Todays Goal

- Equation of motion. part02

If $\vec{a}$ is const.

✓ $v = u + at$

✓ $s = ut + \frac{1}{2}at^2$

✓ $v^2 = u^2 + 2as$

** $S_{nth} = u + \frac{1}{2}(2n-1)a$

$\langle v \rangle = \dfrac{u_i + v}{2}$

} a const

$u \longrightarrow$ initial velocity

$v \longrightarrow$ final velocity

$a \longrightarrow$ acc.

$t \longrightarrow$ time

$s \longrightarrow$ Displacement

$S_{nth} \longrightarrow$ Displacement in n^{th} second.

Skc , $u, v, a, s \longrightarrow$ with sign put karna hai

Q A particle start motion with initial velocity ± 30 m/s along $+X$Axis such that acc is ± 10 m/s^2.

① Find velocity at $t = 5$ sec

② " displacement in 5 sec.

③ Find velocity of the particle after travelling distance 500m.

④ Avrg velocity from $t=0$ to $t=5$

Sol $u_i = 30$, $v_f = 80$

$$\langle \vec{v} \rangle = \frac{30+80}{2} = 55$$

or

$$\langle \vec{v} \rangle = \frac{Displacement}{time} = \frac{275}{5} = 55$$

Sol $u = +30$, $a = +10$, $t = 5$

① $v = u + at$

$v = 30 + 10 \times 5 = 80$

② $s = ut + \frac{1}{2}at^2$

$s = 30 \times 5 + \frac{1}{2} \times 10 \times 5^2$

$s = 275$

③ $v^2 = u^2 + 2as$

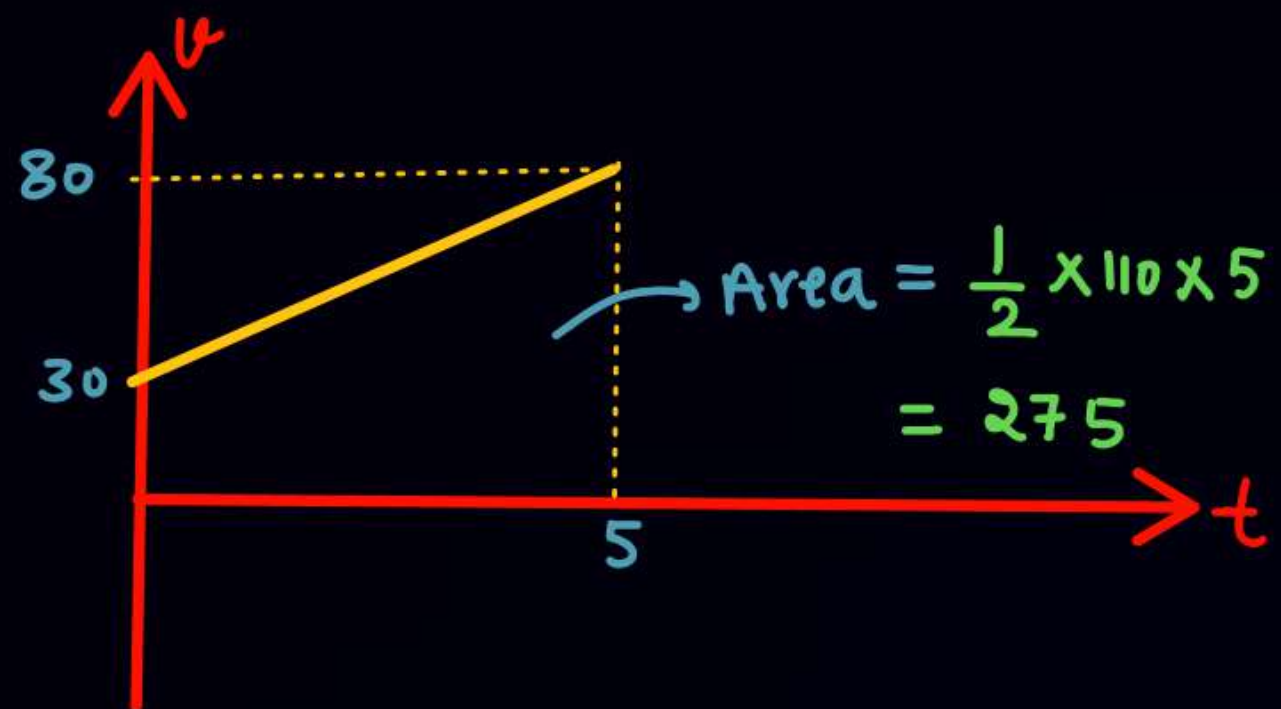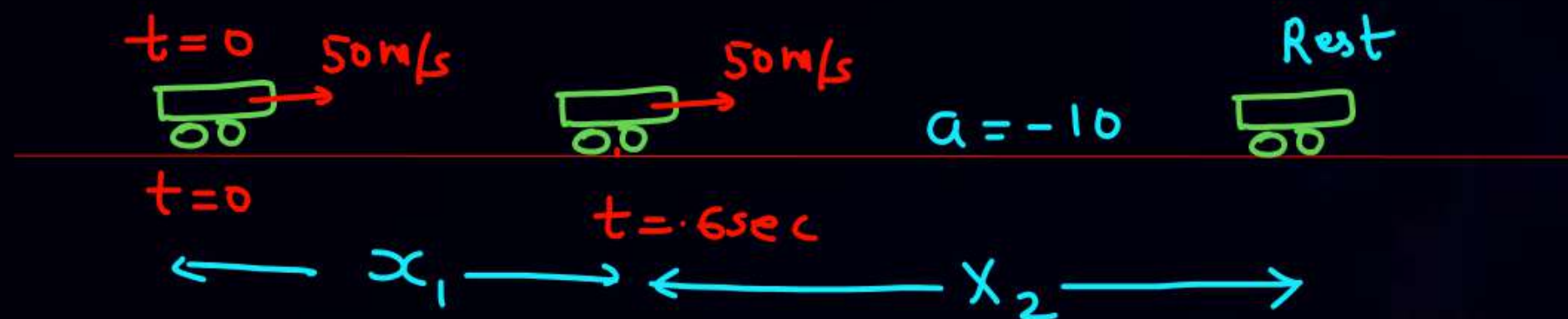$v^2 = 900 + 2 \times 10 \times 500$

$v = \sqrt{10900}$

Graph

$$\text{Area} = \frac{1}{2} \times 110 \times 5$$
$$= 275$$

* Sabse pahle jo given hai or jo pucha hai vo likh lo.

