

YAKEEN NEET 2.0

2026

Kinematics - - -

Motion in a straight line

PHYSICS

Lecture - 08

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Today's Goal

- Advance Level up ques Practice
- Equation of motion



* $(x-t)_{\text{slope}} \rightarrow \text{Velocity}$

* $(v-t)_{\text{slope}} \rightarrow a$

* $(v-t)_{\text{area}} \rightarrow A_{\text{ऊपर}} + A_{\text{नीचे}} = \text{Distance}$

$A_{\text{ऊपर}} - A_{\text{नीचे}} = \text{Displacement} = \text{change in position}$

*** $(a-t)_{\text{area}} \rightarrow \text{velocity} \times$

$\rightarrow \text{change in velocity}$

a, v sign \rightarrow same speed up
 \rightarrow opposite (speed down)

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

$$\int_{x_i}^{x_f} dx = \int_{t_1}^{t_2} v dt$$

$$(x_f - x_i) = \int_{t_1}^{t_2} v dt = \text{Area (v-t) graph}$$

→ change in position = Displacement

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

$$\int_{v_i}^{v_f} dv = \int_{t_1}^{t_2} a dt$$

$$(v_f - v_i) = \int_{t_1}^{t_2} a dt = \text{Area (a-t) graph}$$

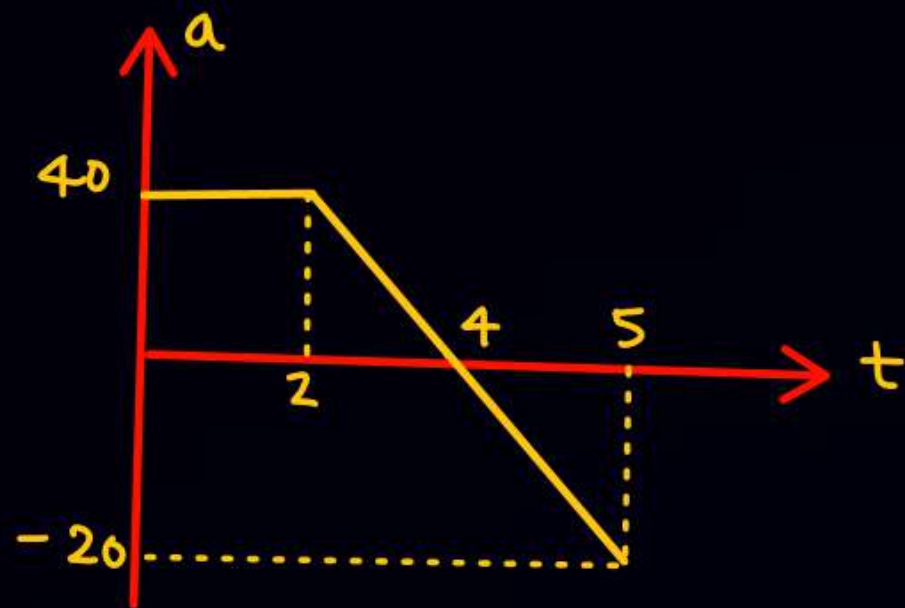
→ change in velocity

Q A particle start motion from rest s.t. its a-t graph is given as

① find velocity at $t = 5 \text{ sec.}$

Solⁿ

$$A_{\text{net}} = A_{\text{अपर}} - A_{\text{नीचे}}$$

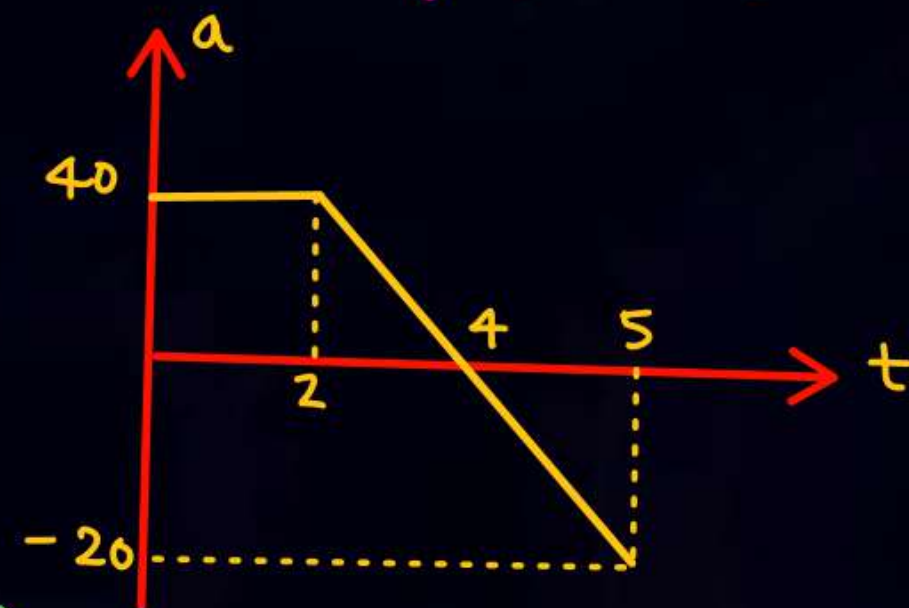


$$\Delta V = \frac{1}{2} (2+4) \times 40 - \frac{1}{2} \times 1 \times 20$$

$$V_f - V_i = 120 - 10 = 110$$

$$V_f - 0 = 110 \quad | \quad V_f = 110$$

Q A particle start motion with initial velocity $+10 \text{ m/s}$ and a-t graph is given find velocity at $t = 5$



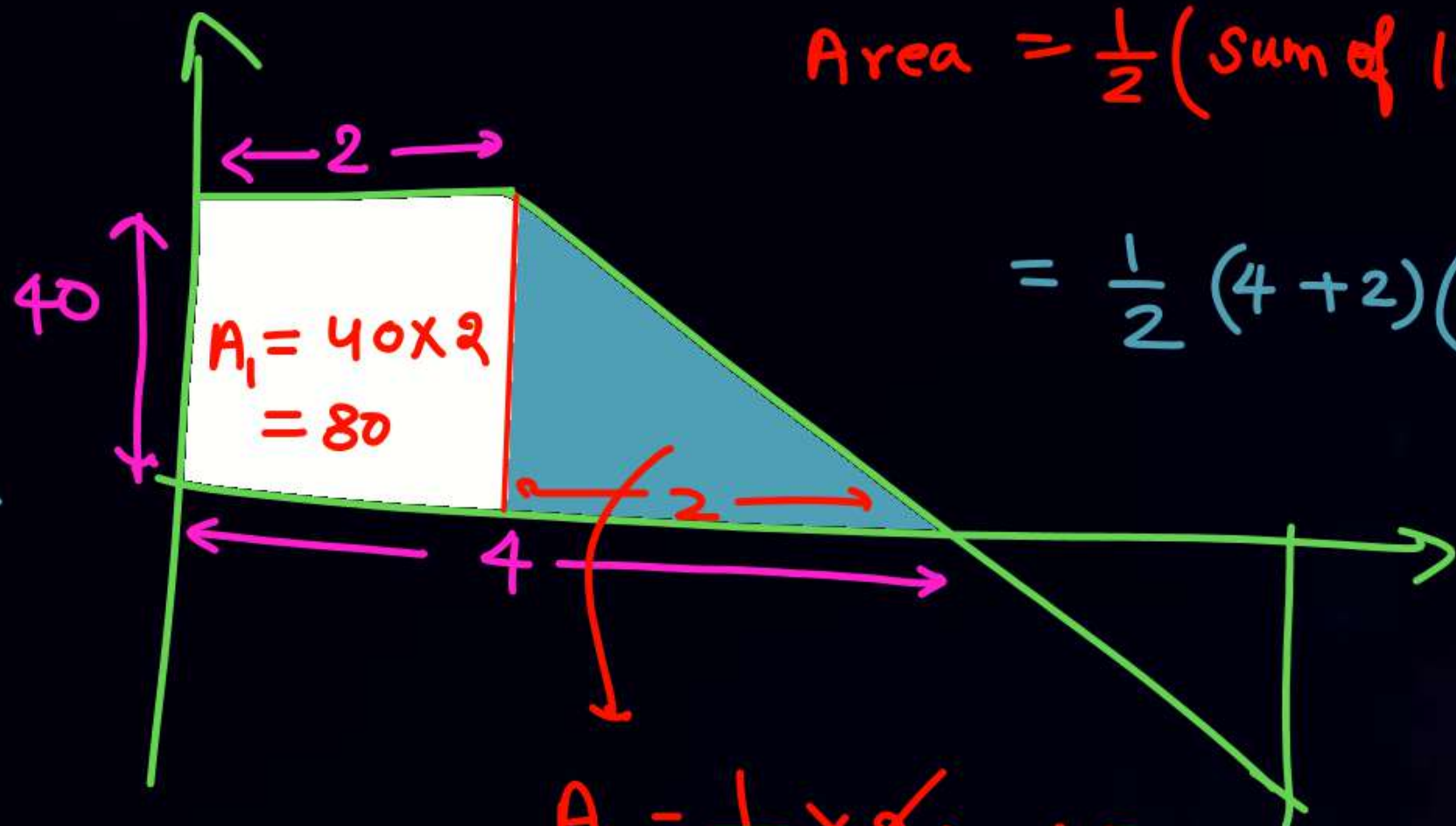
Solⁿ $\Delta \vec{V} = \vec{A}_{\text{net}}$

$$V_f - V_i = 120 - 10 = 110$$

$$V_f - 10 = 110$$

$$\boxed{V_f = 120}$$





$$\text{Area} = \frac{1}{2} (\text{sum of } 11^{\text{th}} \text{ side}) \times (\text{shortest perpendicular distance})$$

$$= \frac{1}{2} (4 + 2) (40) = \frac{1}{2} 6 \times 40$$

$$= 3 \times 40$$

$$= 120$$

$$A_2 = \frac{1}{2} \times 2 \times 40$$

$$A_2 = 40$$

$$\begin{array}{r} 80 \\ 40 \\ \hline 120 \end{array}$$

Q A particle start motion from rest s.t. its a-t graph is given as

① find velocity at $t = 4$ sec

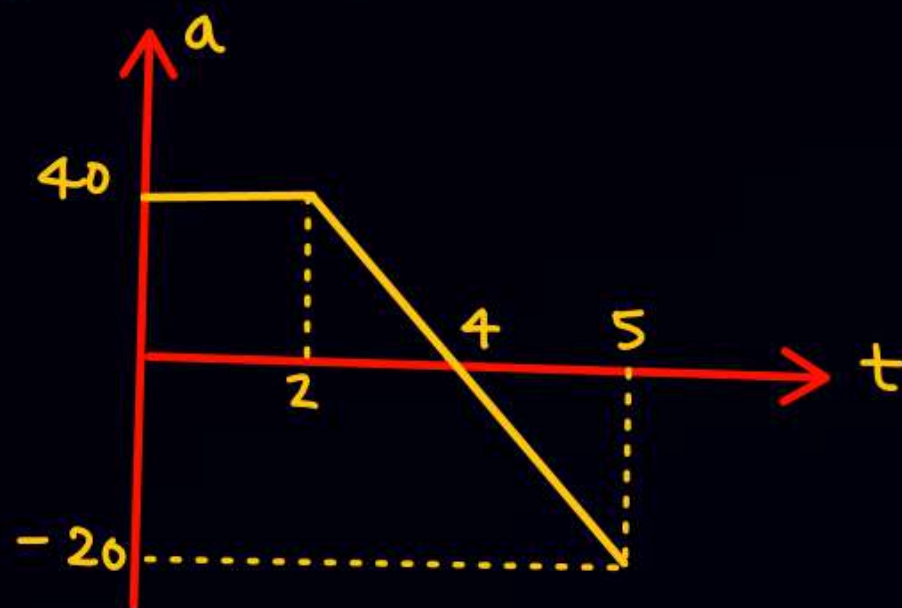
Solⁿ

$t = 0 \rightarrow t = 4$
कहा Ka Area

$$\Delta \vec{V} = \text{Area} = 120$$

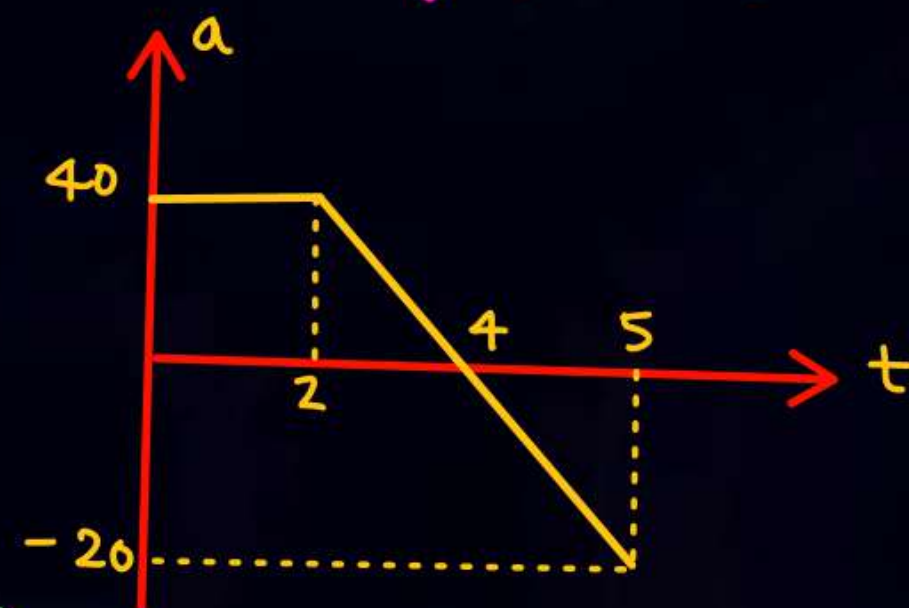
$$V_f - 0 = 120$$

$$\boxed{V_f = 120}$$



Q A particle start motion with initial velocity $+10 \text{ m/s}$ and a-t graph is given
find velocity at $t = 4$

Solⁿ $\Delta \vec{V} = \vec{A}_{\text{net}}$
 $V_f - V_i = 120$
 $V_f - 10 = 120$
 $\boxed{V_f = 130}$



SKC (silly mistakes)

- * $(a-t)$ का area \implies Change in velocity Dega Area = $V_f - V_i$
- * उतना ही Area लेना है जितना पूछा है (time interval)
Utna hi area Lena hai jitna poocha hai.



