

YAKEEN NEET 2.0

2026

Motion in a Straight Line

Physics

Lecture -

10

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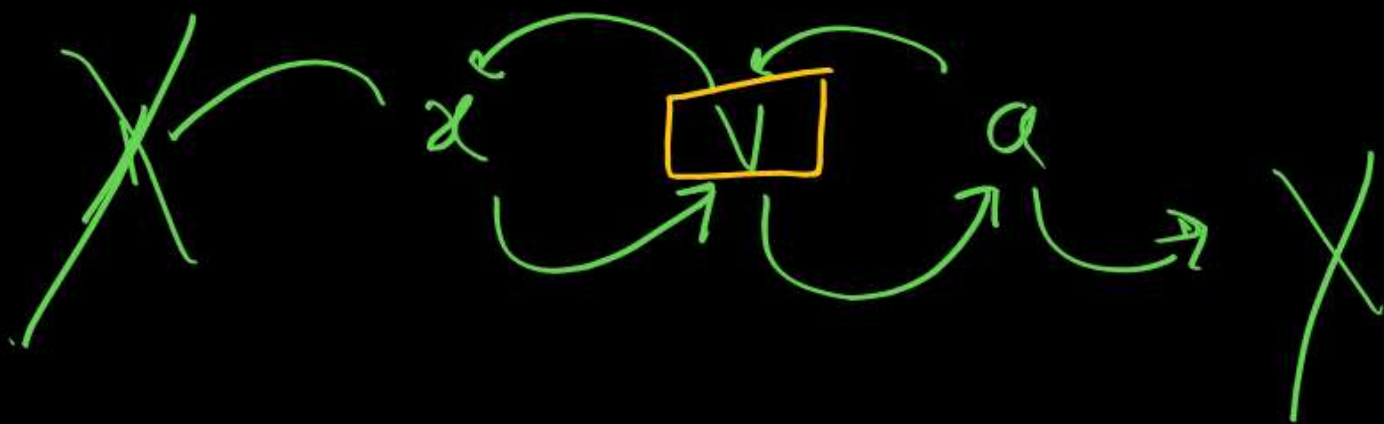




Today's goal

Velocity-time graph :-

accⁿ-time graph



MR* Box for graph

$$\Delta x = \int v dt$$

Area of v/t graph

$$\Delta v = \int a dt$$

Area of a/t graph

$$\Delta x = \int v dt$$

Area of v/t graph

Position (x)

velocity (v)

accⁿ (a)

slope of a/t graph is = $\frac{\Delta v}{\Delta t}$



$$v = \frac{dx}{dt}$$

slope of x/t graph is velocity

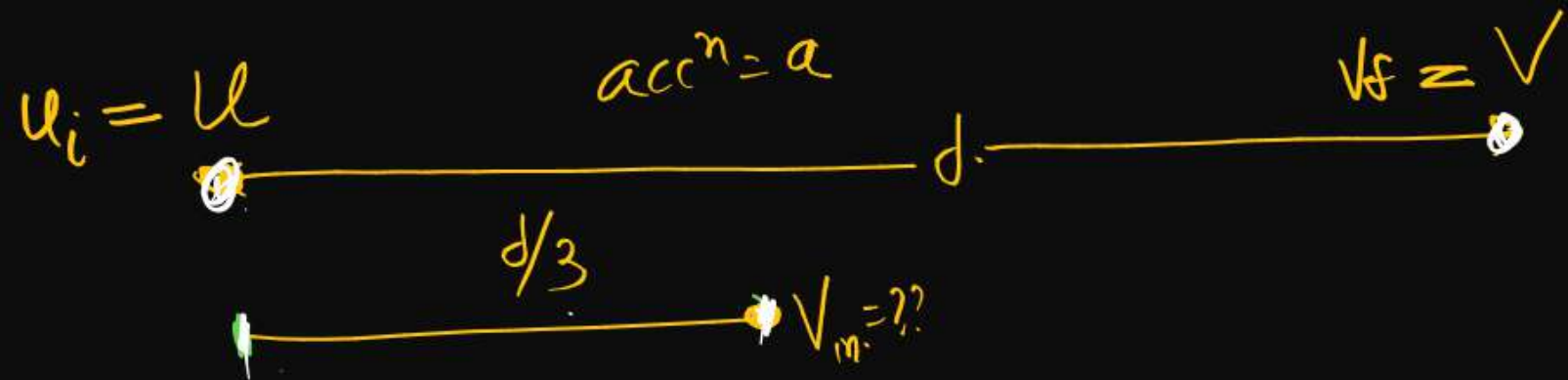
$$a = \frac{dv}{dt}$$

slope of v/t graph is accⁿ

Question



Object starts his motion with u and constant acceleration a then find its velocity at one 3rd displacement of complete journey if final velocity is V .



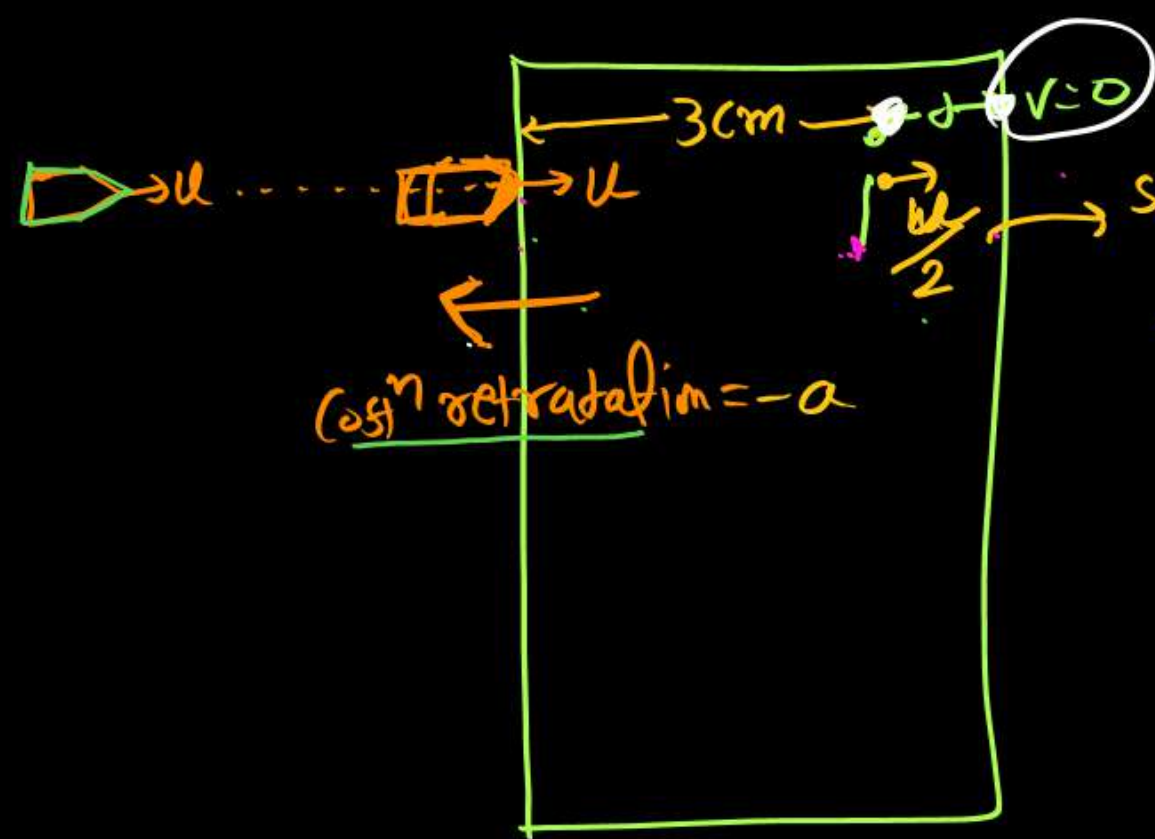
Comp^t Journey

$$V^2 - u^2 = 2ad \quad \text{--- (1)}$$

$$v_m^2 - u^2 = 2a \frac{d}{3} \quad \text{--- (2)}$$

$$V^2 - u^2 = 3(v_m^2 - u^2)$$

$$V^2 - u^2 = 3v_m^2 - 3u^2$$
$$V^2 + 2u^2 = 3v_m^2$$
$$v_m = \sqrt{\frac{V^2 + 2u^2}{3}}$$



const retardation = $-a$

Plank.

speed after 3cm becomes half;
then find after how much distance it will stop:—

Solⁿ given $u_i = u$ $v_f = u/2$
← $d = 3\text{cm}$ →

3rd eqⁿ of
motion from
 u to $u/2$

$$\left(\frac{u}{2}\right)^2 - u^2 = -2a \times 3\text{cm} \quad \text{--- (i)}$$

from $u/2$ to
zero.

$$0 - \left(\frac{u}{2}\right)^2 = -2a \times d\text{cm} \quad \text{--- (ii)}$$

#

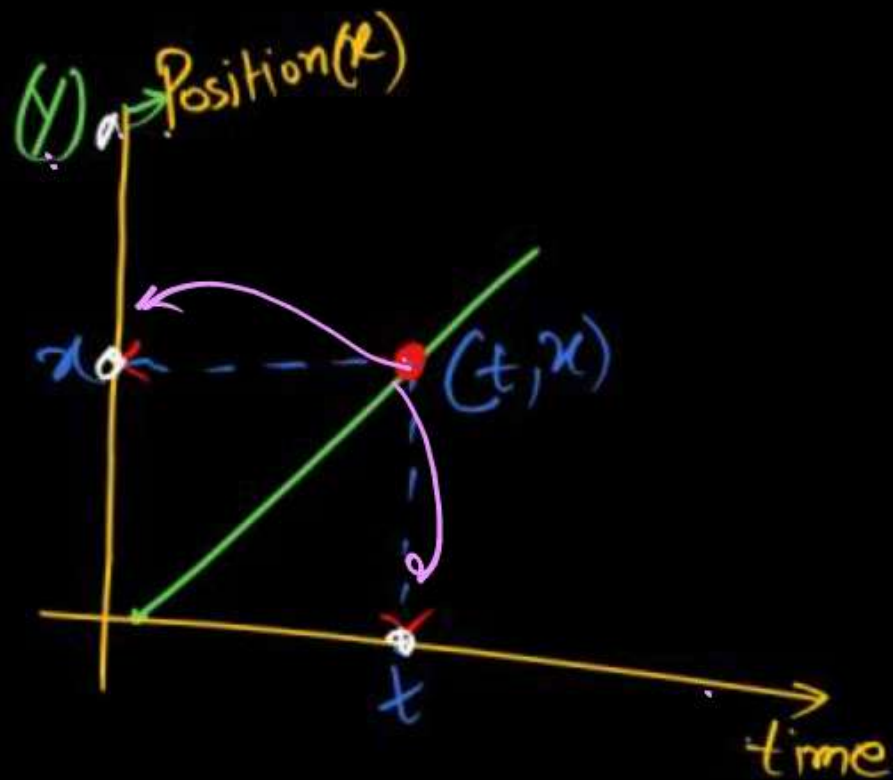
from initial position of
cassⁿ is $(3+1) = 4\text{cm}$

$$\frac{\frac{u^2}{4} - u^2}{-\frac{u^2}{4}} = \frac{-2a \times 3}{-2a d}$$

$$\Rightarrow \frac{\frac{1}{4} - 1}{-1/4} = \frac{3}{d}$$

$d = 1\text{cm}$

Ans.



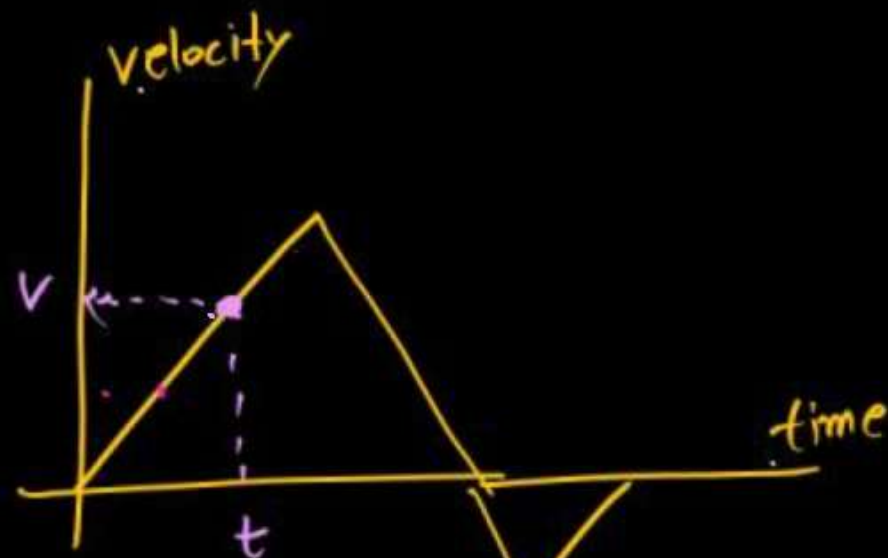
$$\text{Slope} = \frac{dy}{dx} \quad \begin{matrix} \text{Position} \\ x = \text{time} \end{matrix}$$

$$\# \text{ Slope} = \frac{dx}{dt} = \text{velocity}$$

y^{th} co-ordinate \rightarrow Position

x^{th} co-ordinate \rightarrow time

\times Area $\int x dt = \text{time}$



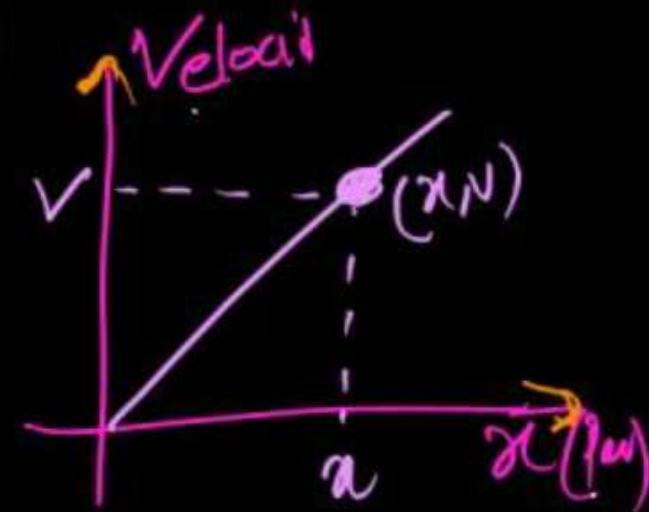
y^{th} co-ordinate \rightarrow velocity

x^{th} co-ordinate \rightarrow time

$$\text{Slope} = \frac{dv}{dt} = \text{acc}^n$$

Area under curve = disp^m

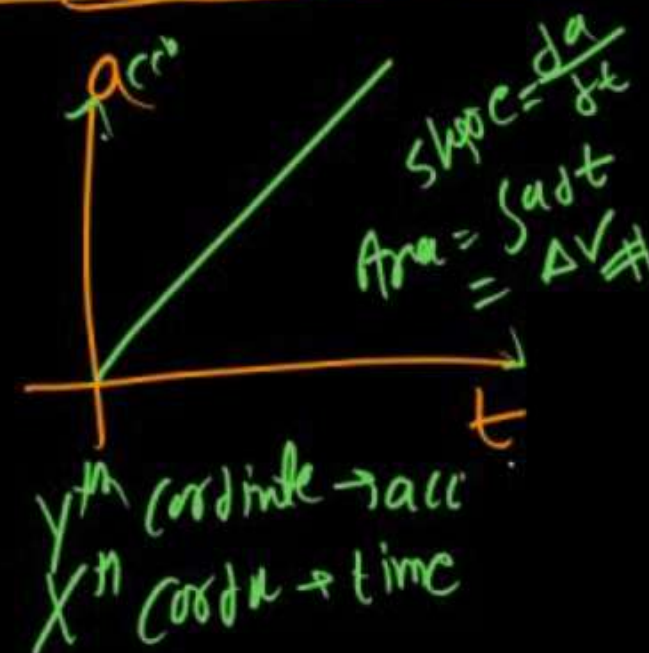
$$\text{change in position} = \int v dt = \text{disp}^m$$



y^{th} co-ordinate \rightarrow velocity

x^{th} co-ordinate \rightarrow position

$$\# \text{ Slope} = \frac{dv}{dx}$$

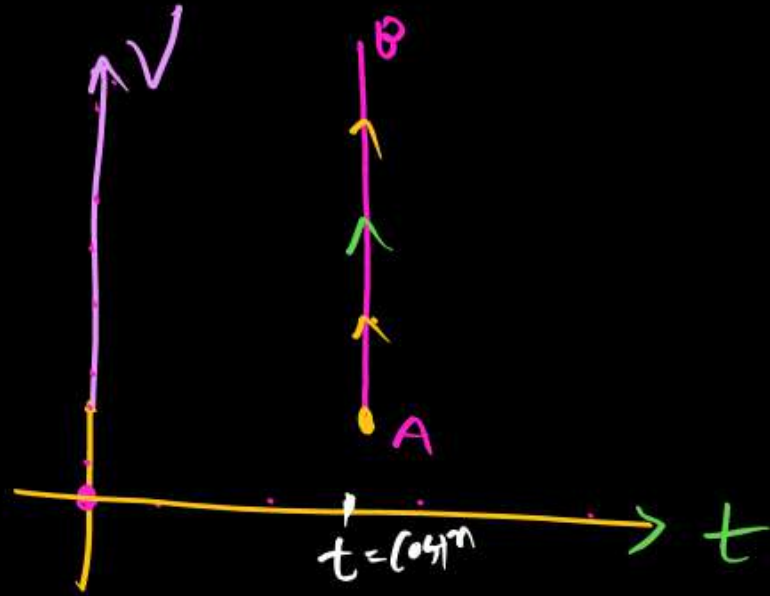


y^{th} co-ordinate \rightarrow acc

x^{th} co-ordinate \rightarrow time

Velocity - time graph :-

①



~~scam $\frac{m}{s}$~~
(a) velocity \uparrow

(b) velocity \downarrow

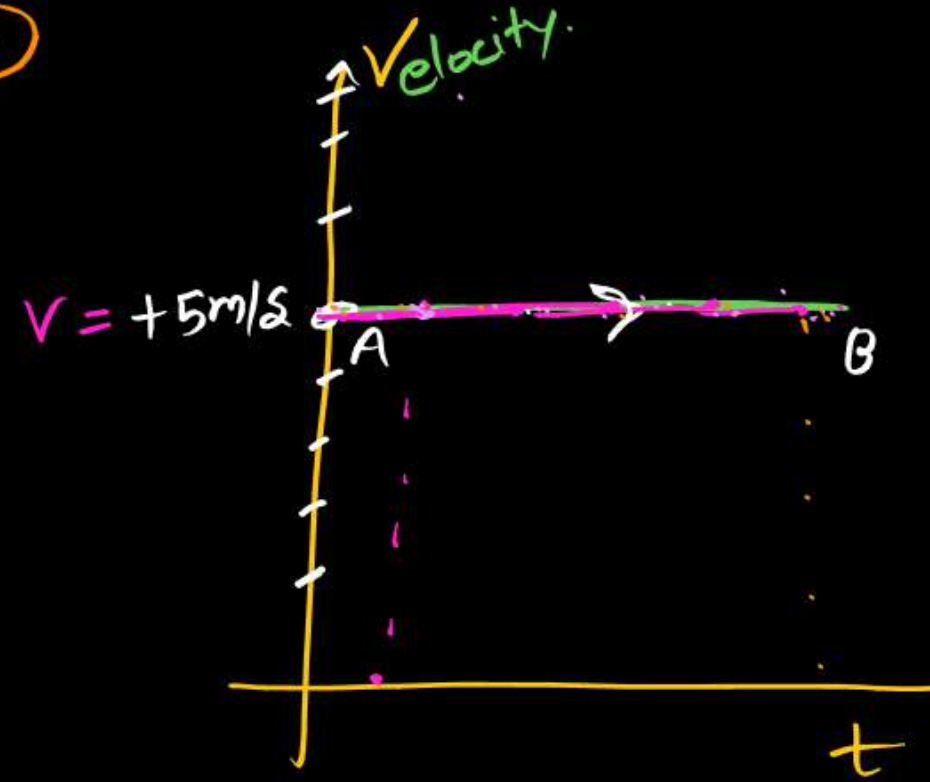
(c) const velu

(d) kuch nahi hoga bekar hai

wrong graph.