Jab tak likhaga Nahi . . . . . Tab tak dikhega Nahi

* Uske bad ghutna lagakar ye dikho kaun si eq^n match ho rhi hai

*** Agar kisi cheez ki jarurat ho . . . to use man lo . . . .

Q A driver is driving a car with velocity 50 m/s, he takes
.60 sec to apply the break after he see need for it. that is called
the reaction time. If retardation is $10 m/s^2$ find stopping distance.

Sol^n

(m1)

$t = 0$ 50m/s

50m/s

Rest

$a = -10$

$t = 0$

$t = .6 sec$

$\longleftarrow x_1 \longrightarrow \longleftarrow \underline{\hspace{2cm}} x_2 \longrightarrow$

Aw

$x_1 + x_2$

$x_1 = 50 \times .6 = 30$

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

$0 = (50)^2 + 2 \times (-10) x_2$

$\boxed{x_2 = 125}$

Ans

$30 + 125 = \underline{155}$

Q. A driver is driving a car with velocity 50 m/s, he takes .60 sec to apply the break after he see need for it. that is called the reaction time. If retardation is $10 m/s^2$ find stopping distance.
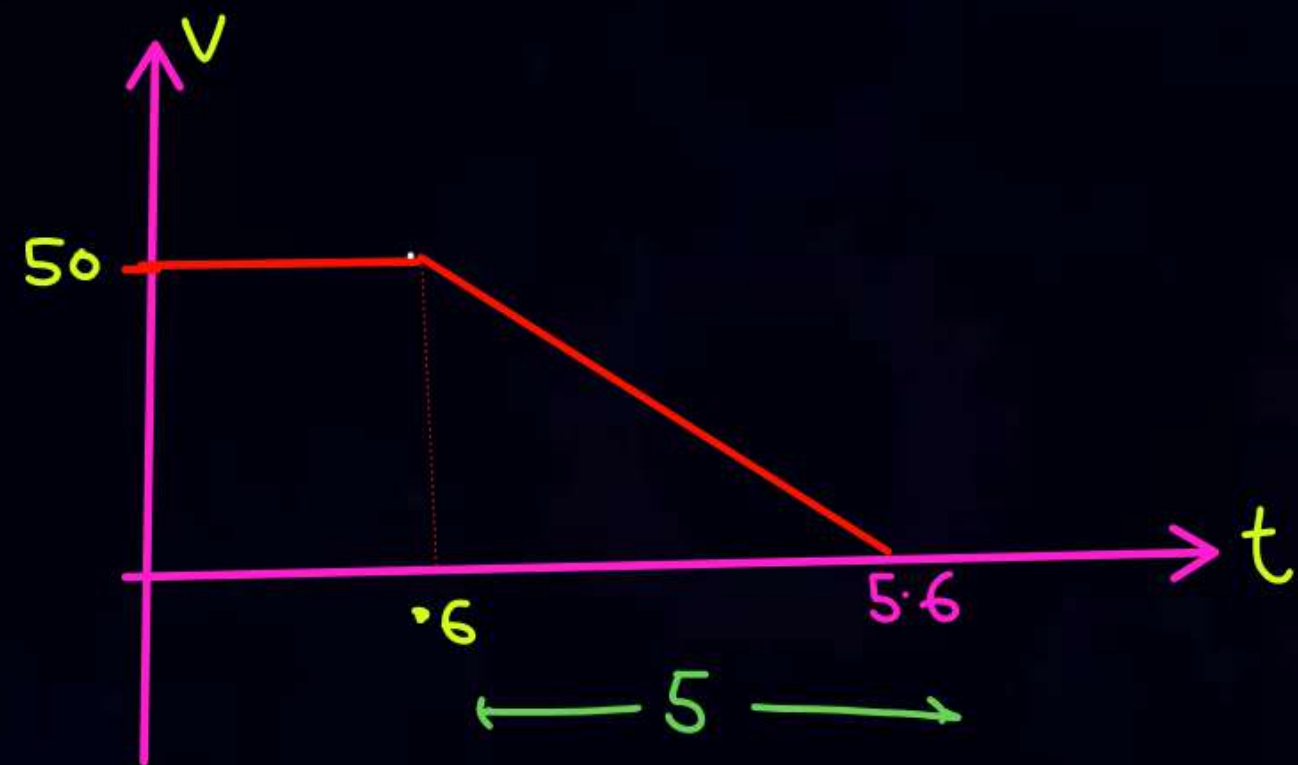
Sol^n (M-2)

Ans $\quad \frac{1}{2} (.6 + 5.6) \times 50$

$= \underline{155}$

Q   A bullet enter into wooden
    with velocity 40 m/s and
    comes to at rest after penetrating
    2m inside wooden.
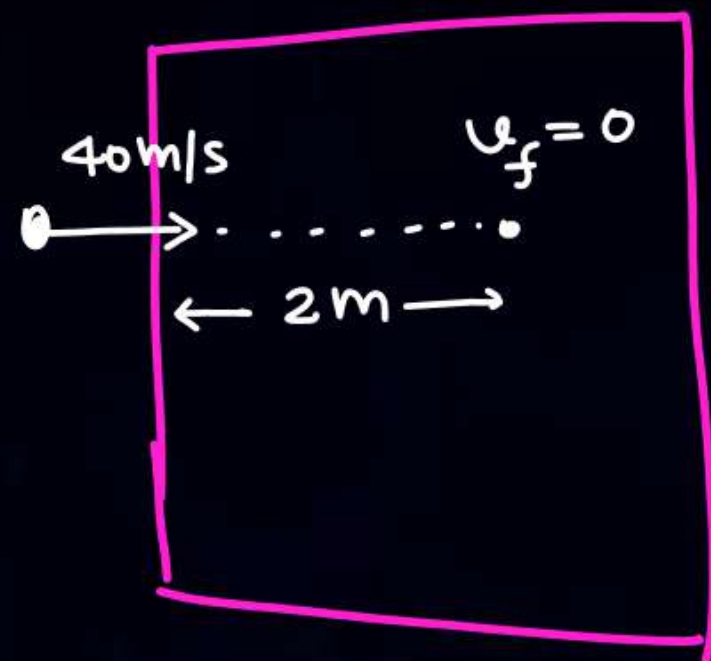   find acc & time taken $\left(m = \frac{1}{2}kg\right)$