Q A particle start motion with initial velocity $+20\text{m/s}$. find KE of particle at $t=10\text{sec}$, ($m=2\text{kg}$)

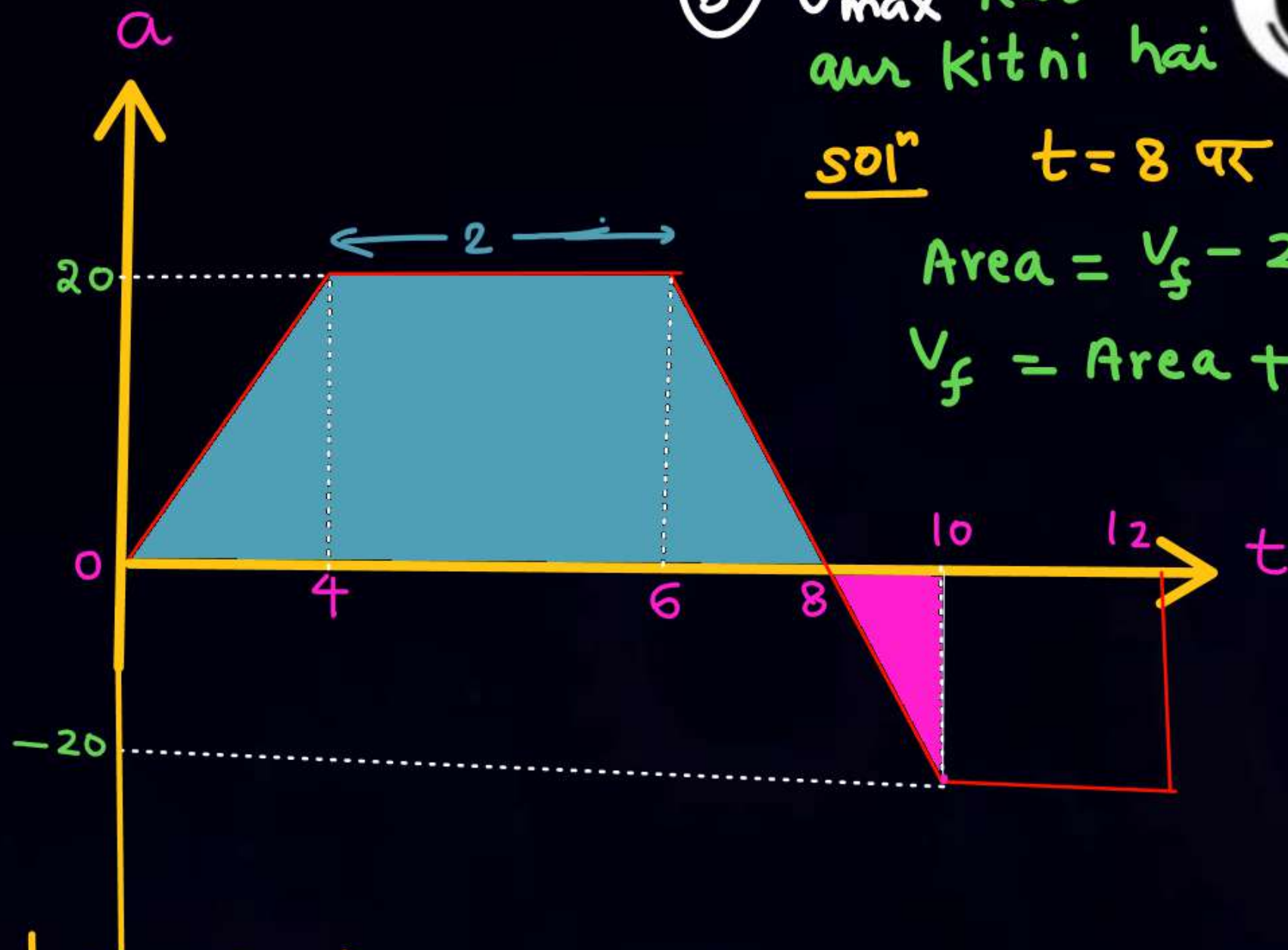
Solⁿ

$$V_f - 20 = \frac{1}{2}(8+2) \times 20 - \frac{1}{2} \times 2 \times 20$$

$$V_f - 20 = 100 - 20$$

$$\boxed{V_f = 100}$$

$$KE = \frac{1}{2}mv^2 = \frac{1}{2} \times 2 \times (100)^2 = \underline{10000}$$



(b) v_{\max} Kab aur kitni hai

Solⁿ $t=8$ or v_{\max}

$$\text{Area} = V_f - 20$$

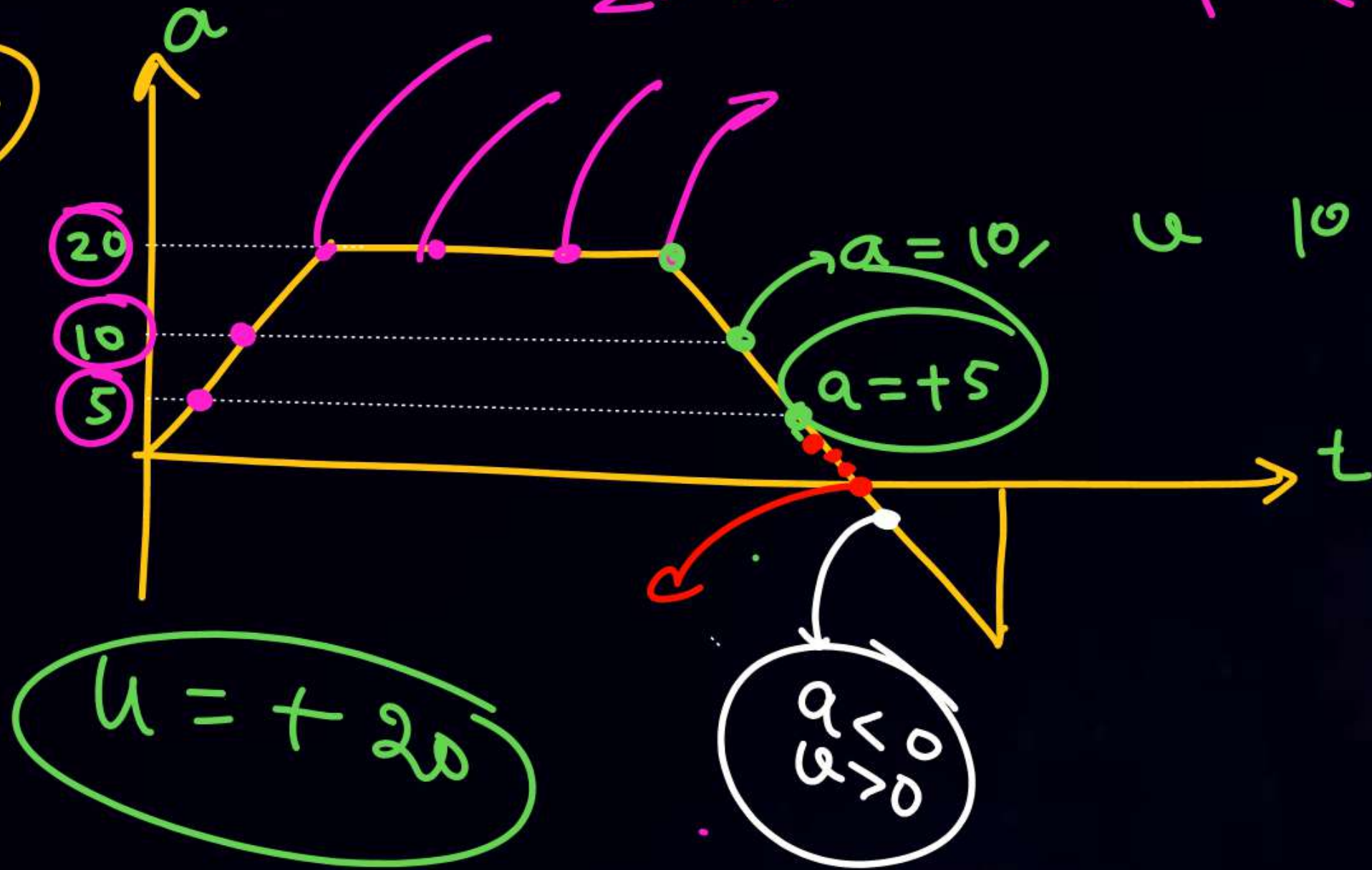
$$V_f = \text{Area} + 20$$

दादा
SKL



20 के Rate से \uparrow रही है

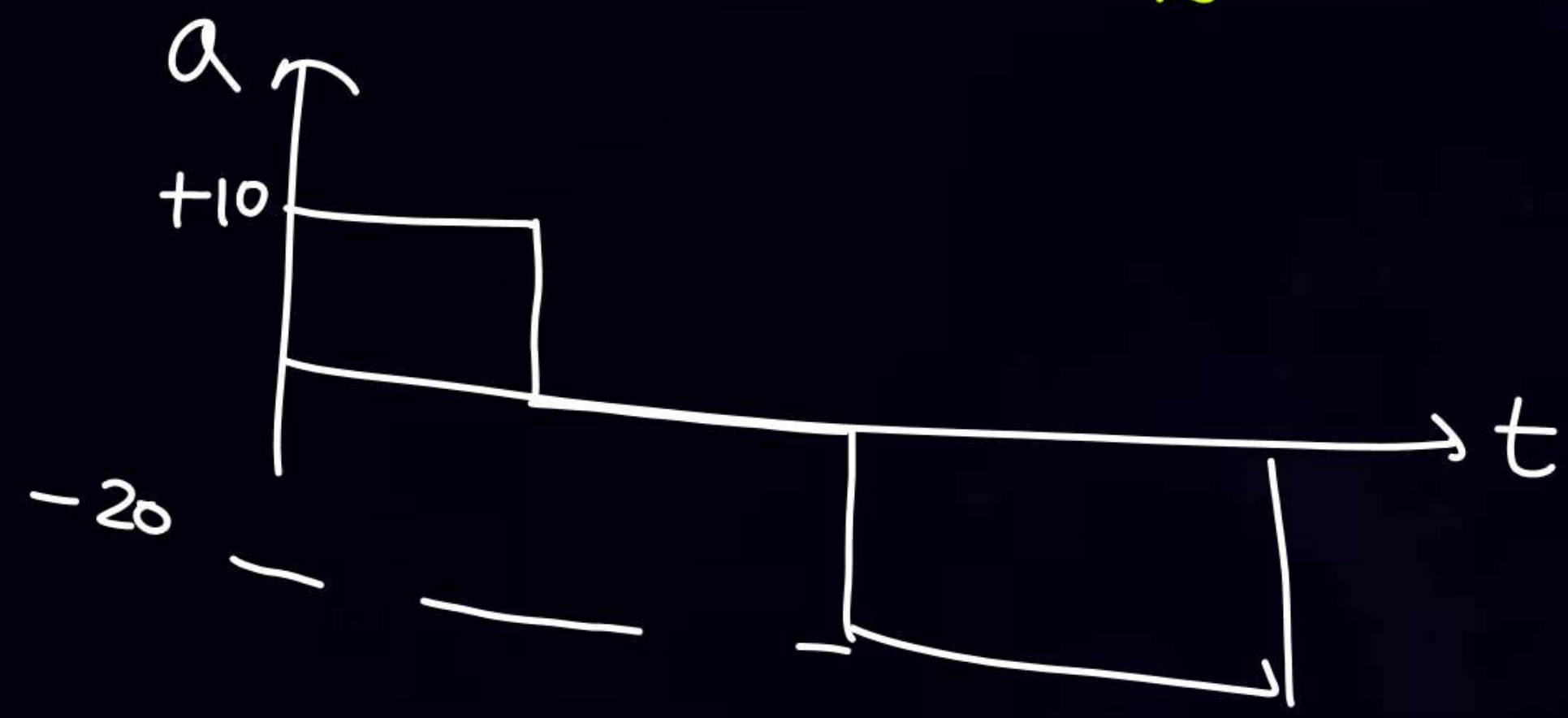
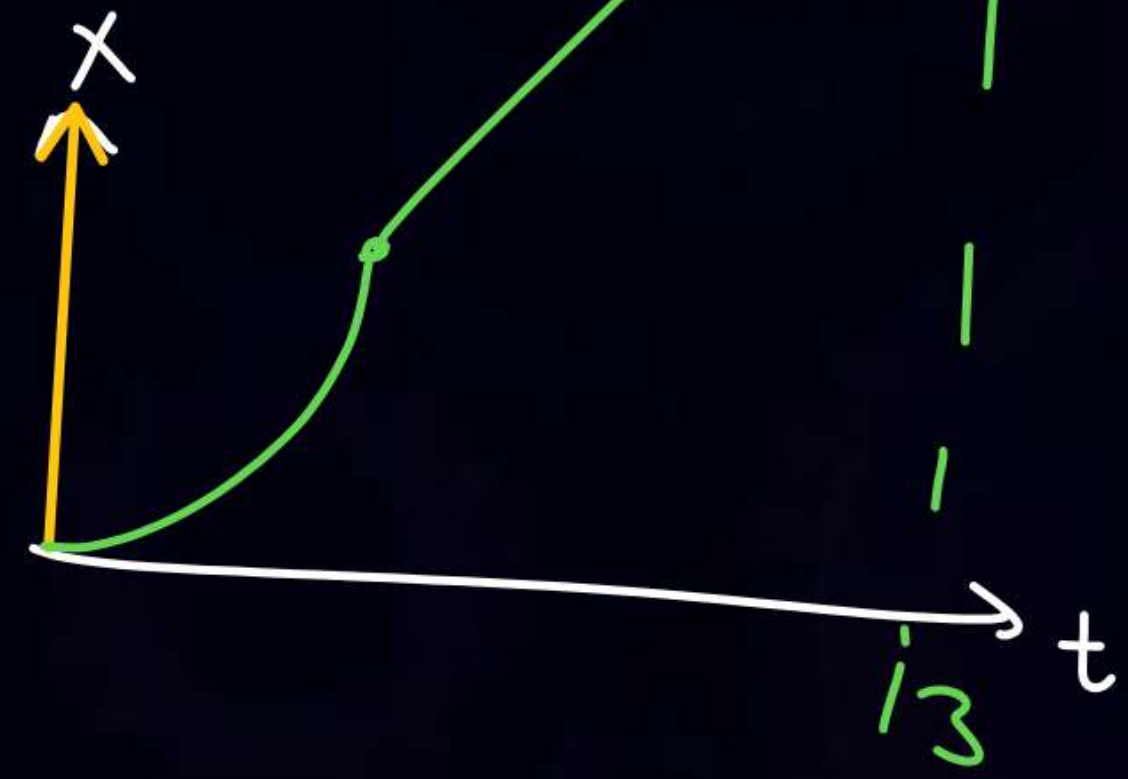
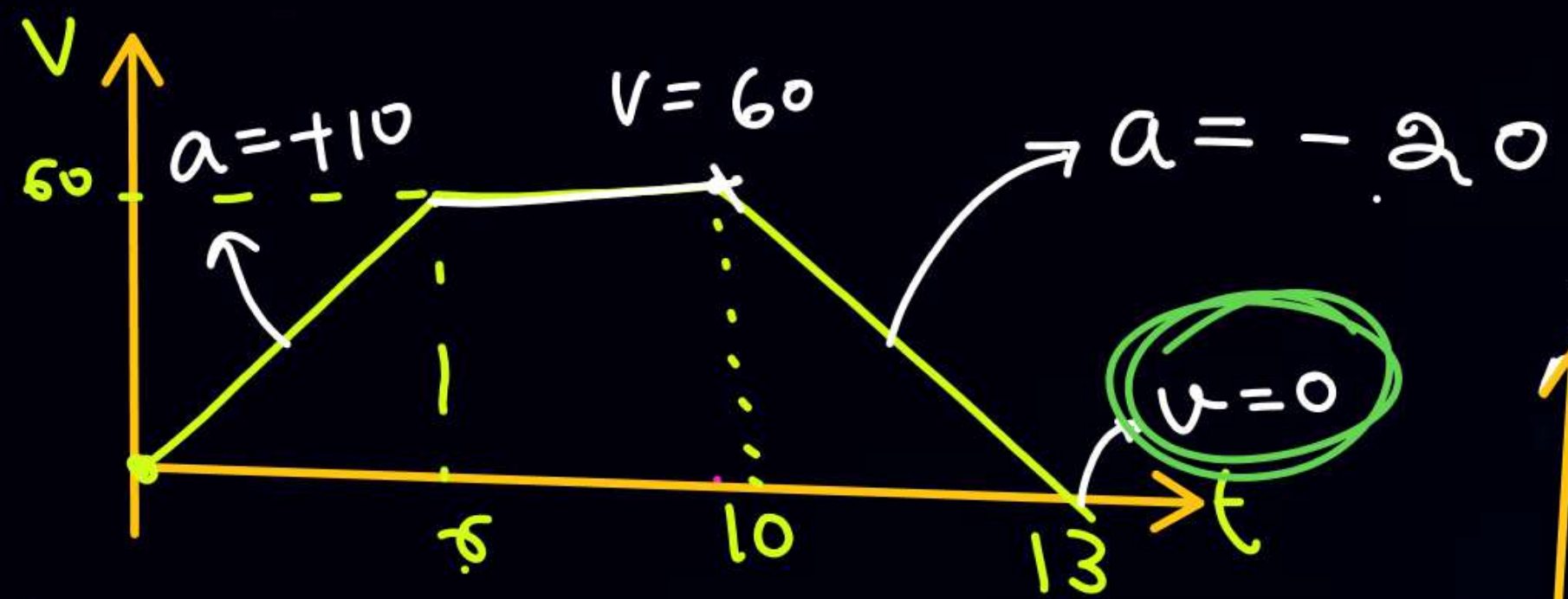
10 के Rate से \uparrow





s

Sol



Q

A particle start motion from origin $x=0$, from rest at $t=0$. Initially particle has acc $+10\text{m/s}^2$ for six second after that it travel with const velocity for four sec. Now particle start slow down and comes to rest in 3 sec with const acc. Find

