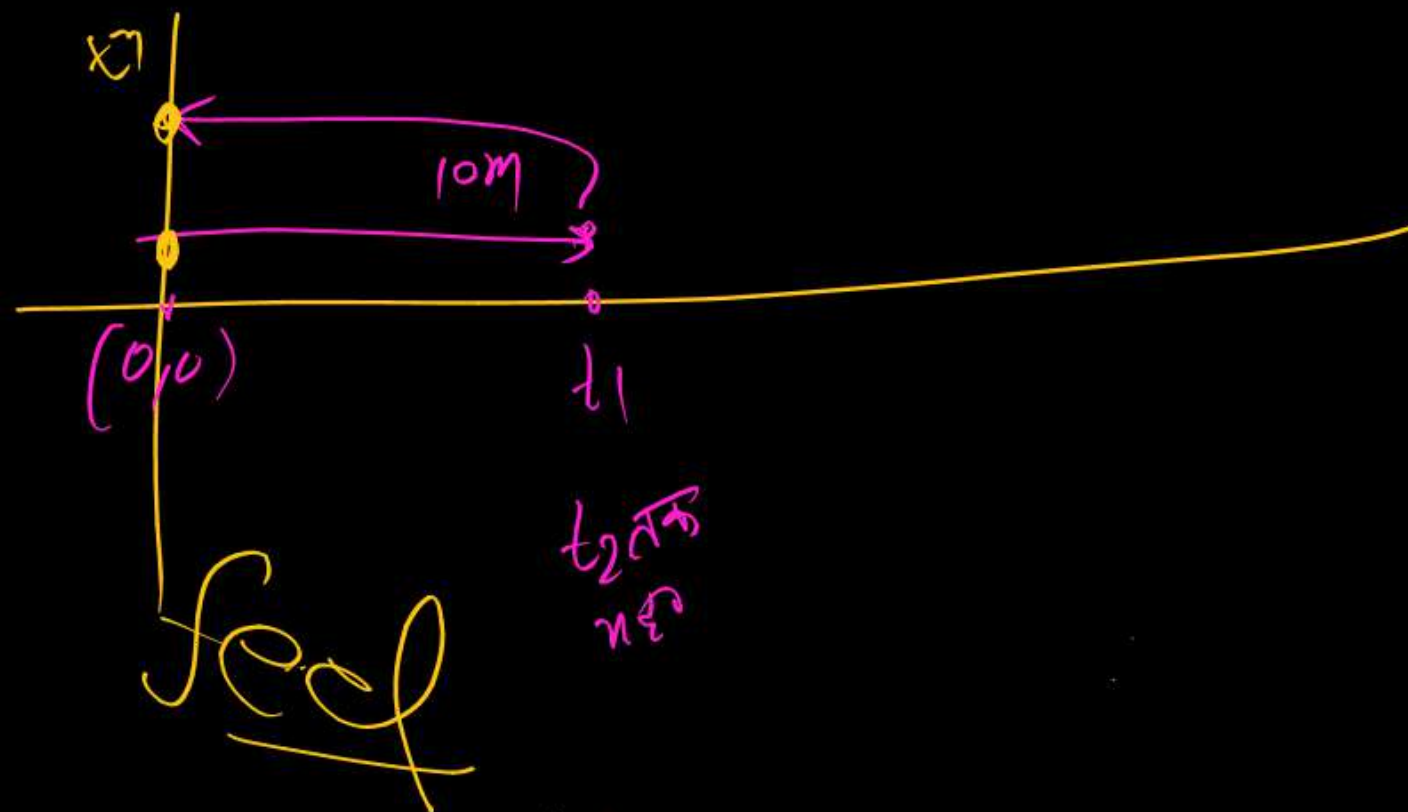


disp^m = Change in position
= change in yth coordinate (Position)