Sol^n

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

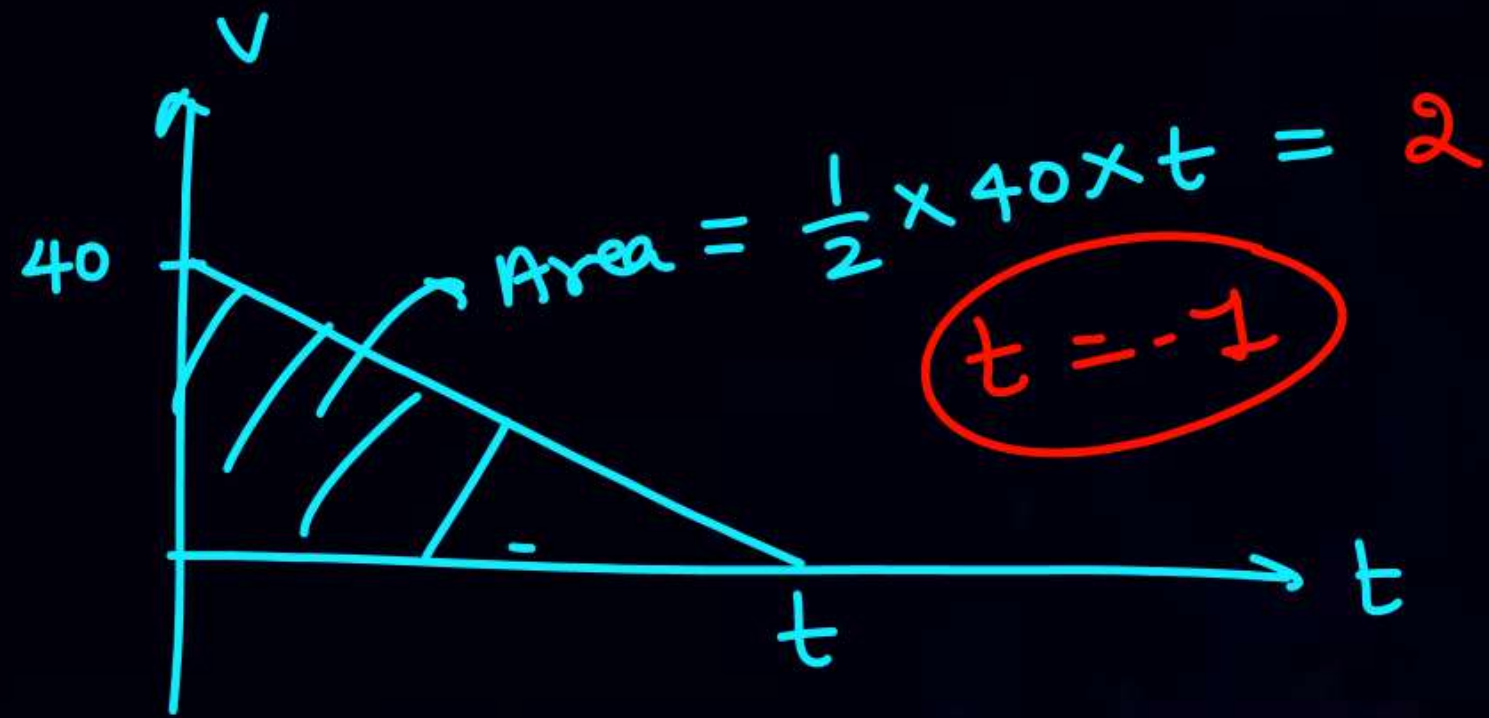$$0 = (40)^2 + 2 \times a \times 2$$

$$\boxed{a = -400}$$

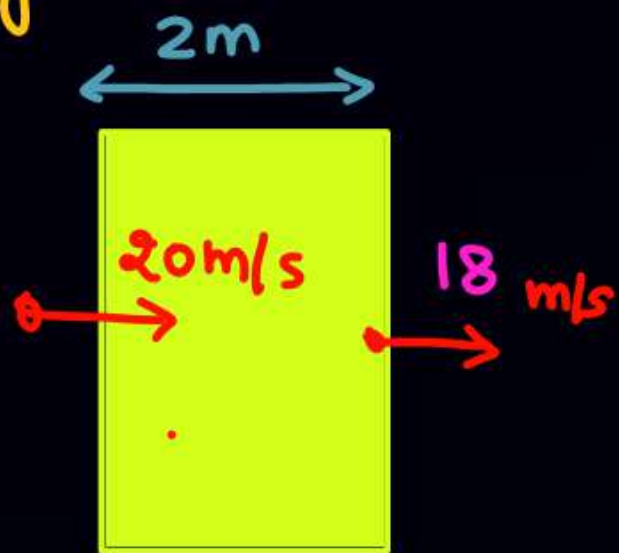$$F_{on\ bullet} = ma = \frac{1}{2} \times 400 = 200$$

$$v = u + at$$

$$0 = 40 + (-400)t$$

$$\boxed{t = \cdot 1 \sec}$$

$$\text{Area} = \frac{1}{2} \times 40 \times t = 2$$

$$t = -1$$

Q A bullet enter Into a wooden solid box of thickness 2m If bullet enter with velocity 20m/s and comes out with velocity 18 m/s. Find min. number of wooden box required to bring the bullet at rest.
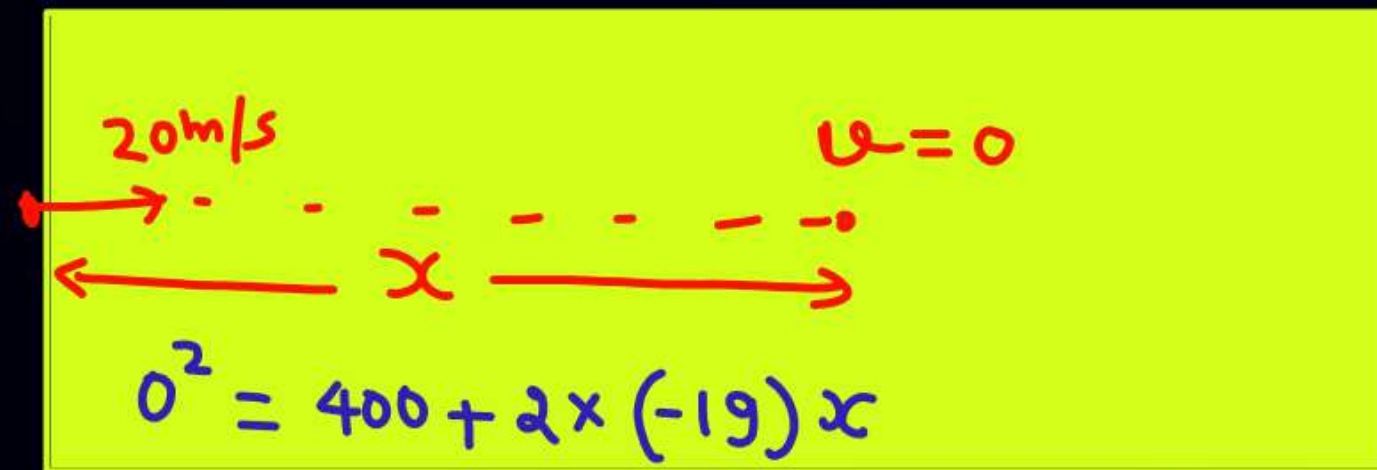
Sol^n