① Distance

Solⁿ

② Displacement

③ $\langle \text{speed} \rangle = \frac{510}{13}$

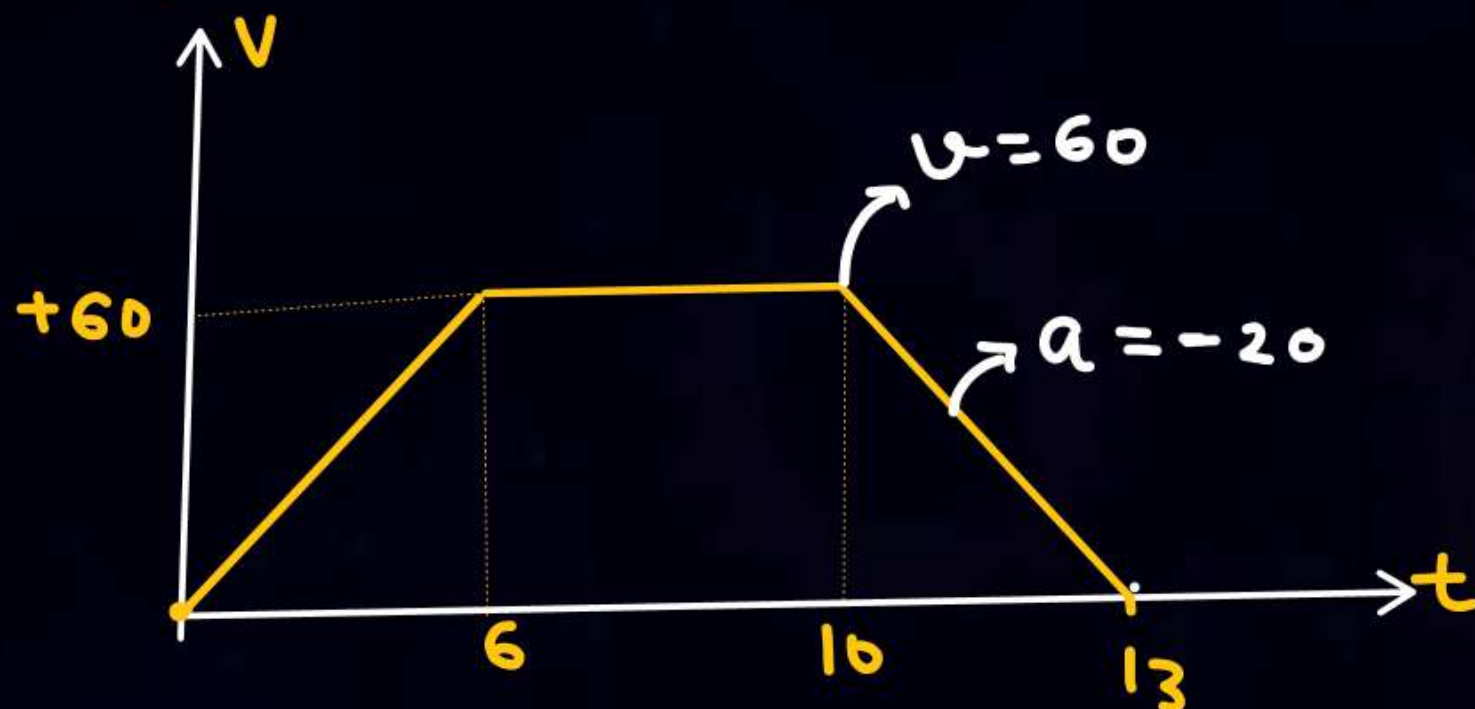
④ $\langle \text{velocity} \rangle = \frac{510}{13}$

⑤ Draw (V-t) graph

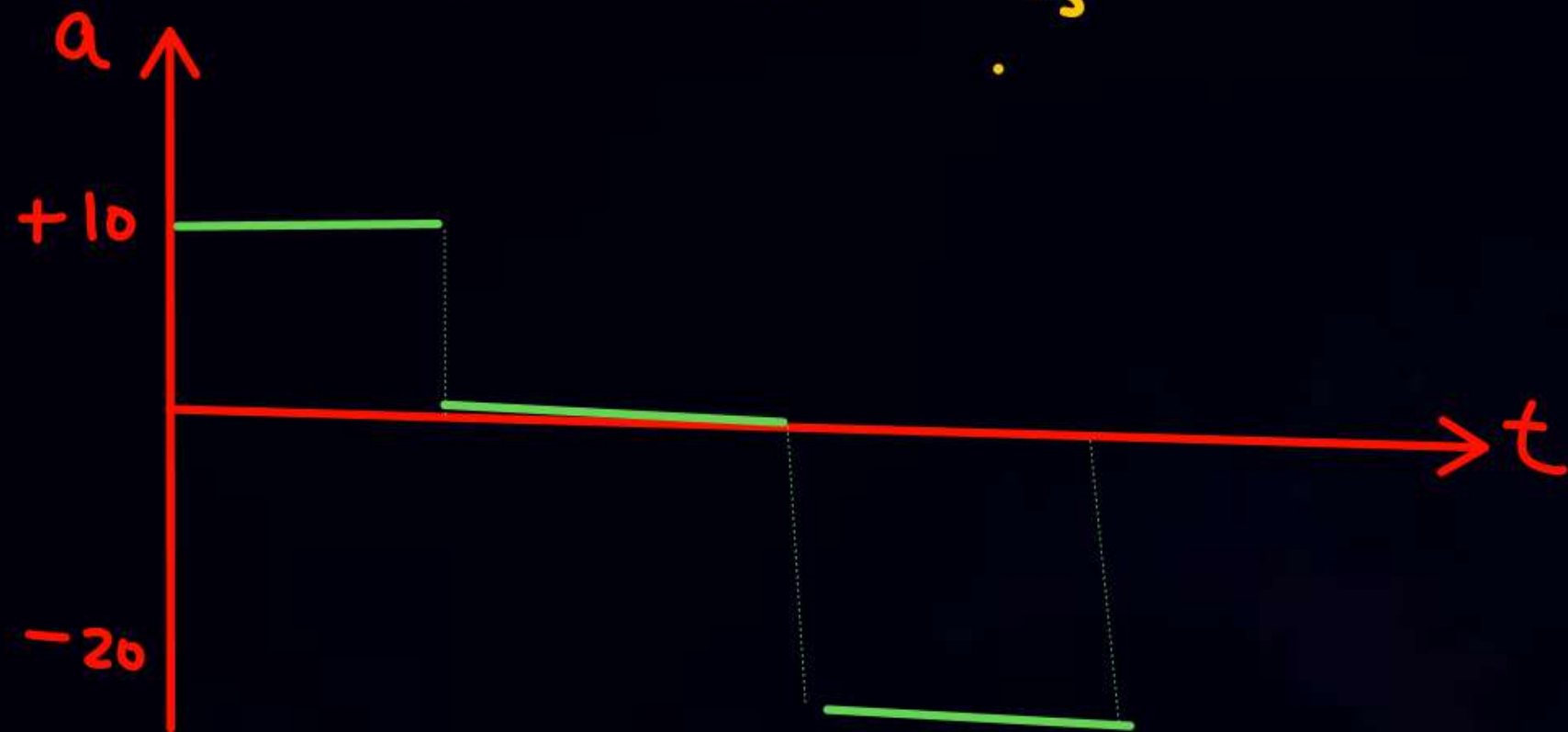
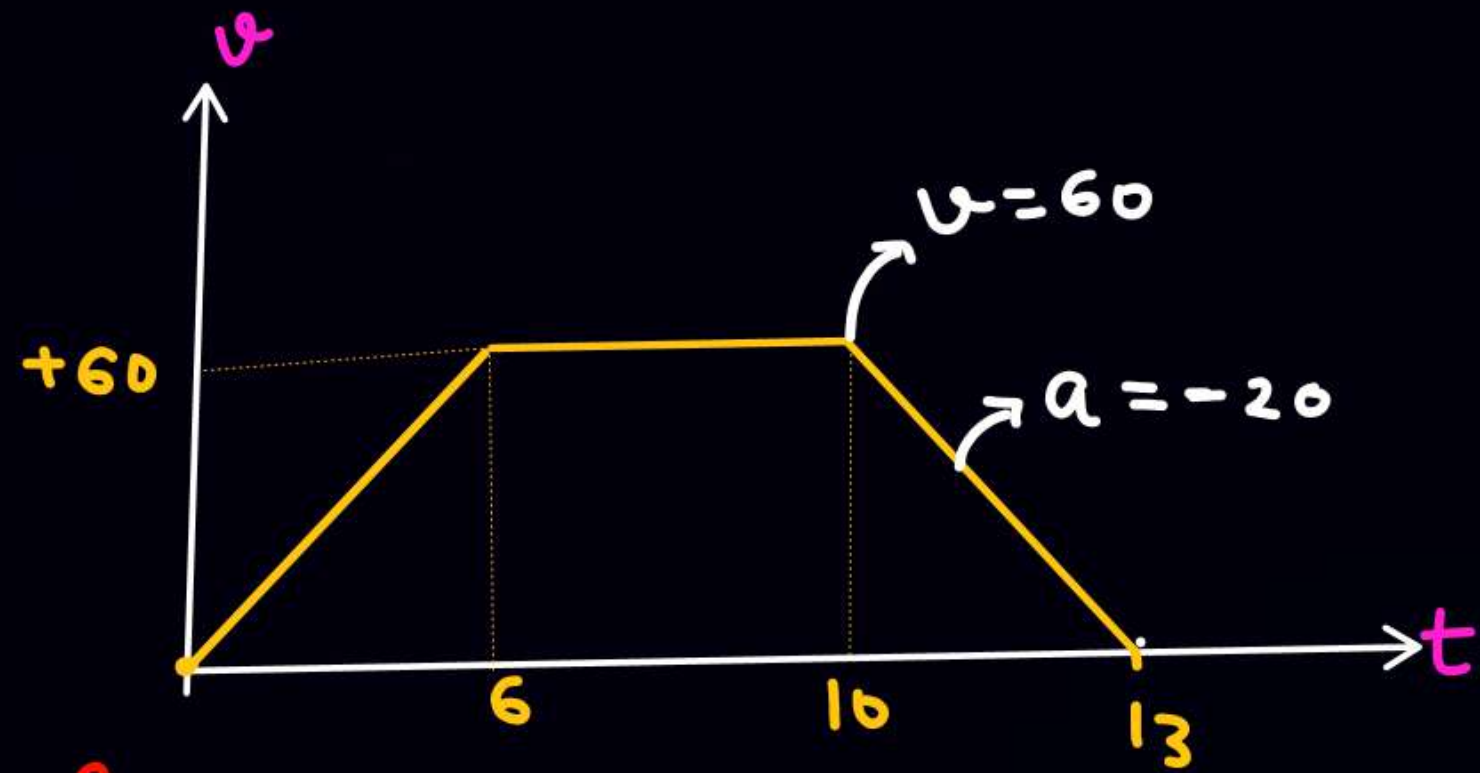
⑥ Draw (a-t) graph