ek hi time pe
velocity increase

②



Object is moving with $+5m/s$ const velu

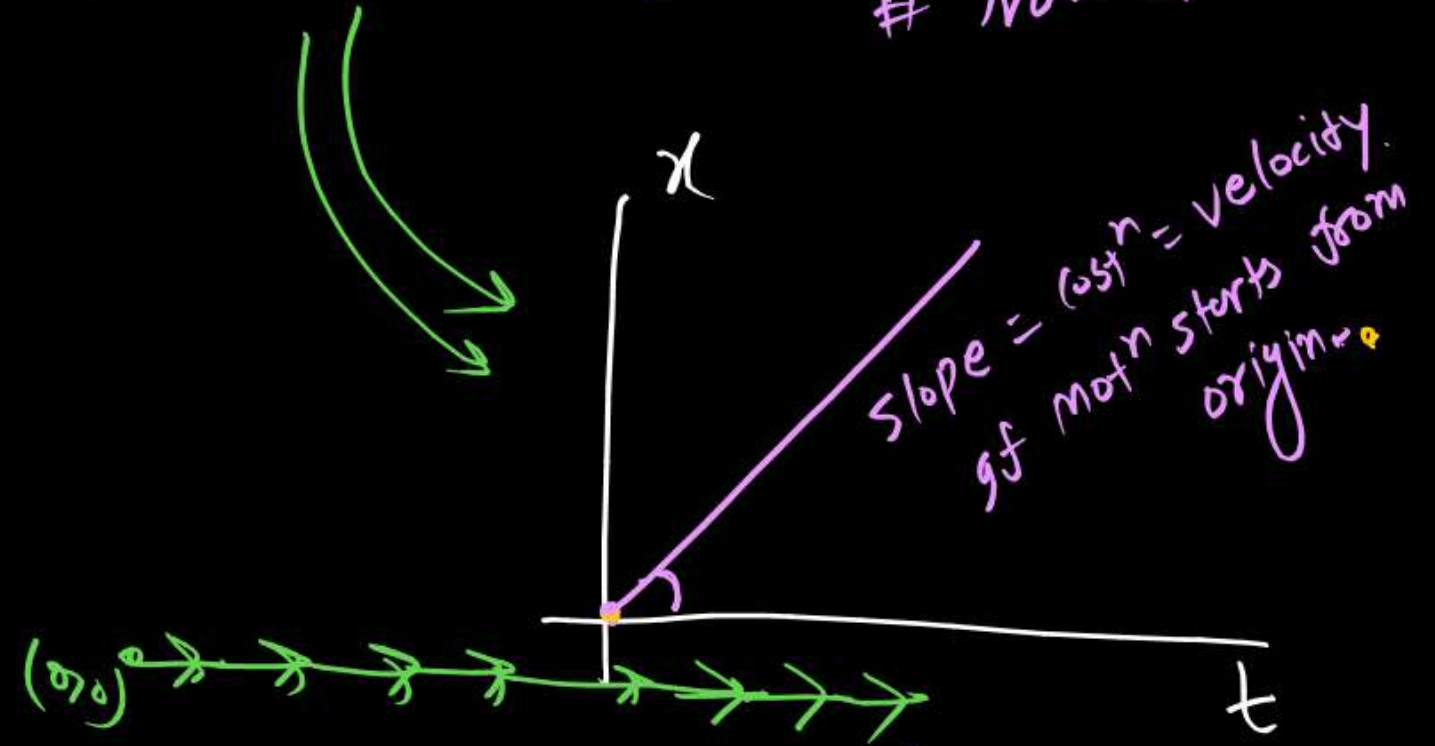
$$velocity = +5m/s$$

velocity = const
time increasing

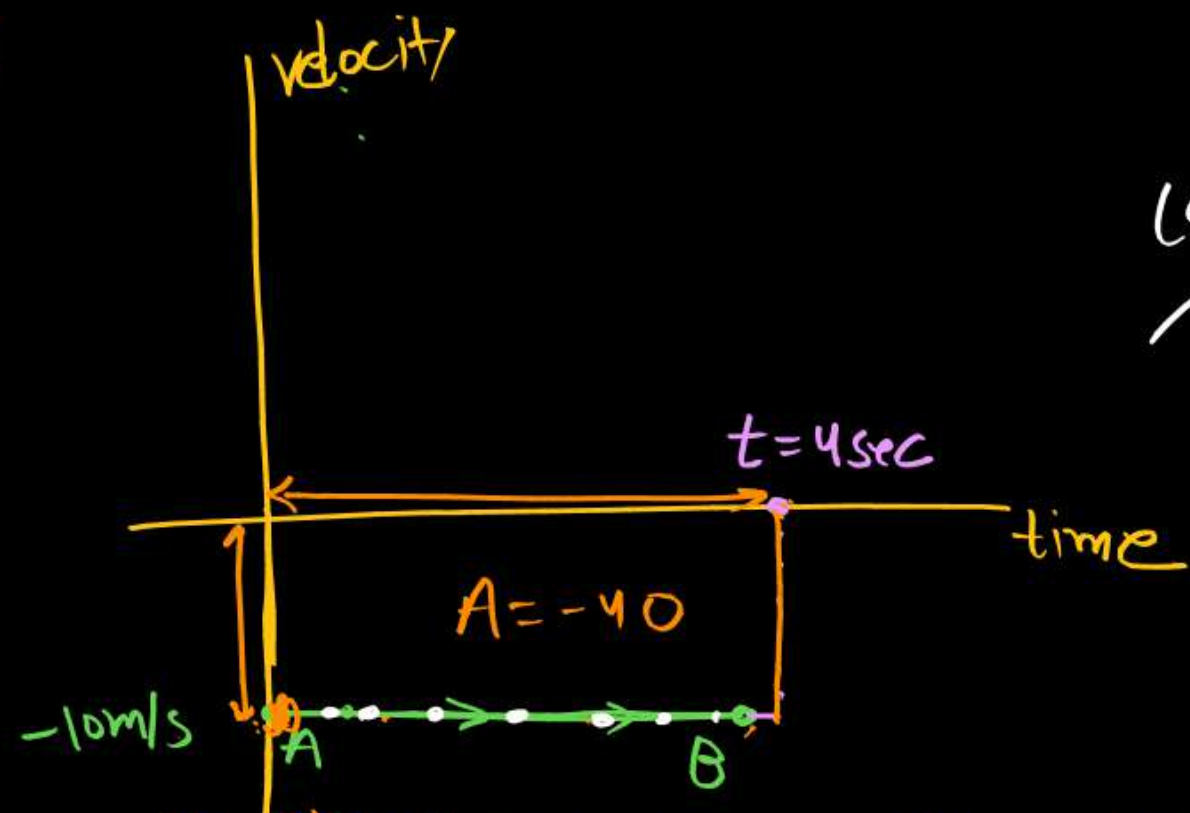
$$\# \boxed{acc^n = 0 = slope}$$

uniform motⁿ

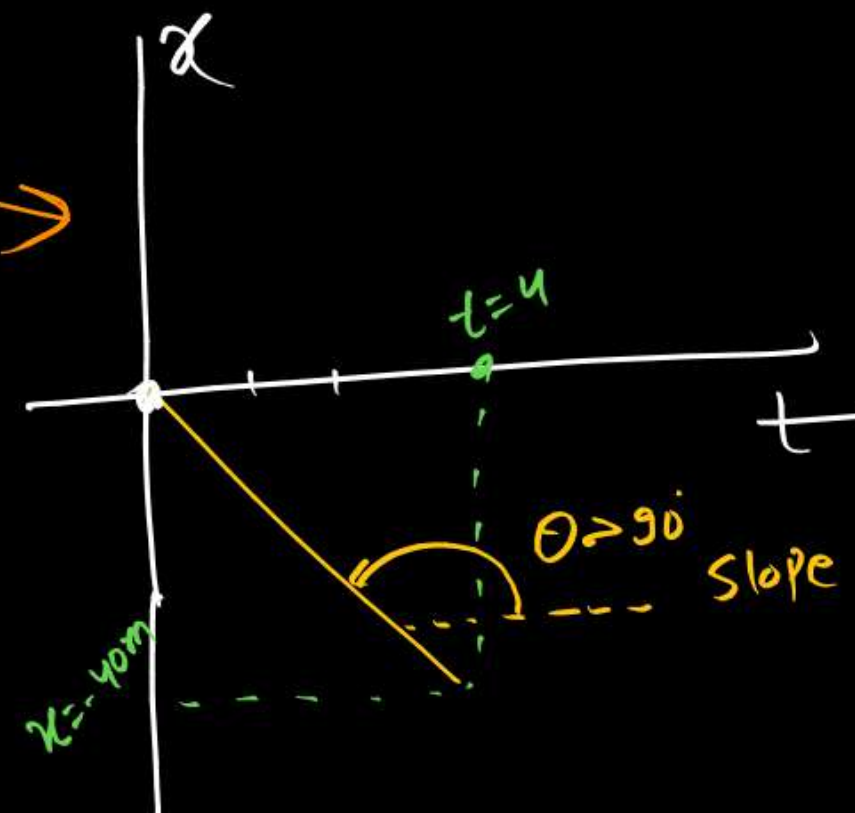
No - turn



③



Convert in alt
graph if
initial position
zero.



slope of (x/t) graph = -ve
velocity = -ve.

Object is moving with -10 m/s velocity.

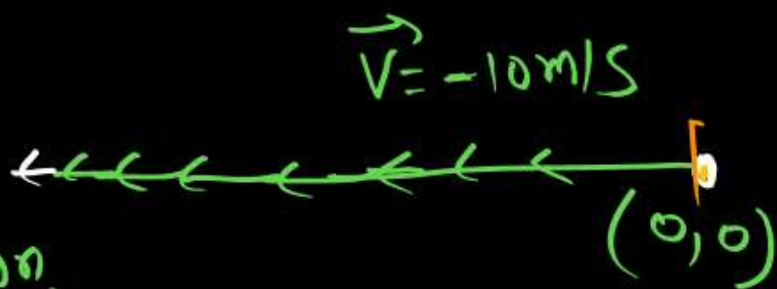
velocity = -10 m/s

= $\cos t^n$.

$a = 0$

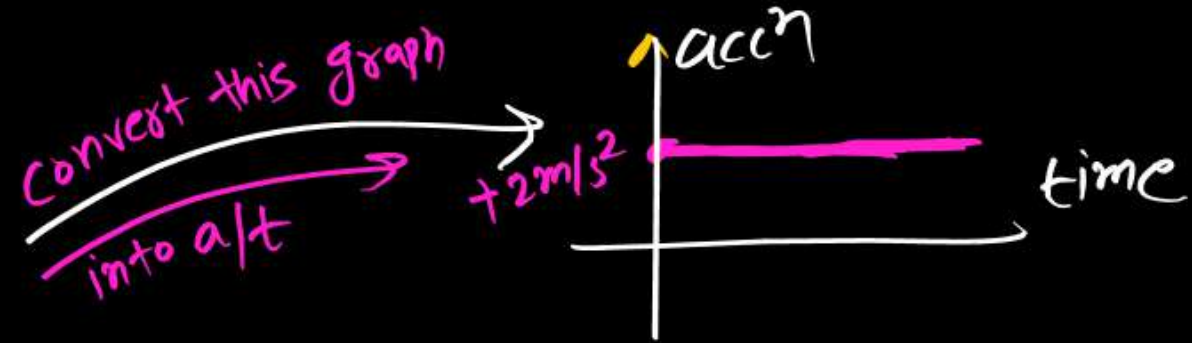
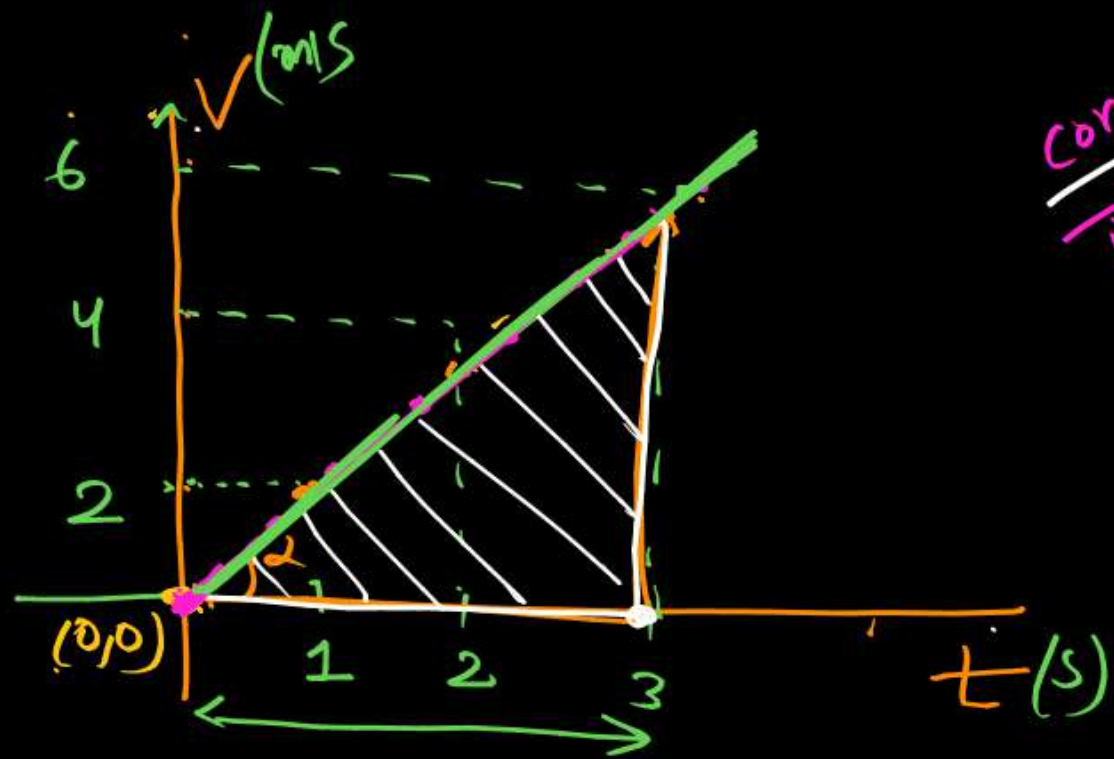
Uniform motion.

no U-turn.



disp^m in 4-sec = $u \times t = -10 \times 4 = -40\text{ m}$ # Area = -40 m

4



$disp^m$ in 3-sec = $ut + \frac{1}{2}at^2$
 $= \frac{1}{2} \times 2 \times (3)^2 = 9m$

Initial velocity of object is zero ✓
 & Increase with time.

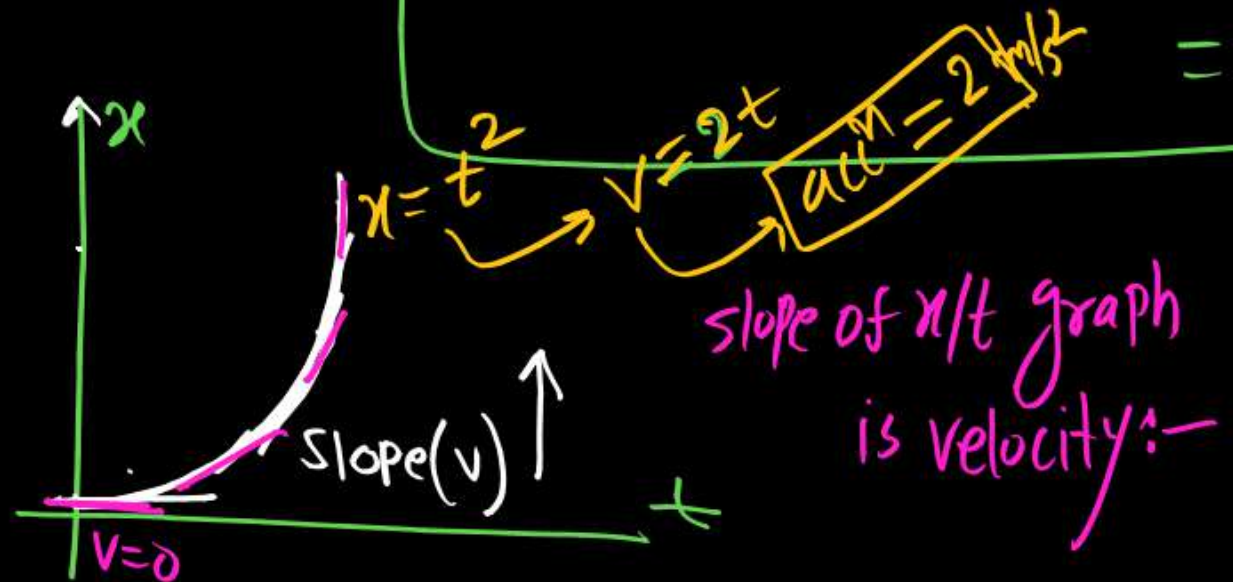
$slope = cost^n = acc^n$

$acc^n = \tan \alpha = \frac{6}{3} = 2 \text{ m/s}^2$ ✓
 Const at all time.