Let n box ही Need hai

2m

20m/s   18 m/s

$$v^2 = u^2 + 2as$$
$$18^2 = 20^2 + 2 \times a \times 2$$
$$4a = -38 \times 2$$
$$\boxed{a = -19}$$

20m/s $v = 0$

x

$$0^2 = 400 + 2 \times (-19) x$$

$$x = \frac{400}{38} = 10.5$$

No. of box need $\equiv \frac{10.5}{2} = 5.25$

Aⁿs ⑥

$$a^2 - b^2 = (a+b)(a-b)$$
$$18^2 - 20^2 = -38 \times 2$$

Q. A particle start motion with initial velocity $20 \, m/s$
having acc $+10 \, m/s^2$.
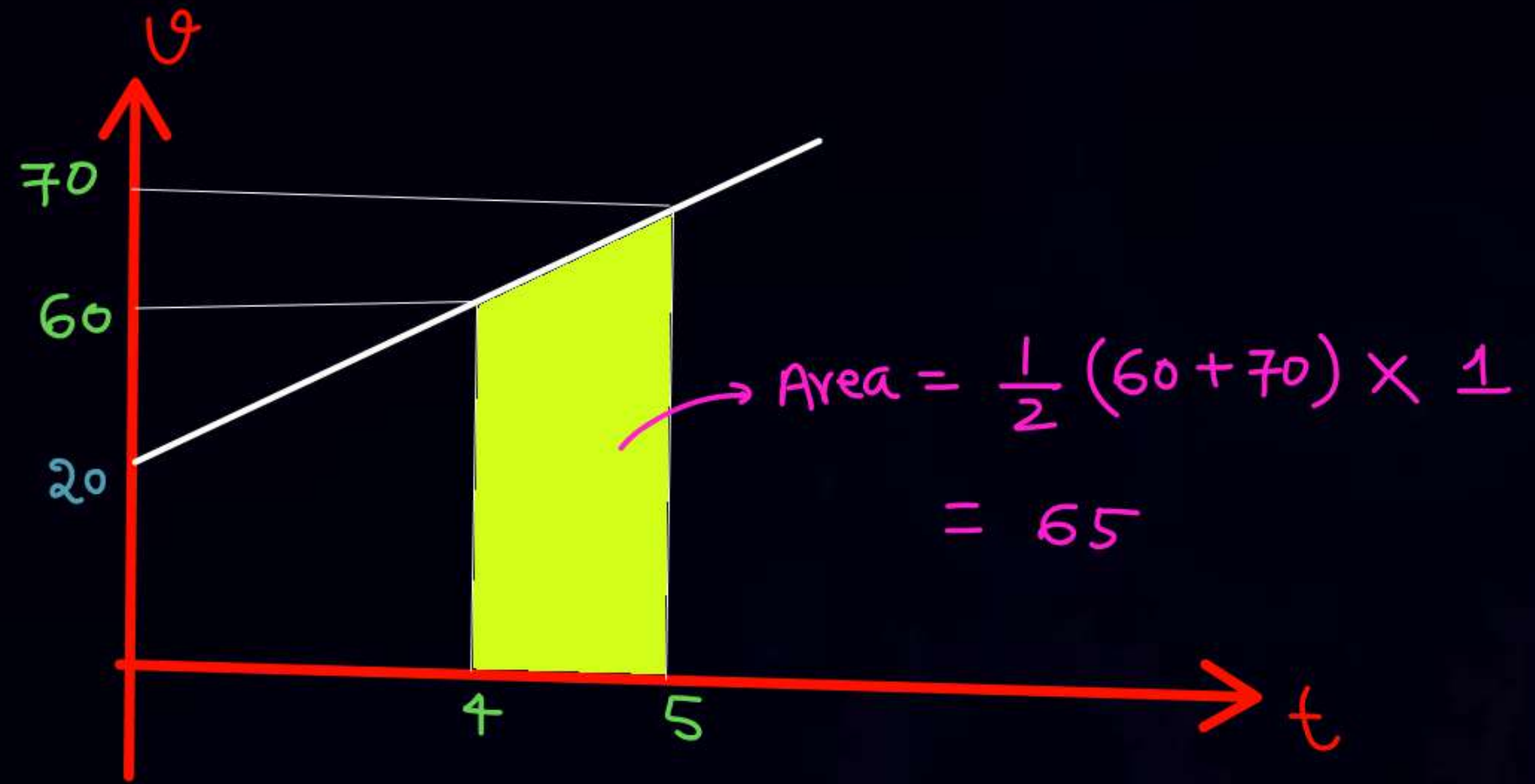find displacement of particle in 5th sec.

Sol^n

5th sec $\Rightarrow$ $t = 4$ $\xrightarrow{\text{Duration}}$ $t = 5$
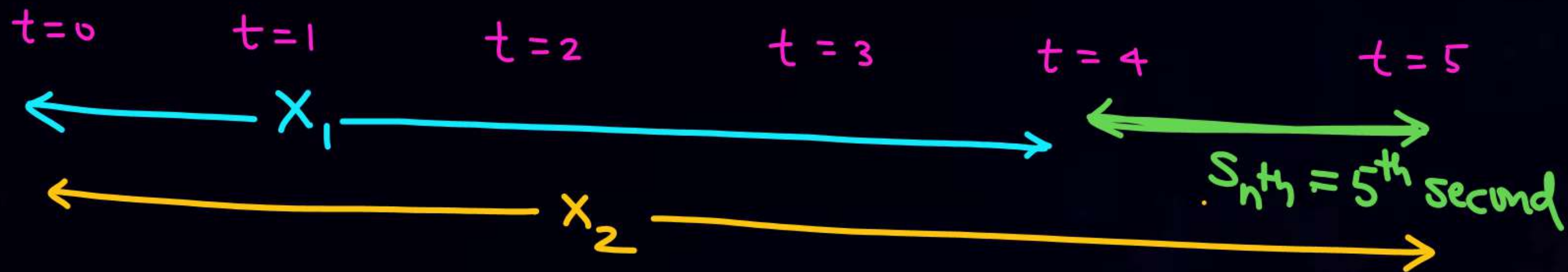
$$S_{n^{th}} = u + \frac{1}{2}(2n-1)a$$

