

YAKEEN NEET 2.0

2026

Motion in a Straight Line

Physics

Lecture -

5

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Topics to be covered

1

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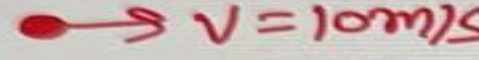
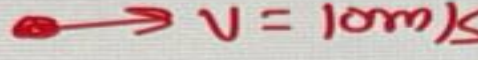
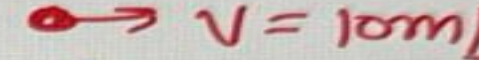


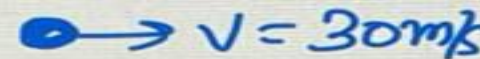
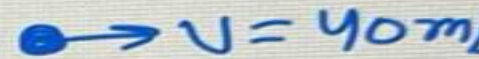
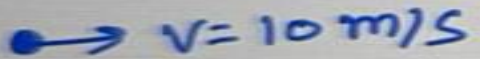
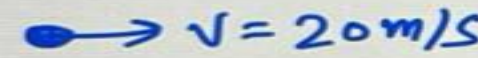
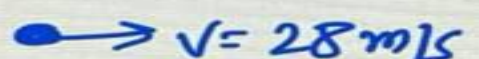









2

3

4

M/w

PhD on acc^v

time $t=0$	$t=1s$	$t=2s$	$t=3s$	
 $v = 10 \text{ m/s}$ $a = 0$	 $v = 10 \text{ m/s}$ $a = 0$	 $v = 10 \text{ m/s}$ $a = \frac{10-10}{1} = 0$	 $v = 10 \text{ m/s}$ $a = 0$	velocity = (const) $a = 0$
 $v = 10 \text{ m/s}$ $a = 0$	 $v = 20 \text{ m/s}$ $a = \frac{20-10}{1-0} = 10 \text{ m/s}^2$	 $v = 30 \text{ m/s}$ $a = \frac{30-20}{2-1} = 10 \text{ m/s}^2$	 $v = 40 \text{ m/s}$ $a = \frac{40-30}{3-2} = 10 \text{ m/s}^2$	velocity \uparrow $a = 10 \text{ m/s}^2$ $= 10 \text{ m/s}^2$
 $v = 10 \text{ m/s}$ $a = \frac{20-10}{1-0} = 10 \text{ m/s}^2$	 $v = 20 \text{ m/s}$ $a = \frac{28-20}{2-1} = 8 \text{ m/s}^2$	 $v = 28 \text{ m/s}$ $a = \frac{32-28}{3-2} = 4 \text{ m/s}^2$	 $v = 32 \text{ m/s}$ $a = \frac{32-28}{3-2} = 4 \text{ m/s}^2$	$v \uparrow$ $a \downarrow$
 $v = 20 \text{ m/s}$ $a = \frac{10-20}{1-0} = -10 \text{ m/s}^2$	 $v = 10 \text{ m/s}$ $a = \frac{4-10}{2-1} = -6 \text{ m/s}^2$	 $v = 4 \text{ m/s}$ $a = \frac{2-4}{3-2} = -2 \text{ m/s}^2$	 $v = 2 \text{ m/s}$ $a = -2 \text{ m/s}^2$	$v \downarrow$ $ \vec{a} \downarrow$
 $v = 10 \text{ m/s}$ $a = 0$	 $v = 14 \text{ m/s}$ $a = 4 \text{ m/s}^2$	 $v = 20 \text{ m/s}$ $a = 6 \text{ m/s}^2$	 $v = 30 \text{ m/s}$ $a = 10 \text{ m/s}^2$	$v \uparrow$ $a \uparrow$

Uniform (constant) velocity

Bhot udas hai Motⁿ → No change in speed (magnitude of velocity)
→ No change in direction.