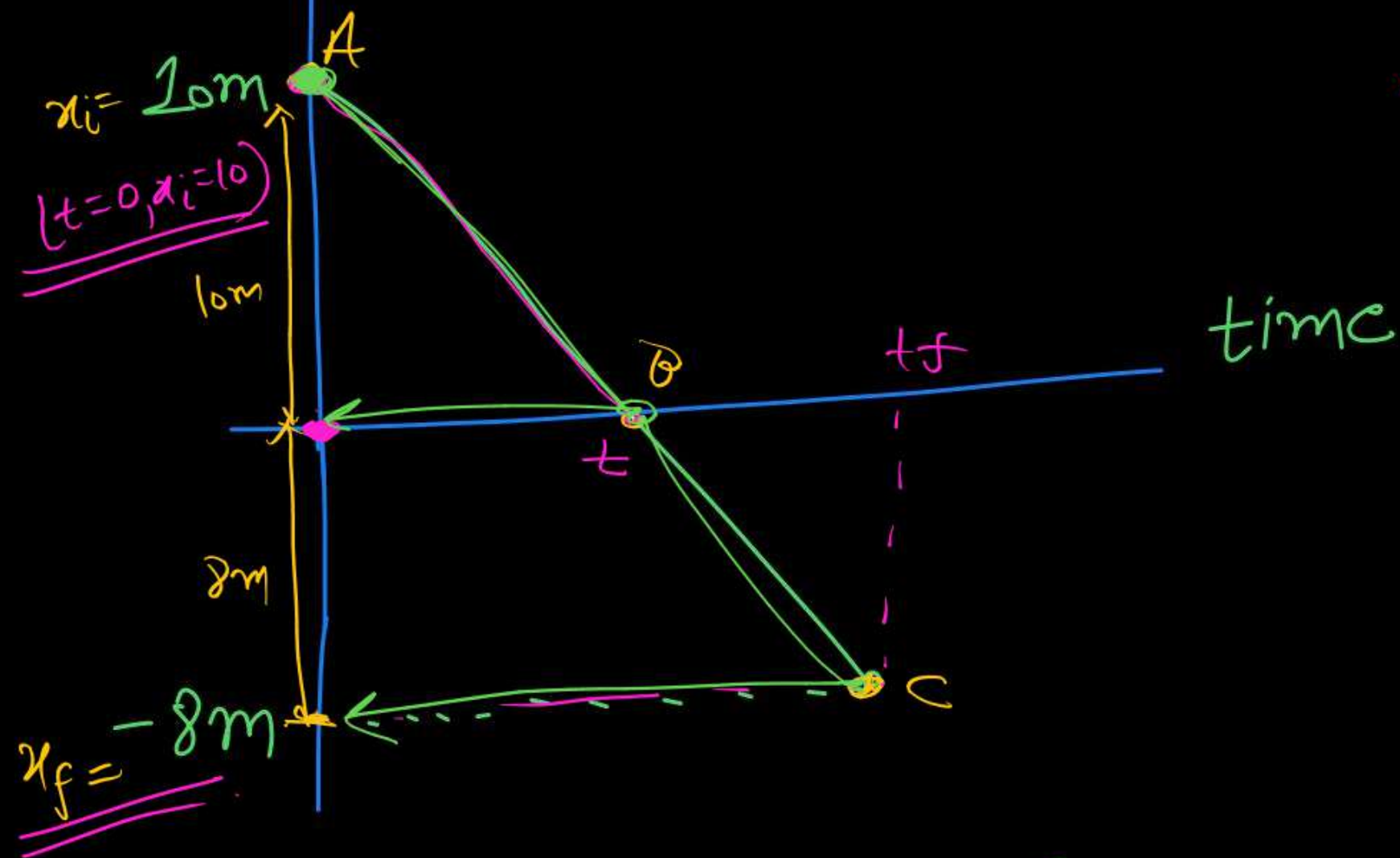


$$|\text{disp}^m|_{AB} = 0$$

$$\text{dist}^m = 20\text{m}$$

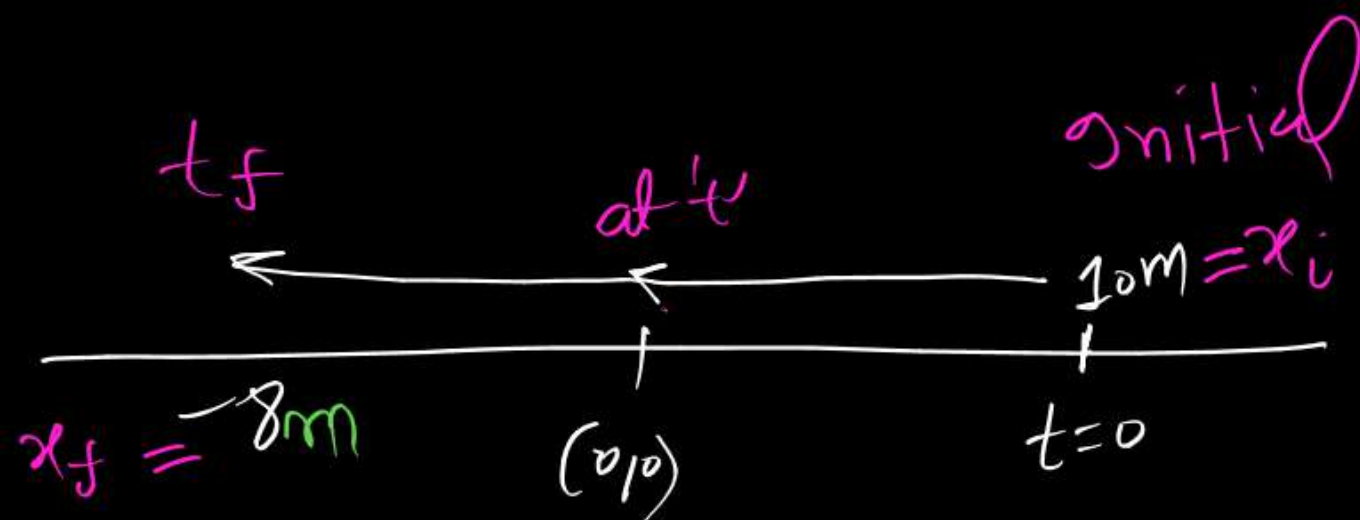


Position



$\text{dist}^n = 18\text{m} \checkmark$
 $\text{disp}^n = -8 - 10 = -18\text{m} \checkmark$