$S_{n^{th}} = 20 + \frac{1}{2} \times (2 \times 5 - 1) \times 10$

$\quad = 20 + 45 = 65$

$$\text{Area} = \frac{1}{2}(60+70) \times 1$$
$$= 65$$

$n^{th} sec$ $(n-1) \longrightarrow n$

$5^{th} sec \Rightarrow t = 4 \xrightarrow{\text{Duration}} t = 5$

$t = 0$ $\qquad t = 1$ $\qquad t = 2$ $\qquad t = 3$ $\qquad t = 4$ $\qquad t = 5$

X_1

X_2

$S_{nth} = 5^{th} second$

Displacement in $5^{th} sec = X_2 - X_1$

$t = 0 \longrightarrow t = 4 \Rightarrow x_1 = \checkmark$

$t = 0 \longrightarrow t = 5 \Rightarrow x_2 = \checkmark$

Displacement in $n^{th} = \underset{t=0 \longrightarrow t=n}{S} - \underset{t=0 \longrightarrow t=n-1}{S}$

$$= \left(un + \frac{1}{2}an^2\right) - \left(u(n-1) + \frac{1}{2}a(n-1)^2\right)$$

$$= un - u(n-1) + \frac{1}{2}a\left[n^2 - (n-1)^2\right]$$

$$S_n = \underset{(m/s)\ (1sec)}{u \times 1} + \frac{1}{2}a(2n-1)$$

$\underset{Displ.}{\Big(} \boxed{S_n} = \boxed{u} + \frac{1}{2}a(2n-1)$ $\left. \begin{array}{c} Dimensionally \\ Correct \end{array} \right)$

LT^{-1}

$$\boxed{u_n} - u(n-1)$$

$$u \times 5\,sec - u \times 4\,sec$$

$$= u(5\,sec - 4\,sec)$$

$$= u \times 1\,sec$$

$$LT^{-1}\,T = L$$

Q A particle start motion from rest from $X = 0$, initially having acc $+10 \text{ m/s}^2$

अगला
Adv.
level

for six second. Then it move with const velocity for next four sec. After that acc of particle become -15 m/s^2 for next 10 sec. And then it travel with zero acc for next three second.

Draw ① X-t (graph)

② distance-time graph

} with proper Data

Displacement

Q A particle start motion from rest from $X=0$, initially having acc $+10 \, m/s^2$ for six second. Then it move with const velocity for next four sec. After that acc of particle become $-15 \, m/s^2$ for next 10 sec. And then it travel with zero acc for next three second.

Adv.
level

$$\frac{1}{2} \times (14+4) \times 60$$

$$- \frac{1}{2} (9+3) \times 90$$

$$= 540 - 540$$

$$= 0$$

Distance $= \underline{1080}$

Displacement

$u=0$

60 ... 66

6 ... 10 ... 14 ... 20 ... 23

-90

$$\langle speed \rangle = \frac{1080}{23}$$

Q A particle start motion from rest from $X = 0$, initially having acc $+10 \text{m/s}^2$ for six second. Then it move with const velocity for next four sec. After that acc of particle become -15m/s^2 for next 10 sec. And then it travel with zero acc for next three second.

Draw ① $X-t$ (graph)

② distance-time graph

} with proper Data

Displacement

The distance travelled by a particle starting from rest and moving with an acceleration $\frac{4}{3}$ ms^{-2}, in the third second is:

[2008]

(1) $\frac{10}{3}$ m

(2) $\frac{19}{3}$ m

(3) 6m

(4) 4m

$$S = U + \frac{1}{2}(2n-1)\,a$$

$$= 0 + \frac{1}{2}(2\times3-1)\times\frac{4}{3}$$
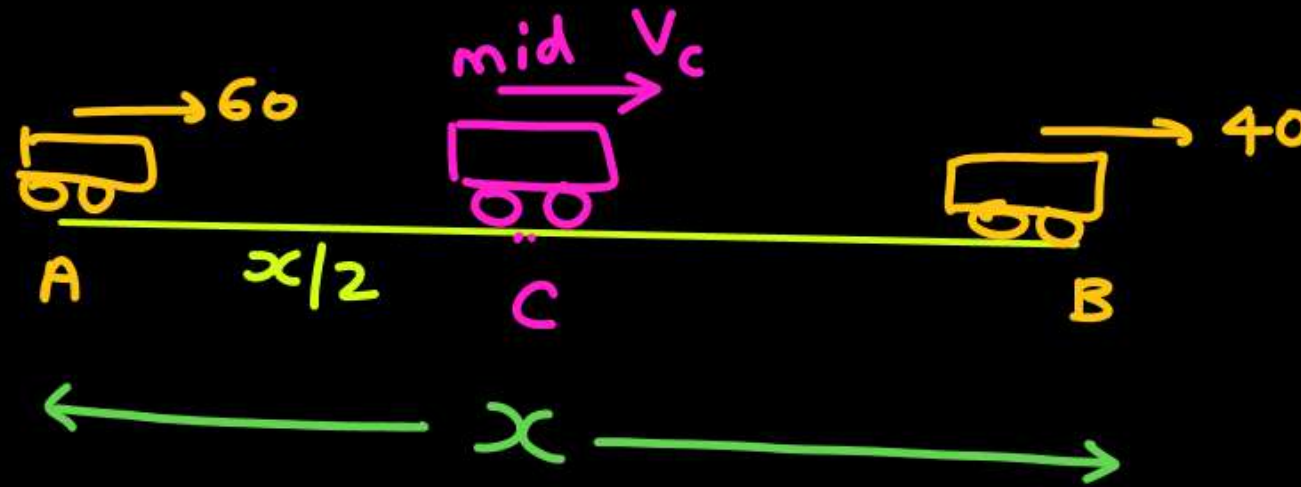
$$= \frac{5}{2}\times\frac{4}{3}$$

Ans : (1)

* Daigram

A truck travelling with _uniform acceleration_ crosses two points A and B with velocities 60 m/s and 40 m/s respectively. The speed of the body at the midpoint of A and B is nearest to:

~~(1)~~ ~~17 m/s~~

~~(2)~~ ~~20 m/s~~

~~(3)~~ ~~19.49 m/s~~

(4) 50.9 m/s

$$40^2 = 60^2 + 2ax$$

$$2ax = -100 \times 20$$

$$V_c^2 = 60^2 + 2a\frac{x}{2}$$

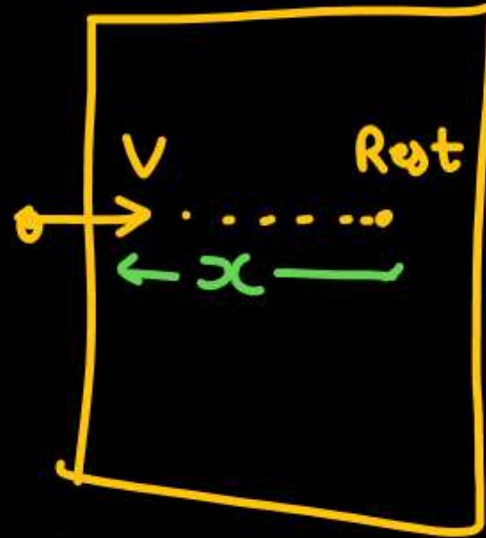$$V_c^2 = 60^2 - \frac{2000}{2} = 3600 - 1000 = 2606$$

$$V_c = 10\sqrt{26}$$

Ans. (4)

A bullet moving with a velocity of 200 cm/s penetrates a wooden block and comes to rest after travelling 4 cm inside it. What velocity is needed for travelling distance of 9 cm in same block?

