

Kinematics - 1

Extra lecture



Distance

How Far

→ Total Path length

magnitude

→ no direction.

→ Scalar

→ distance can not decrease with time

→ distⁿ depends upon path taken.

→ distance always +ve.



→ is not a information of Path.
Displacement

How far / where

→ Have direction
→ (vector)

→ does not depend upon Path.
→ shortest length b/w initial & final position

→ Does not depend on Path
→ disp^m can decrease with time

→ +ve, -ve, zero for moving object.

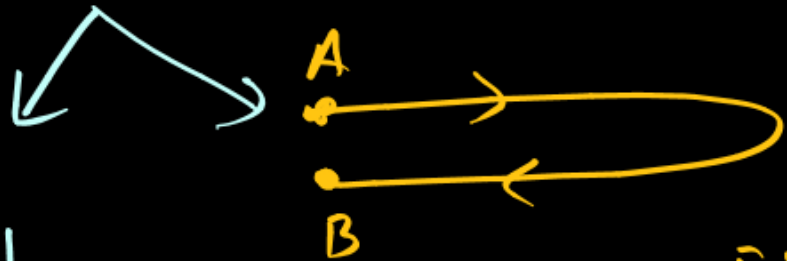
Correct statement among the following is...

- (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. (distⁿ must be zero)
- (d) Distance travelled and displacement are always equal.

Solⁿ

(a) dispⁿ can be zero in two case

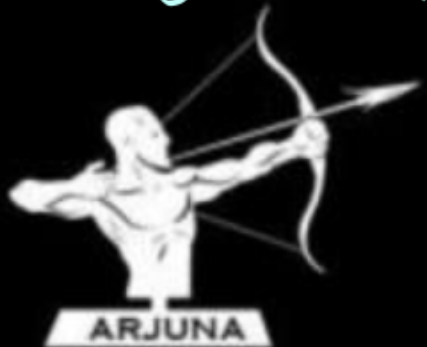
• Object at rest

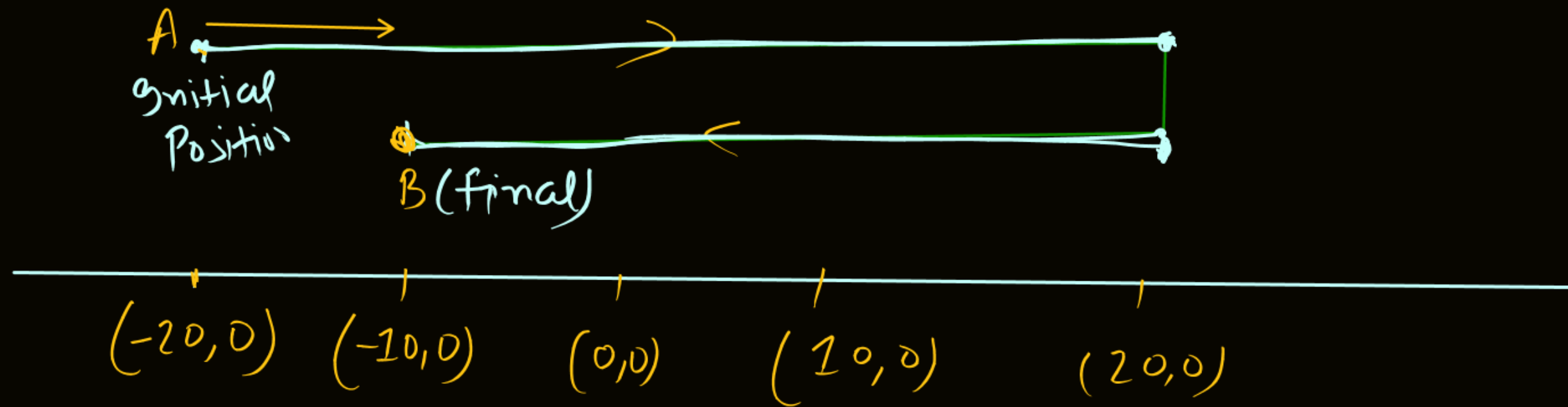


initial & final position
Same $dist^n \neq 0$

→ (option) D

distⁿ & dispⁿ may be equal





$$\text{dist}^n = 70\text{m}$$

$$\text{disp}^n = x_f - x_i$$
$$= -10 - (-20)$$

$\text{disp}^n = 10\text{m}$ (In the direction towards the final position.)