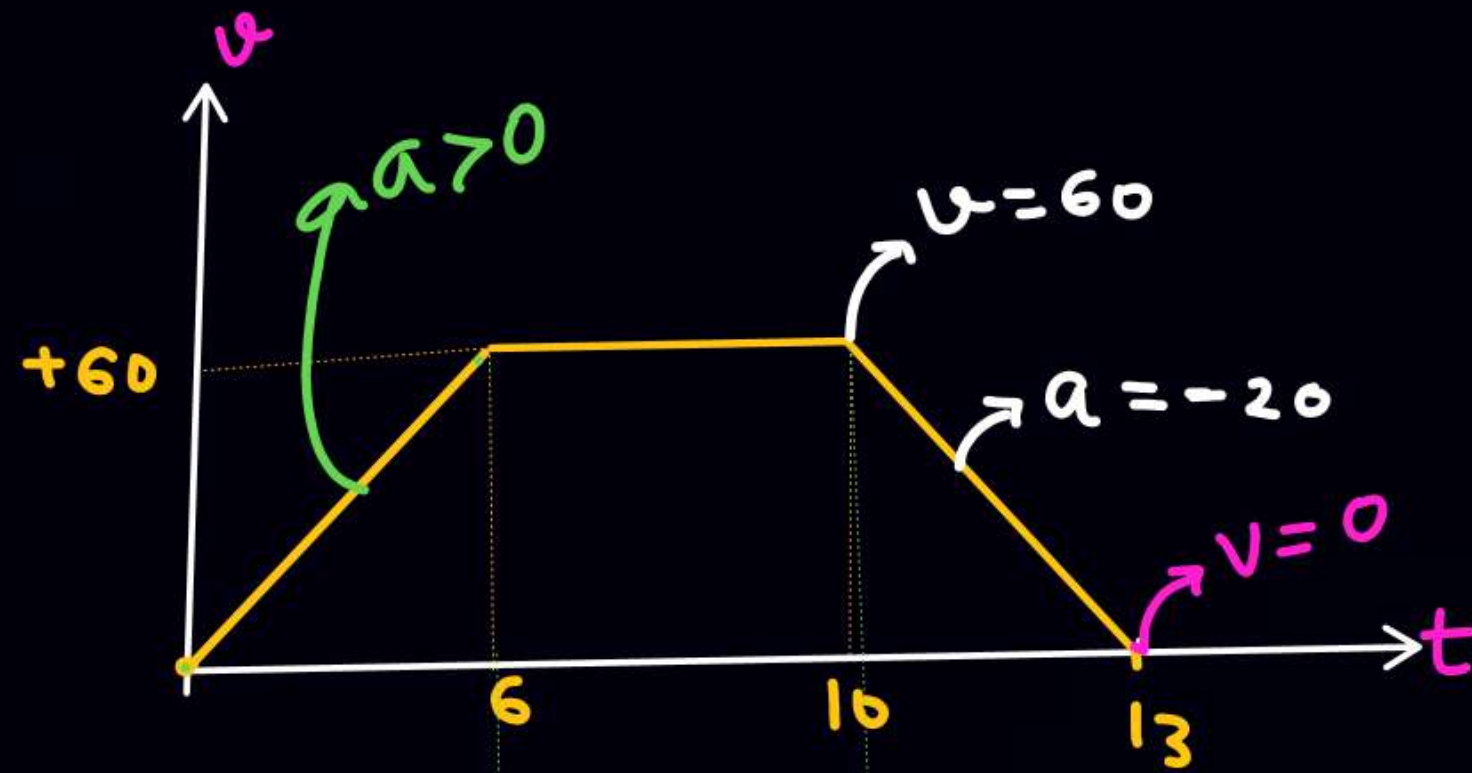
⑦ Draw (x-t) graph

⑧ acc in last part of journey
 $a = -20$

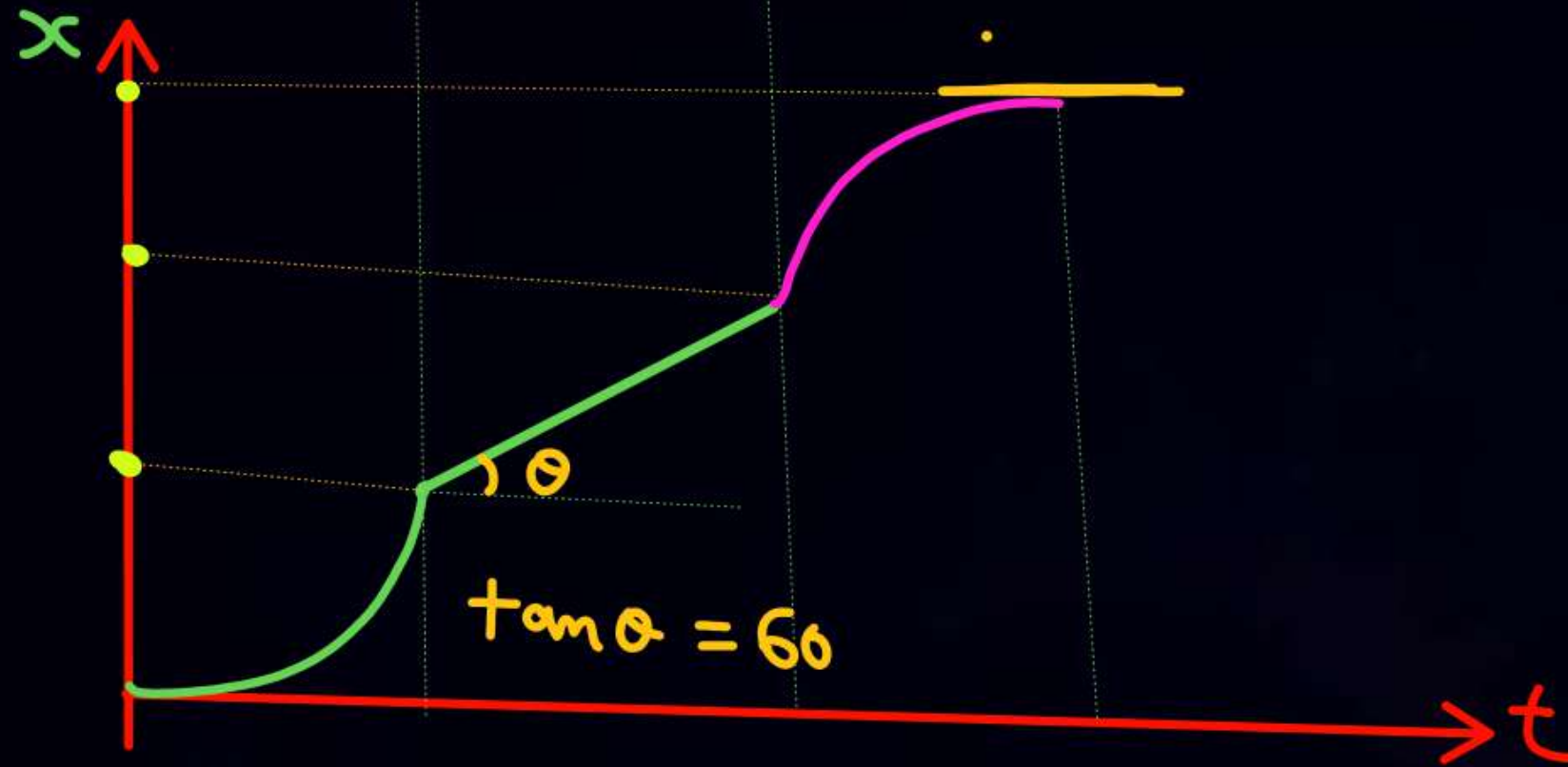


$$\text{Area} = \frac{1}{2} (13+6) \times 60 = 510 = \text{Distance} = \text{Displacement}$$



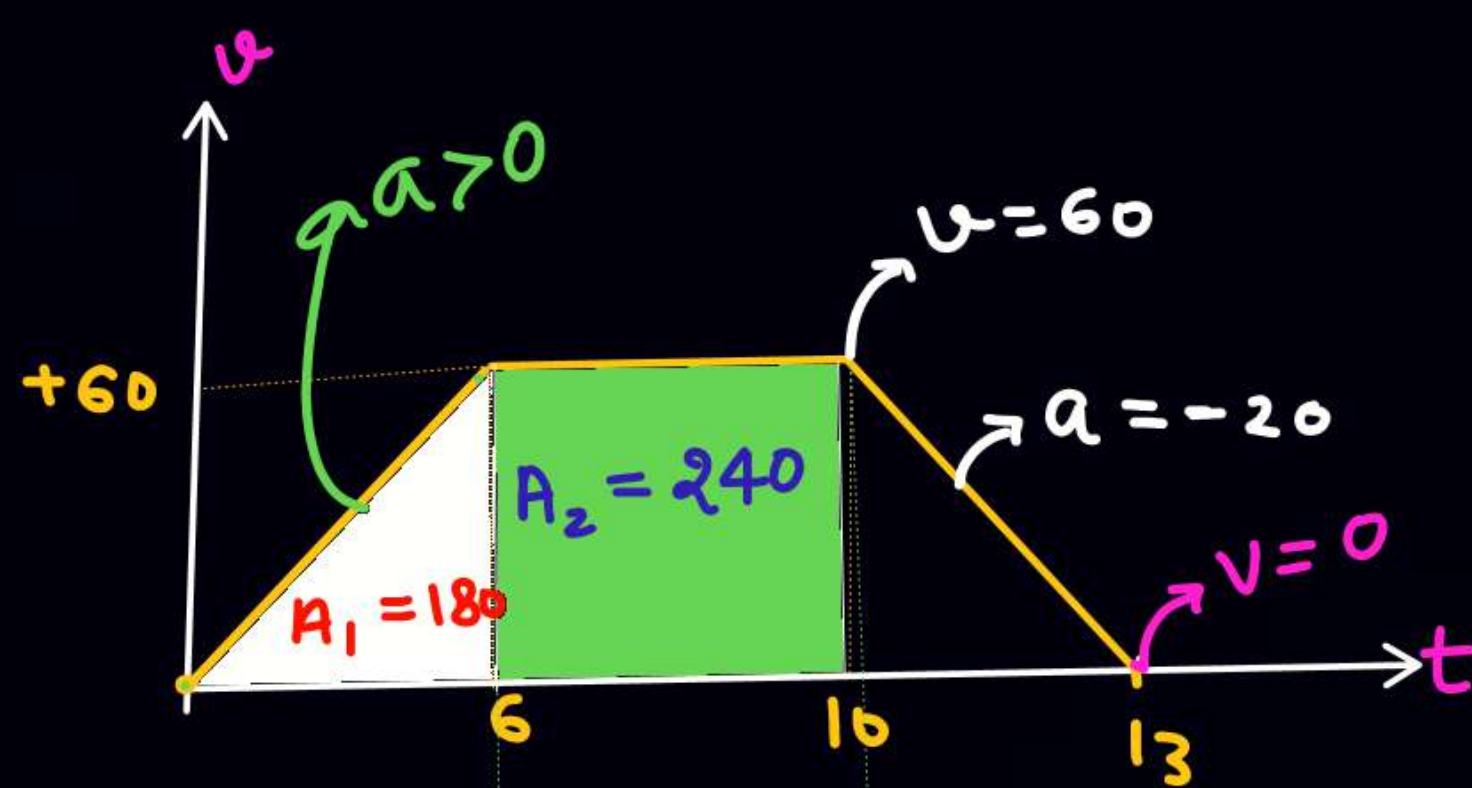


180
420
510



S

JA

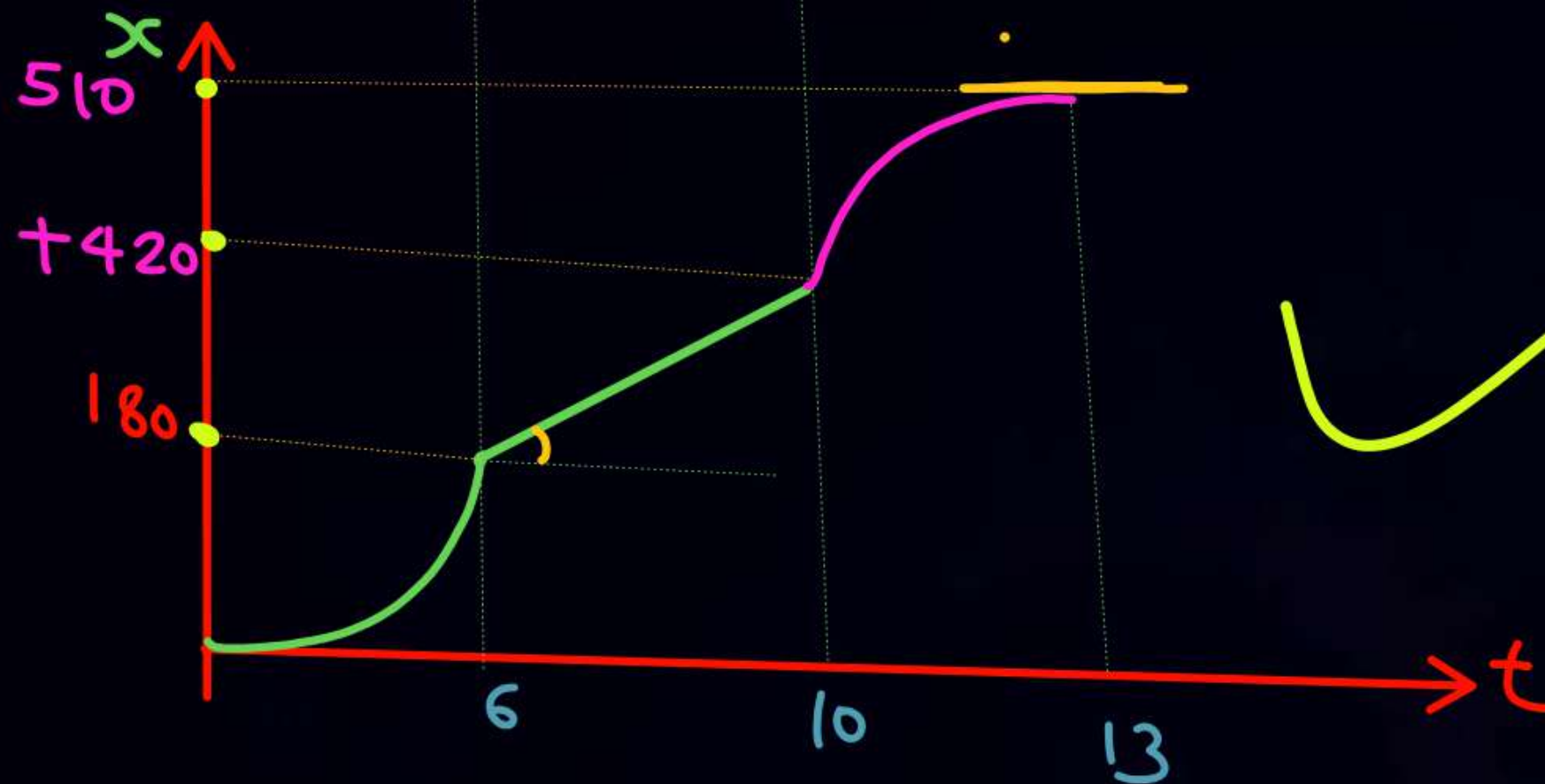


~~xxxx~~

180
420
510

$$A_1 = \frac{1}{2} \times 6 \times 60 = 180$$

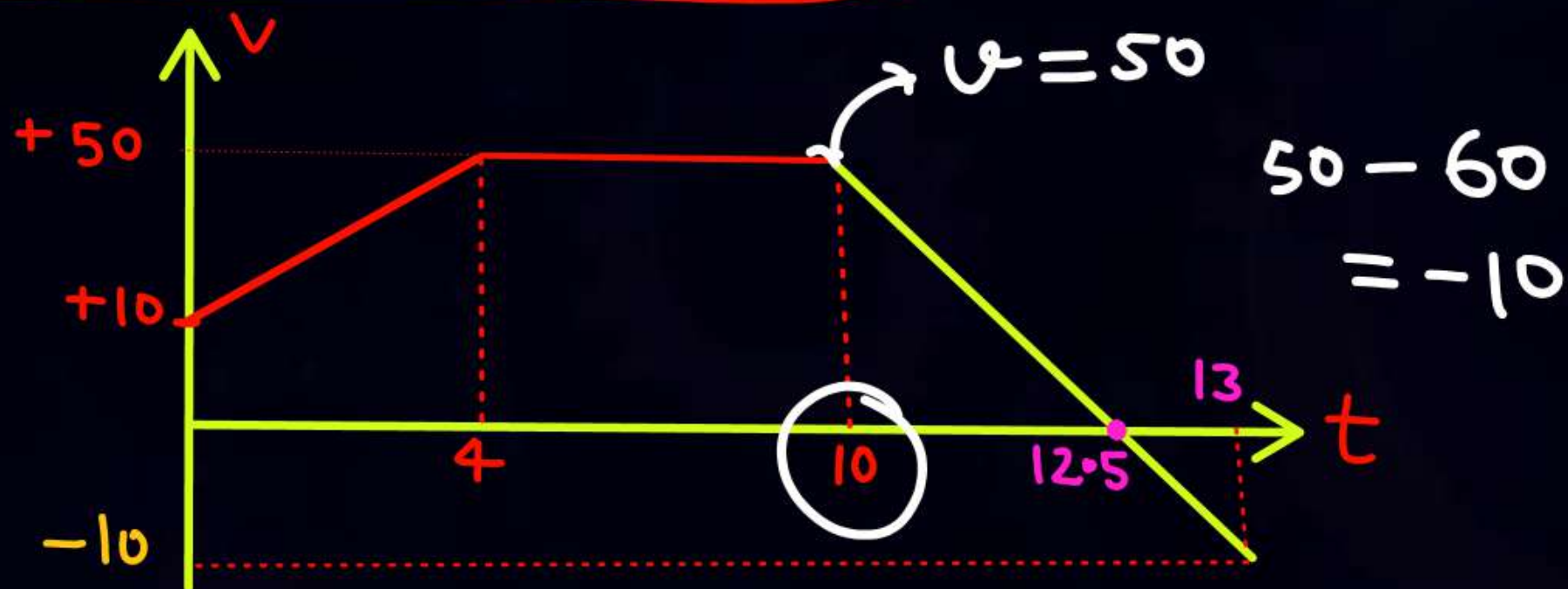
$$\begin{array}{r} +240 \\ \hline 420 \end{array}$$



JA

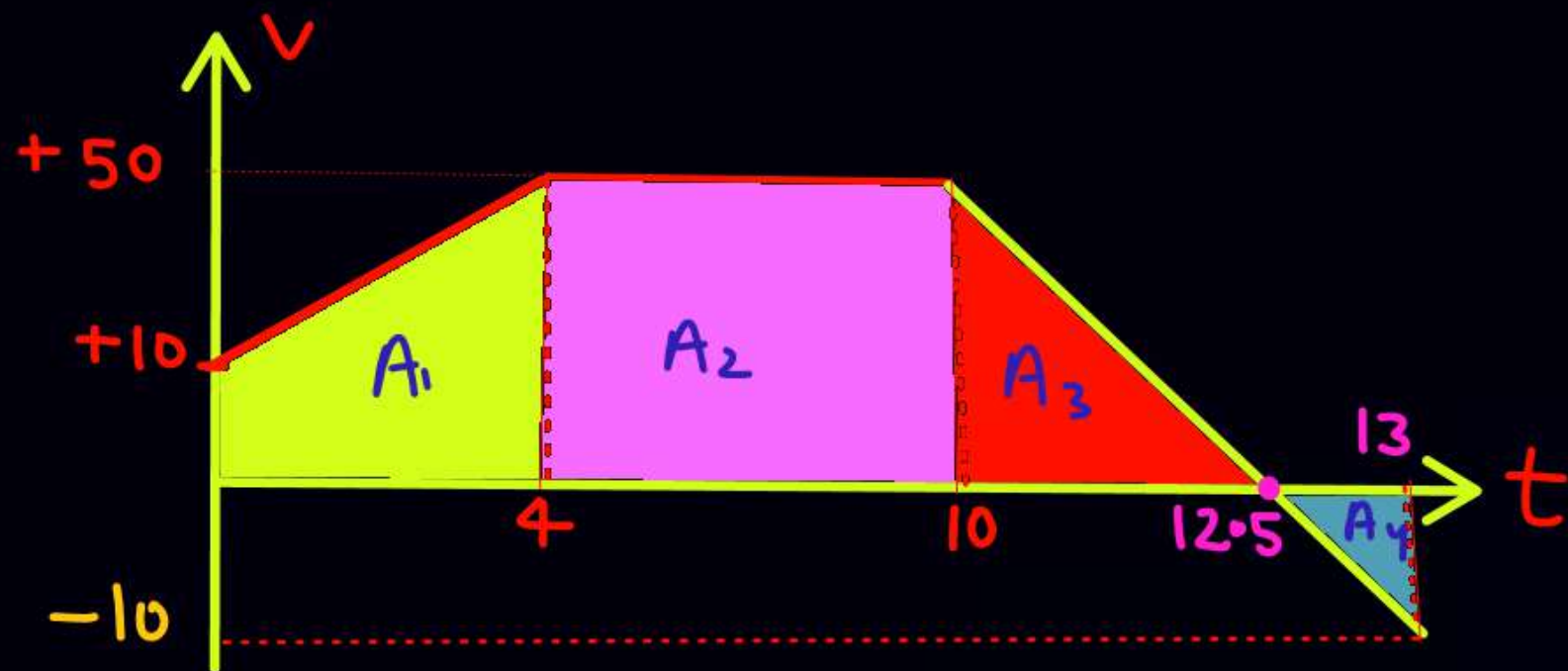
Q A particle start motion from origin with initial velocity $+10 \text{ m/s}$ and having acc $+10 \text{ m/s}^2$ for four second. After that it travel with zero acc (const velocity) for next six second. Now acc of the particle become -20 m/s^2 for three second. Find

- Sol
- ① Avg velocity
 - ② Avg speed
 - ③ Avg acc
 - ④ Draw (v-t) graph
 - ⑤ Draw (x-t) graph
 - ⑥ Draw (Distance-time) graph.