(1) 100 cm/s

(2) 136.2 cm/s

(3) 300 cm/s

(4) 250 cm/s

$$\frac{V_1^2}{V_2^2} = \frac{x_1}{x_2}$$

$$\frac{200 \times 200}{V_2^2} = \frac{4}{9}$$

$$V_2 = \sqrt{\frac{9 \times 200 \times 200}{4}}$$

$$= \frac{3 \times 200}{2} = 300$$

$$0^2 = V^2 - 2ax$$

$$\underline{V^2 = 2ax}$$

Ans. (3)

(P
W)

A bullet moving with a velocity of 200 cm/s penetrates a wooden block and comes to rest after travelling 4 cm inside it. What velocity is needed for travelling distance of 9 cm in same block?

$$0^2 = (200)^2 + 2 \cdot a \cdot 4$$

$$0^2 = v^2 + 2 \times a \times 9$$

(1) 100 cm/s

(2) 136.2 cm/s

(3) 300 cm/s

(4) 250 cm/s

Ans. (3)

(P.W)

A car moving with a velocity of 10 m/s can be stopped by the application of a constant force F in a distance of 20 m. If the velocity of the car is 30 m/s. It can be stopped by this force in

(1) 20/3 m

(2) 20 m

(3) 60 m

(4) 180 m

$v = 0$

$$0^2 = 100 + 2a \times 20$$

$$0^2 = 30^2 + 2a x$$

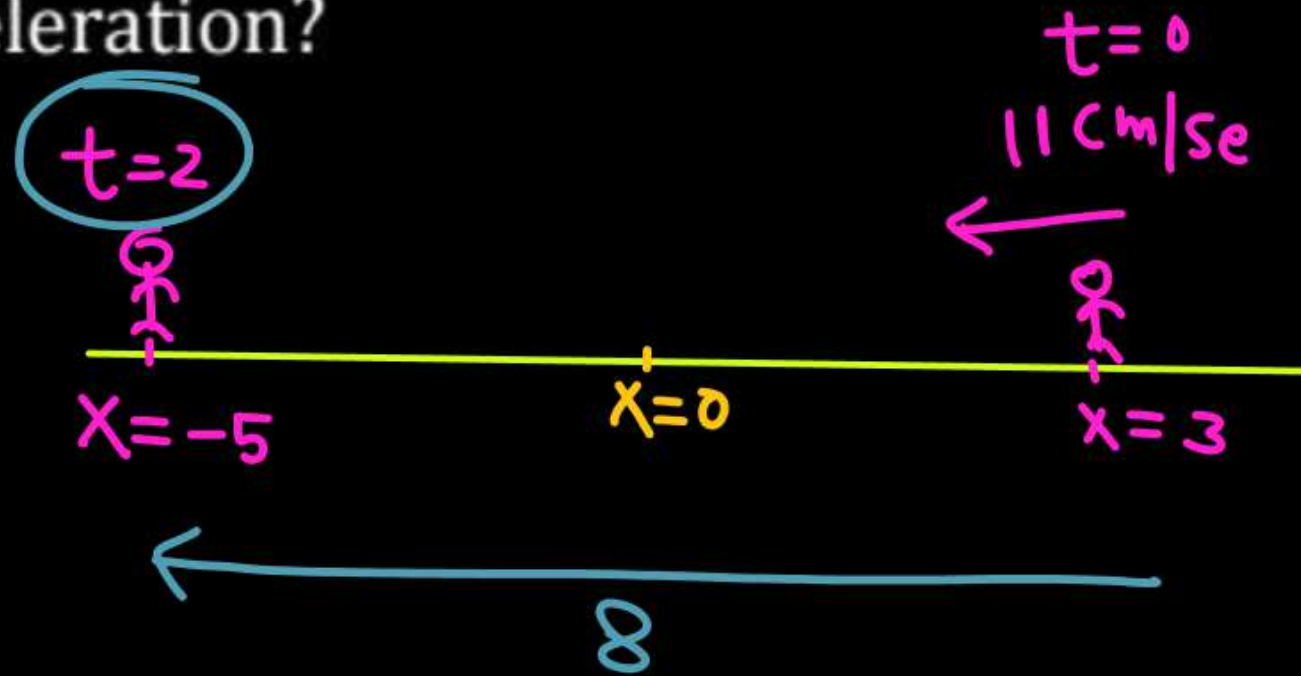$$a = -\frac{100}{40}$$

$$900 = 2 \times \frac{100}{40} \times x$$

$$x = 180$$

Ans. (4)

A body moving with uniform acceleration has a velocity of -11 cm/s when its x coordinate is 3.00 cm. If its x coordinate 2 s later is -5 cm, what is the magnitude in cm/s^2 of its acceleration?

$t=0$

$11\ cm/se$

$t=2$

$x=-5$ $x=0$ $x=3$

8

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

$$-8 = -11 \times 2 + \frac{1}{2}a \times 2^2$$

$$14 = 2a$$

$$\boxed{a = 7}$$

Ans. (7)