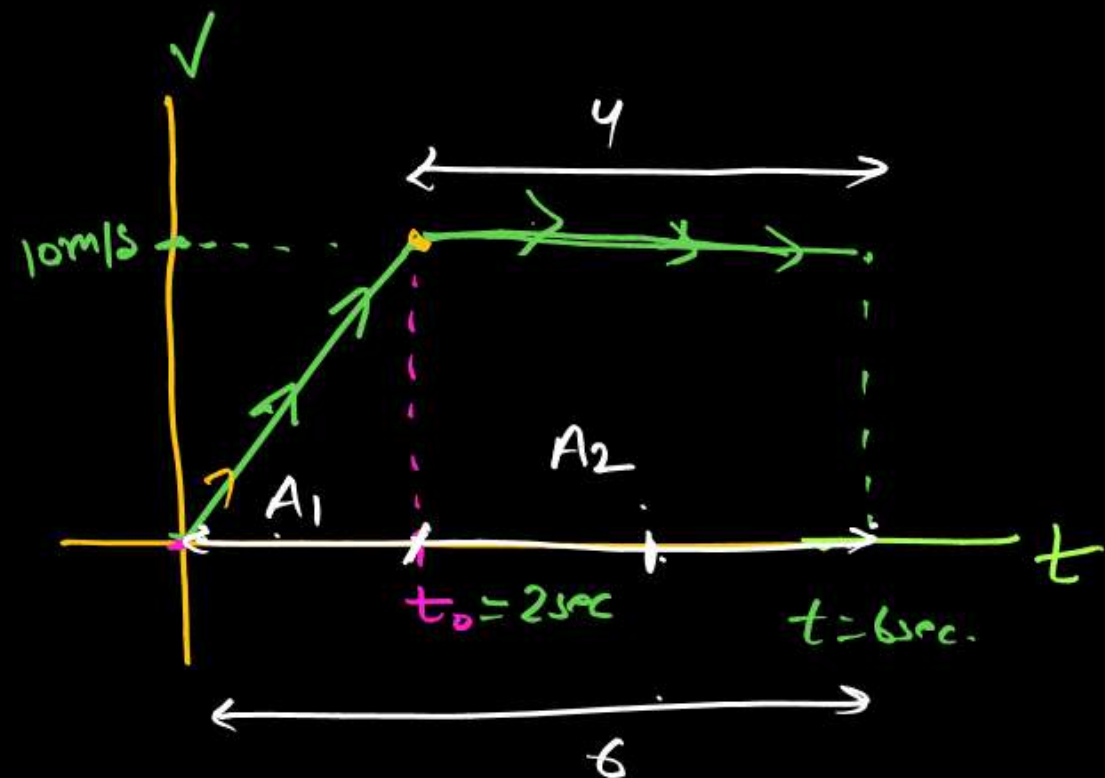
Non-uniform Motⁿ with constⁿ acc^n .
 # No-Dturn

convert v/t into x/t

Area of $(v-t) = disp^m = \frac{1}{2} \times 3 \times 6 = 9m$ ✓



(5)

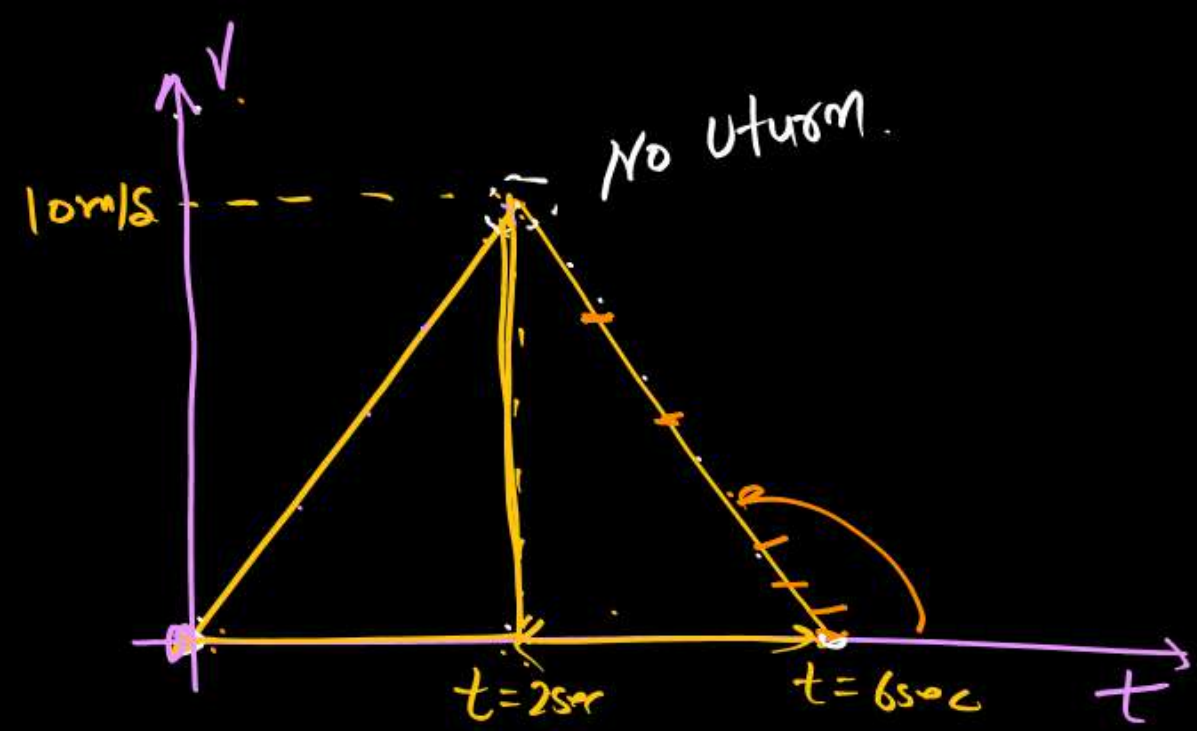


∴ Initial velocity of object is zero
∴ V increases upto t_0 then
velocity becomes constant.

Total disp^m in 6 sec

$$\text{Area} = \frac{1}{2} (6+4) \times 10^5$$
$$= 50 \text{ m} \checkmark$$

6



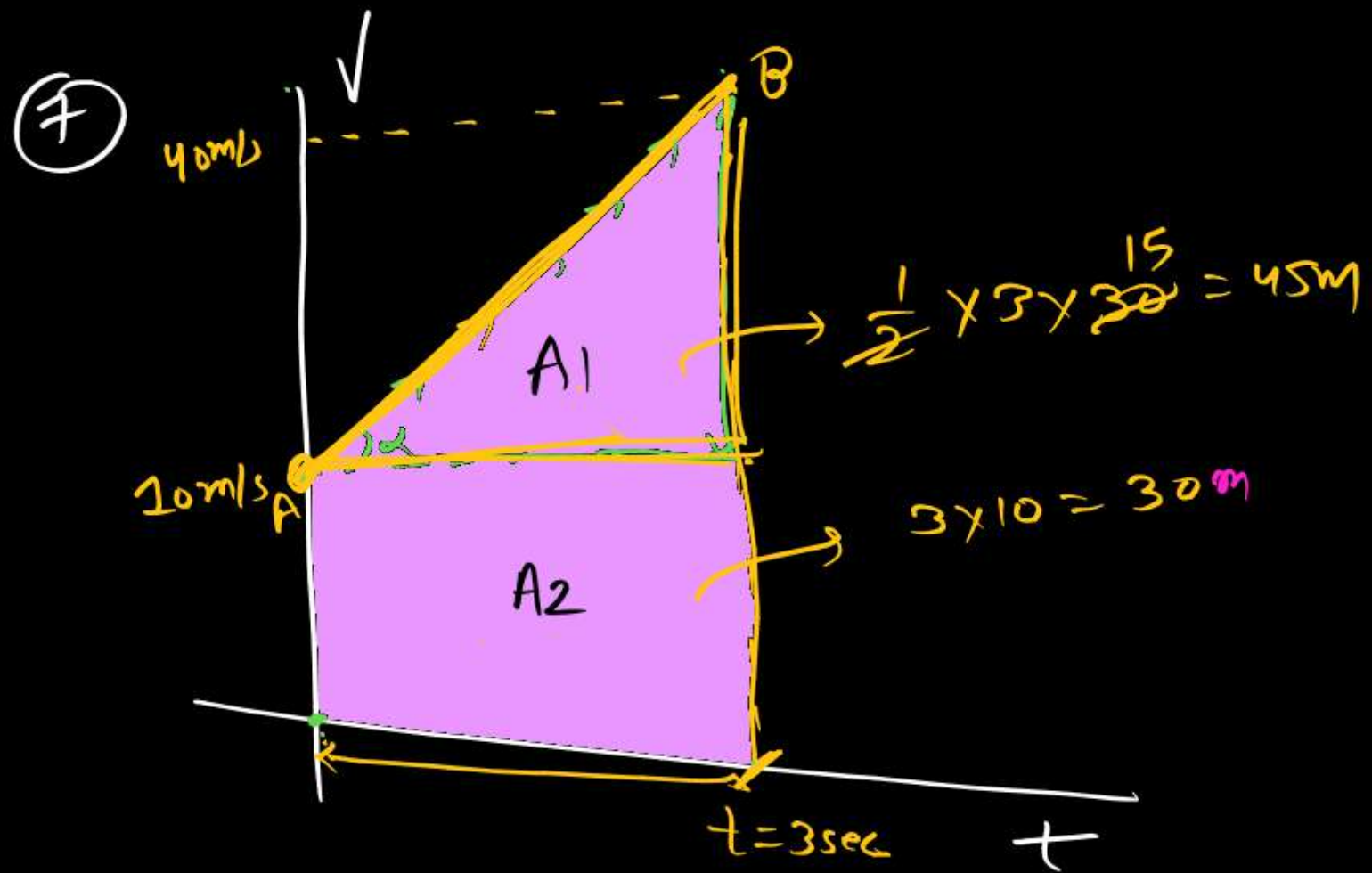
motⁿ start from rest &
constⁿ accⁿ upto 2 sec ✓
then it retards &
comes to at rest
at 6 sec

disp^m in 6-sec = ??

$$\text{Area} = \frac{1}{2} \times 6 \times 10$$

distance = disp^m = 30m

$$\text{Avg acc}^n_{\text{in 6sec}} = \frac{V_f - V_i}{\Delta t} = \frac{0 - 0}{6} = 0$$



dispm in 3-sec ??

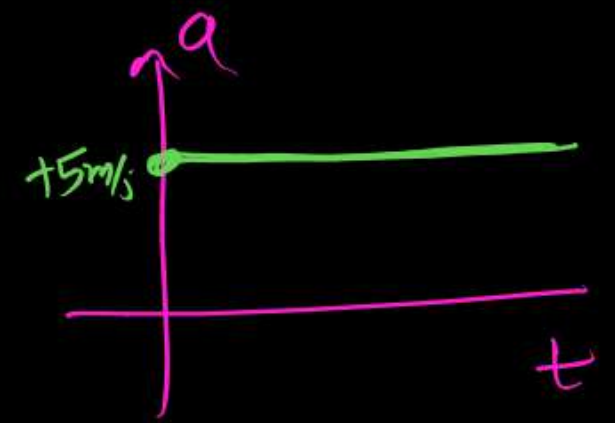
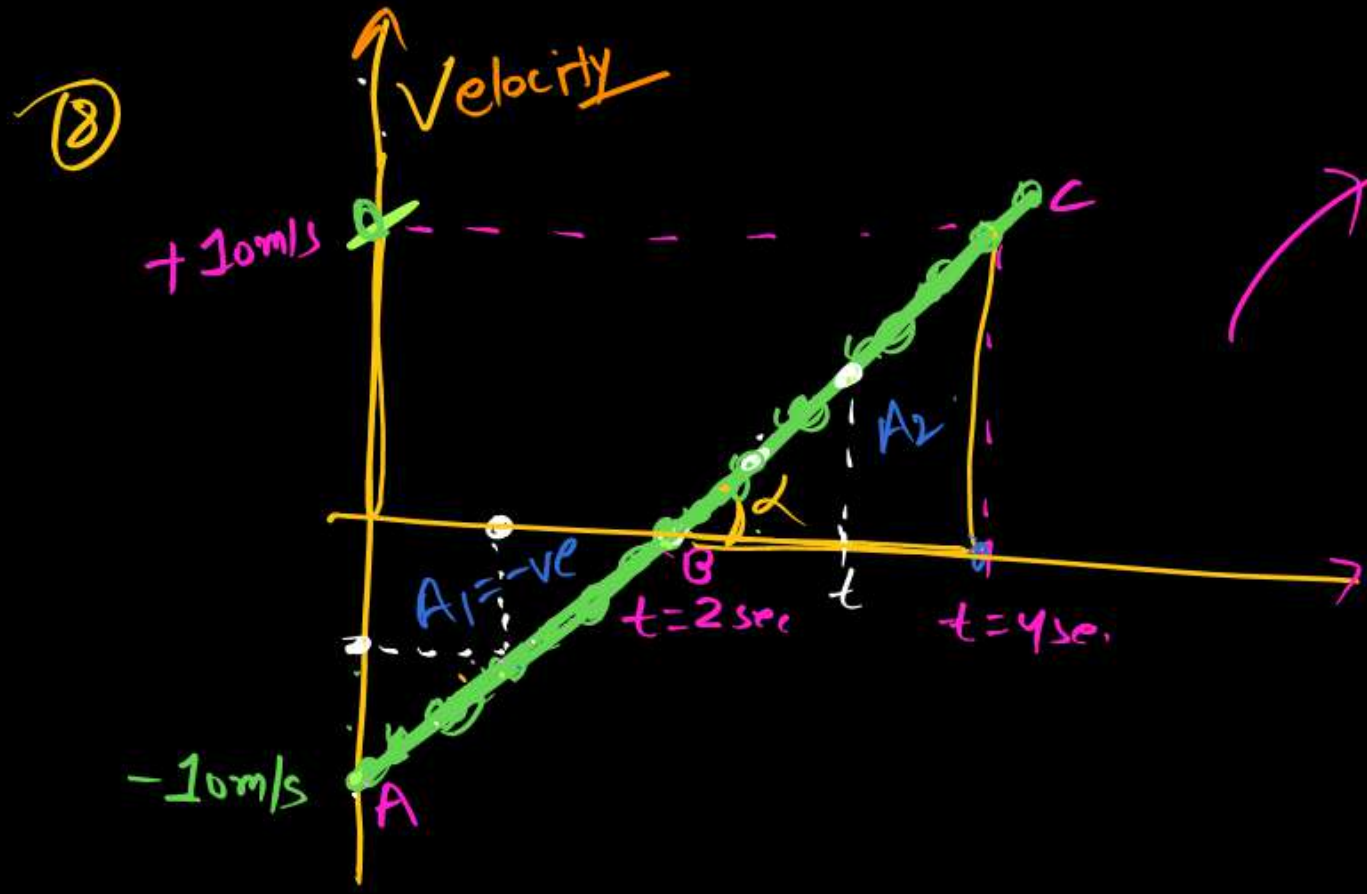
$$= \frac{1}{2} \times (40 + 10) \times 3$$

Area of v/t graph.

$$= \frac{3}{2} \times \frac{25}{50} = \underline{\underline{75 \text{ m}}}$$

Objⁿ starts from 10 m/s & moves
with constⁿ accⁿ.

$$\text{acc} = \tan \alpha = \frac{40 - 10}{3 - 0} = \frac{30}{3} = 10 \text{ m/s}^2$$



MR* BOX
 # $\text{disp}^m = A_1 + A_2$
 # $\text{dist}^n = |A_1| + |A_2|$

Slope of (v-t) graph is accⁿ.

$\text{acc}^n = \left(\begin{smallmatrix} \text{straight} \\ \text{line} \\ \text{kg} \\ \text{slope} \\ \text{cost}^n \end{smallmatrix} \right) = \frac{10}{2} = 5 \text{ m/s}^2$

$|a^{\text{acc}}| \text{ at } t=2\text{sec} = +5 \text{ m/s}^2$ at $t=2\text{sec } V=0$

Object starts his motⁿ from -10 m/sec & costⁿ accⁿ & comes to at rest at $t=2\text{sec}$, & velocity becomes +ve after $t=2\text{sec}$

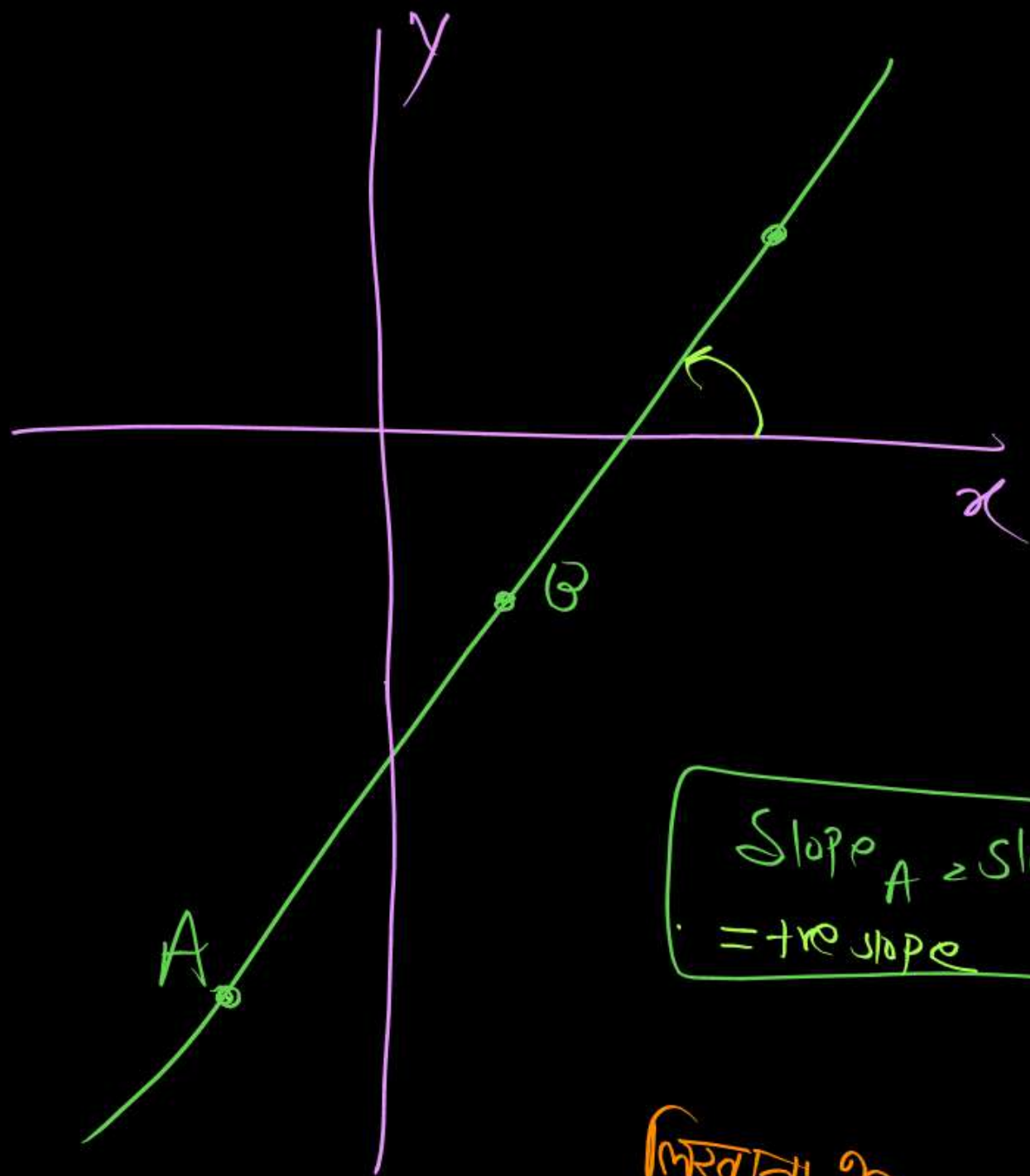
U-turn at $t=2\text{sec}$ at B

MR* BOX $V = +ve$ motⁿ forward
 $V = -ve$ motⁿ backward

disp^m in 4-sec = 4-sec tak ka Area

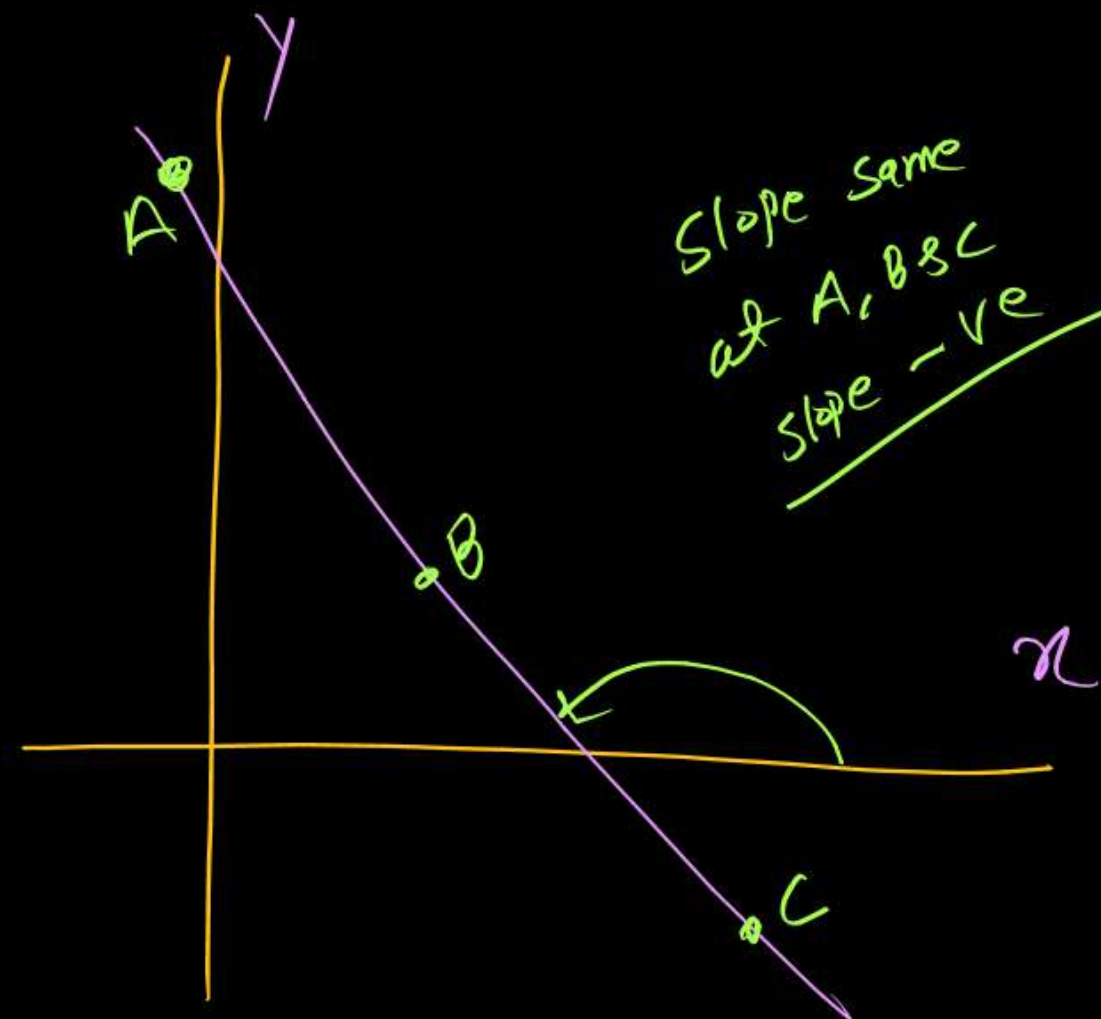
$\text{dist}^n = 20 \text{ m}$

$= A_1 + A_2$
 $= \frac{1}{2} \times 2 \times -10 + \frac{1}{2} \times 2 \times 10$
 $= -10 + 10 = 0$