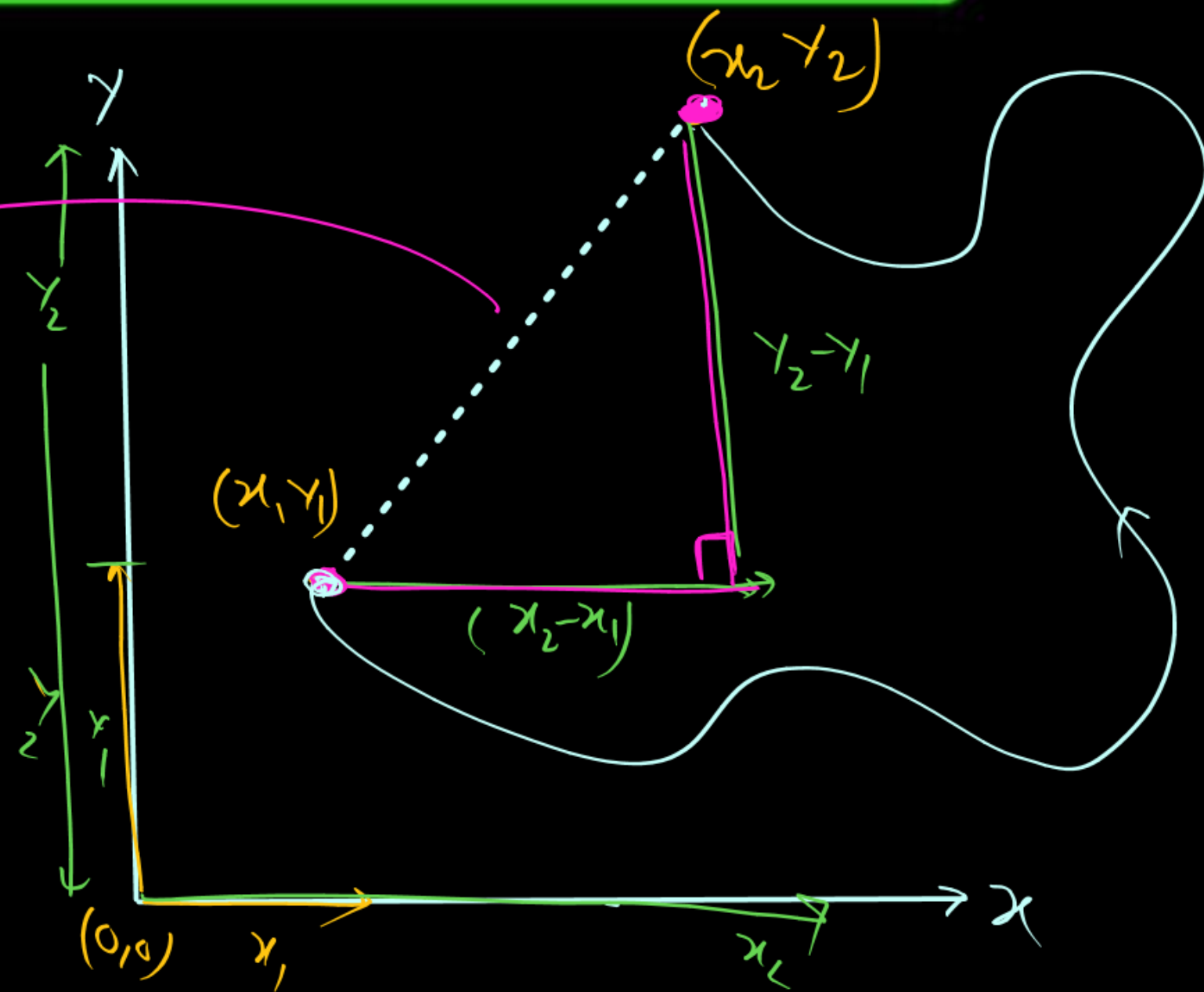
Object moves 6 m in east then 8 m in north and 10 m in vertically upward, then find displacement.



$$\text{disp}^n = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

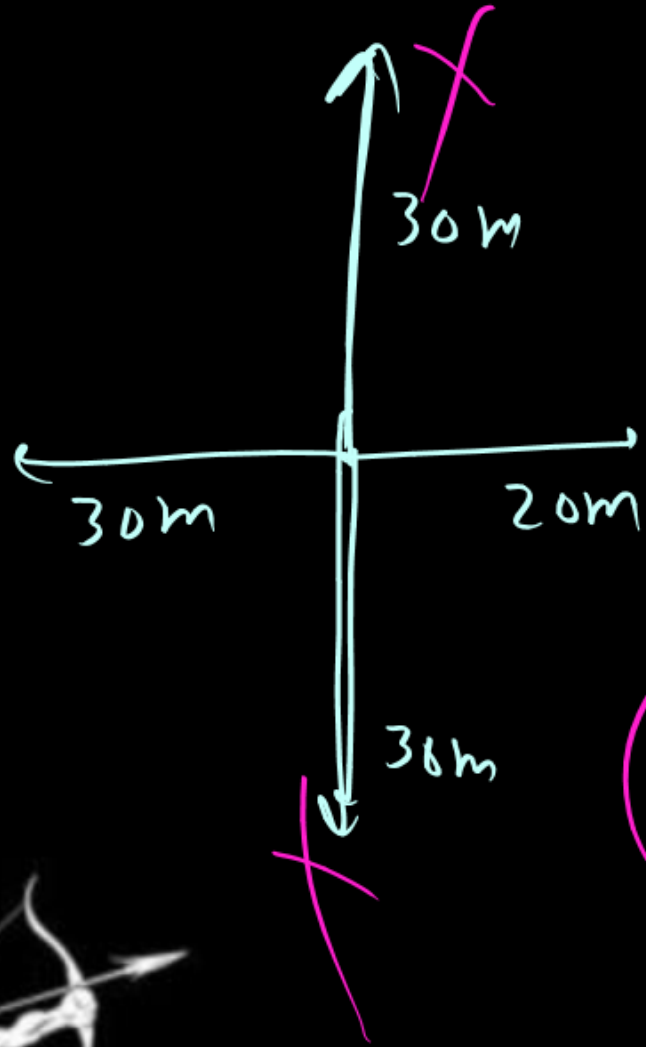
$$\text{disp}^n = \sqrt{(\Delta x)^2 + (\Delta y)^2 + (\Delta z)^2}$$