(13) **Sol.**
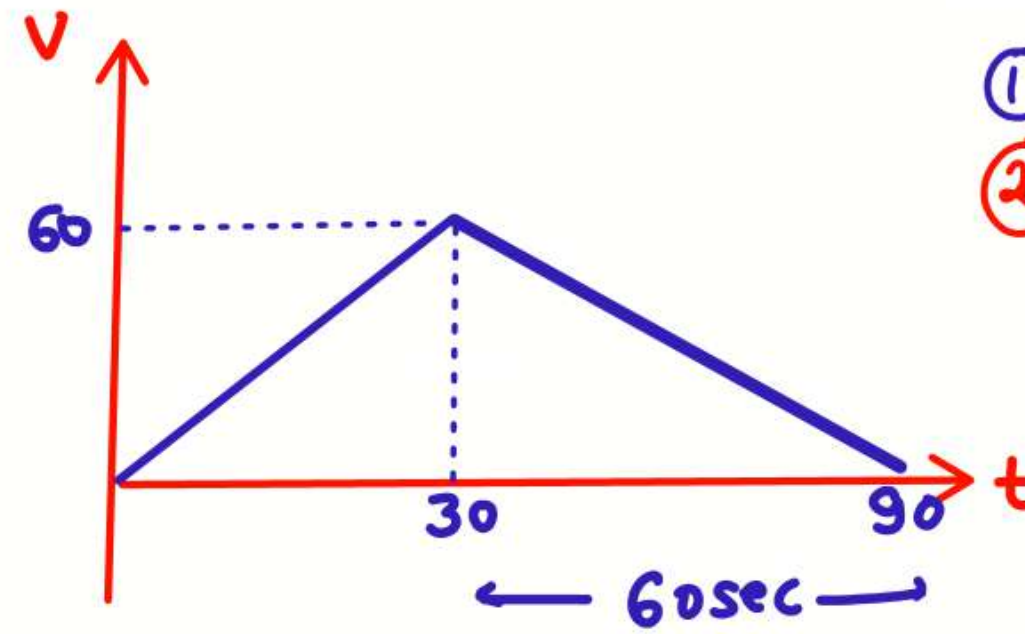
① Distance $= \frac{1}{2} \times 90 \times 60 = 270$

② $V_{max} = 60$

60

30   90   t

← 60 sec →

※

(15.) A train starts from rest and moves with a constant acceleration of $2{\cdot}0\ m/s^2$ for half a minute. The brakes are then applied and the train comes to rest in one minute. Find (a) the total distance moved by the train, (b) the maximum speed attained by the train and (c) the position(s) of the train at half the maximum speed.
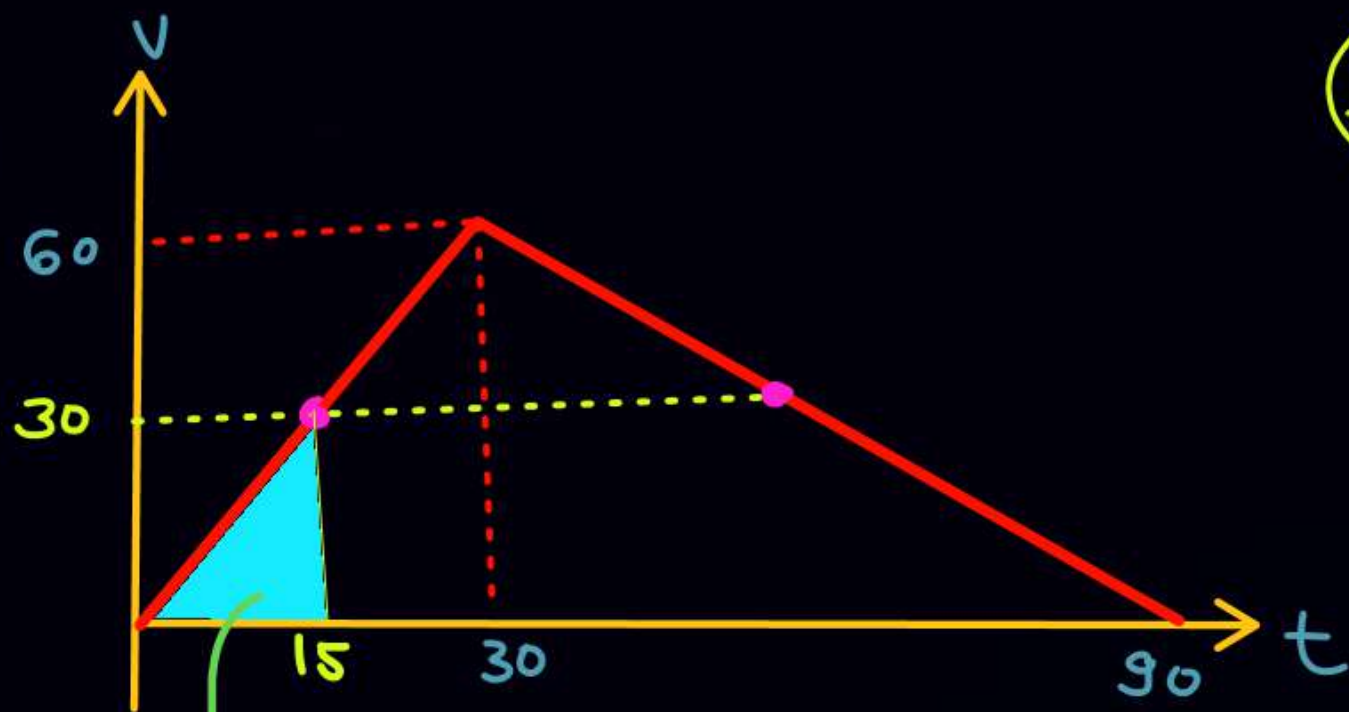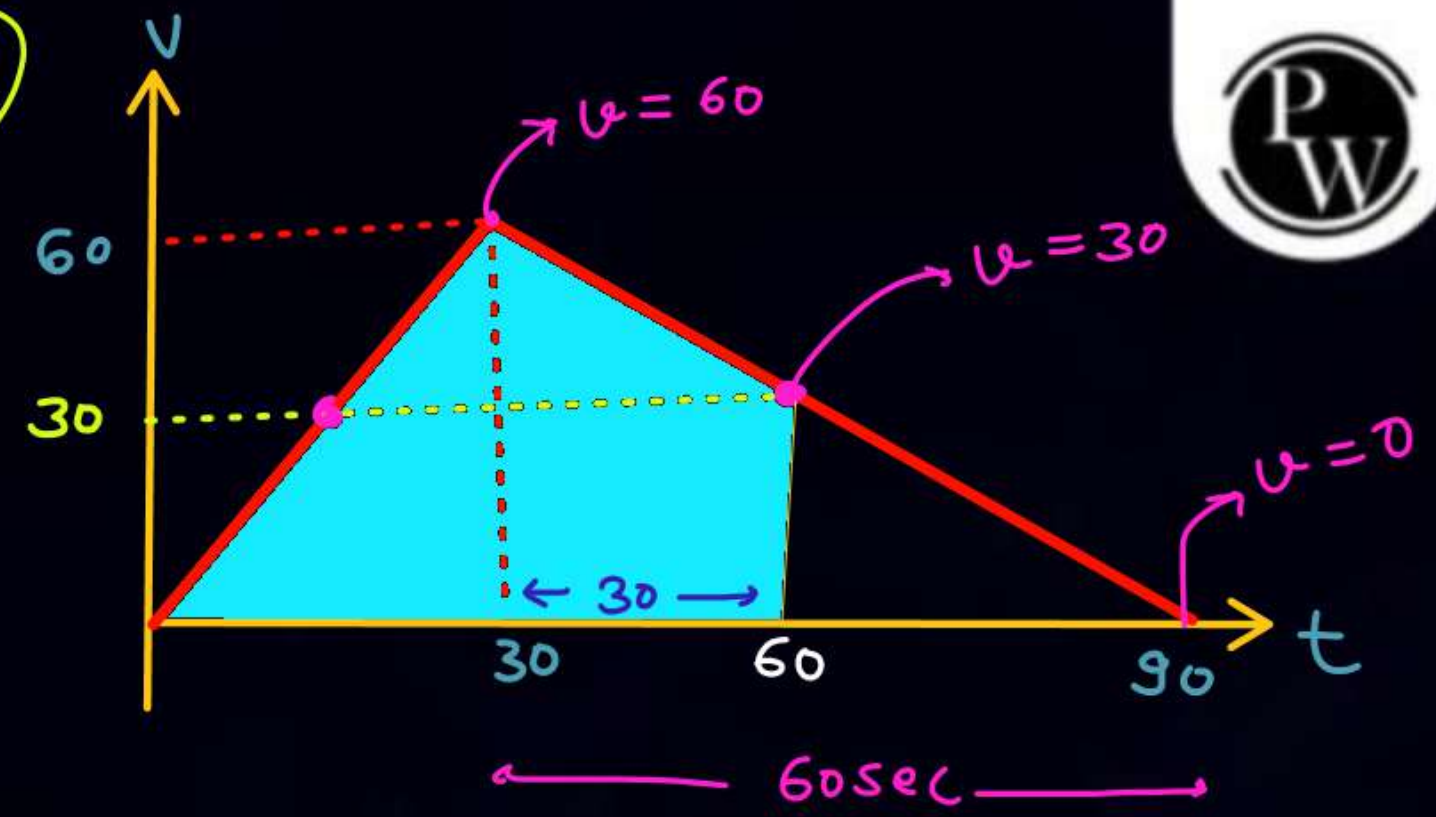
(hhr)