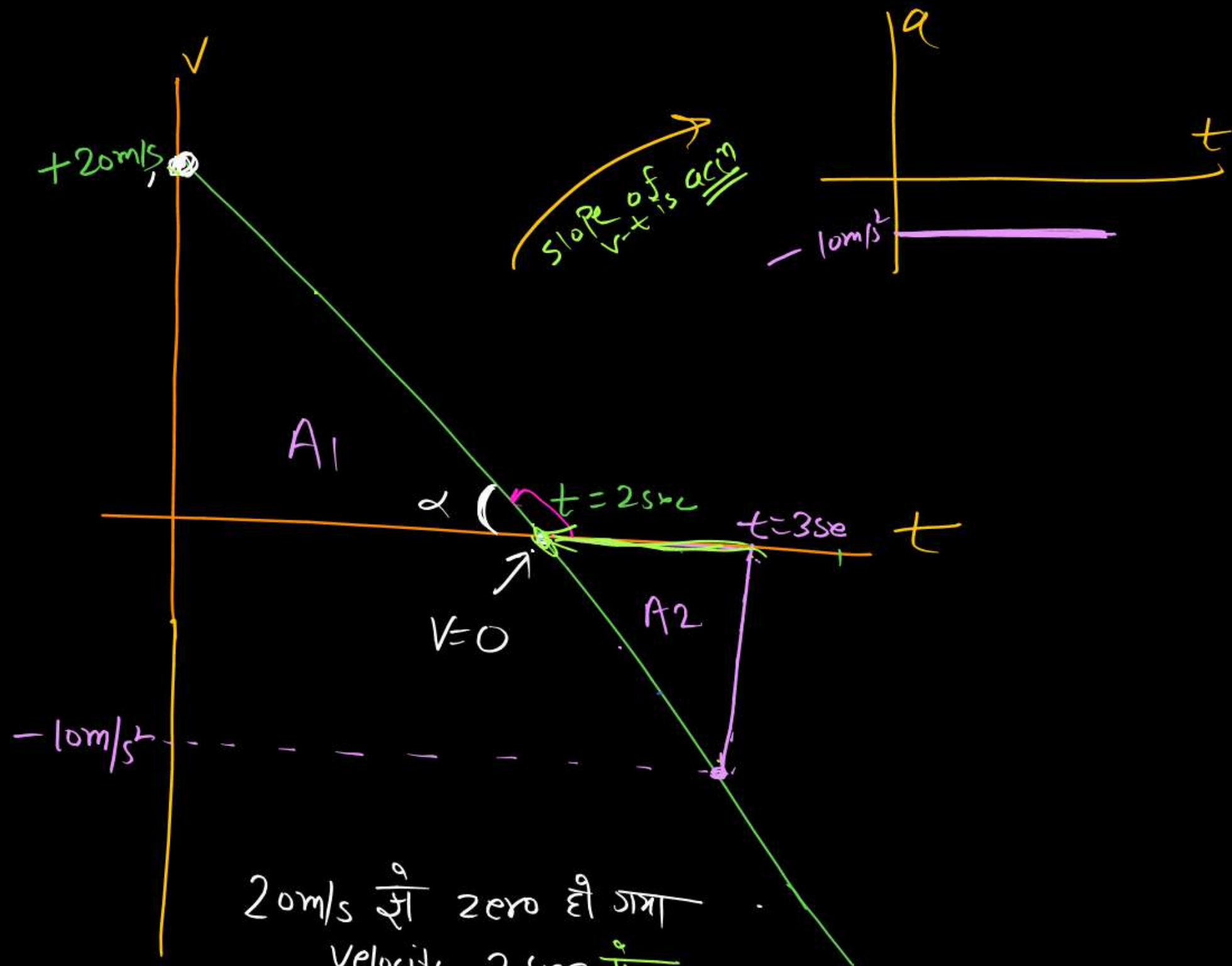
Slope_A = Slope_B = Slope_C
= +ve slope

मिरवानी ३७



Slope same
at A, B, C
slope -ve

9



20 m/s से zero हो गया
Velocity 2 sec में

1 sec में 10 m/s का कम होना

$a = -10 \text{ m/s}^2$ ✓

motⁿ starts with velocity
20 m/s & constⁿ retardation
slope (a) = -10 m/s^2
& comes to rest
at $t = 2 \text{ sec}$ &
then moves with
-ve velocity.

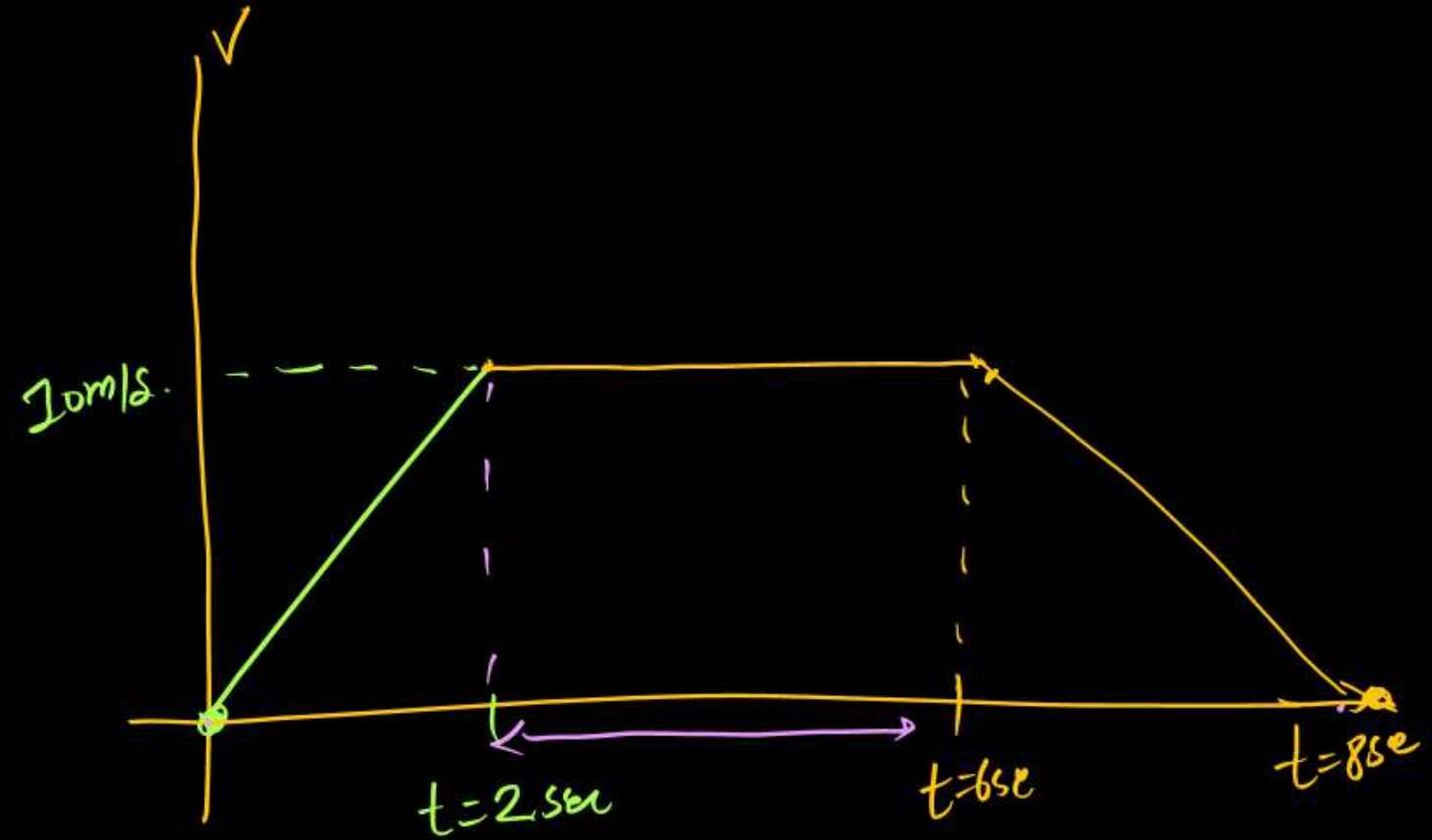
displacement in 3-sec.

$$\begin{aligned} S &= A_1 + A_2 \\ &= \frac{1}{2} \times 2 \times 20 - \frac{1}{2} \times 1 \times 10 \\ &= 20 - 5 = +15 \text{ m} \end{aligned}$$

$$\begin{aligned} \text{dist}^n &= |A_1| + |A_2| \\ &= 20 + 5 = \underline{\underline{25 \text{ m}}} \end{aligned}$$

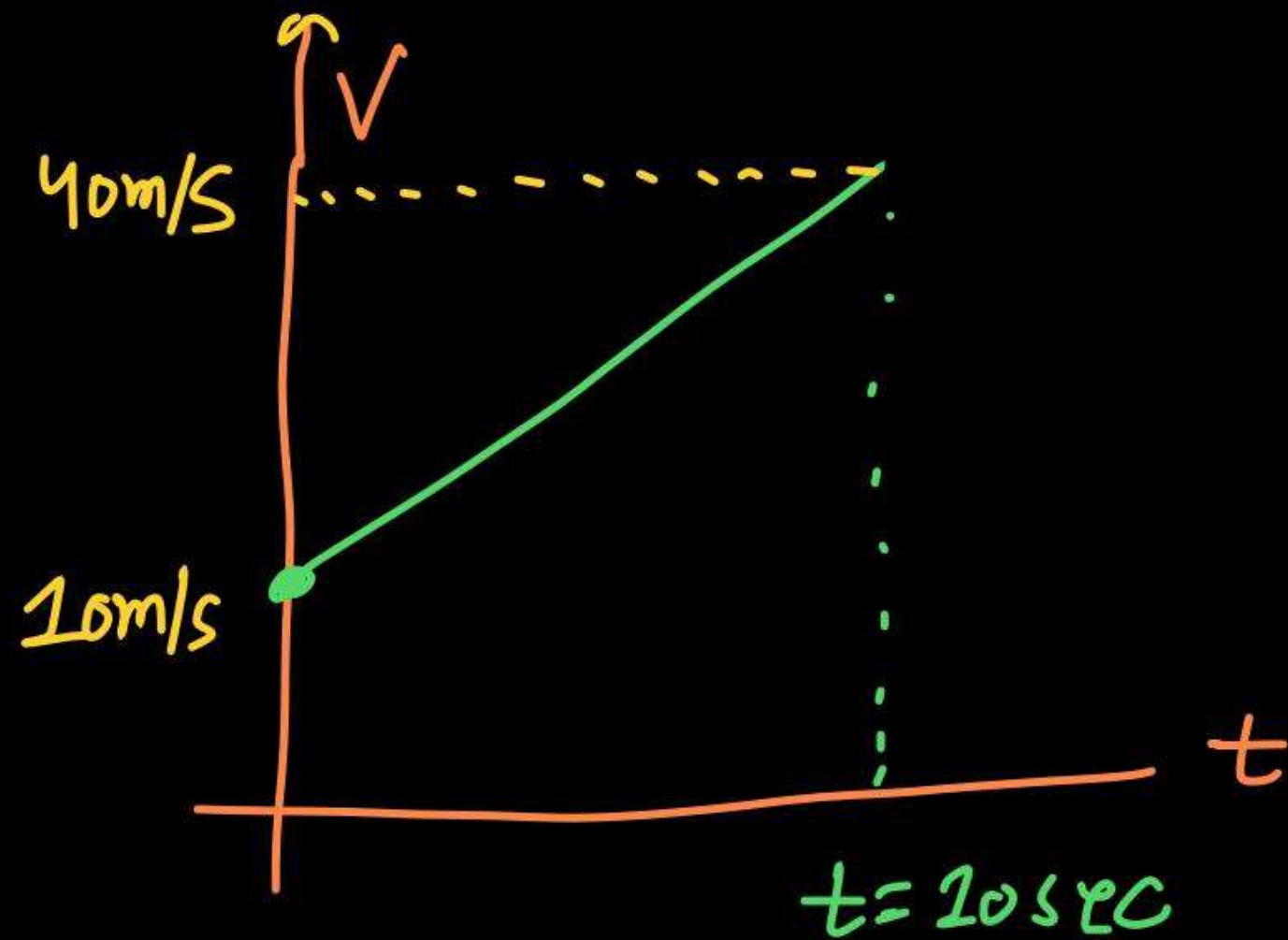
✓✓ Q. Object starts from rest
3. constⁿ accⁿ 5m/s^2 for 2 sec
then moves with constⁿ
velocity upto $t=6\text{sec}$
then retards & comes
to rest at $t=8\text{sec}$
then total disp^m.

Solⁿ



$$\text{Area} = \frac{1}{2} \times 10 \times (8 + 4)$$

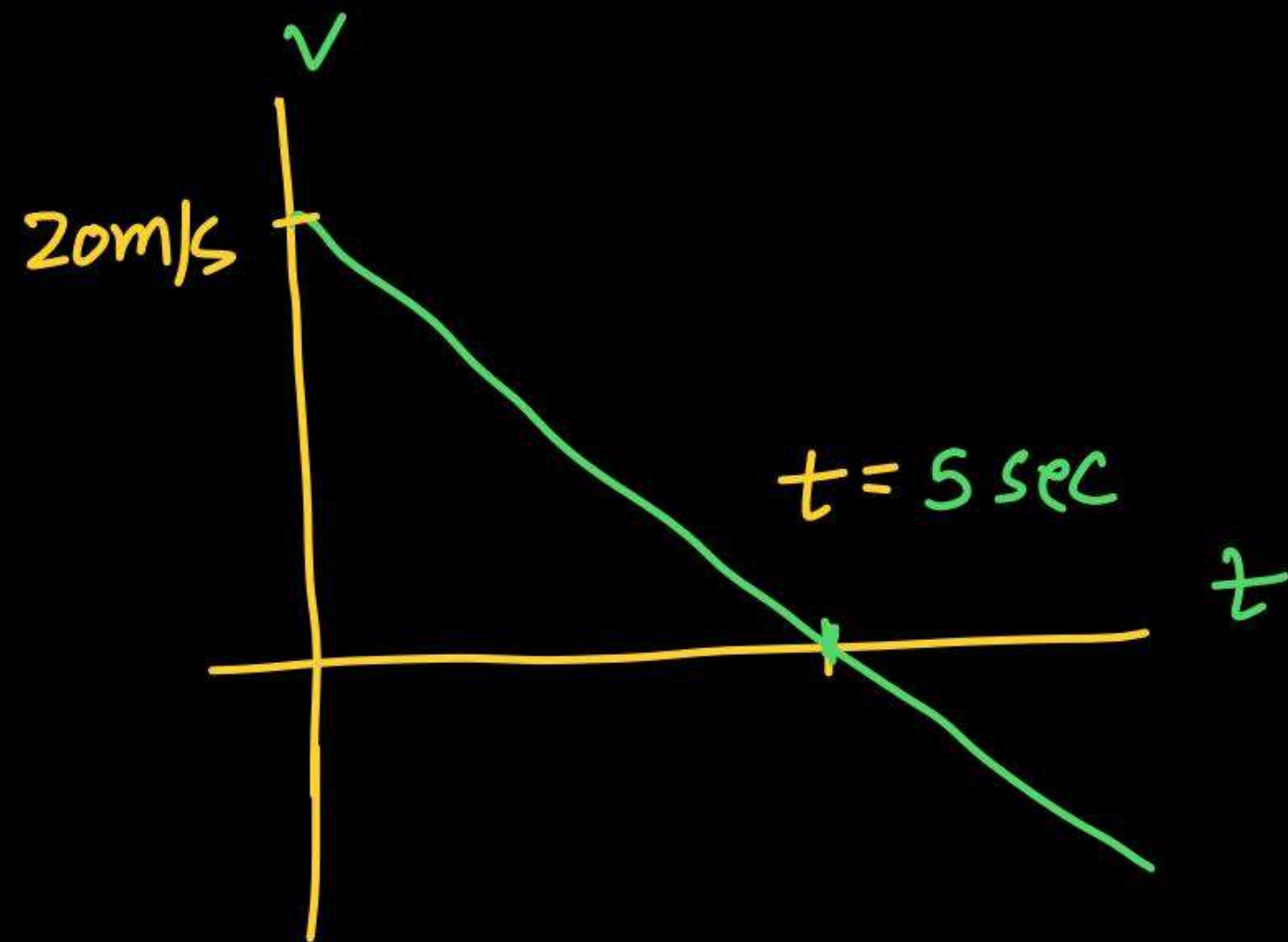
$$= 5 \times 12 = \underline{\underline{60\text{m}}}$$