$$= \underline{\underline{10\sqrt{2}}}$$



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

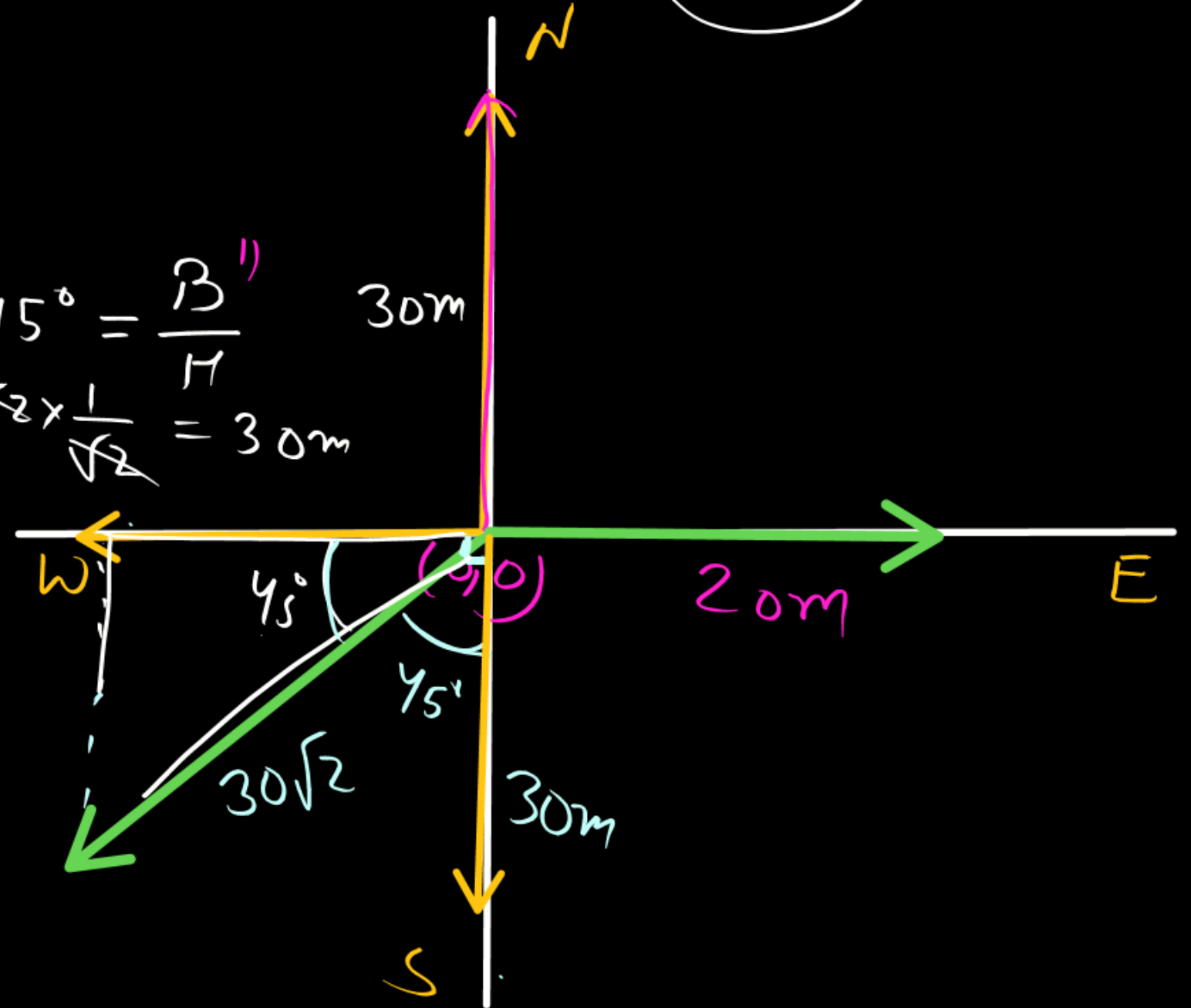
117-



$$\cos 45^\circ = \frac{B}{H}$$

$$B = 30\sqrt{2} \times \frac{1}{\sqrt{2}} = 30\text{m}$$

dispⁿ = 10m West



Distance and displacement on circular path-



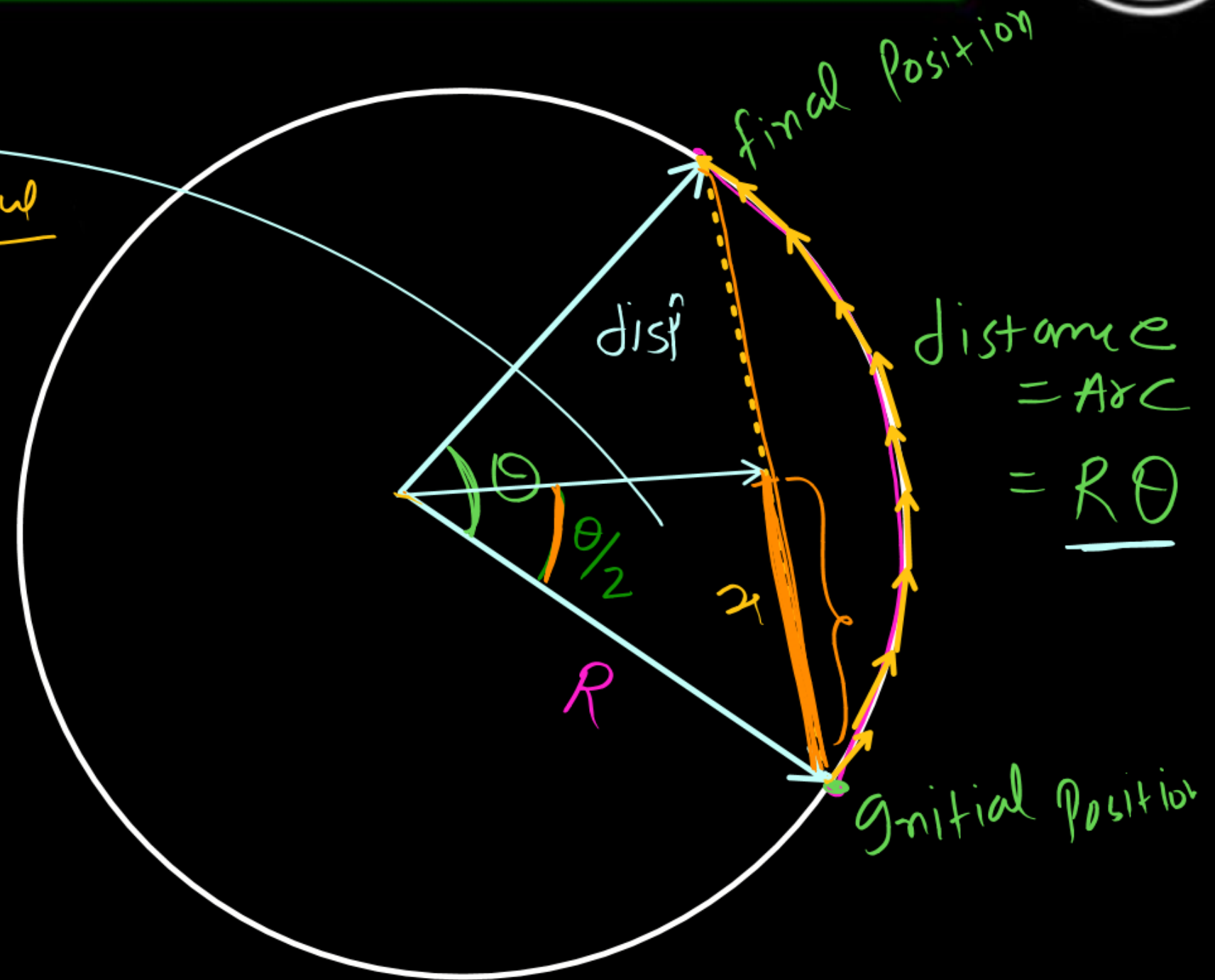
$$\sin(\theta/2) = \frac{\text{perpendicular}}{h}$$