$$\vec{a} = \frac{\Delta v}{\Delta t} = 0$$

external factor to change in velocity

$$\odot \rightarrow v = 10 \text{ m/s}$$

$$\odot \rightarrow 10 \text{ m/s}$$

$$\odot \rightarrow 10 \text{ m/s}$$

$$\odot \rightarrow 10 \text{ m/s}$$

$$\odot \rightarrow 10 \text{ m/s}$$

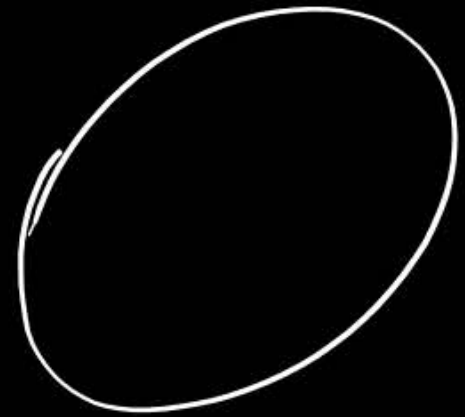
→ Path must be straight line (No - U turn)

→ Avg velocity = inst velocity

(Avg speed = |Avg. Velocity|)

must uniform speed.

likho



$mR^* \text{ Box}$

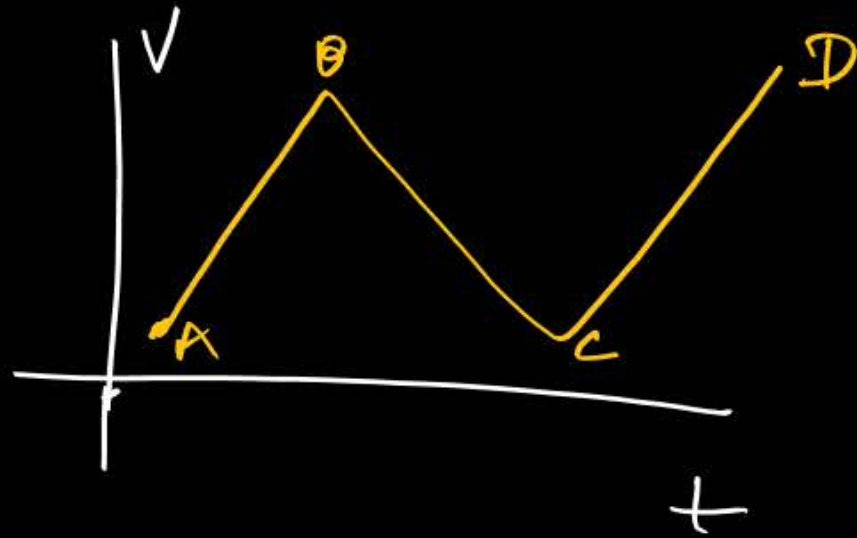
direction of velocity
along motion

$\odot \rightarrow u + ve$

$\leftarrow \odot$

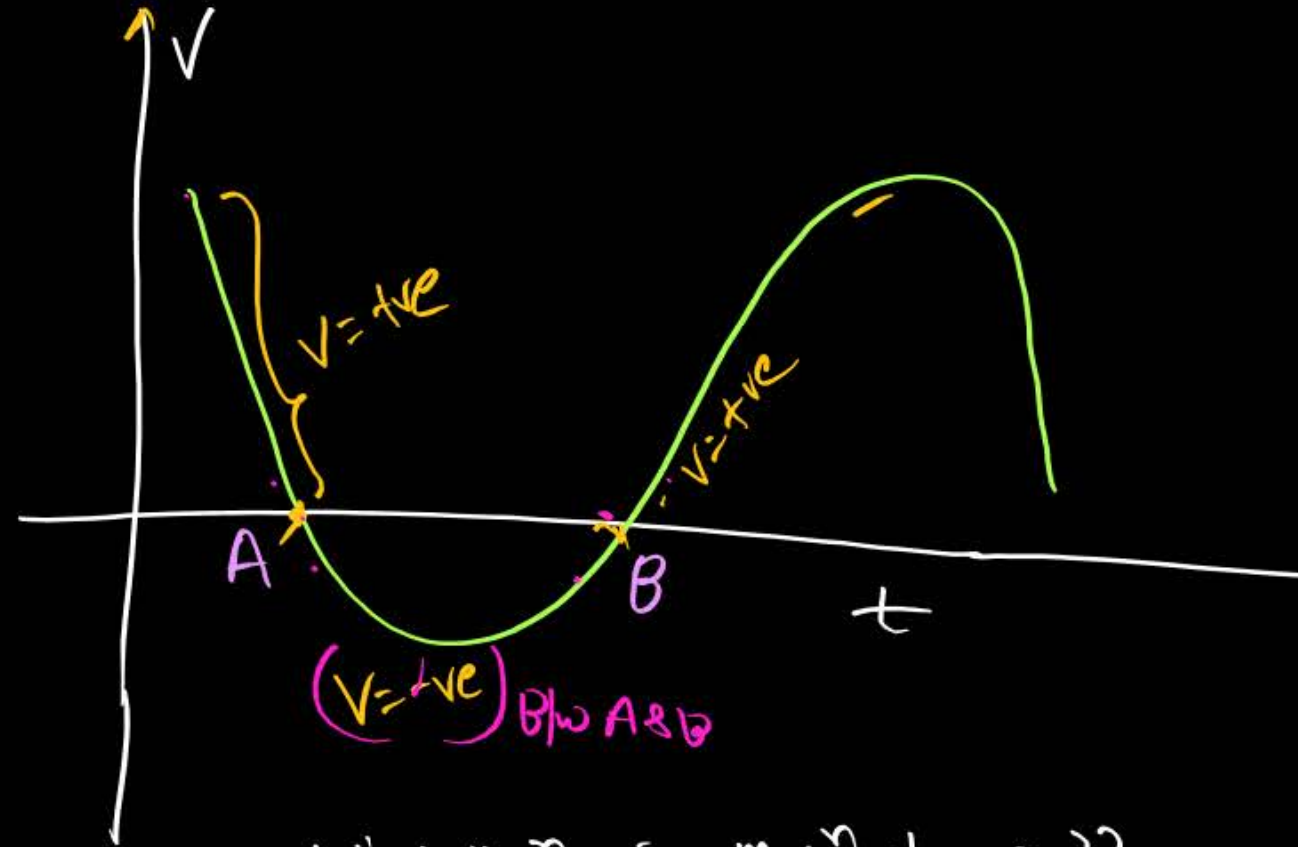
$u = -ve.$

likho
#



How many times
object change his direction
of motion.

→ No change in dirⁿ



How many times dirⁿ of motⁿ change??

→ Ans → Two times At A & B. ✓

Question



A man is moving on circular path as shown then find avg. speed in one rotation.