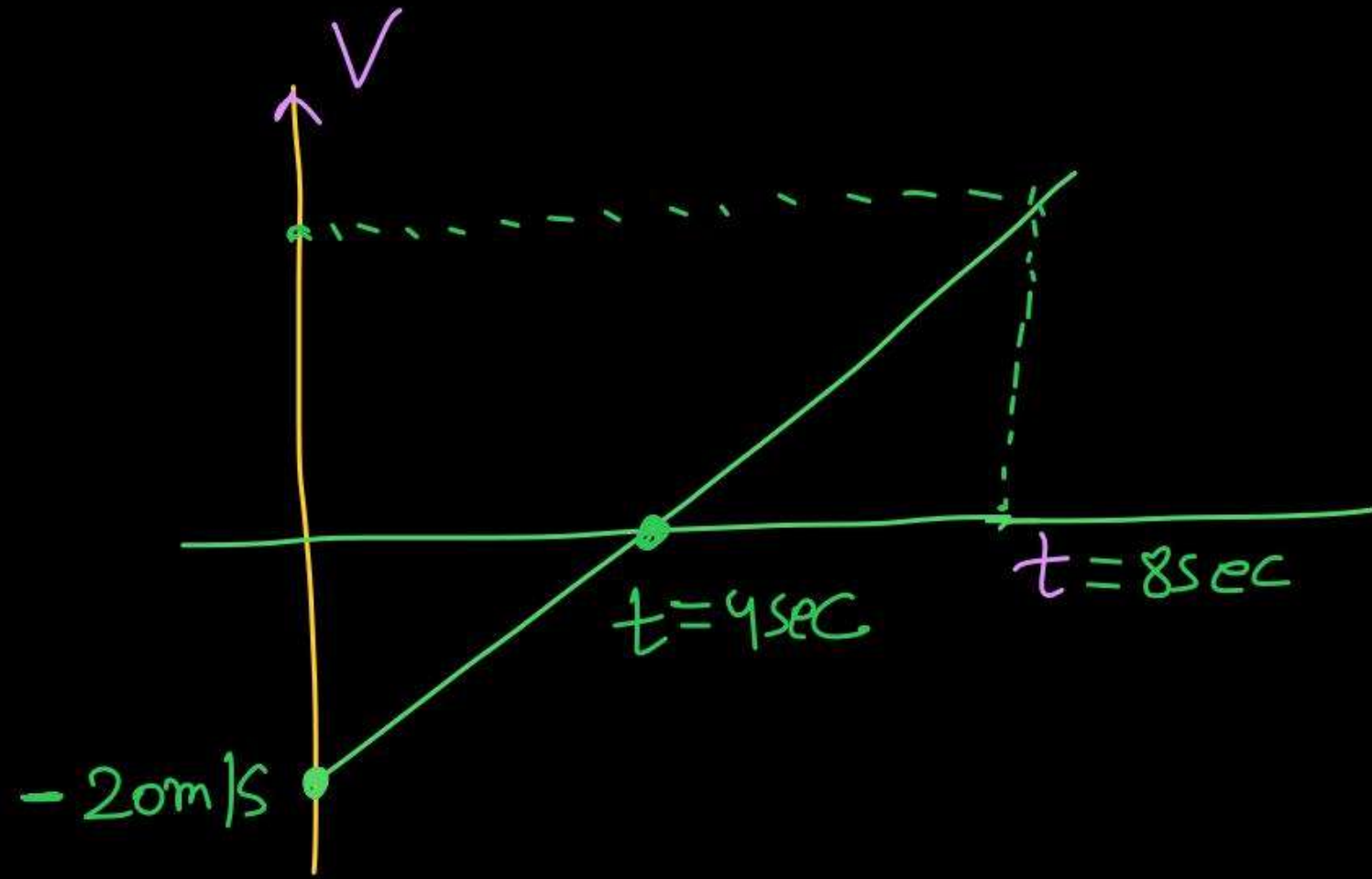


find accⁿ &

velocity at $t = 4\text{ sec}$
& displacement in
 10 sec .

find velocity
at $t = 4 \text{ sec}$

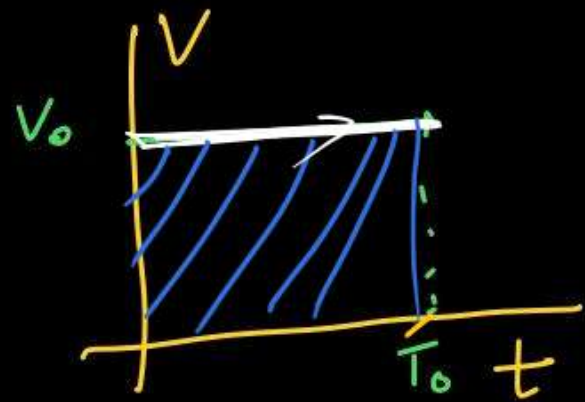




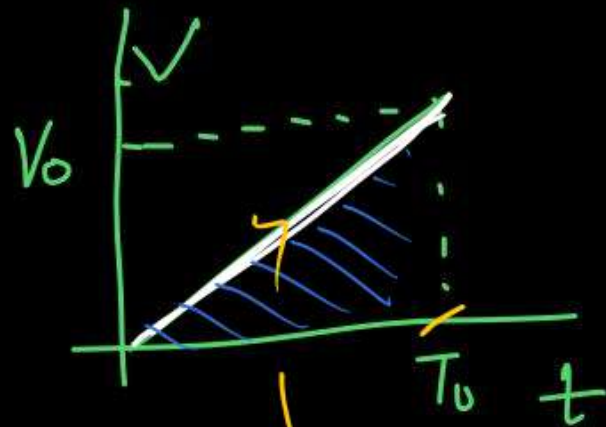
find acceleration & velocity
at $t = 8 \text{ sec}$.

(Q) In which graph:—

Avg. velocity is maximum in time 0 to T_0 :-

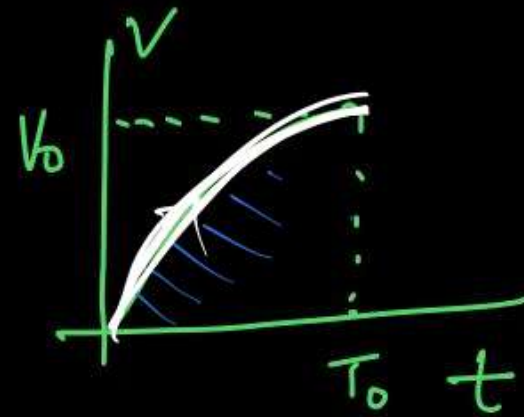


(A)



(B)

~~55%~~



(C)

MR
Scam

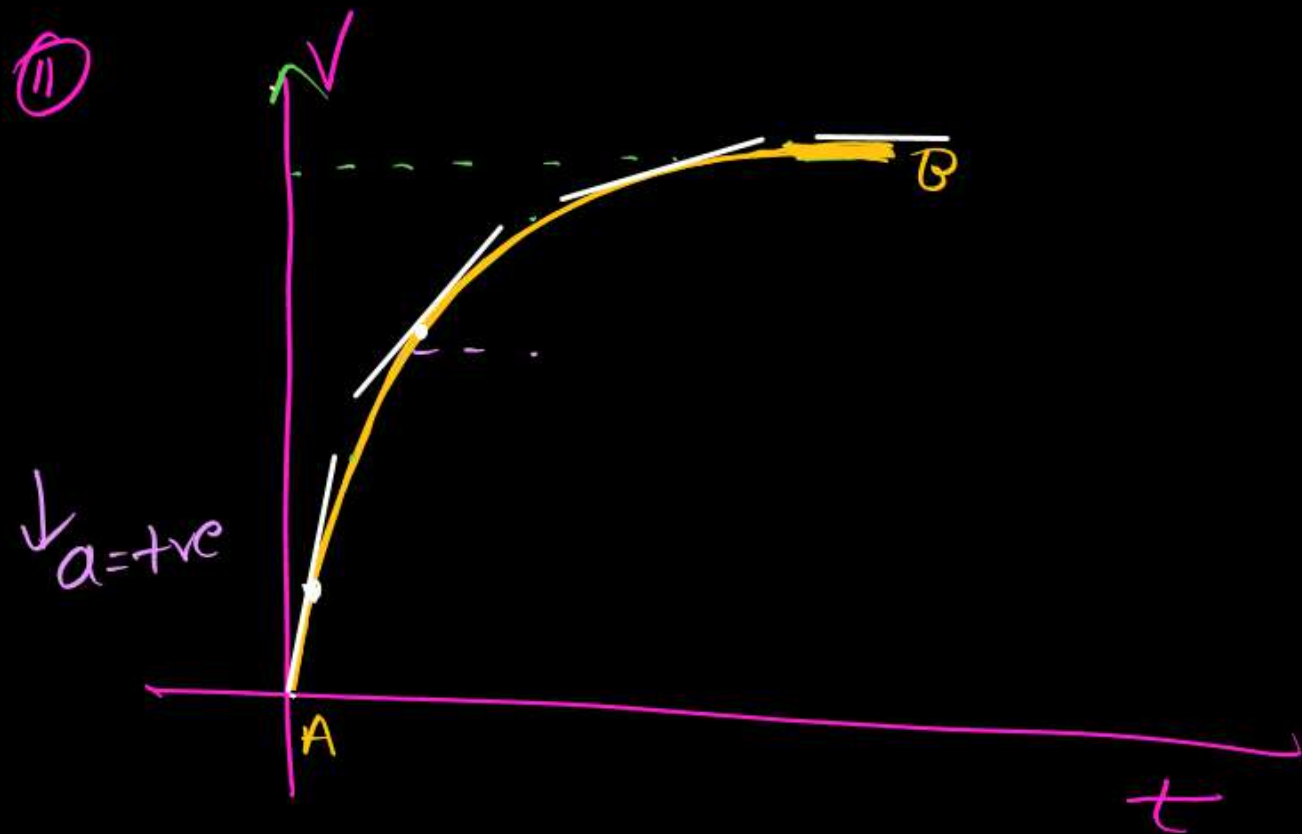
$$\begin{aligned} \# \text{ (Avg velocity)}_{\text{Max}} &= \frac{\text{Total disp}^m}{\text{total time}} \\ &= \frac{(\text{Area of } v/t \text{ graph})_{\text{Max}}}{\text{total time}} \end{aligned}$$

Ans (A) graph

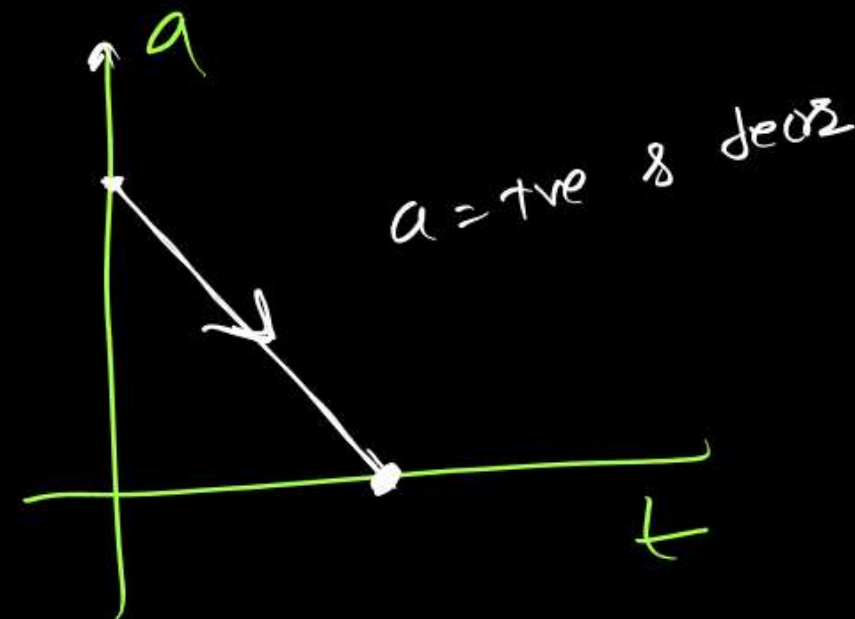
$$\text{Avg velocity} = \frac{v_f - v_i}{\Delta t}$$

$$\text{Avg velocity} = \frac{u+v}{2}$$

sirf cut n



v^{th} coordinate \rightarrow velocity
 slope \rightarrow accⁿ

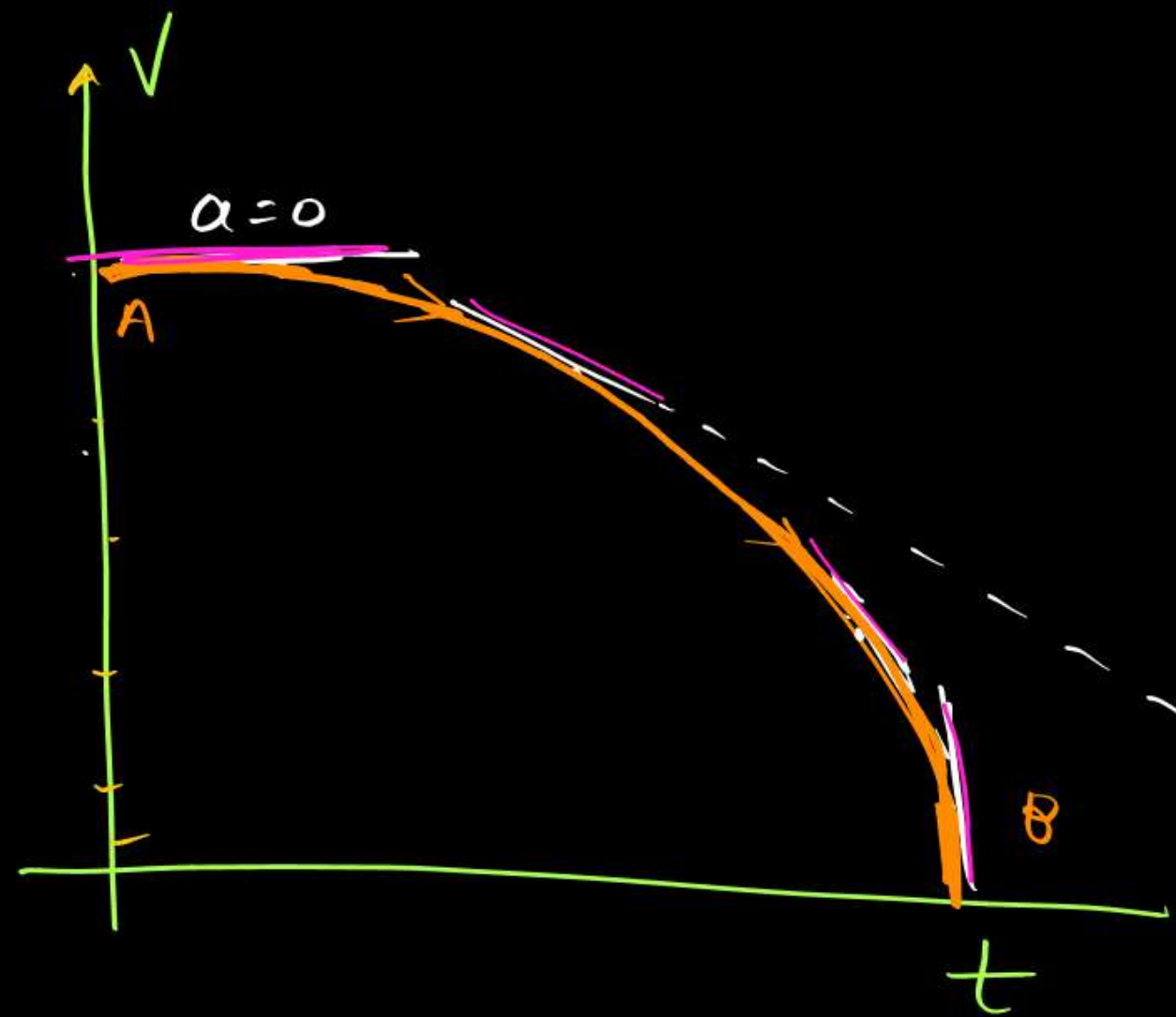


$A \rightarrow B$ [velocity Increasing]
 becoms costⁿ at end

$A \rightarrow B$ accⁿ (slope of v/t graph) = [trve and decreasing]
 becom zero.