find distance & dispⁿ



No Change in dirⁿ



@MRPHYSICSS

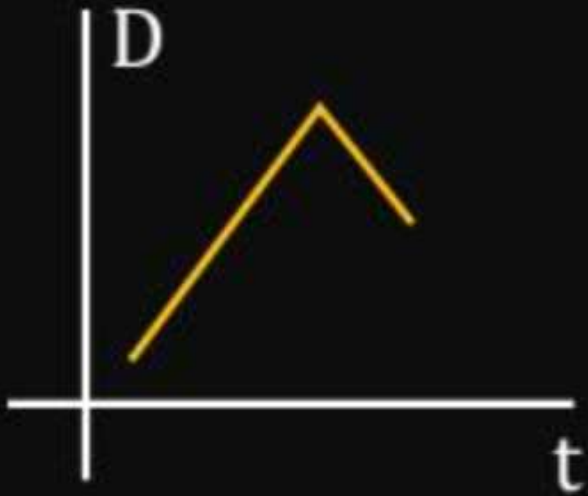
maha-manthan
(sheet)

5m 10s 10s

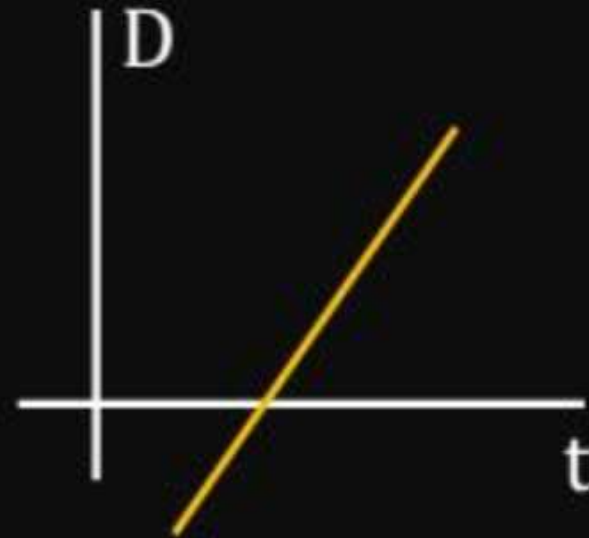
Question

Which of the following graph is correct for distance-time.