Hlw
Nahi likhna

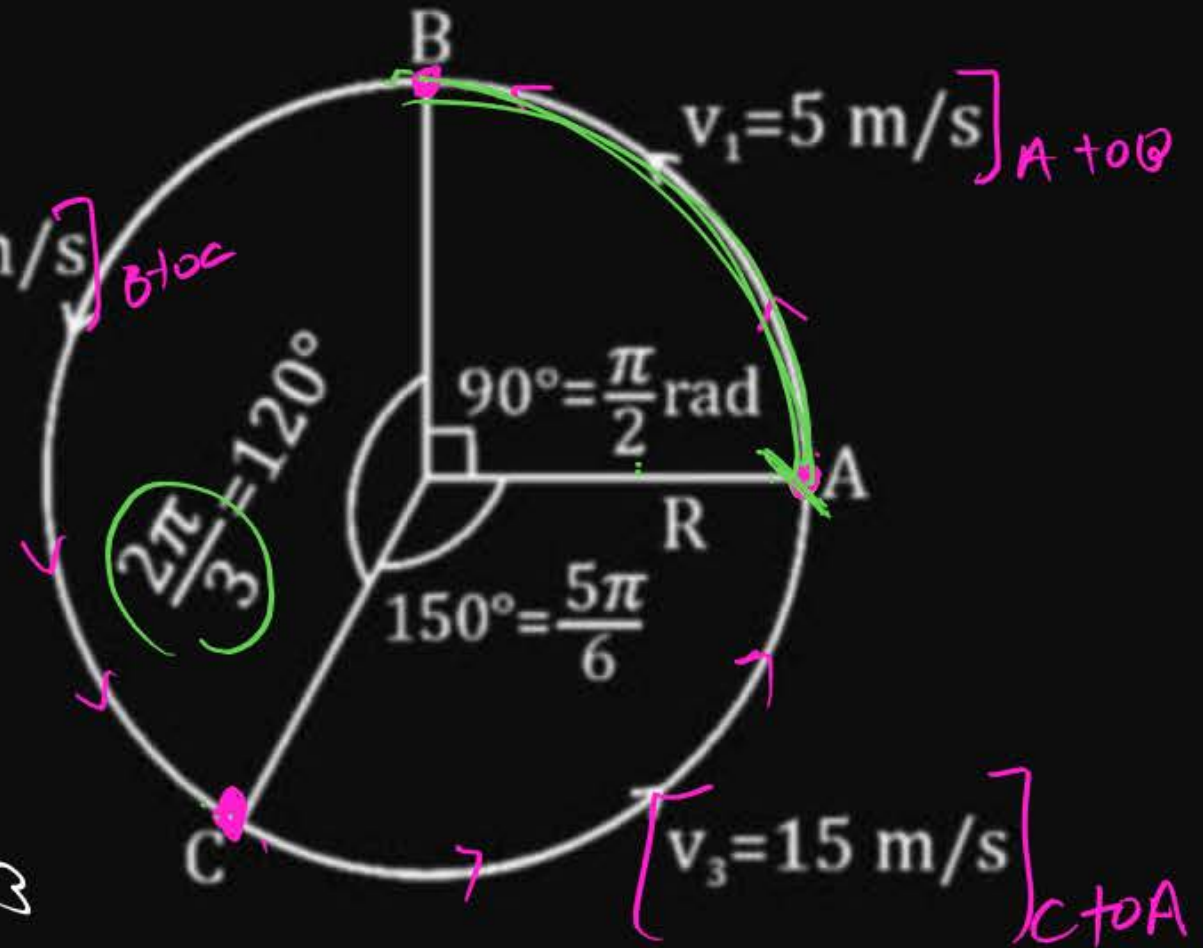
$$(Avg \text{ velocity})_{A \rightarrow A} = 0$$

$$Avg \text{ speed} = \frac{d_1 + d_2 + d_3}{t_1 + t_2 + t_3}$$

$$= \frac{2\pi R}{\frac{\pi R}{2 \times 5} + \frac{2\pi R}{3 \times 10} + \frac{5\pi R}{6 \times 15}}$$

$$= \frac{2}{\frac{1}{10} + \frac{1}{15} + \frac{1}{18}} = \underline{\underline{9 \text{ m/s}}}$$

bluait



Question

A particle is executing a circular motion of radius R with a uniform speed v . After completing half the circle, the change in velocity and in speed will be respectively

Note
A = $\frac{v}{r}$
Angular velocity

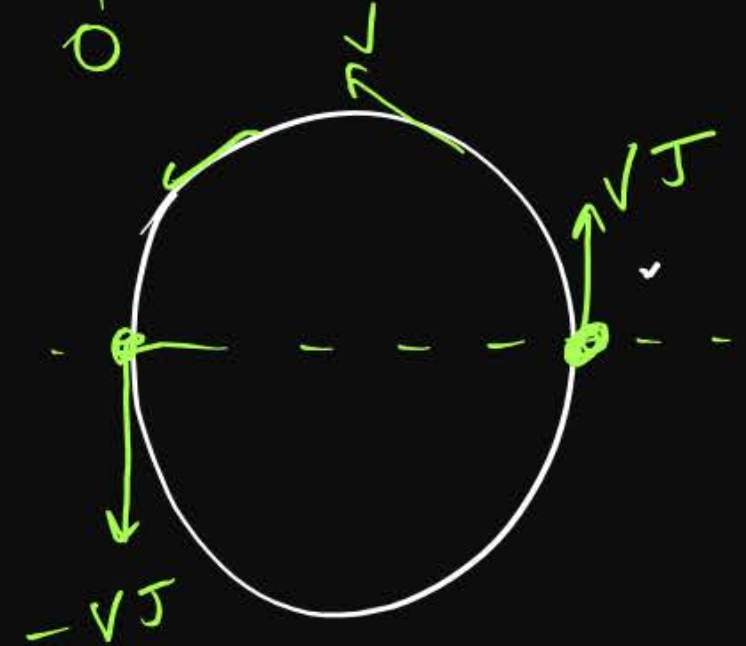
1 zero, zero

2 $2v$, zero ✓

3 $2v$, $2v$

4 zero, $2v$

also done in vector ✓



$$\begin{aligned}\Delta \mathbf{v} &= \mathbf{v}_f - \mathbf{v}_i \\ &= -v\hat{j} - v\hat{j} \\ &= \underline{\underline{-2v\hat{j}}}\end{aligned}$$