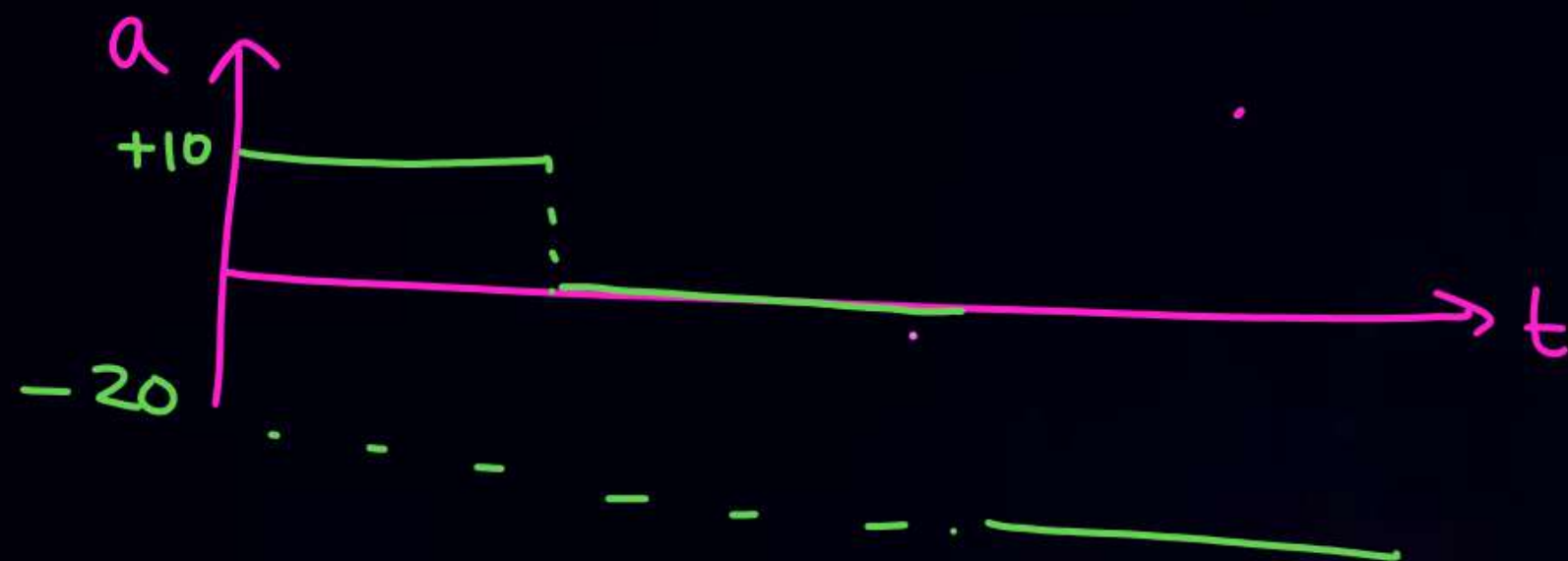
Q



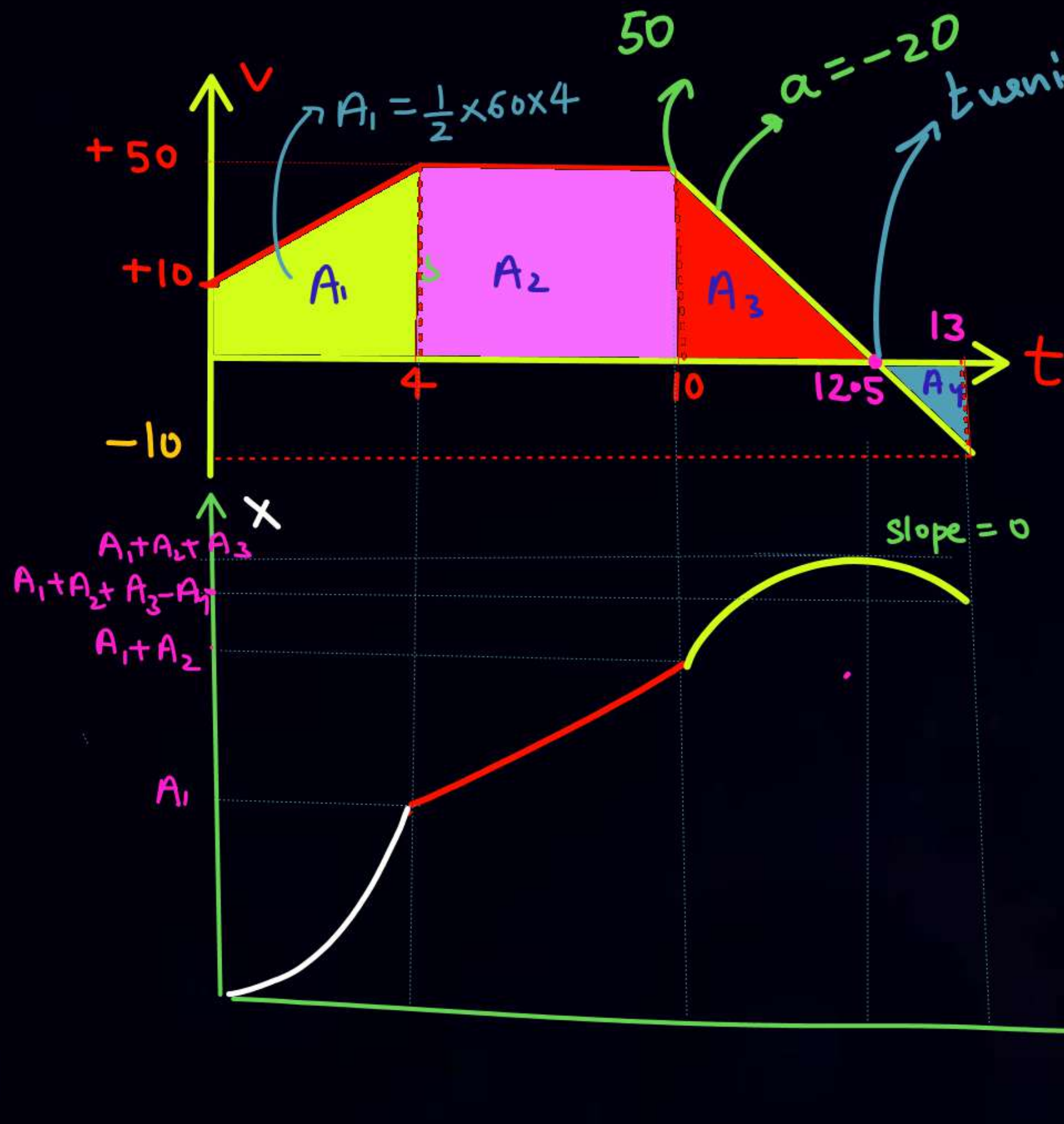
$$\text{Distance} = A_1 + A_2 + A_3 + A_4$$

$$\text{Displacement} = A_1 + A_2 + A_3 - A_4$$

$$\langle \vec{a} \rangle = \frac{V_f - V_i}{\text{time}} = \frac{-10 - 10}{13} = -\frac{20}{13}$$



Q



Distance = $A_1 + A_2 + A_3 + A_4$

$$\text{Displacement} = A_1 + A_2 + A_3 - A_4$$

$$\langle \vec{a} \rangle = \frac{V_f - V_i}{\text{time}} = \frac{-10 - 10}{13} = -\frac{20}{13}$$

$$A_1 = \frac{1}{2} \times (10 + 50) \times 4 = 120$$

$$A_2 = 6 \times 50 = 300$$

$$A_3 = \frac{1}{2} \times 2.5 \times 50 = 62.5$$

$$A_4 = \frac{1}{2} \times \frac{1}{2} \times 10 = 2.5$$

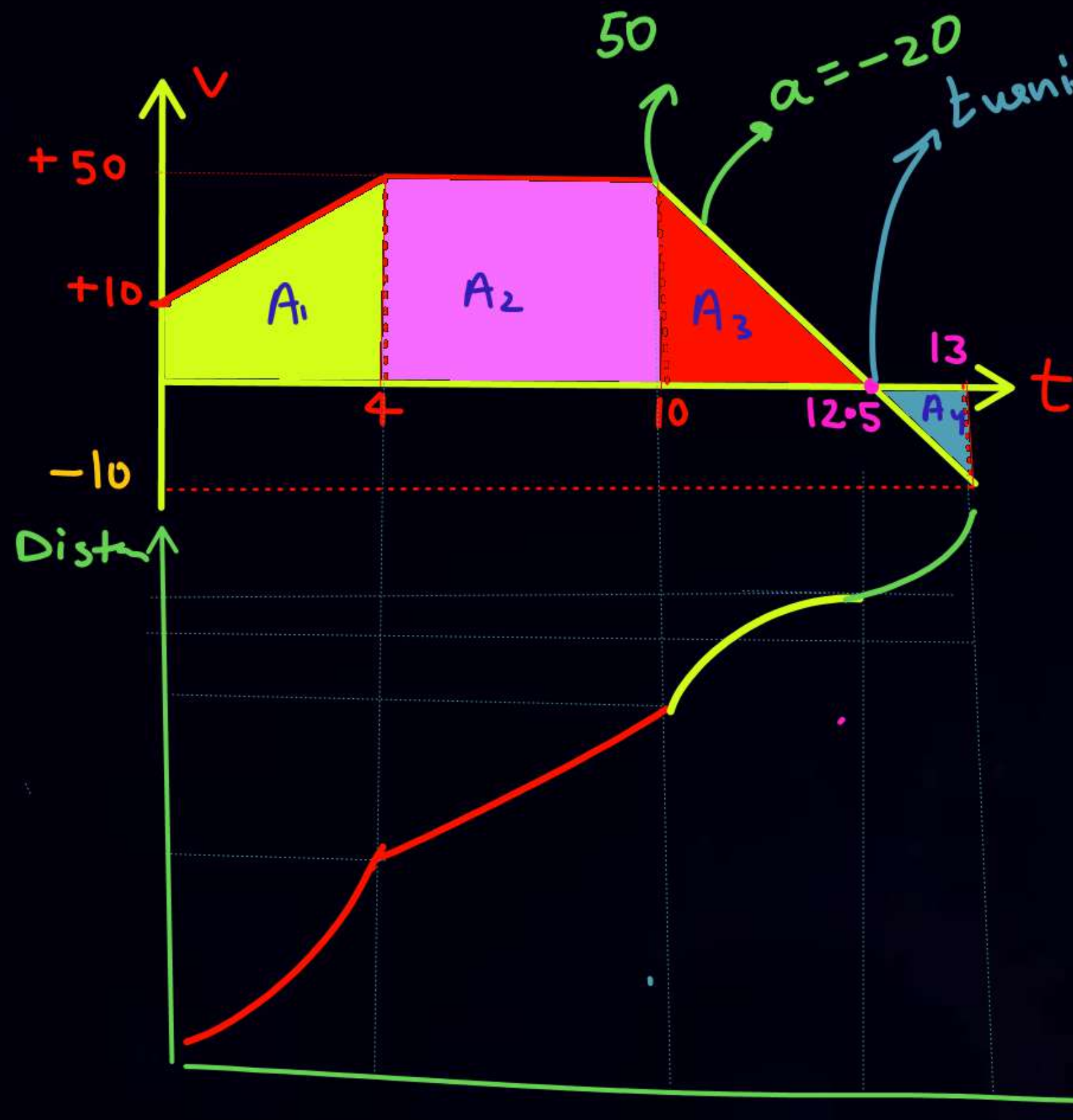
$$\text{Distance} = 485$$

$$\text{Displacement} = 480$$

$$\langle \vec{a} \rangle = \frac{V_f - V_i}{\text{time}} =$$



Q



Distance = $A_1 + A_2 + A_3 + A_4$

$$\text{Displacement} = A_1 + A_2 + A_3 - A_4$$

$$\langle \vec{a} \rangle = \frac{V_f - V_i}{\text{time}} = \frac{-10 - 10}{13} = -\frac{20}{13}$$

$$A_1 = \frac{1}{2} \times (10 + 50) \times 4 = 120$$

$$A_2 = 6 \times 50 = 300$$

$$A_3 = \frac{1}{2} \times 2.5 \times 50 = 62.5$$

$$A_4 = \frac{1}{2} \times \frac{1}{2} \times 10 = 2.5$$

$$\text{Distance} = 485$$

$$\text{Displacement} = 480$$



Eqⁿ of motion

If acc is const

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

$a \rightarrow \text{const}$

$u \rightarrow$ initial velocity

$a \rightarrow$ acc

$s \rightarrow$ Displacement

$v \rightarrow$ final velocity

$t \rightarrow$ time

$$S_n = u + \frac{1}{2}(2n-1)a$$

Displacement
in n^{th} sec

$$\langle \vec{v} \rangle = \frac{\vec{u} + \vec{v}}{2}$$

Q A particle start motion from rest having acc $a = +10 \text{ m/s}^2$
find

- ① velocity at $t = 6 \text{ sec}$
- ② displacement in Six second.