$a = +ve$
 $v = +ve$
 \rightarrow speed \uparrow

magnit^d of velocity



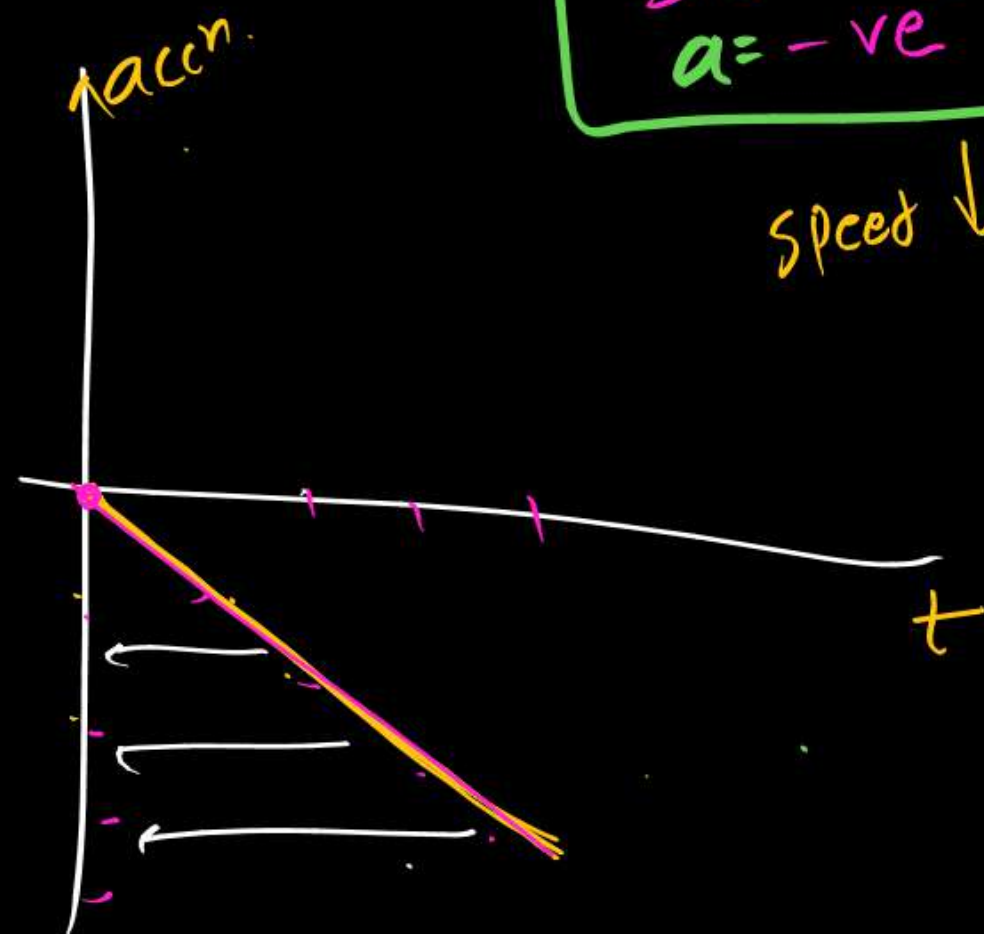
Convert v/t
to a/t

velocity is decreasing
 $V = +ve \downarrow$

$acc^n =$ initially
 acc^n is zero

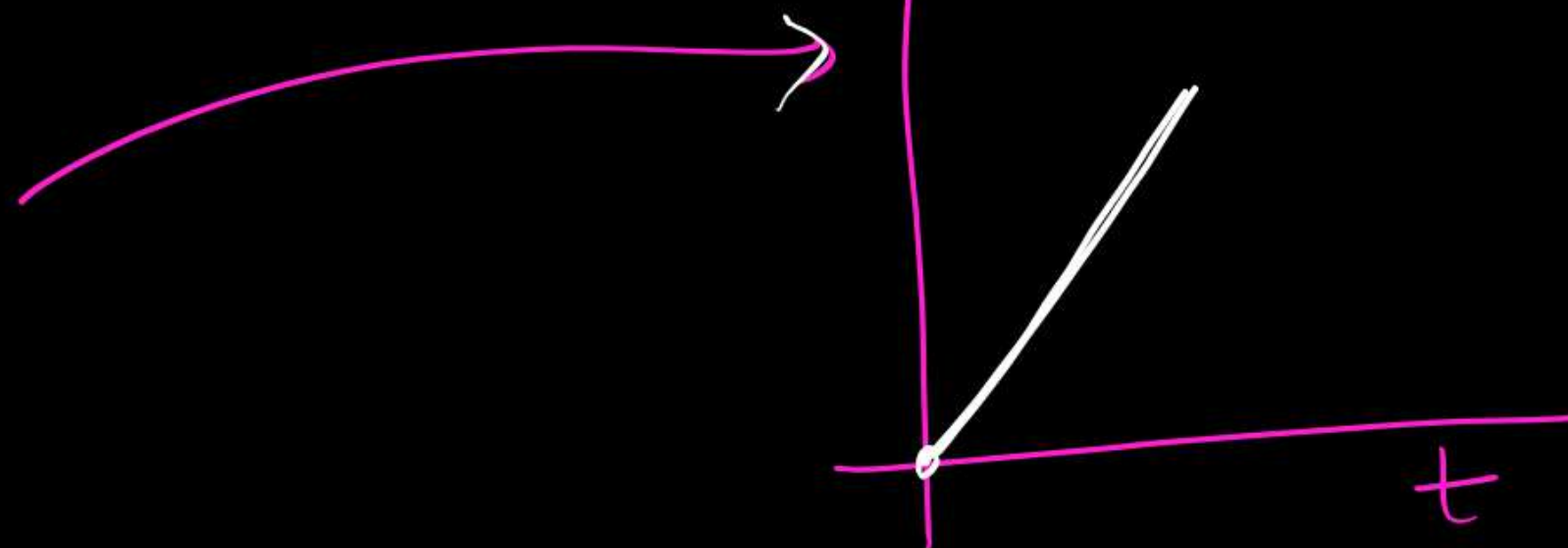
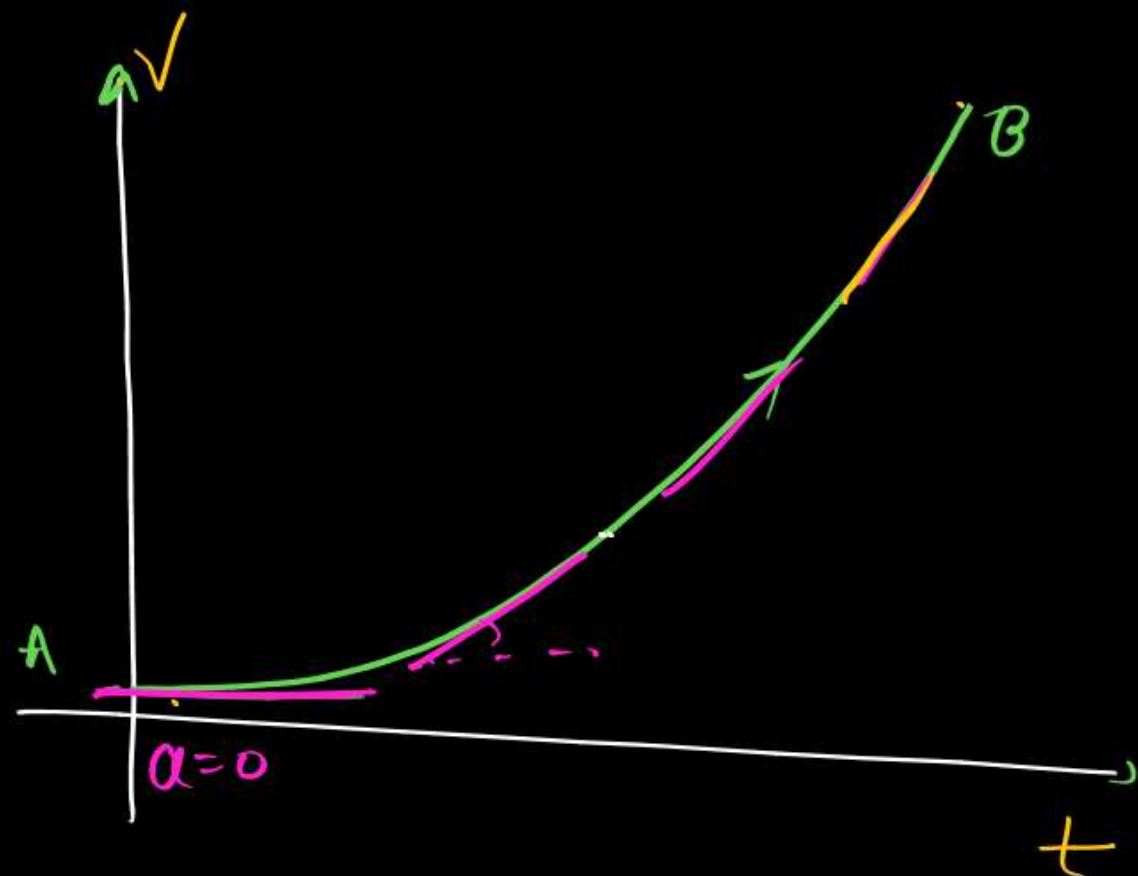
& Increasing in
 $a = -ve$

speed \downarrow



* If dirⁿ of a & v
 is same speed \uparrow
 & if a & v opposite speed \downarrow

(12)



Velocity ($A \rightarrow B$) \rightarrow +ve & Increasing.
Velocity at y^{th} co-ordinate

$\begin{cases} \rightarrow v = +ve \\ a = +ve \end{cases}$
Speed \uparrow

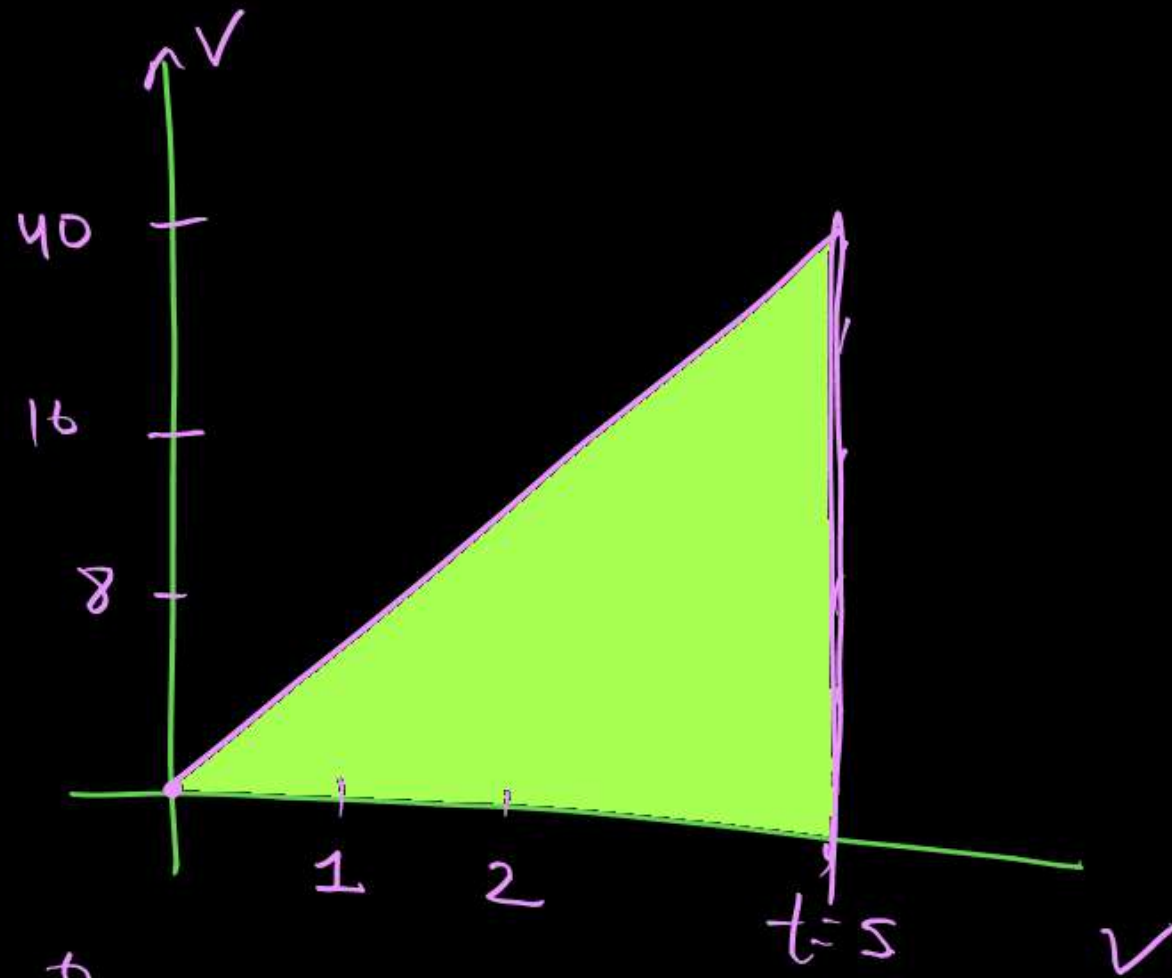
Slope of (v/t) accⁿ \Rightarrow initially $a=0$
& Increasingly +ve \uparrow

Object starts his motion from rest and constant acceleration 8 m/s^2

then find displacement in 5 sec

MR*
lostⁿ accⁿ ke case में disp^m पढ़ाई
to v/t graph का
आना

Solⁿ

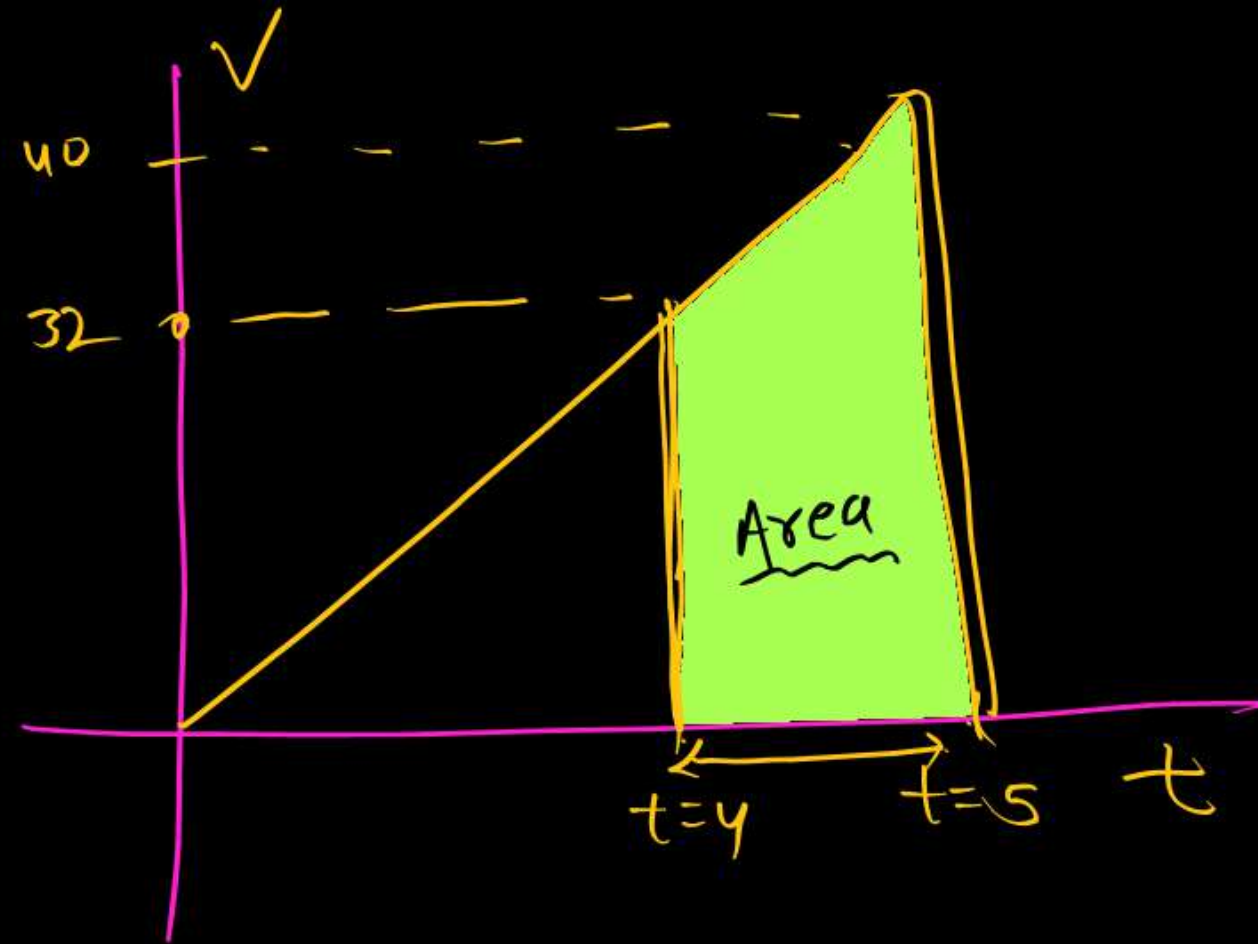


$v = u + at$
 $v = 8 \times 5$
 $v = 40$

$$\text{disp}^n = \frac{1}{2} \times 5 \times 40 = \underline{\underline{100\text{ m}}}$$

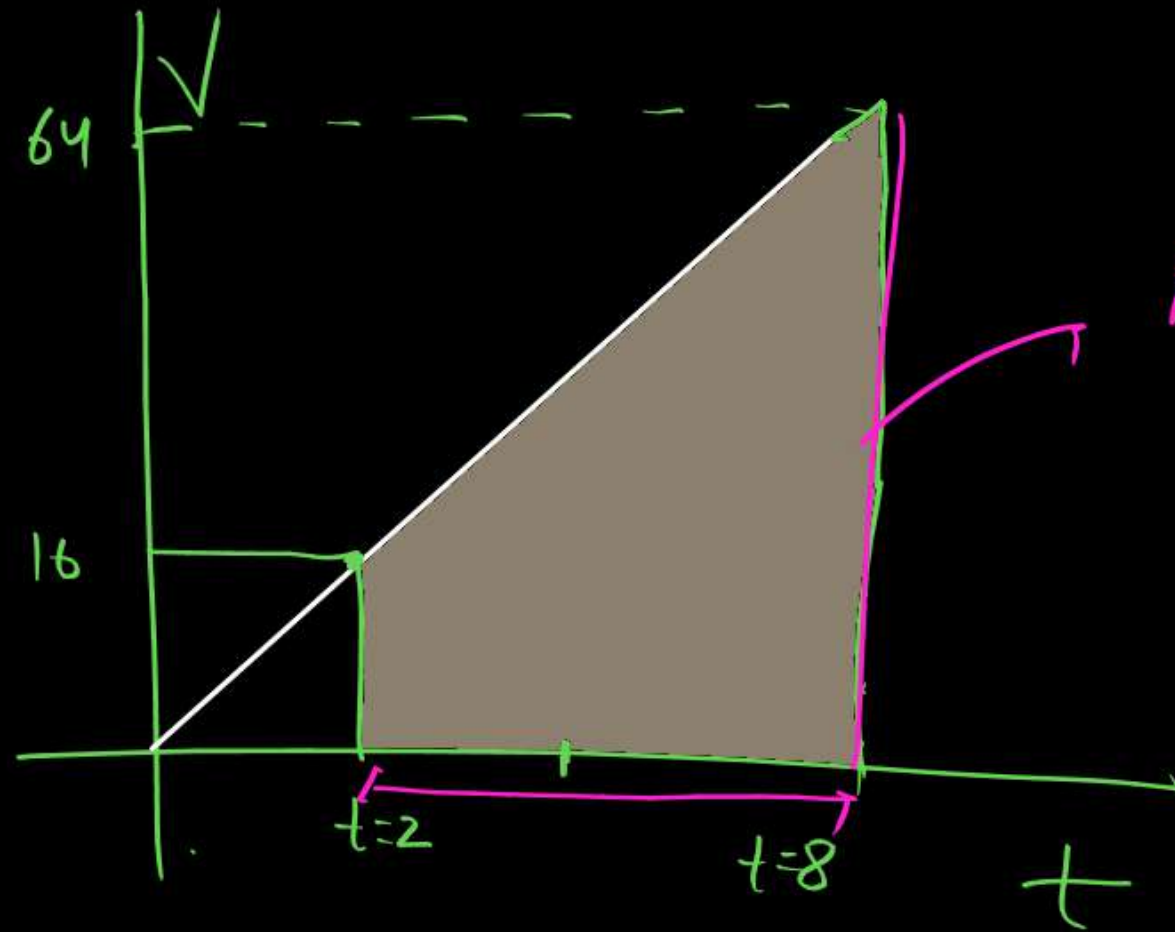
वर्ग का
फल

Object starts his motion from rest and constant acceleration 8m/s^2
then find displacement in 5th sec.



$$= \frac{1}{2} \times (40 + 32) \times 1$$
$$S = \frac{72}{2} = 36\text{m}$$

Object starts his motion from rest and constant acceleration 8m/s^2
 then find displacement b/w $t=2\text{sec}$ to $t=8\text{sec}$

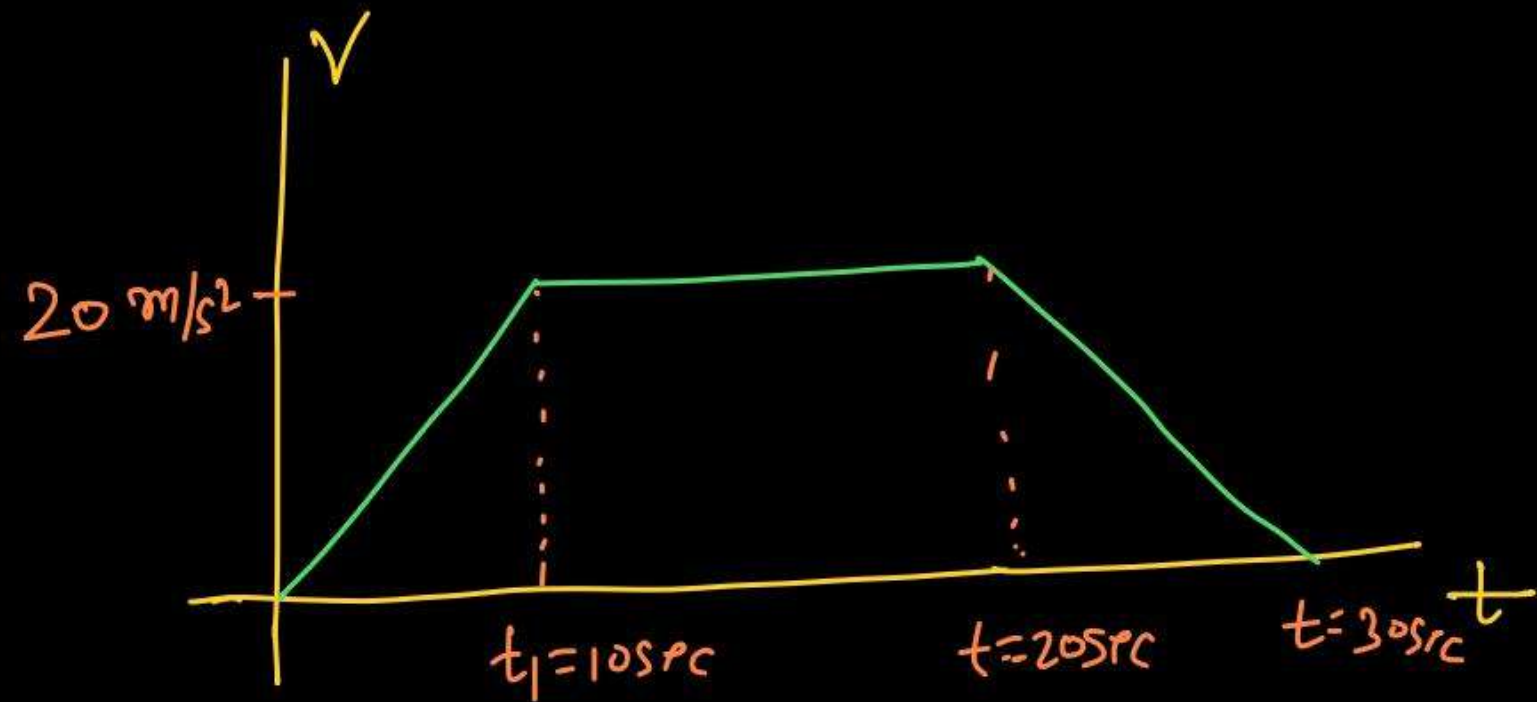


$$\begin{aligned}
 A &= \frac{1}{2} \times 6 \times (64 + 16) \\
 &= 3 \times 80 \\
 &= 240\text{m}
 \end{aligned}$$

$$\begin{aligned}
 &\xleftarrow{S_{8\text{sec}}} \xrightarrow{S_{2\text{sec}}} \\
 &\quad \quad \quad S_{860} - S_m
 \end{aligned}$$