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

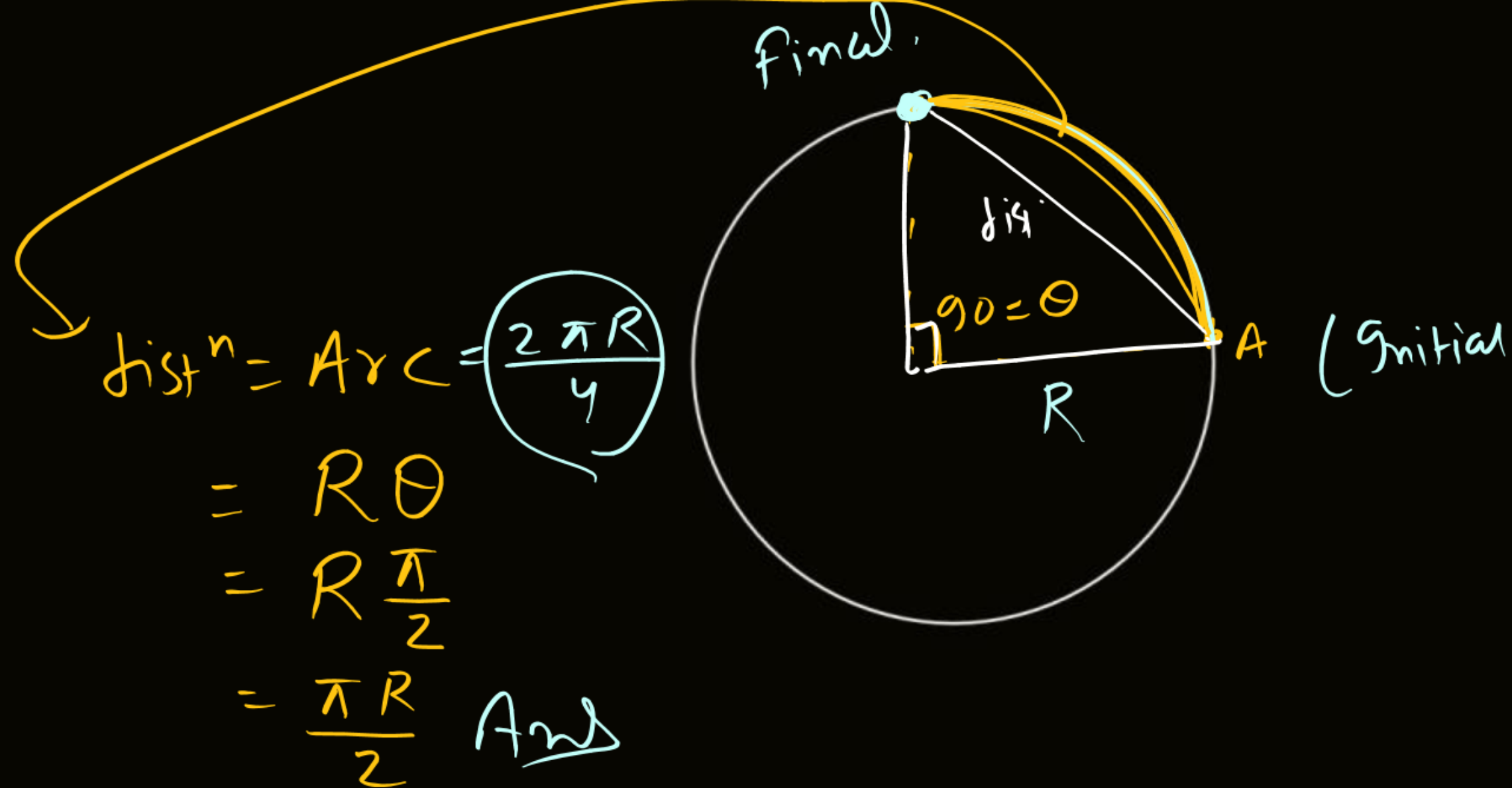
$$x = R \sin(\theta/2)$$

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

→ Ratha



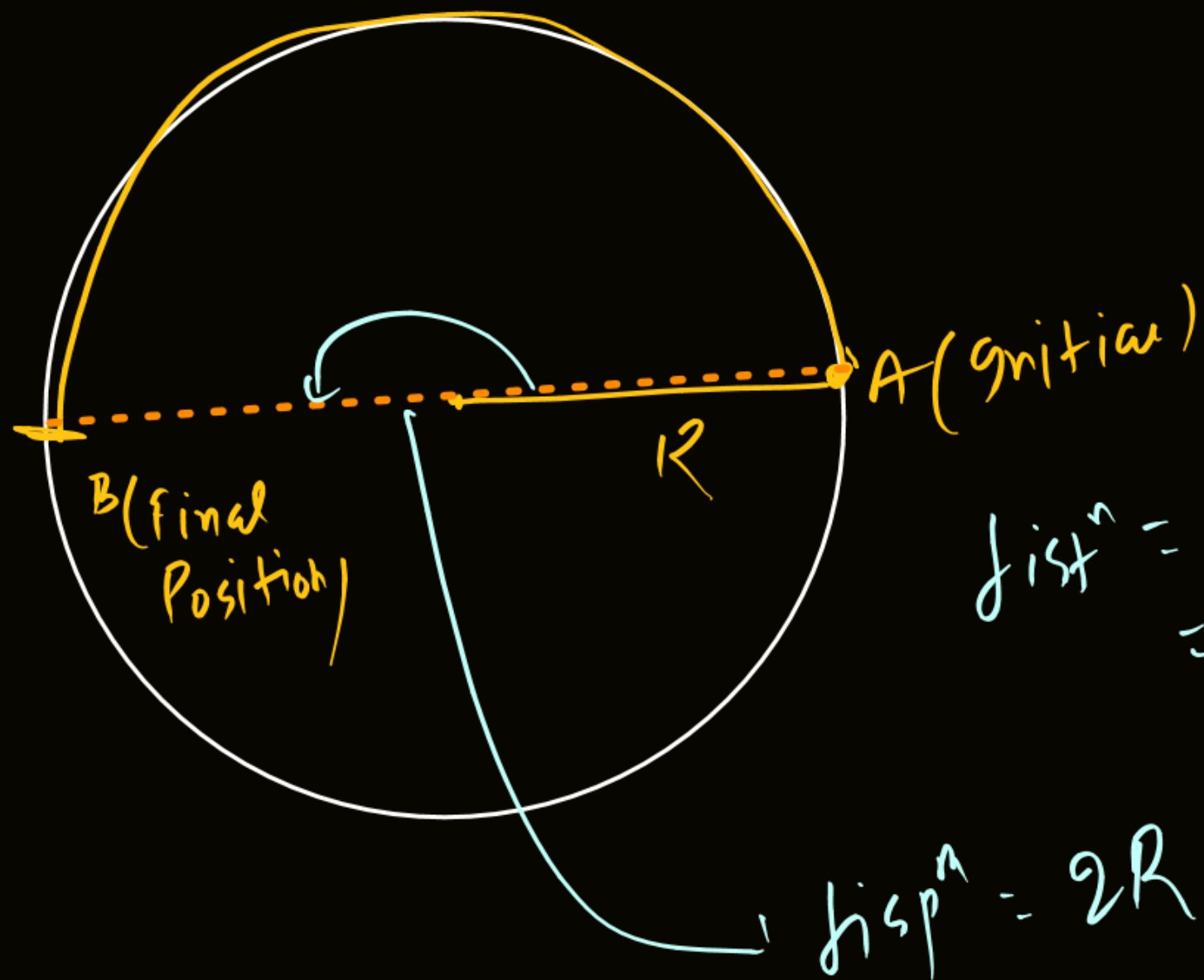
Final.



$$\frac{2}{\sqrt{2}} = \sqrt{2}$$

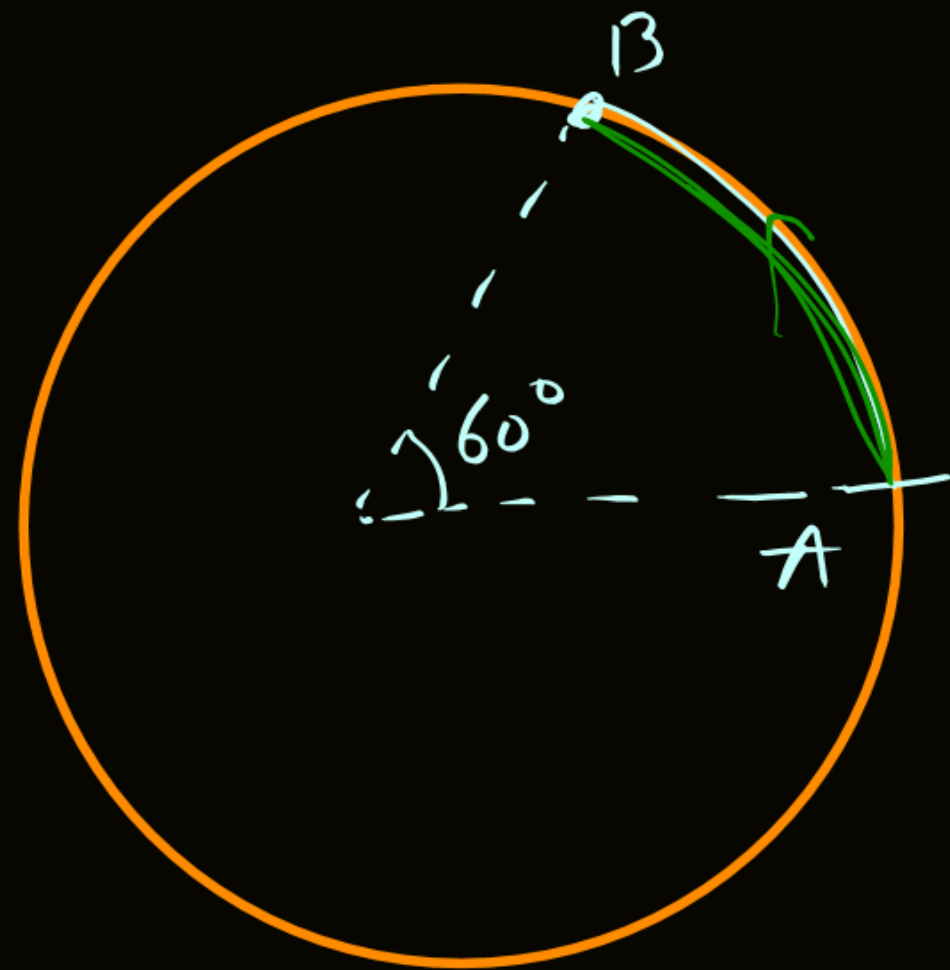
$$\text{disp}^m = 2R \sin(\theta/2) \text{ i.e.}$$

$$= 2R \sin\left(\frac{90}{2}\right) = 2R \frac{1}{\sqrt{2}} = \sqrt{2}R \checkmark$$



$$\text{dist}^n = R\theta = \pi R \text{ m}$$

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



$$|\text{dist}^n|_{A \rightarrow B} = R\theta = \left(\frac{R\pi}{3} \right)$$

$$|\text{disp}^n|_{A \rightarrow B} = 2R \sin\left(\frac{\theta}{2}\right) = R \text{ m}$$

$(0,0)$

$$x = t^2 + 2t - 4$$

↑
position

Q object is moving in 1-D and its position is given as function of time as $x = t^2 + 2t - 4$ then find position at $t = 0$ sec.