Solⁿ

$$u_i = 0$$

$$a = 10$$

$$t = 6$$

$$v = u + at$$

$$v = 0 + 10 \times 6$$

$$\boxed{v = 60}$$

$$s = ut + \frac{1}{2} at^2$$

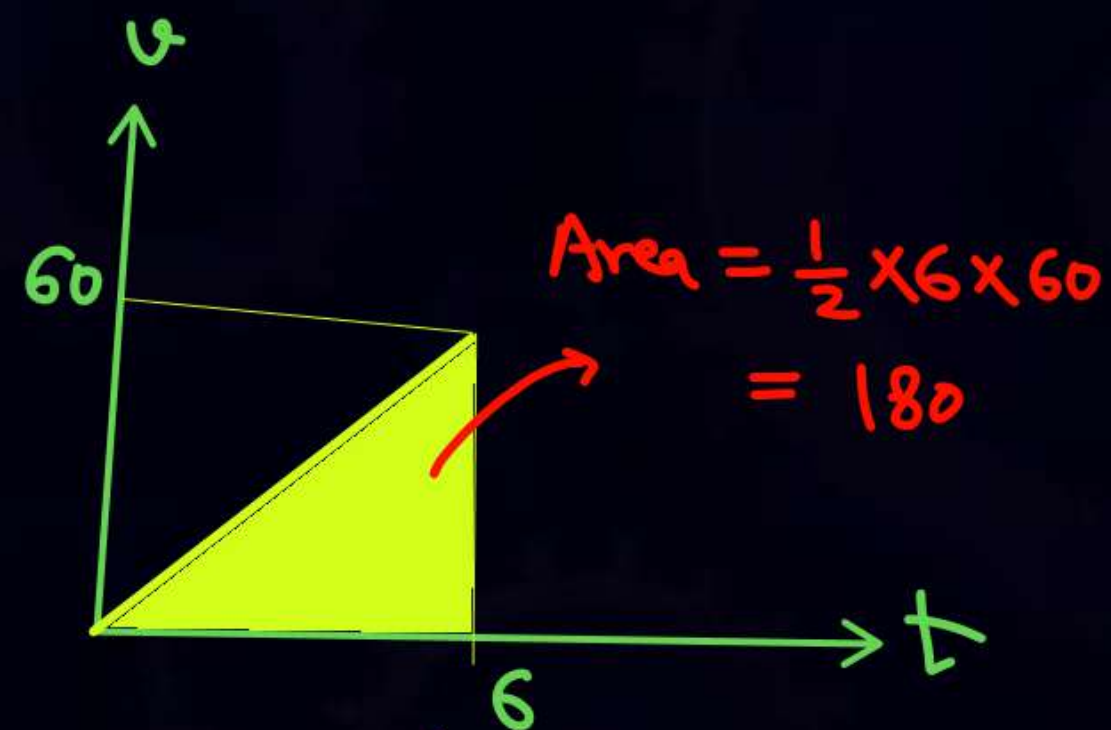
$$s = 0 + \frac{1}{2} \times 10 \times 6^2$$

$$\boxed{s = 180}$$

SKC

* जो given है लिख लो
ये देखो कि पूछा क्या

* Eqⁿ of motion को ताज़ो



Q A particle start motion with initial velocity $+10 \text{ m/s}$
having $\text{acc} = +20 \text{ m/s}^2$

① v at $t = 4 \text{ sec}$

② displacement in four second

Solⁿ

$$u = +10$$

$$a = 20$$

$$v = u + at$$

$$= 10 + 20 \times 4$$

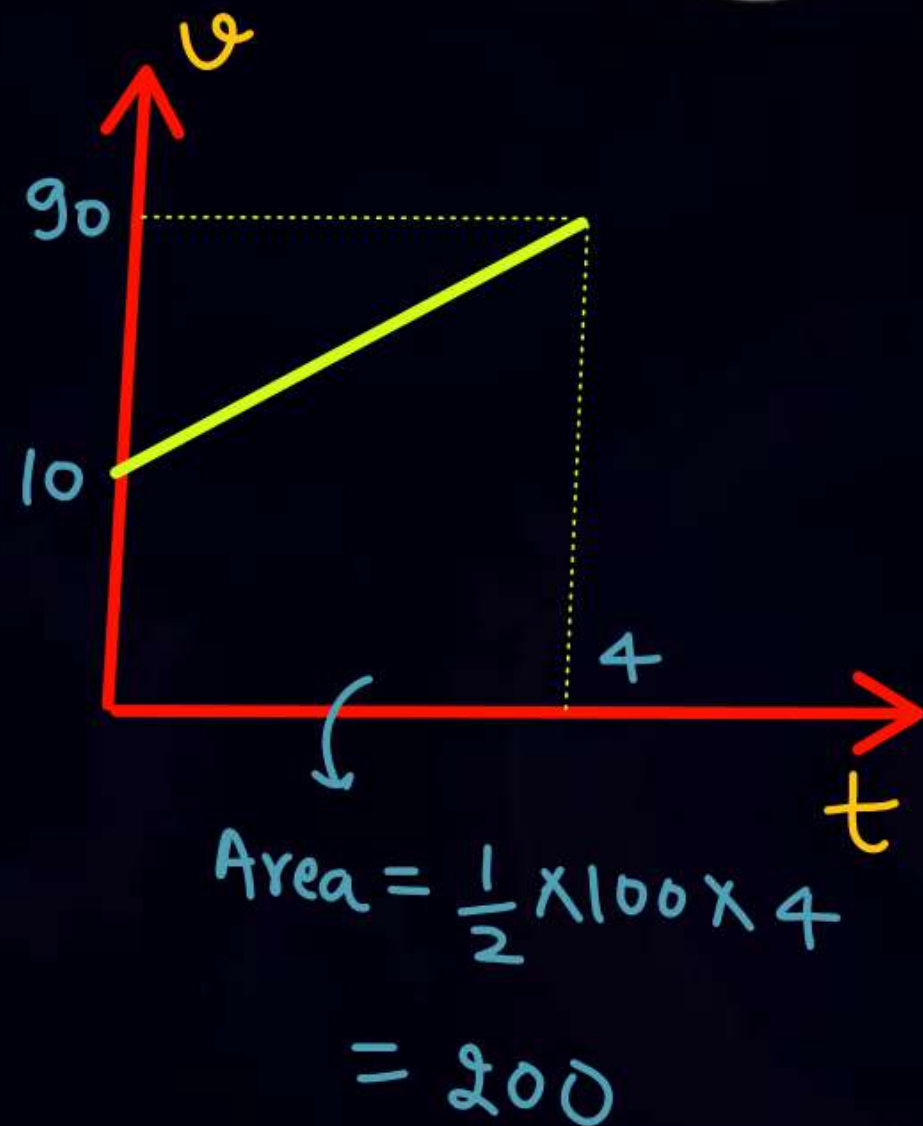
$$\boxed{v = 90}$$

$$S = ut + \frac{1}{2}at^2$$

$$S = 10 \times 4 + \frac{1}{2} \times 20 \times 4^2$$

$$S = 40 + 160$$

$$\boxed{S = 200}$$



QUESTION



A particle starts from rest at $t = 0$ and $x = 0$ to move with a constant acceleration $= +2 \text{ m/s}^2$, for 20 seconds. After that, it moves with -4 m/s^2 for the next 20 seconds. Finally, it moves with positive acceleration for 10 seconds until its velocity becomes zero.

- (a) What is the value of the acceleration in the last phase of motion?
- (b) What is the final x-coordinate of the particle?
- (c) Find the total distance covered by the particle during the whole motion.

Ans: (a) 4 m/s^2 , (b) 200 m, (c) 1000 m

15. The motion of a particle along a straight line is described by equation $x = 8 + 12t - t^3$ where x is in metre and t in second. The retardation of the particle when its velocity becomes zero is:

[2012]

(1) 24 m s^{-2}

(2) zero

(3) 6 m s^{-2}

(4) 12 m s^{-2}

18. Motion of a particle is given by equation $s = (3t^3 + 7t^2 + 14t + 8)$ m. The value of acceleration of the particle at $t = 1$ sec is:

[2000]

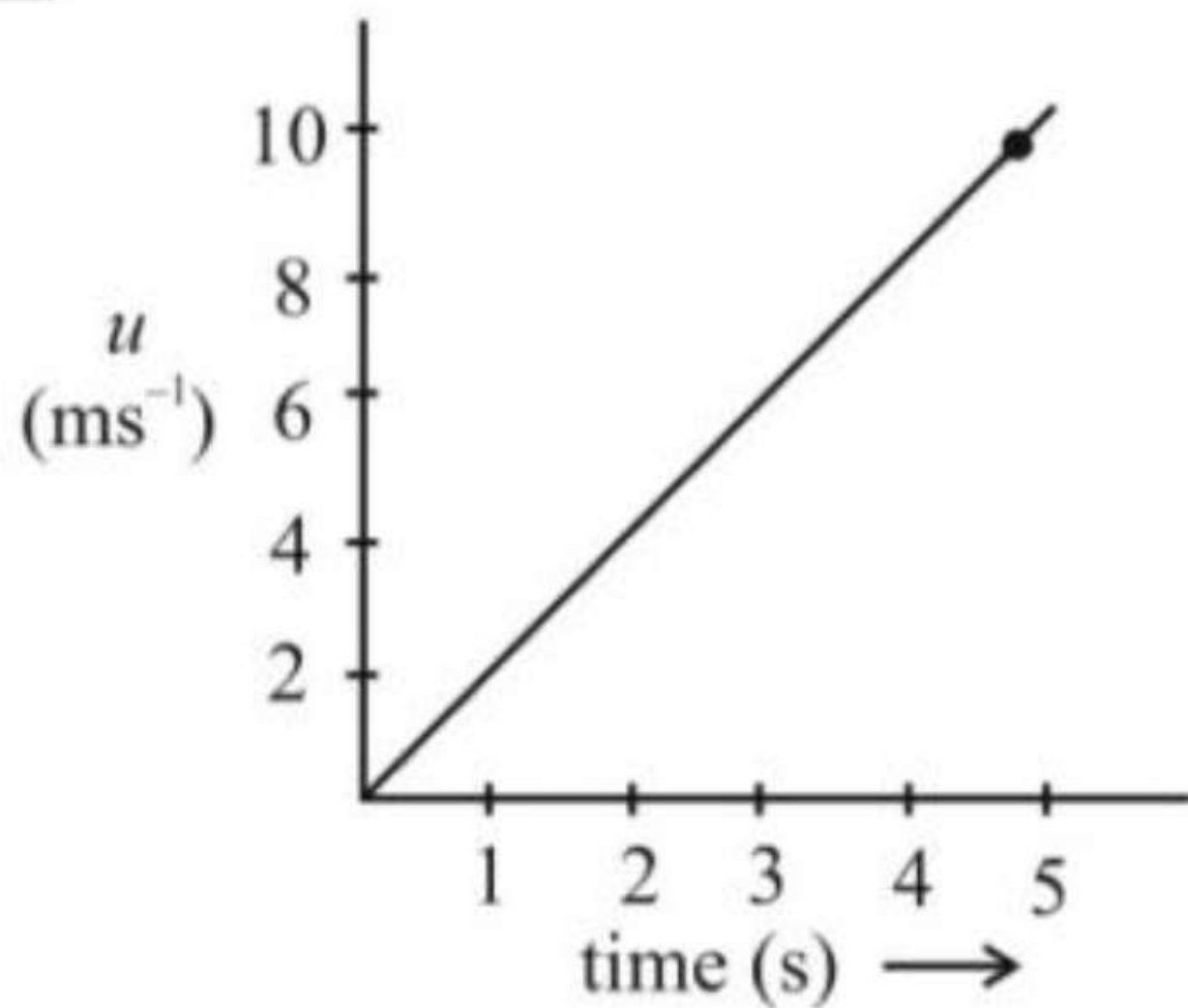
(1) 10 m/s^2

(2) 32 m/s^2

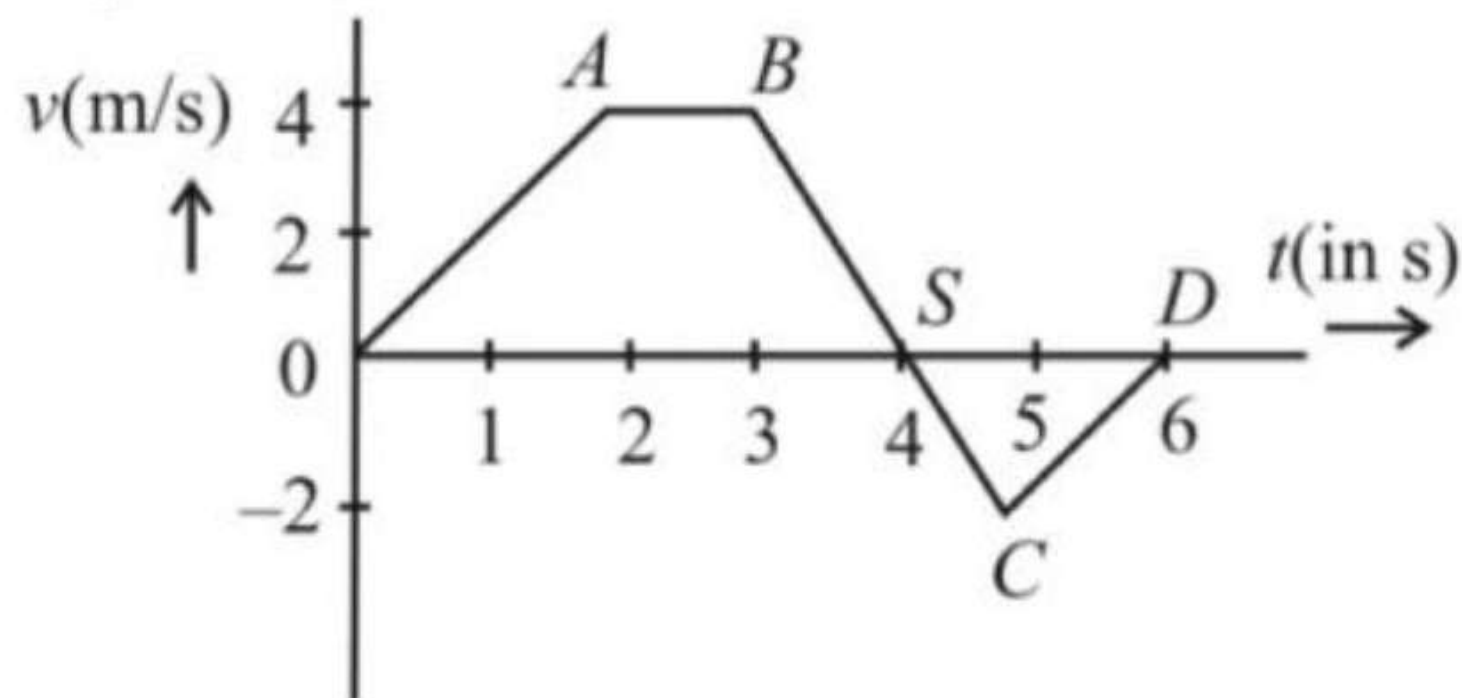
(3) 23 m/s^2

(4) 16 m/s^2

10. The speed versus time graph for a particle is shown in the figure. The distance travelled (in m) by the particle during the time interval $t = 0$ to $t = 5$ s will be _____.
- (JEE Main 2020)**

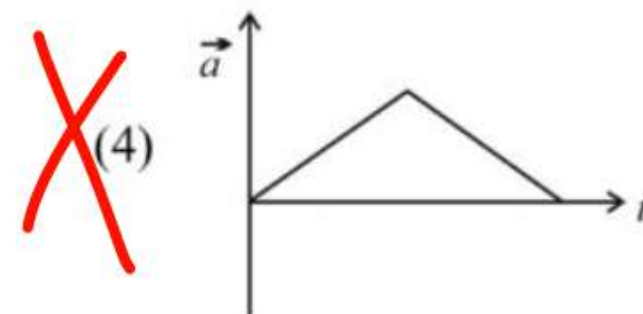
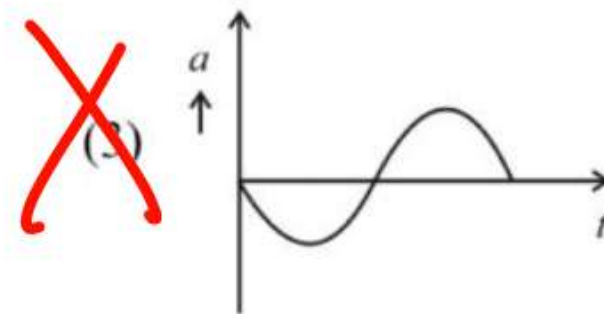
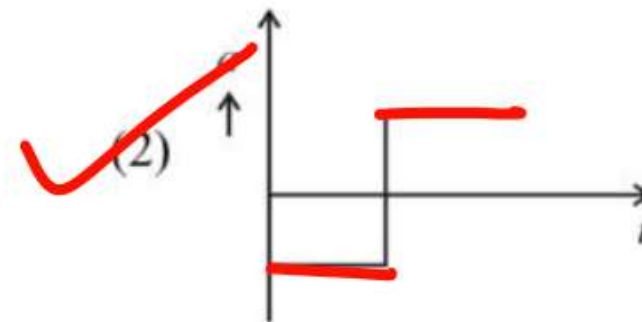
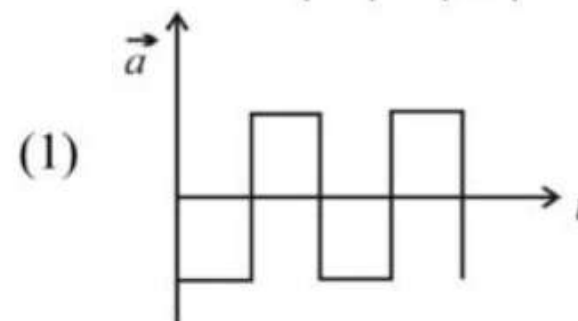
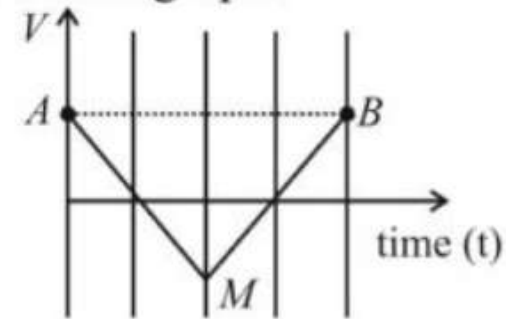