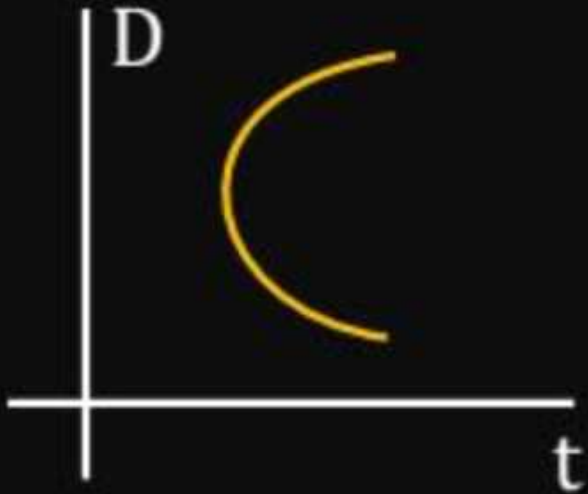
1



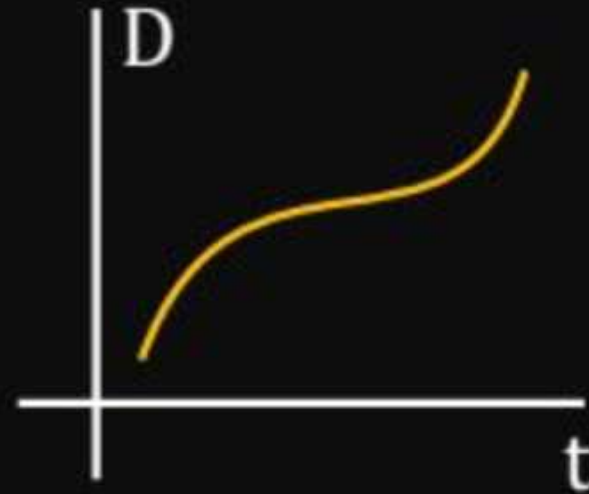
2

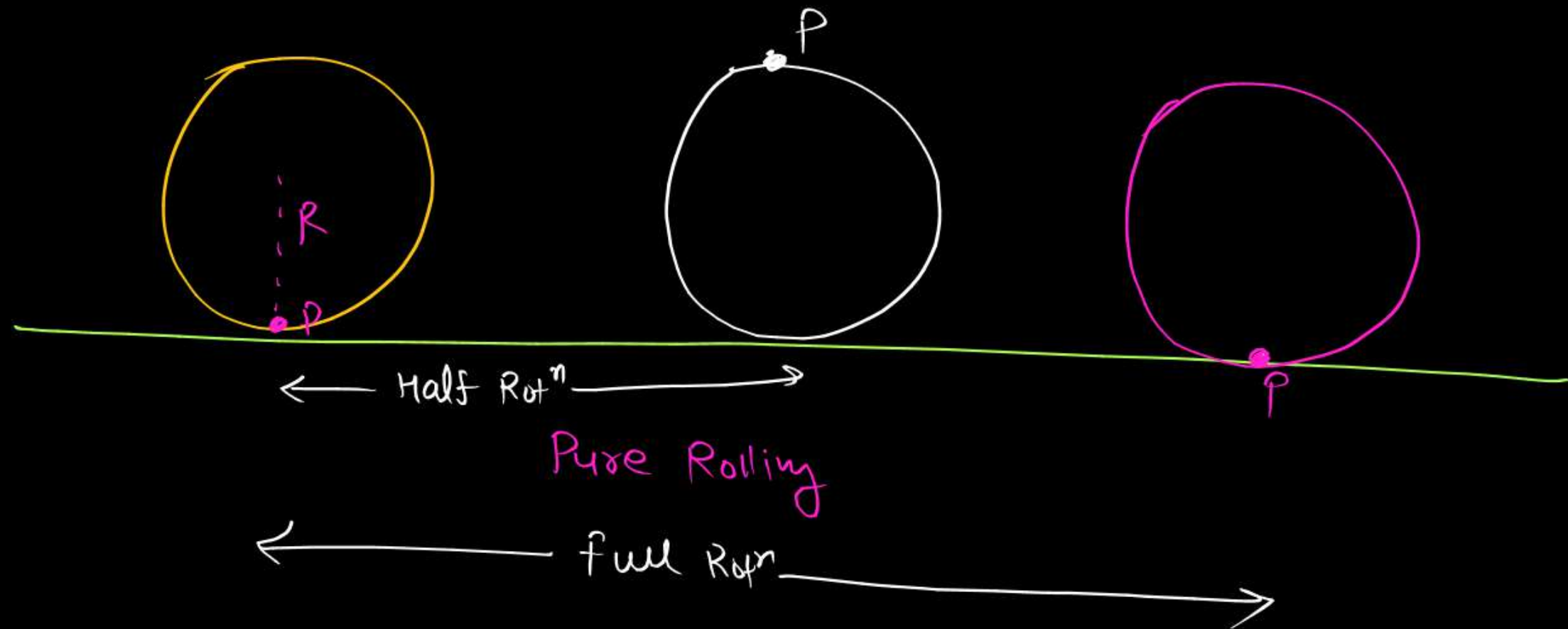


3



4





④ $|disp^m|_P$ in full Rotⁿ = ??
 $|disp^m|_P$ in Half Rotⁿ = ??