$$V = u + at$$

Find displacement in given graph:-



H/W

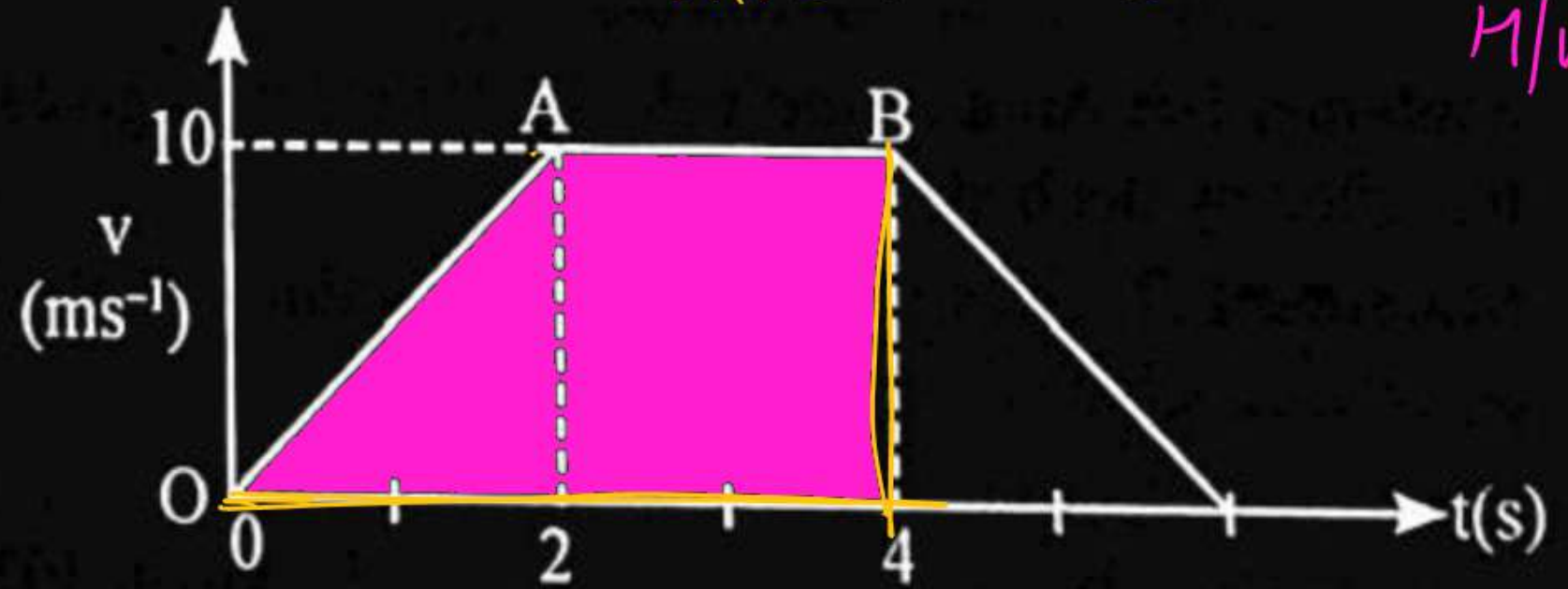
Question



The velocity-time graph of an object moving along a straight line is shown in figure. What is the distance covered by the object between $t = 0$ to $t = 4\text{s}$? **[JEE Main 2025]**

→ Are from 0 to 4s.

M/W



- 1 10 m
- 2 30 m
- 3 13 m
- 4 11 m

Question



A particle starts from rest, accelerates at 2 m/s^2 for 10s and then goes with constant speed for 30s and then decelerates at 4 m/s^2 till it stops. What is the distance travelled by it

- 1 750 m
- 2 800 m
- 3 700 m
- 4 850 m

H/w

A particle starts from rest and moves with constant acceleration 4 m/s^2 for 10 sec after that it moves with constant velocity for 20 more sec then it retards with 8 m/s^2 and stop. find total distance moved by object.

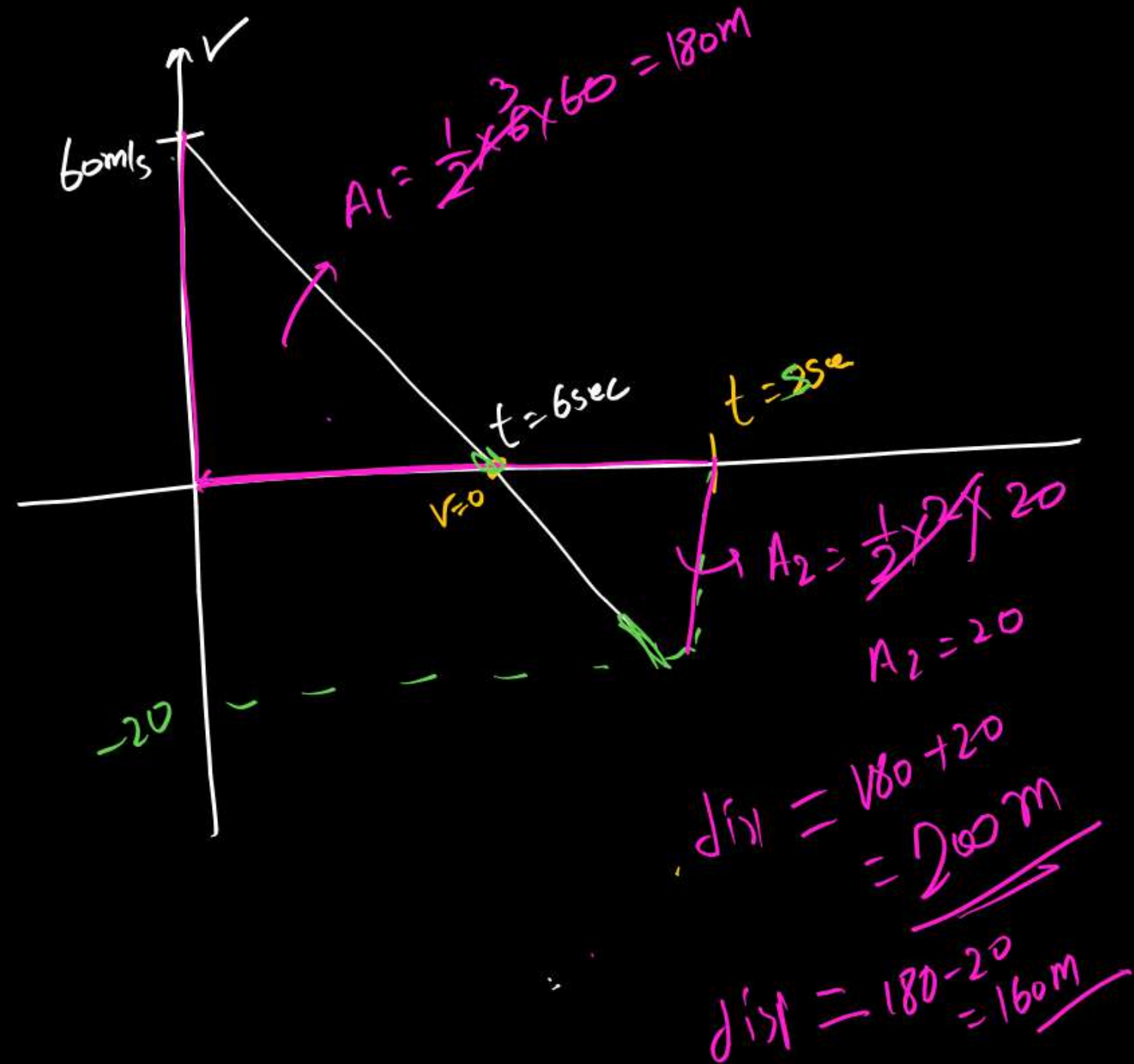
H/W

initial velocity of object is 60 m/s and retardation -10 m/s^2 find distance moved by object is 8-sec.

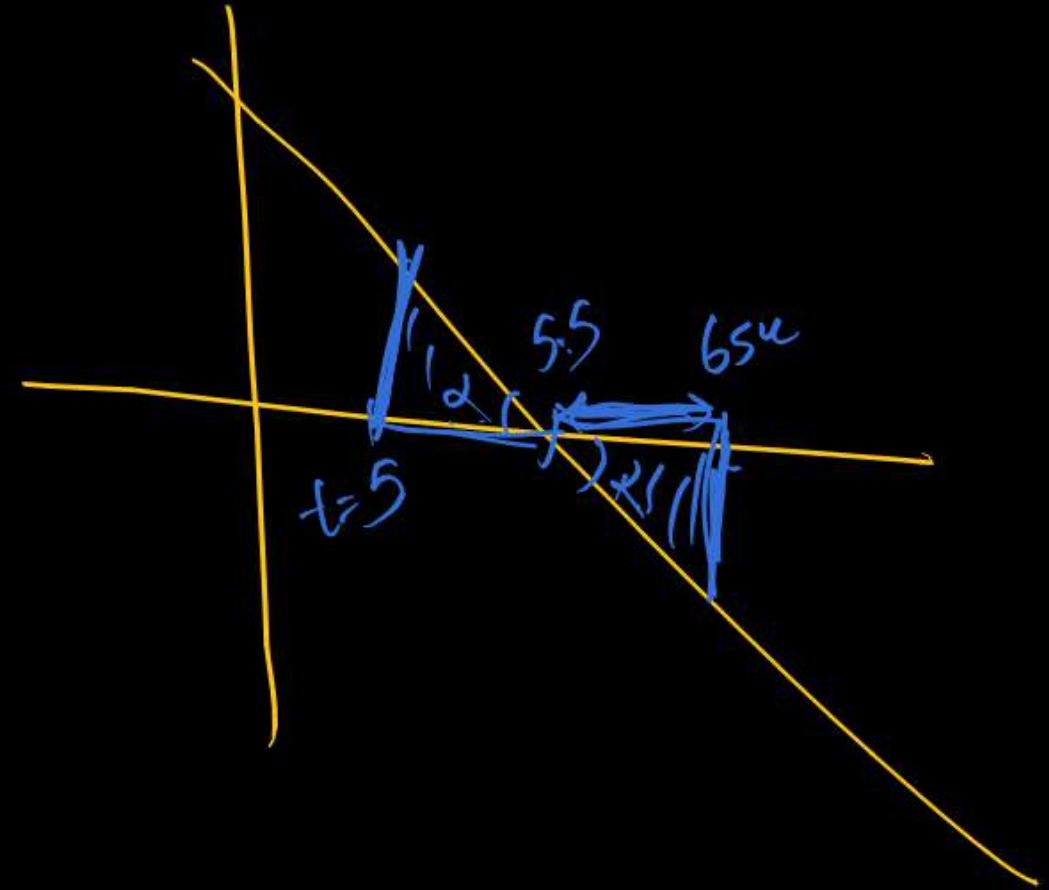
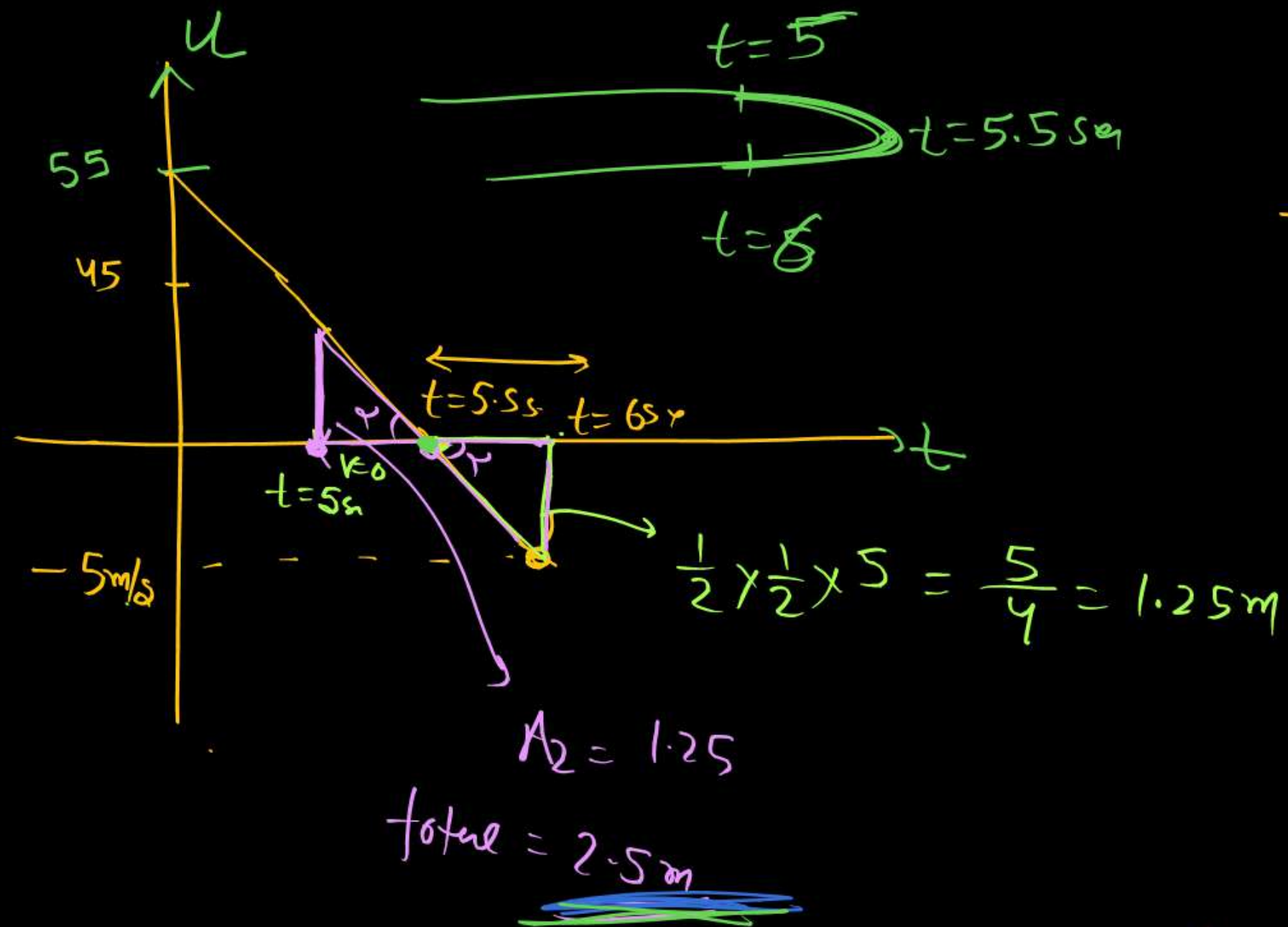
Solⁿ

$$u = +60 \text{ m/s}$$

$$a = -10 \text{ m/s}^2$$



② CAR is moving with initial speed 55 m/s and retardation -10 m/s^2
 find distance in 6th sec.



Position of object in 4-sec $x = t^2 - 4t + 5$ find distance and displacement

$$v = \frac{dx}{dt} = 2t - 4$$

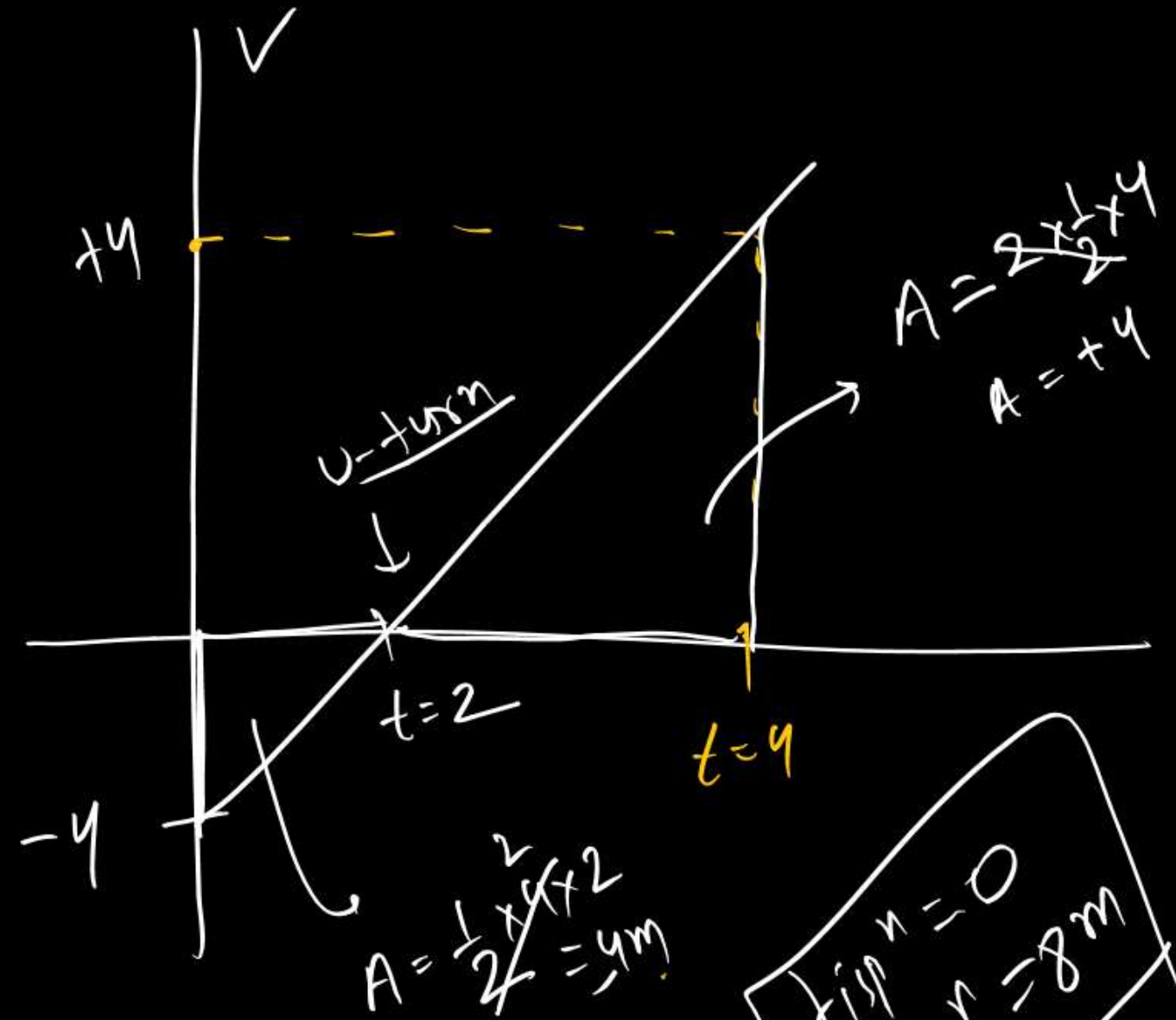
Solⁿ

$V = 2t - 4$
 $y = mx + c$

$$V_{t=0} = -4$$

$$V_{t=2s} = 2 \times 2 - 4 = 0$$

$$V_{t=4} = 8 - 4 = +4$$



displacement = 0
 distance = 8m

$$x = t^2 - 6t + 2$$

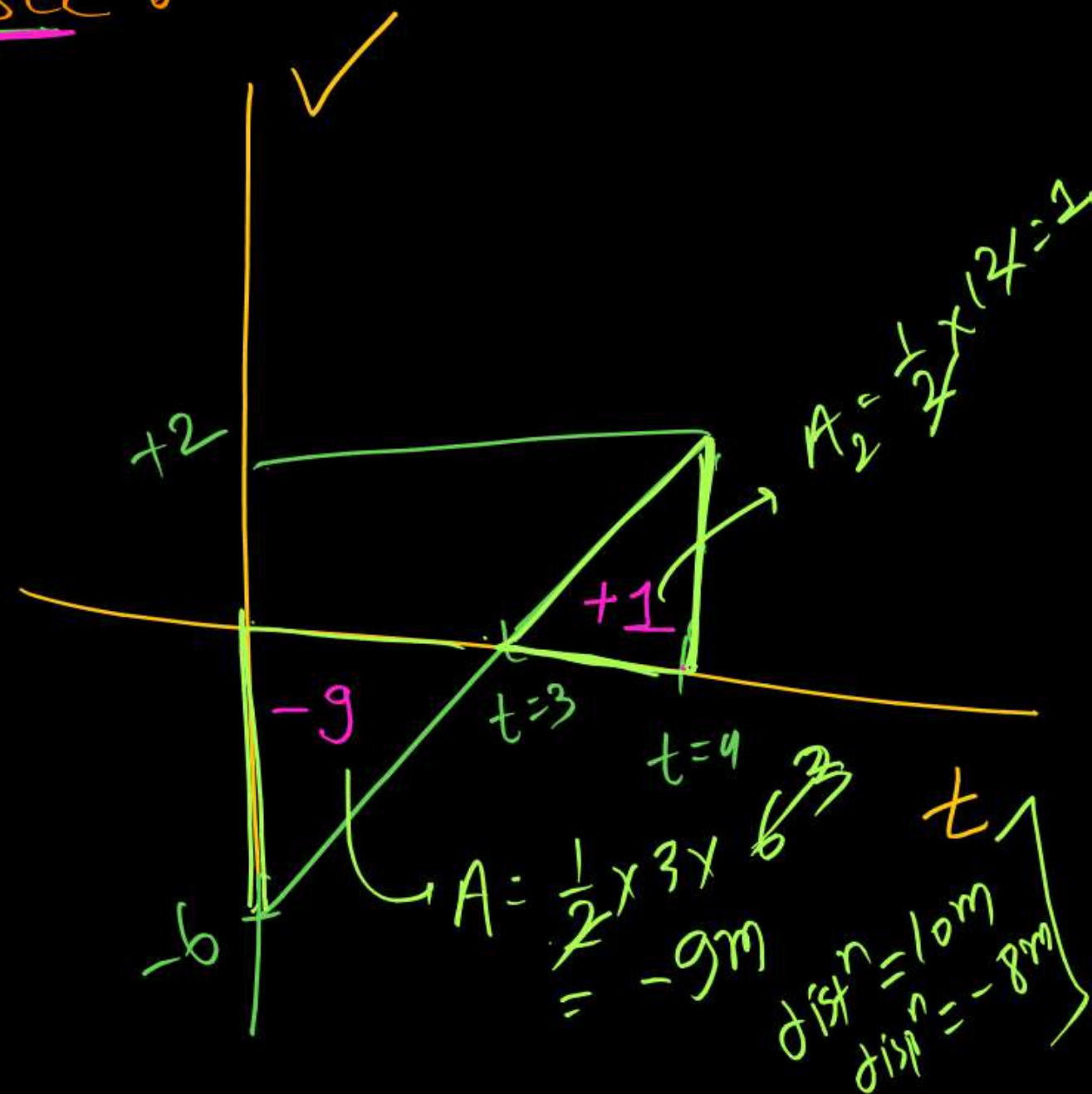
find $1st^n$ & $disp^m$ in $t = \underline{4sec}$.