12. The velocity (v) and time (t) graph of a body in a straight line motion is shown in the figure. The point S is at 4.333 seconds. The total distance covered by the body in 6s is: **(JEE Main 2020)**

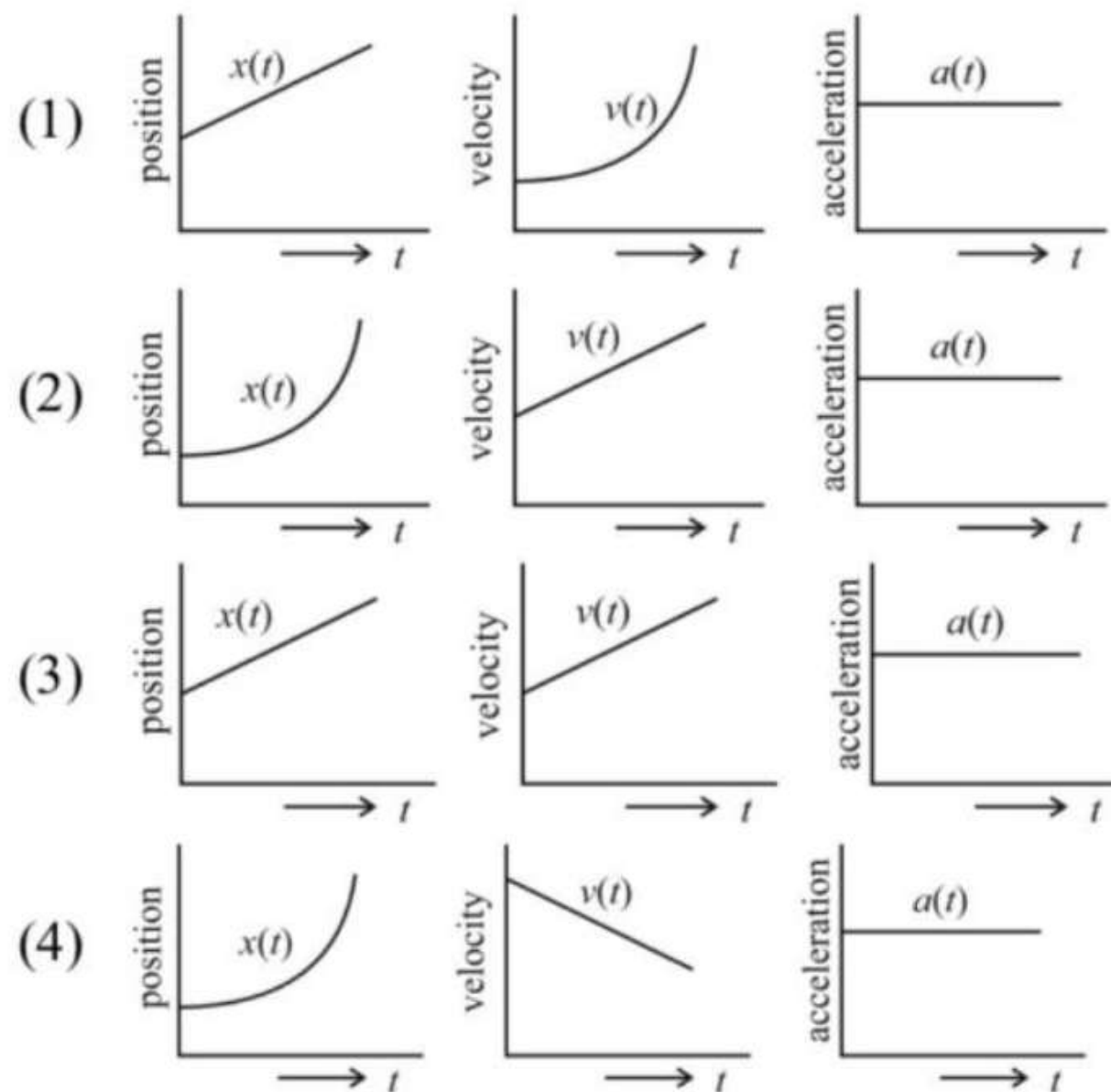


- | | |
|----------|--------------|
| (1) 12 m | (2) $49/4$ m |
| (3) 11 m | (4) $37/3$ m |

14. If the velocity-time graph has the shape AMB , what would be the shape of the corresponding acceleration-time graph? (JEE Main 2021)

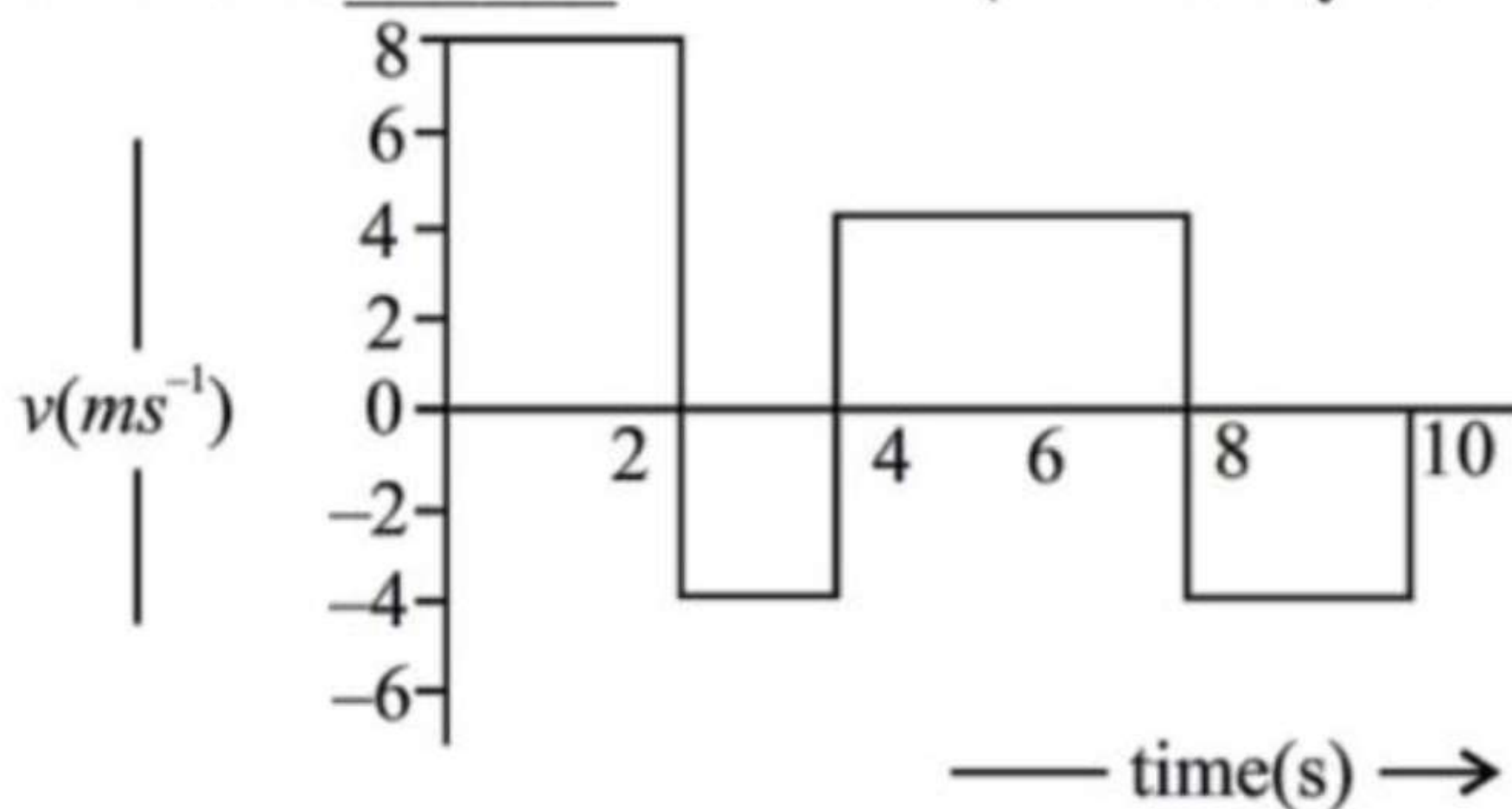


25. The position, velocity and acceleration of a particle moving with a constant acceleration can be represented by: (JEE Main 2021)



MOTION IN ONE DIMENSION:

83. The velocity time graph of a body moving in a straight line is shown in figure. The ratio of displacement to distance travelled by the body in time 0 to 10 s is _____. (24 January 2023 - Shift 2)



- (1) 1 : 1
(3) 1 : 2

- (2) 1 : 4
(4) 1 : 3

85. The distance travelled by a particle is related to time t as $x = 4t^2$. The velocity of the particle at $t = 5$ s is.

(25 January 2023 - Shift 2)

(1) 40 ms^{-1}

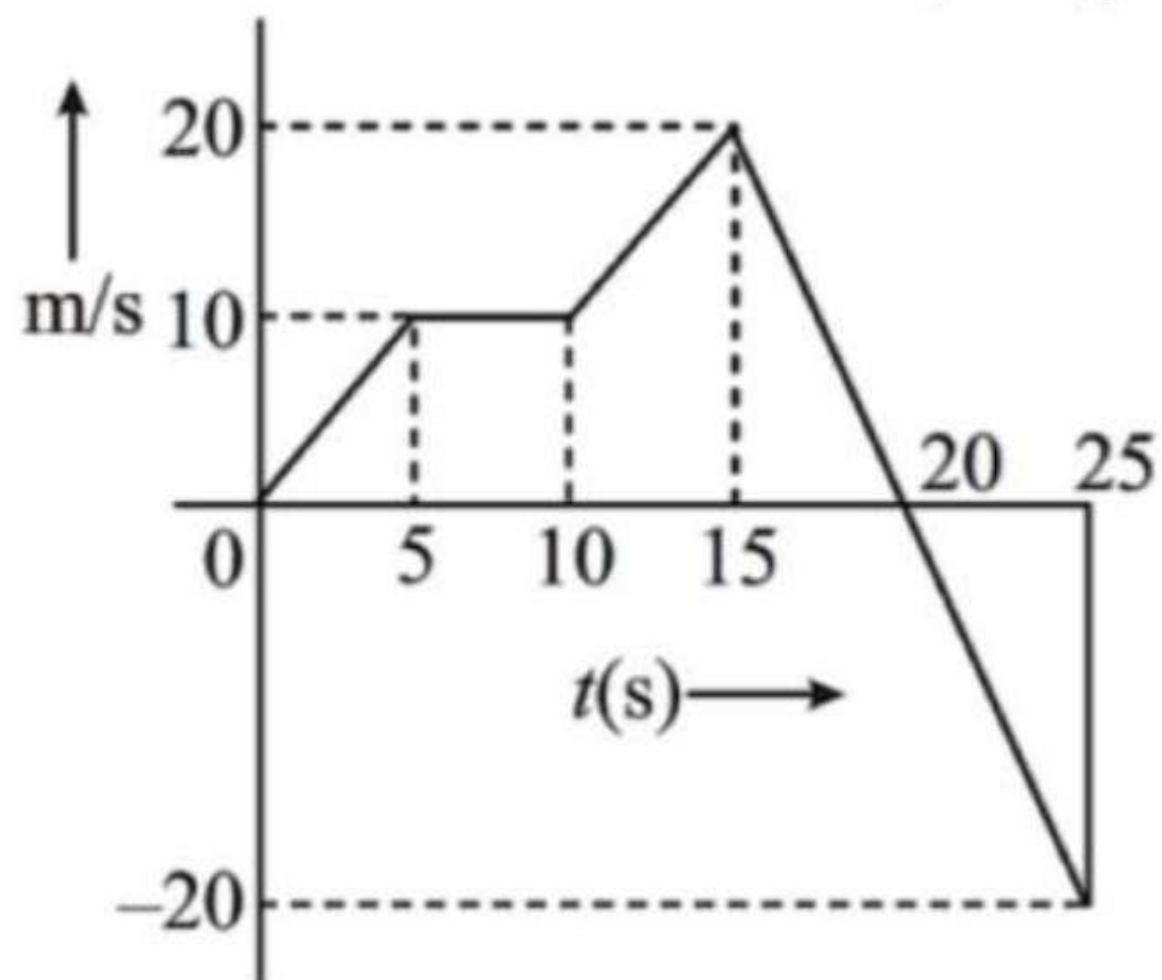
(2) 25 ms^{-1}

(3) 20 ms^{-1}

(4) 8 ms^{-1}

100. Form the $v - t$ graph shown, the ratio of distance to displacement in 25 s of motion is:

(11 April 2023 - Shift 1)



(1) 1

(2) $1/2$

(3) $5/3$

(4) $3/5$

103. The distance travelled by an object in time t is given by $s = (2.5)t^2$. The instantaneous speed of the object at $t = 5$ s will be: **(13 April 2023 - Shift 2)**

(1) 25 ms^{-1}

(2) 5 ms^{-1}

(3) 62.5 ms^{-1}

(4) 12.5 ms^{-1}

105. The position of a particle related to time is given by $x = (5t^2 - 4t + 5)\text{m}$. The magnitude of velocity of the particle at $t = 2\text{ s}$ will be: **(15 April 2023 - Shift 1)**