$$\# \quad (x)_{t=0} = -4 \text{ m}$$

$$\# \quad x_{t=1 \text{ sec}} = (1)^2 + 2 \times 1 - 4 = -1 \text{ m}$$

$$x_{(t=2)} = (2)^2 + 2 \times 2 - 4 = 4 \text{ m}$$

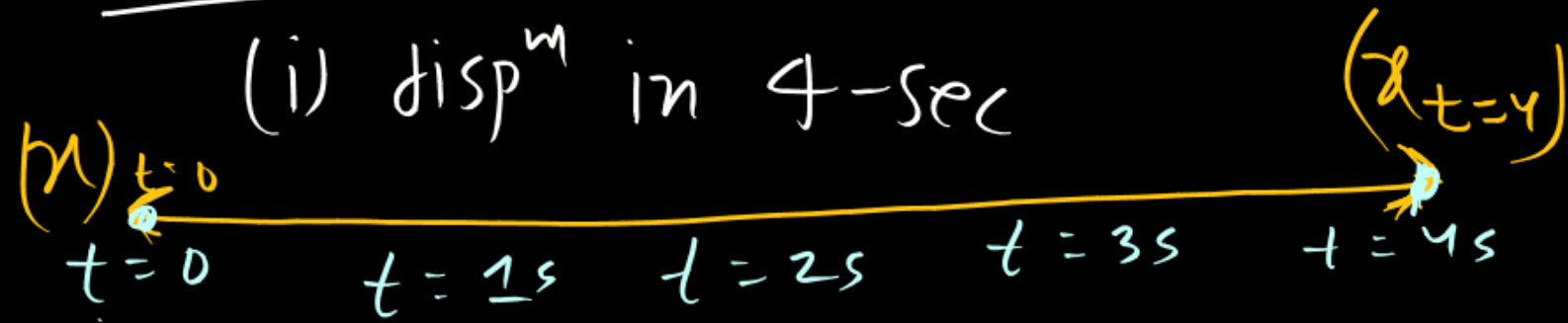
$$x_{(t=3)} = (3)^2 + 2 \times 3 - 4 = 11 \text{ m}$$

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

(i) 4 sec

(ii) 4th sec

Solⁿ

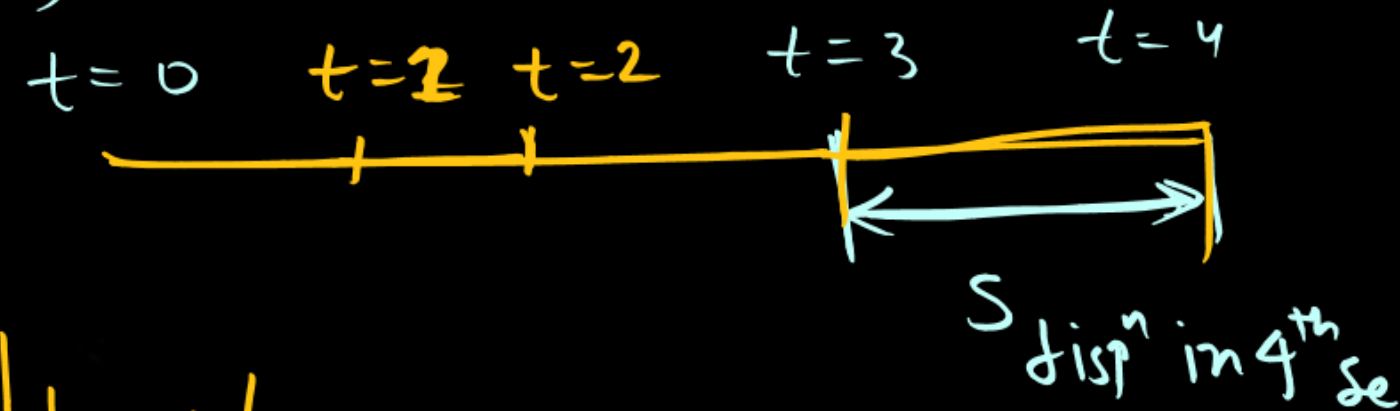


$$\text{dis}^m = x_f - (x_i)_{t=0}$$

$$= (16+8) - 0$$

$$= \underline{24m}$$

(ii) disp^m in 4th sec.