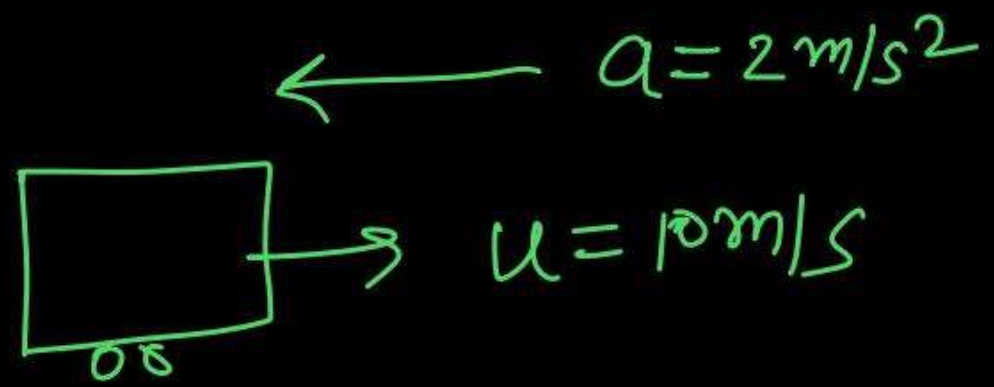
→ Soln

$$V = 2t - 6$$

$$y = mx + c$$

$t = 3 \text{ (} V = 0 \text{)}$





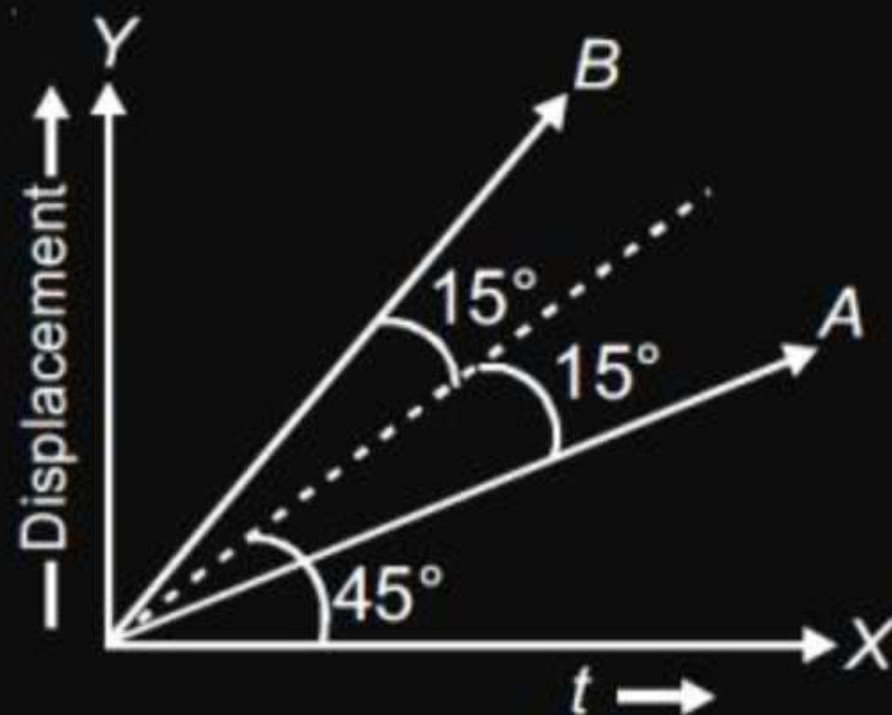
find distance and displacement in 7 sec

CAR is moving with initial speed 55 m/s and retardation -10 m/s^2
find distance in 6^{th} sec.

Question

The displacement-time graph for two particles A and B is follows. The ratio v_A/v_B is

- 1 $1 : 2$
- 2 $1 : \sqrt{3}$
- 3 $13 : 1$
- 4 $1 : 3$



Question



In which graph acceleration is non-zero constant?

1



2



3



4

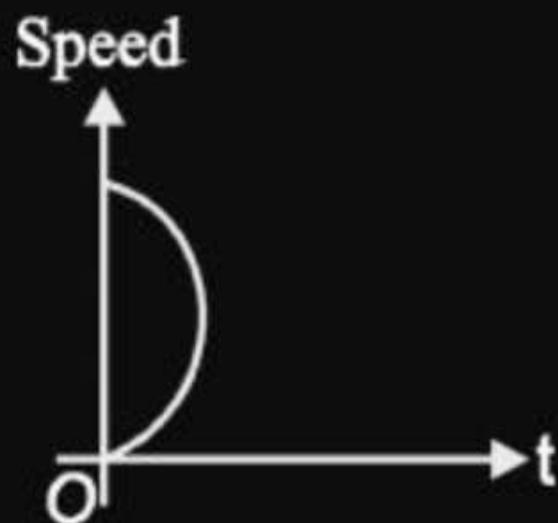
None of these

H/W

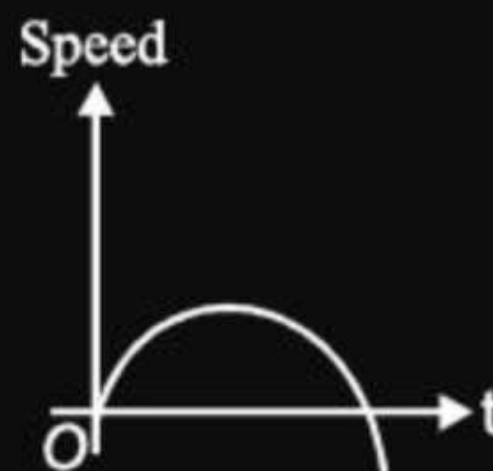
Question

Which one of the following graph for a body moving along a straight line is possible?

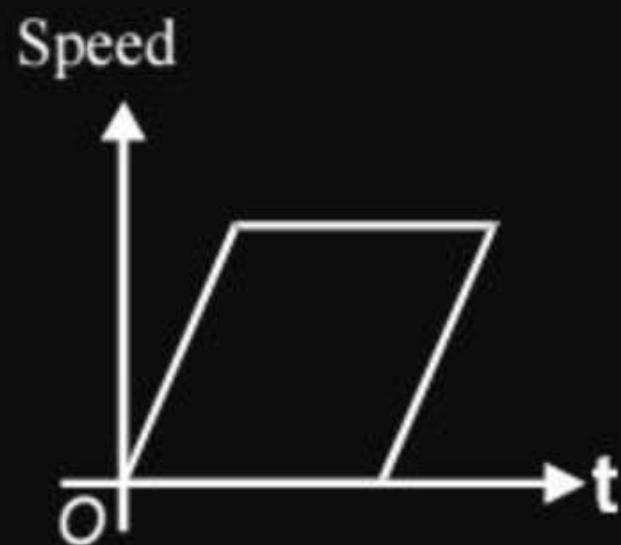
1



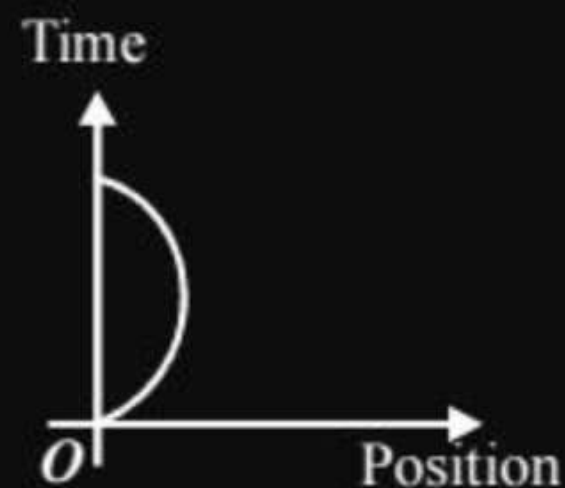
2



3



4



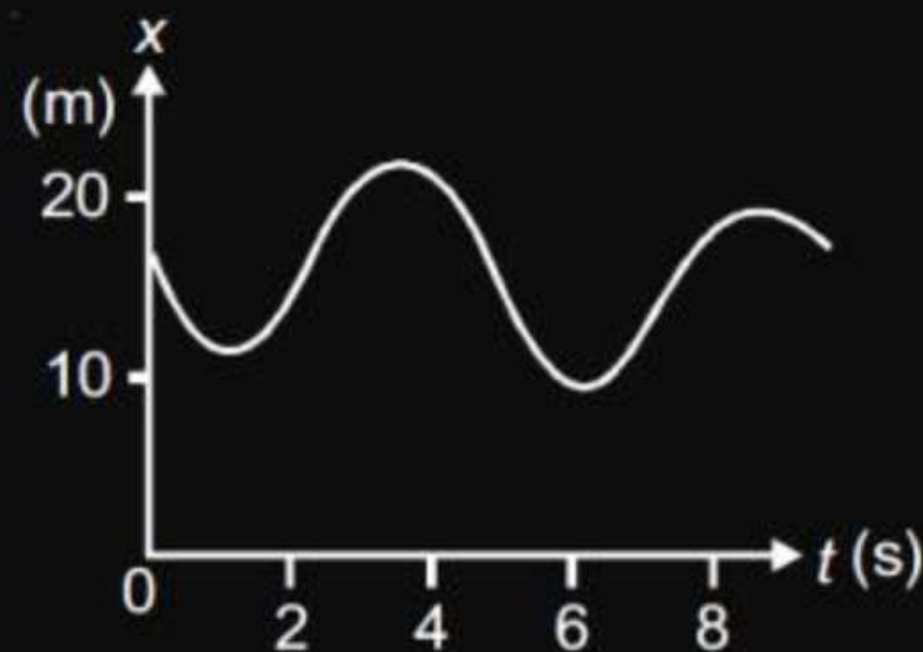
H/W

Question



Figure shows the position of a particle moving on the x -axis as a function of time

- 1 The particle has come to rest 4 times
- 2 The velocity at $t = 8$ s is negative
- 3 The velocity remains positive for $t = 2$ s to $t = 6$ s
- 4 The particle moves with a constant velocity

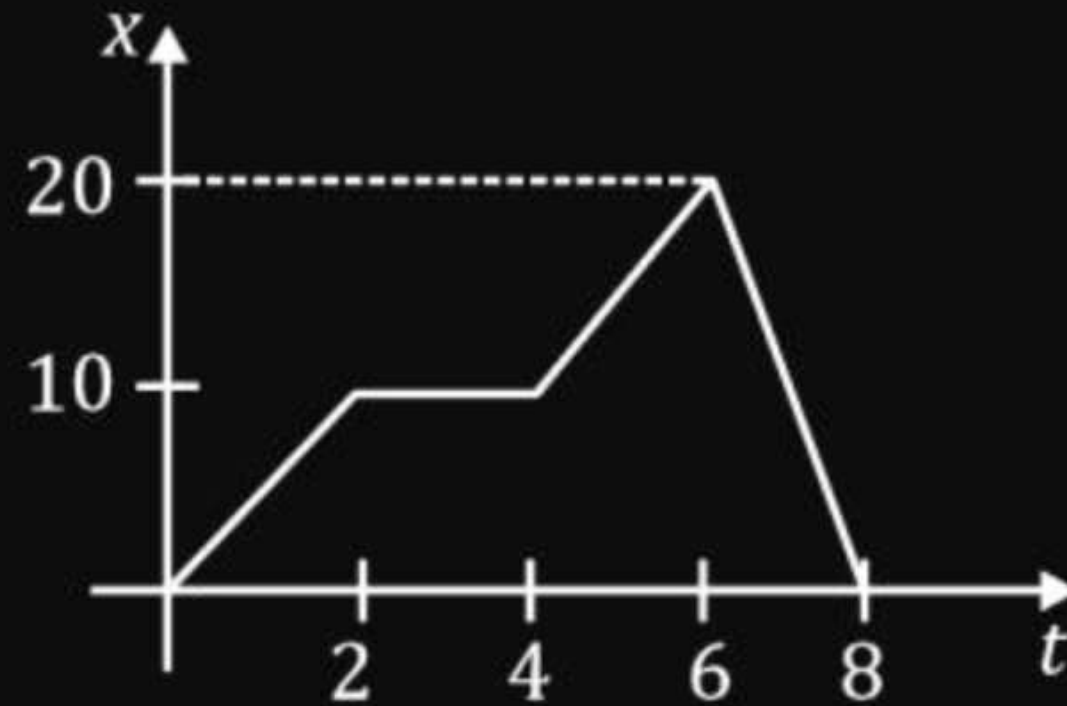


H/W

Question



Find avg speed and velocity in 8 sec.

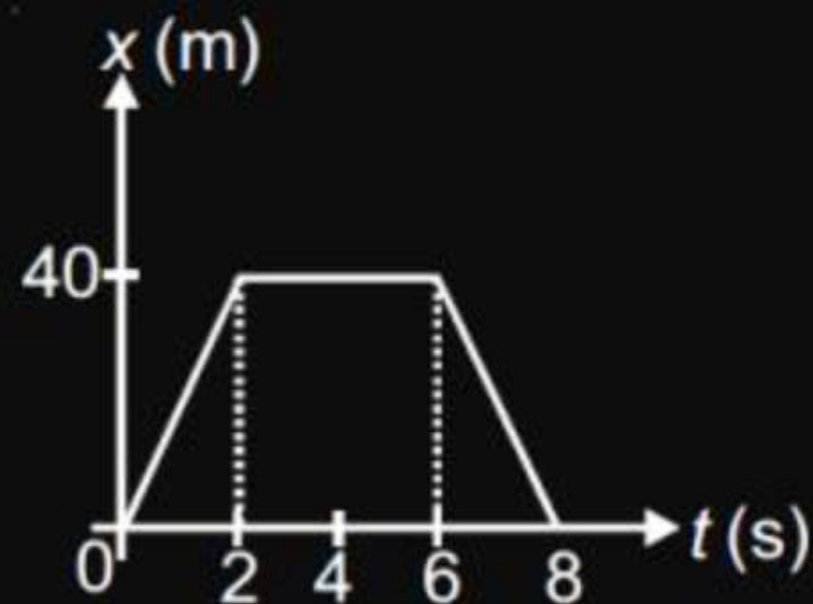


H/W

Question

The position (x) of a particle moving along x -axis varies with time (t) as shown in figure. The average acceleration of particle in time interval $t = 0$ to $t = 8$ s is

- 1 3 m/s^2
- 2 -5 m/s^2
- 3 -4 m/s^2
- 4 2.5 m/s^2



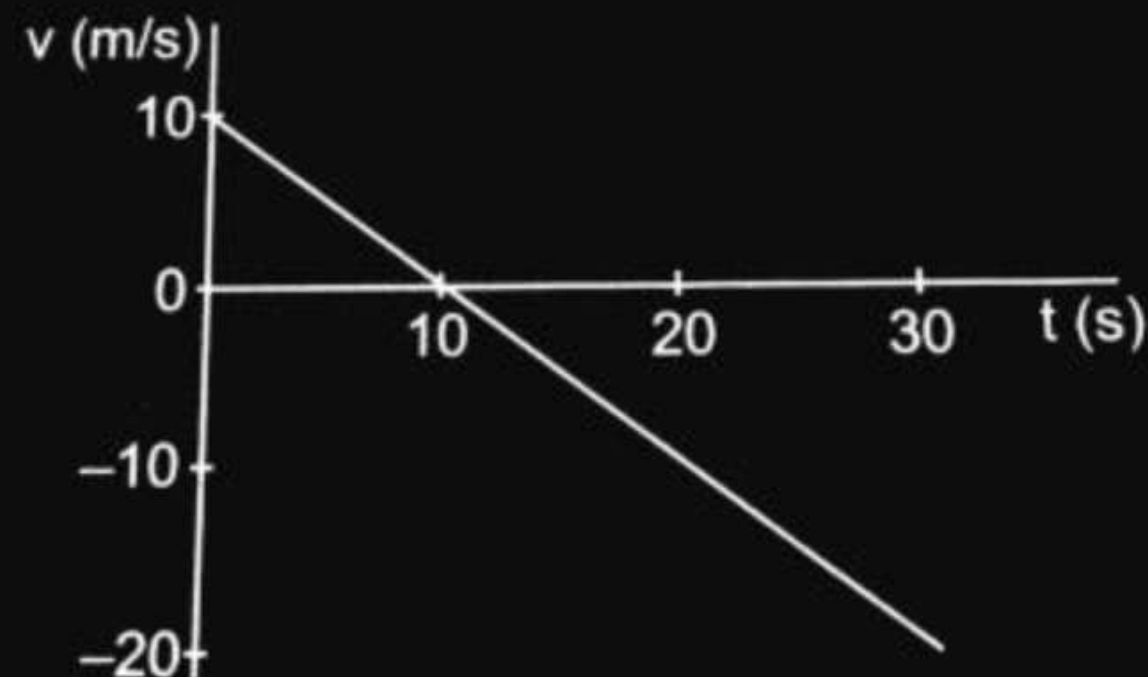
M/W

Question



The velocity-time plot for a particle moving on a straight line shown in the figure

- 1 The particle has a constant acceleration
- 2 The particle has never turned around
- 3 The particle has a zero displacement
- 4 The average speed in the interval 0 to 10s is the same as the average speed in the interval 10s to 30s



H/W

THANK
YOU