(1) 0.6 ms^{-1}

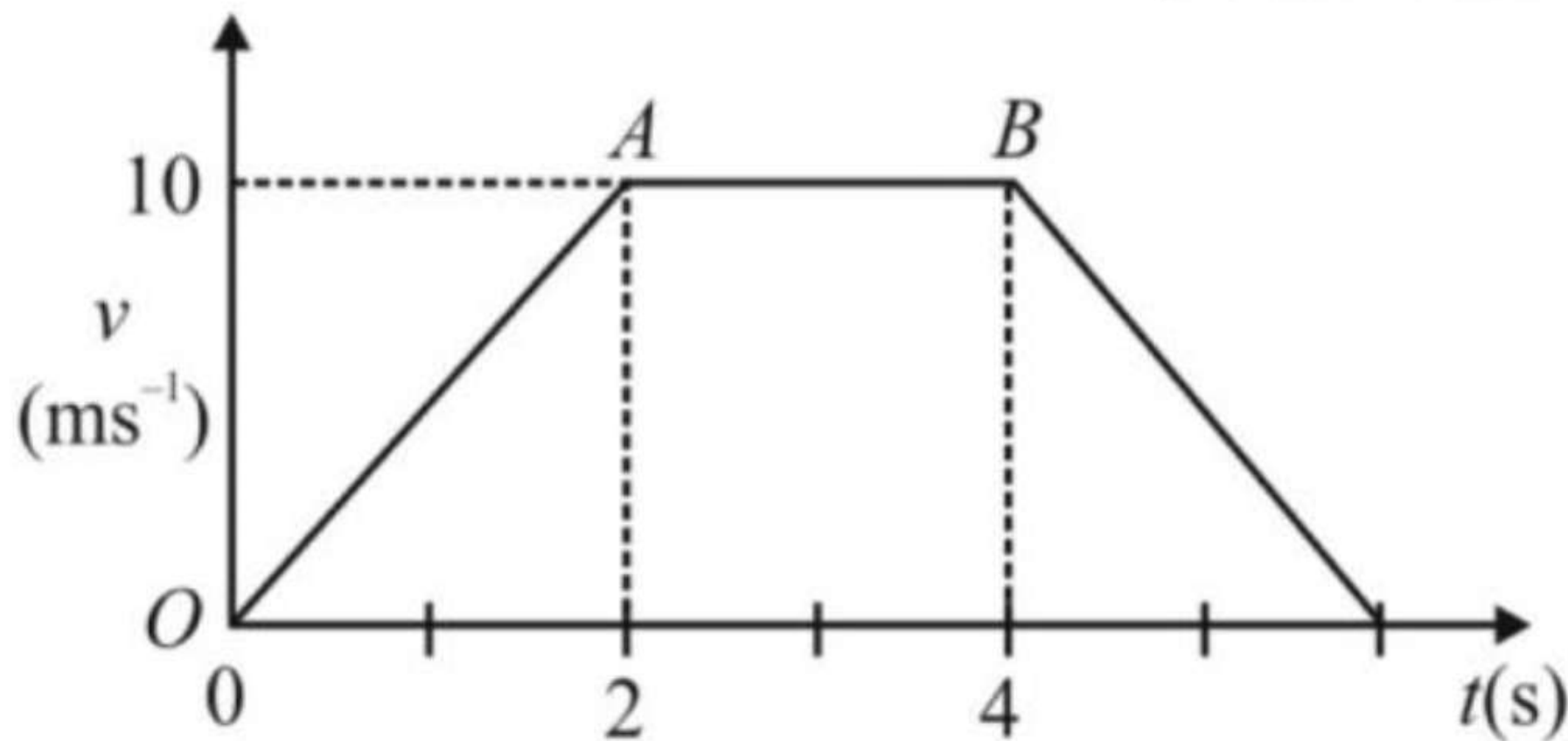
(2) 14 ms^{-1}

(3) 10 ms^{-1}

(4) 16 ms^{-1}

129. 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 $t = 4$ s?

(28 Jan. 2025 - Shift 2)



- (1) 30 m
(3) 10 m

- (2) 11 m
(4) 13 m

18. Motion of a particle is given by equation $s = (3t^3 + 7t^2 + 14t + 8)$ m. The value of acceleration of the particle at $t = 1$ sec is:

[2000]

(1) 10 m/s^2

(2) 32 m/s^2

(3) 23 m/s^2

(4) 16 m/s^2

- 15.** The motion of a particle along a straight line is described by equation $x = 8 + 12t - t^3$ where x is in metre and t in second. The retardation of the particle when its velocity becomes zero is:

[2012]

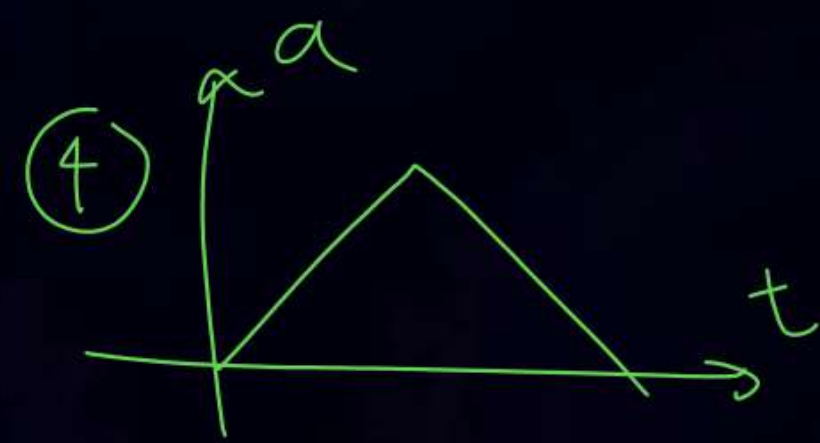
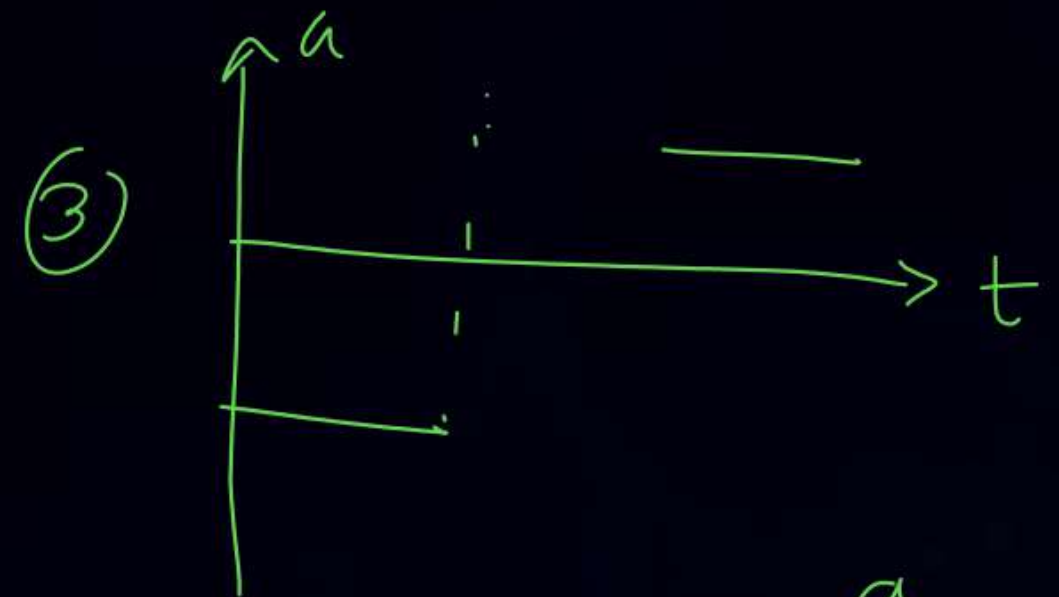
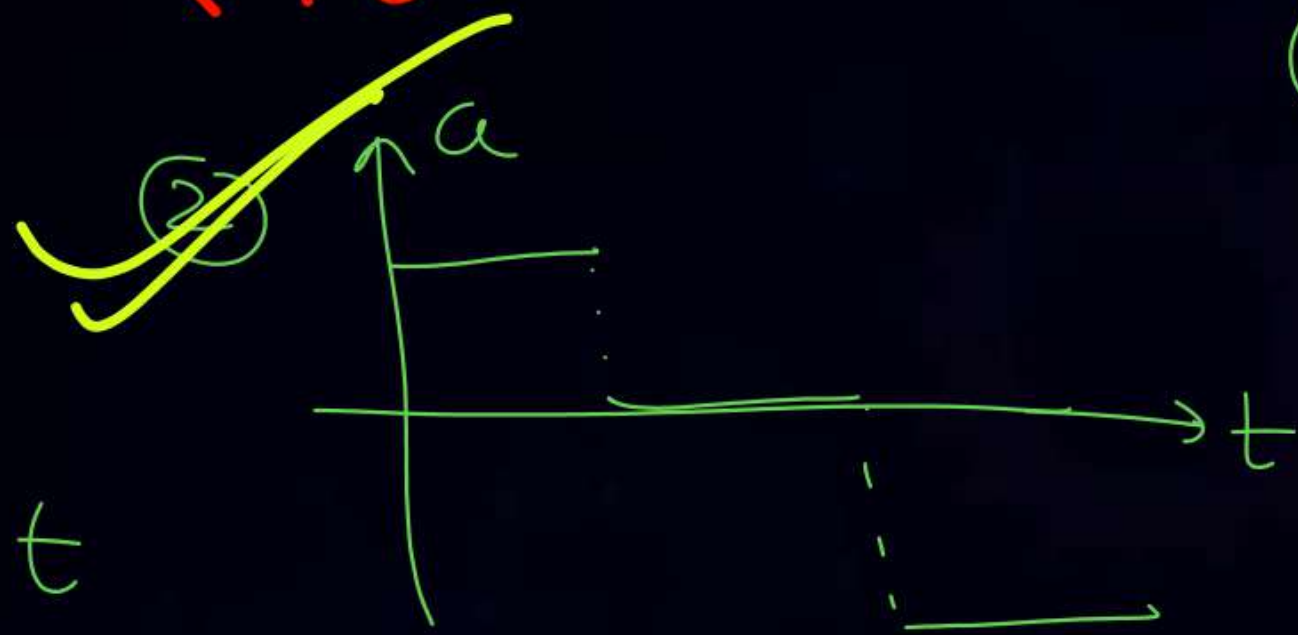
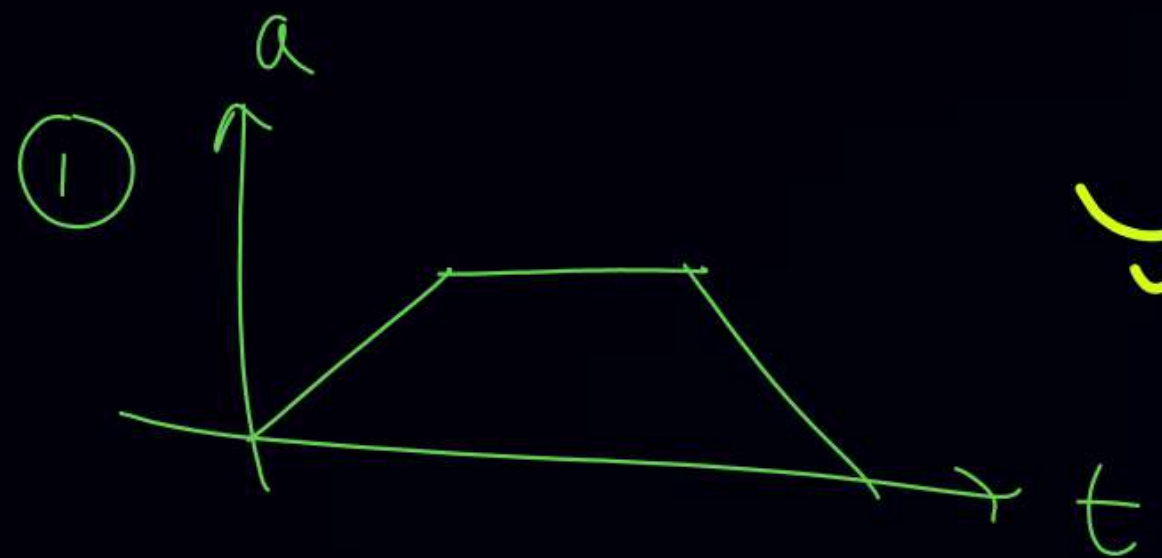
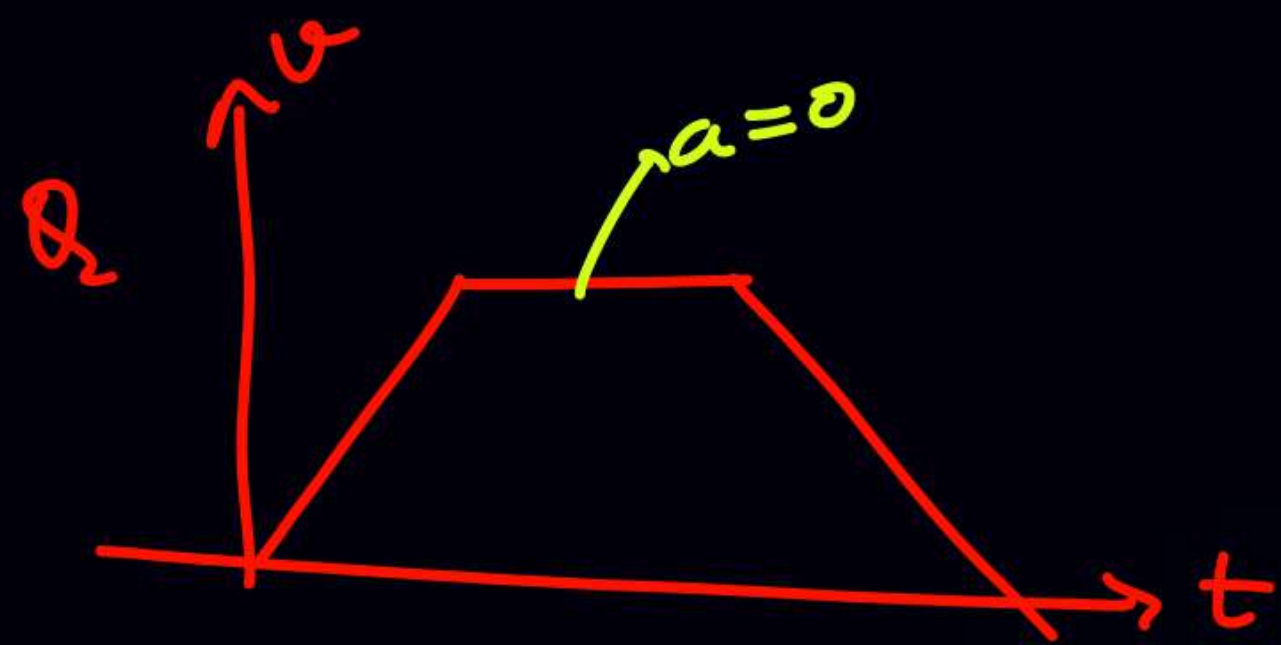
(1) 24 m s^{-2}

(2) zero

(3) 6 m s^{-2}

(4) 12 m s^{-2}

NEET

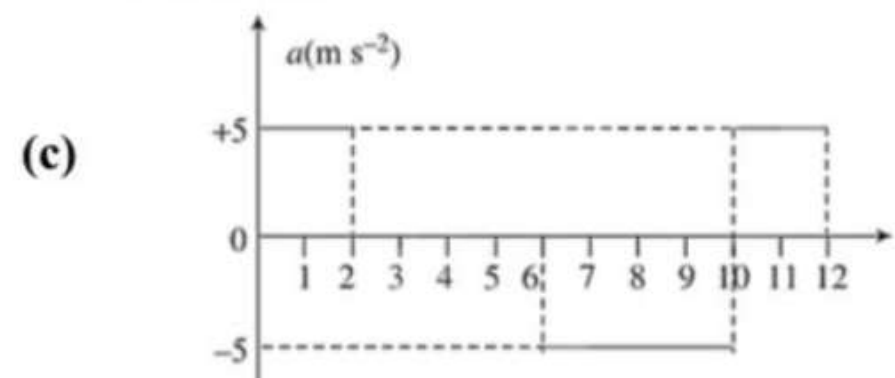


Answer Key

1. (3)
2. (1)
3. (1)
4. (3)
5. (4)
6. (4)
7. (1)
8. (1, 2, 3, 4)
9. (1)
10. (3, 4)
11. (1, 3, 4)
12. (1, 2, 4)
13. (1)
14. (1, 4)

15. (1, 4)
16. (1, 3, 4)
17. (2, 3, 4)
18. (a) 3.33 ms^{-1} , (b) 6.67 ms^{-1} ,

Acceleration:



19. i \rightarrow b,d; ii \rightarrow a,d; iii \rightarrow c; iv \rightarrow a
20. i \rightarrow c,d; ii \rightarrow c,d; iii \rightarrow a,b,c,e; iv \rightarrow a,b,c,e



Homework

- KPP 14 solve again (Discussion video will be uploaded today evening)
- Complete your backlog
- DPP

THANK
YOU