$$|\text{dis}^m|_{4^{\text{th}} \text{ sec}} = x_{t=4s} - x_{t=3s}$$

$$= (24) - 15$$

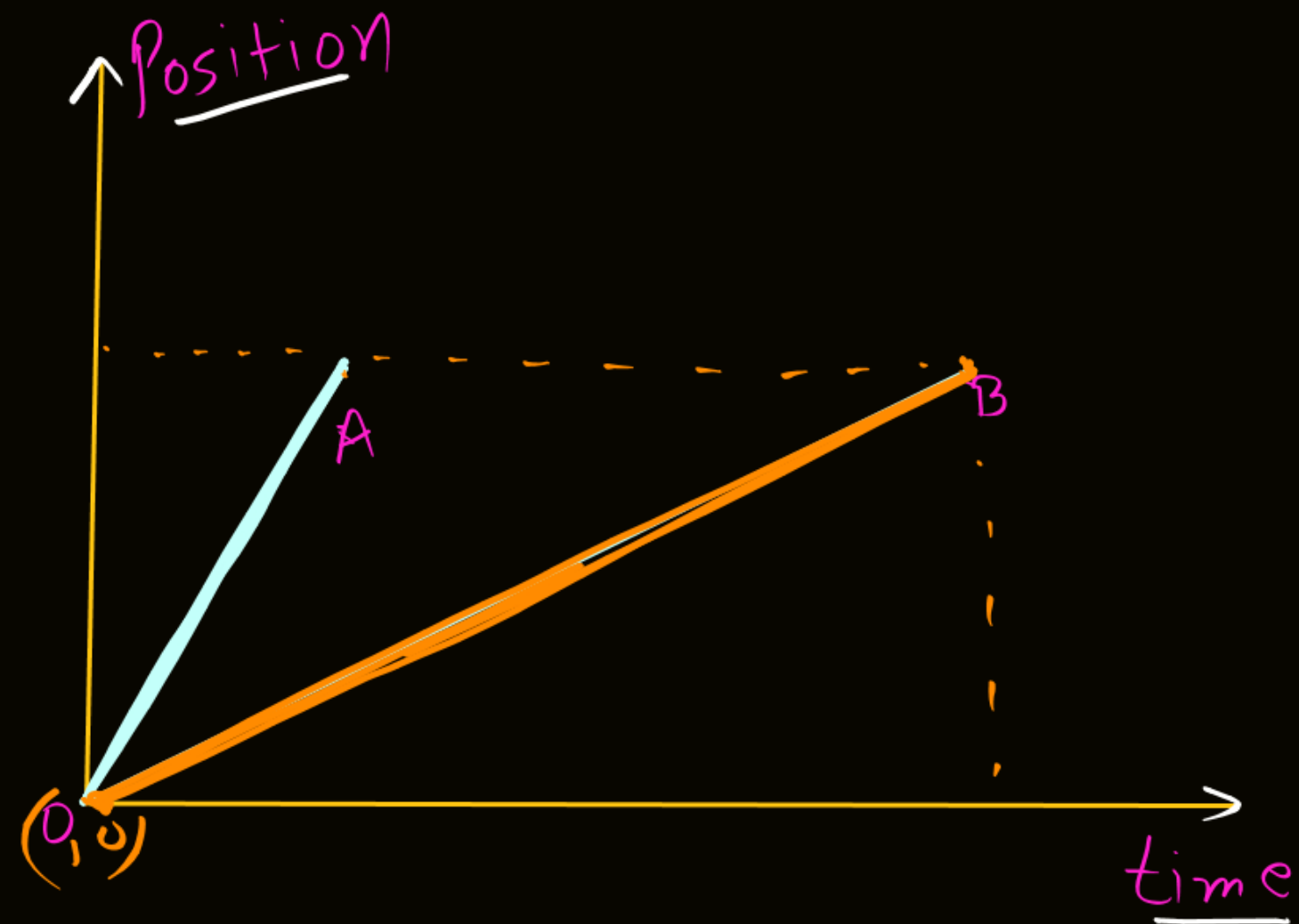
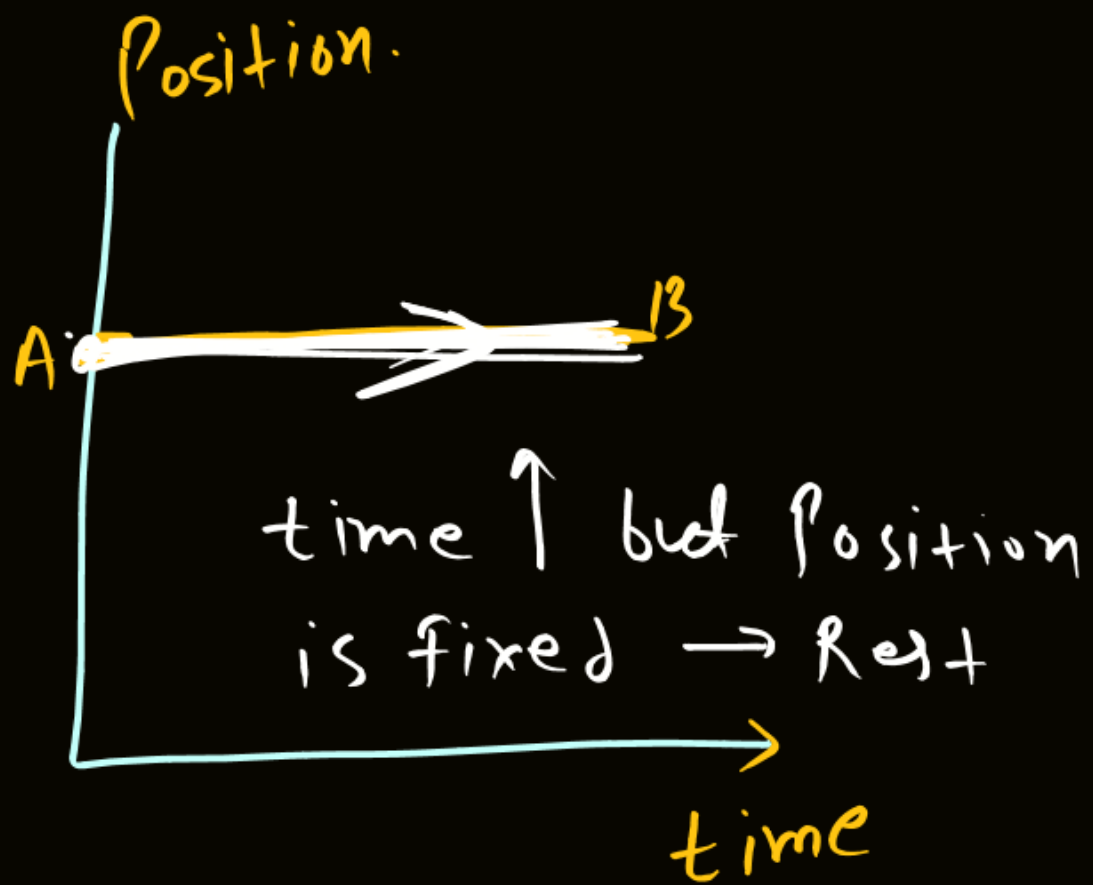
$$= \underline{9m}$$