H/w

(16.) A bullet travelling with a velocity of 16 m/s penetrates a tree trunk and comes to rest in $0{\cdot}4$ m. Find the time taken during the retardation.

$$\text{(c)}$$

Left graph labels: V, 60, 30, 15, 30, 90, t

$$\text{Area} = \frac{1}{2} \times 15 \times 30$$
$$= 225$$

Right graph labels: V, 60, 30, $v = 60$, $v = 30$, $v = 0$, 30, 60, 90, t

$$\leftarrow 30 \rightarrow$$

$$\longleftarrow 60\,sec \longrightarrow$$

V=0   V=10   V=30   V=50   V=60   V=50   V=40   V=30   V=0

X=0   Brek   Rink

← ⎯⎯ 225 m ⎯⎯ →

0 →10 → 20 → 30 ⟹ 40 ⟶ 50 ⟶ 60 ⟶ 50 ⟶ 40 ⟶ 30 → 20 → 10

↓

0
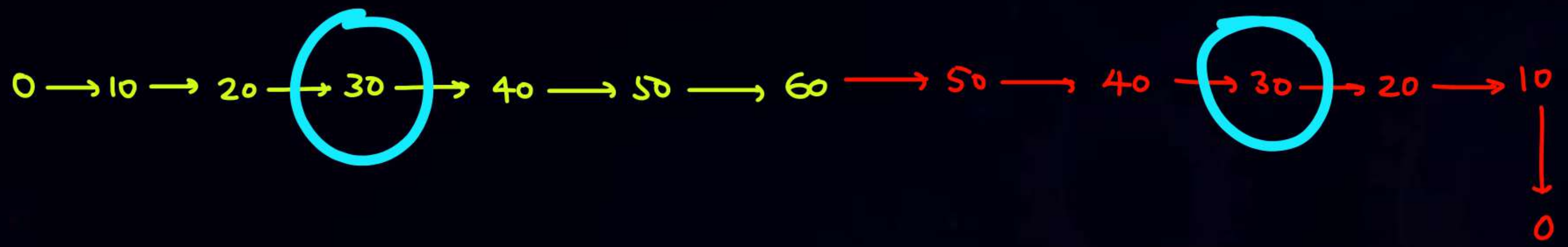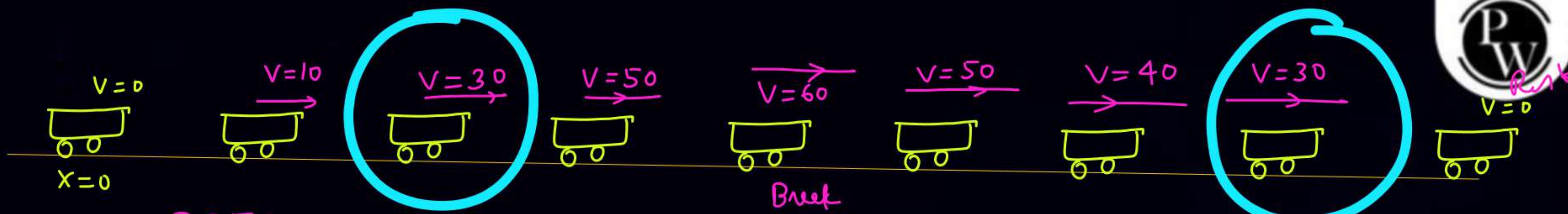
17. A bullet going with speed 350 m/s enters a concrete wall and penetrates a distance of 5·0 cm before coming to rest. Find the deceleration.

18. A particle starting from rest moves with constant acceleration. If it takes 5·0 s to reach the speed 18·0 km/h find (a) the average velocity during this period, and (b) the distance travelled by the particle during this period.

H/W

$$54 \frac{km}{hr} = 54 \times \frac{5}{18} = 15 \, m/s$$

19. A driver takes 0·20 s to apply the brakes after he sees a need for it. This is called the reaction time of the driver. If he is driving a car at a speed of 54 km/h and the brakes cause a deceleration of 6·0 m/s^2, find the distance travelled by the car after he sees the need to put the brakes on.

(13) $u = 0$

$v = 18 \frac{km}{hr} = 18 \times \frac{5}{18} = 5 \, m/s$ 5sec

$a = 1$

$$54 \frac{km}{hr} \longrightarrow 54 \times \frac{1000m}{3600 \, sec}$$

$$= 54 \times \left(\frac{5}{18} \right)$$

Home work

- DPP
- Solve all today ques
- module Prarambh $\rightarrow$ (28-34),
    Prabal $\rightarrow$ 1, 2, 3, 5, 13, 14, 12, 23, 24, 25
    Parikshit $\equiv$ (1-10)

@SALEEMSIR_PW

join it for imp
pdf/information