} Just Try

Question

HW



A drunkard is walking along a straight road. He takes 5 steps forward and 3 steps backward and so on. Each step is 1 m long and takes 1s. There is a pit on the road 11 m away from the starting point. The drunkard will fall into the pit after:

- 1** 21 s
- 2** 29 s
- 3** 31 s
- 4** 37 s

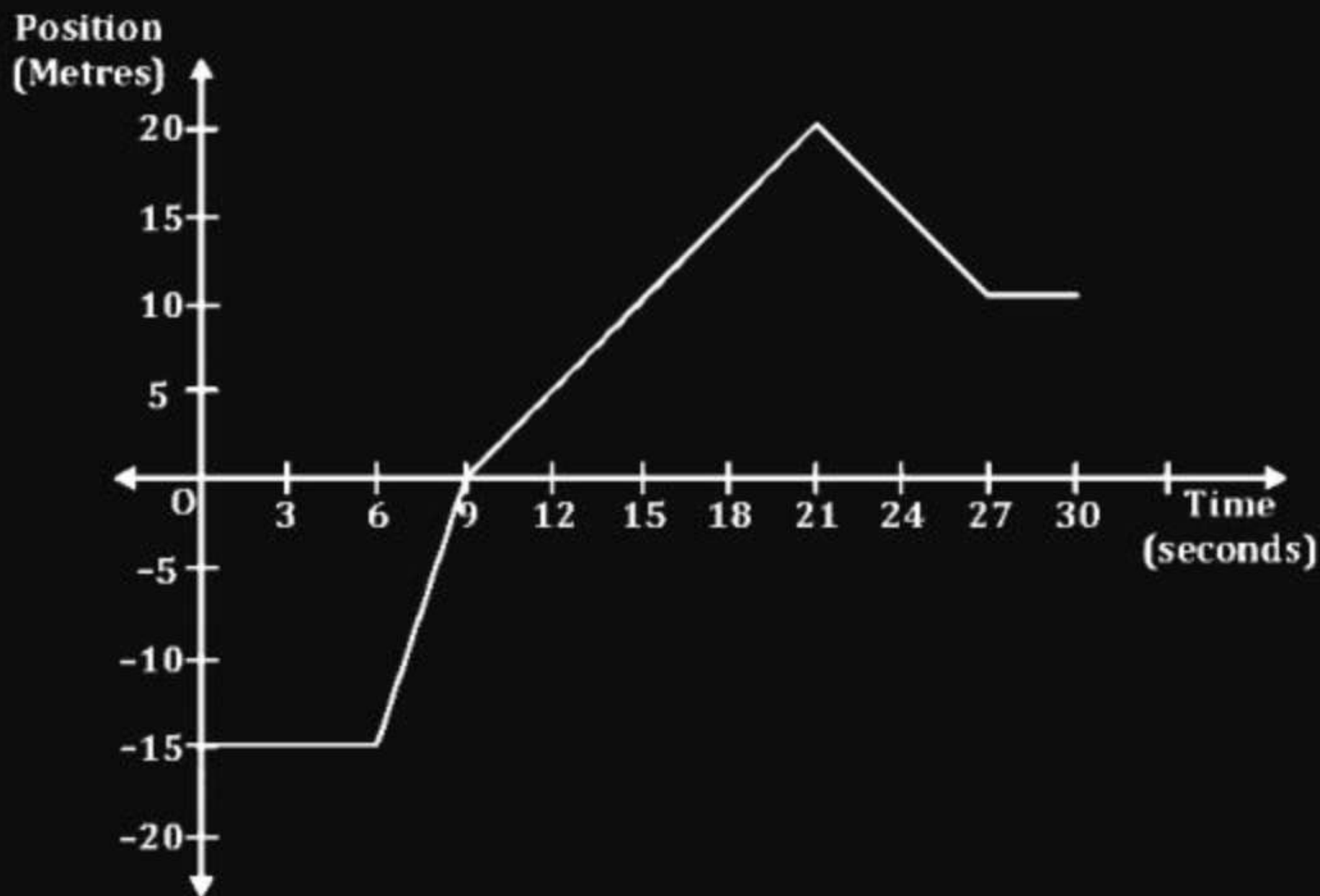
A mosquito net over a $7\text{ ft} \times 4\text{ ft}$ bed is 3 ft high. The net has a hole at one corner of the bed through which a mosquito enters the net. It flies and sits at the diagonally opposite upper corner of the net.

- (a) Find the magnitude of the displacement of the mosquito.
- (b) Taking the hole as the origin, the length of the bed as the X-axis, its width as the Y-axis, and vertically up as the Z-axis, write the components of the displacement vector.

Question



The position-time graph for an elevator travels up and down is given below. Find the distance and displacement of the elevator between 6 seconds and 21 seconds.



n/w

THANK
YOU