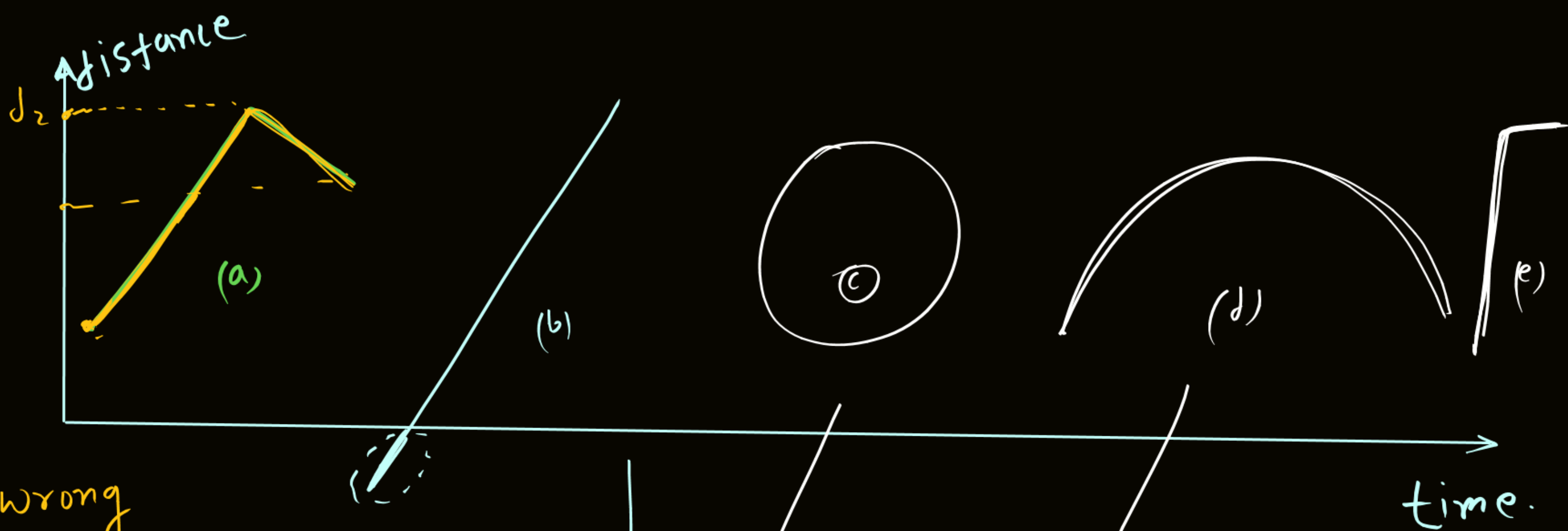
Position of object is given as $x = t^2 + 2t - 4$
then find (i) displacement in 2-sec (ii) Position at $t=2$

Solⁿ (i) $|\text{disp}^m| = (x_f)_{t=2} - (x_i)_{t=0}$

(ii) Position $(x)_{t=2} =$



- (i) $\text{disp}^m_A > \text{disp}^m_B$
- (ii) $\text{disp}^m_B > \text{disp}^m_A$
- (iii) $|\text{disp}^m|_A = \text{disp}^m_B$



(a) wrong

distⁿ can't decres with time

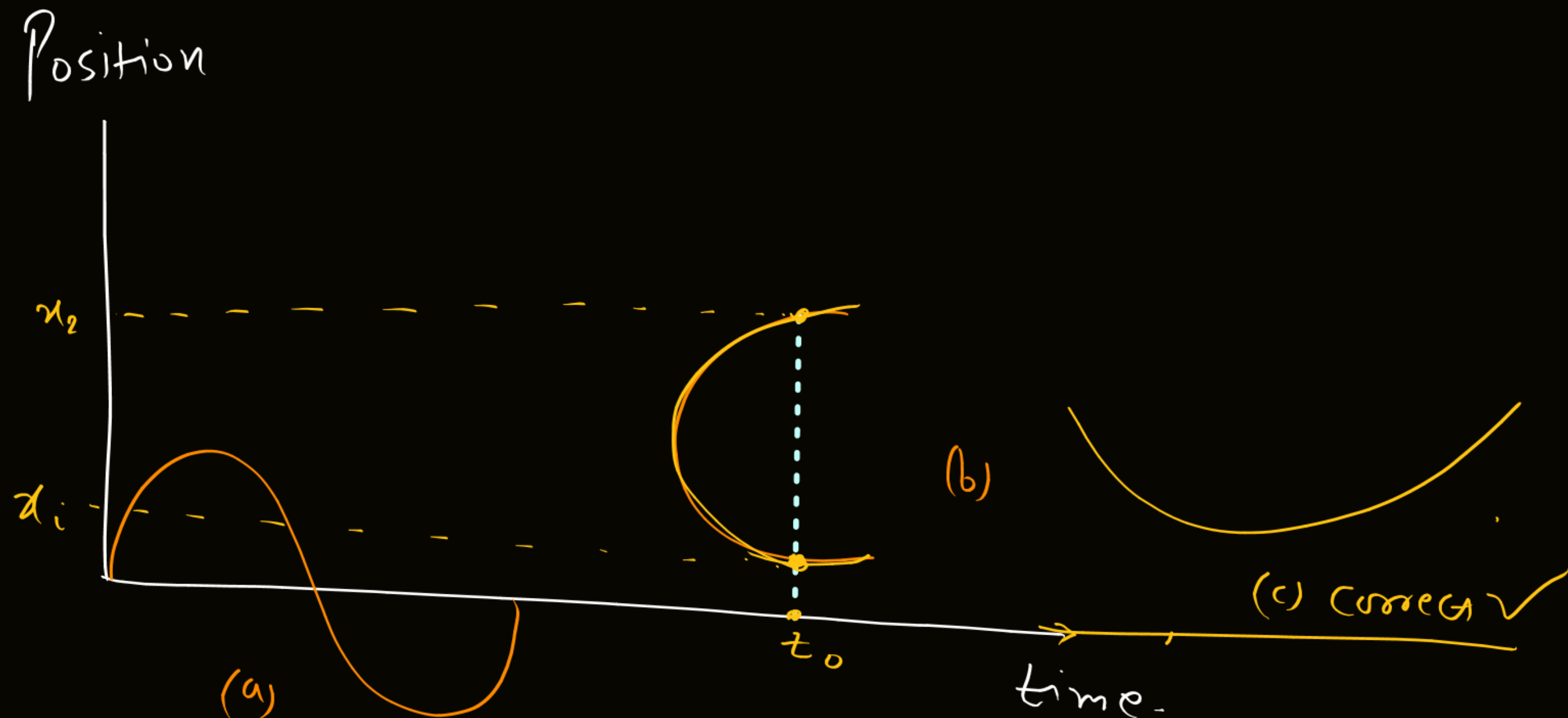
(b) wrong

distⁿ can't be -ve

wrong

wrong

(e)
correct



Correct (a)

(b) Wrong (At a same time two position is not possible)