Question



A particle is moving such that its position coordinates (x, y) are $(2\text{m}, 3\text{m})$ at time $t = 0$, $(6\text{m}, 7\text{m})$ at time $t = 2\text{s}$ and $(13\text{m}, 14\text{m})$ at time $t = 5\text{s}$. The average velocity vector \vec{v}_{avg} from $t = 0$ to $t = 5\text{s}$ is:

initial

final

Simple PYQ

Not a H
सही प्रकार
PYQ.

1 $\frac{1}{5}(13\hat{i} + 14\hat{j})$

2 $\frac{7}{3}(\hat{i} + \hat{j})$

3 $2(\hat{i} + \hat{j})$

4 $\frac{11}{5}(\hat{i} + \hat{j})$

$$\vec{v}_{Avg} = \frac{\vec{x}_f - \vec{x}_i}{\Delta t} = \frac{(13\hat{i} + 14\hat{j}) - (2\hat{i} + 3\hat{j})}{5} = \frac{11\hat{i} + 11\hat{j}}{5}$$

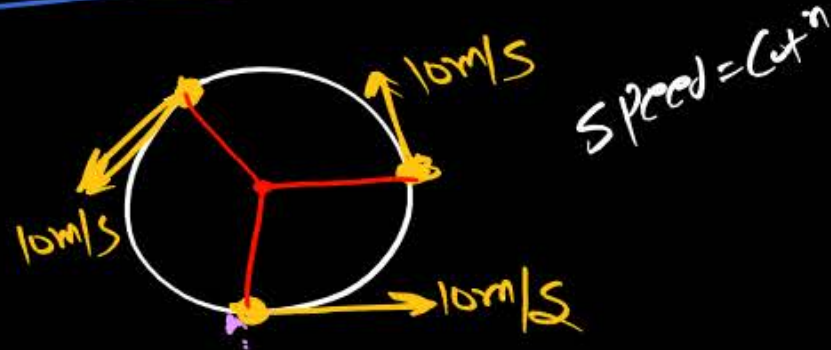
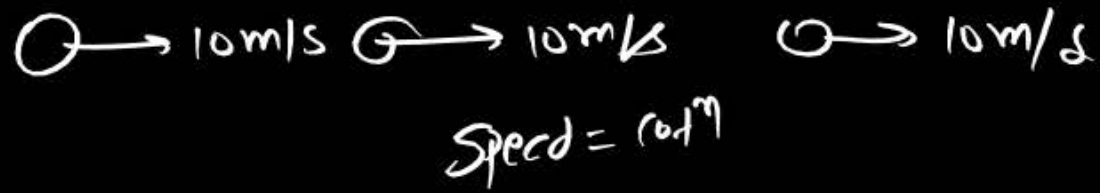
(Q) If speed is constⁿ then what about velocity ??

H/w

Same dirⁿ ka information Nahi Pata.

Ans → velocity may or may not be constant

Ans



(Q) If * speed is variable then what about velocity

H/w

Ans → velocity must be variable

$$* \text{Velocity} = \underbrace{\text{Speed}}_{\text{Change}} \times \underbrace{\text{dir}^n}_{\text{Change}}$$

gf
H/w

velocity is constⁿ then what about speed??

→ udas hai zindagi

speed must be constⁿ Ans

gf
H/w

velocity is variable then what about speed

→ Kiase vary huaa??

Speed chaye kar ke ya dirⁿ
Chaye??

Ans speed may be variable

$$\vec{v} = \boxed{\text{speed}} \times \boxed{\text{dir}^n}$$

Question



Object is moving with constant speed then velocity of object:

- 1 may be variable ✓✓
- 2 must be constant ✗
- 3 must be variable ✗
- 4 may be zero ✗

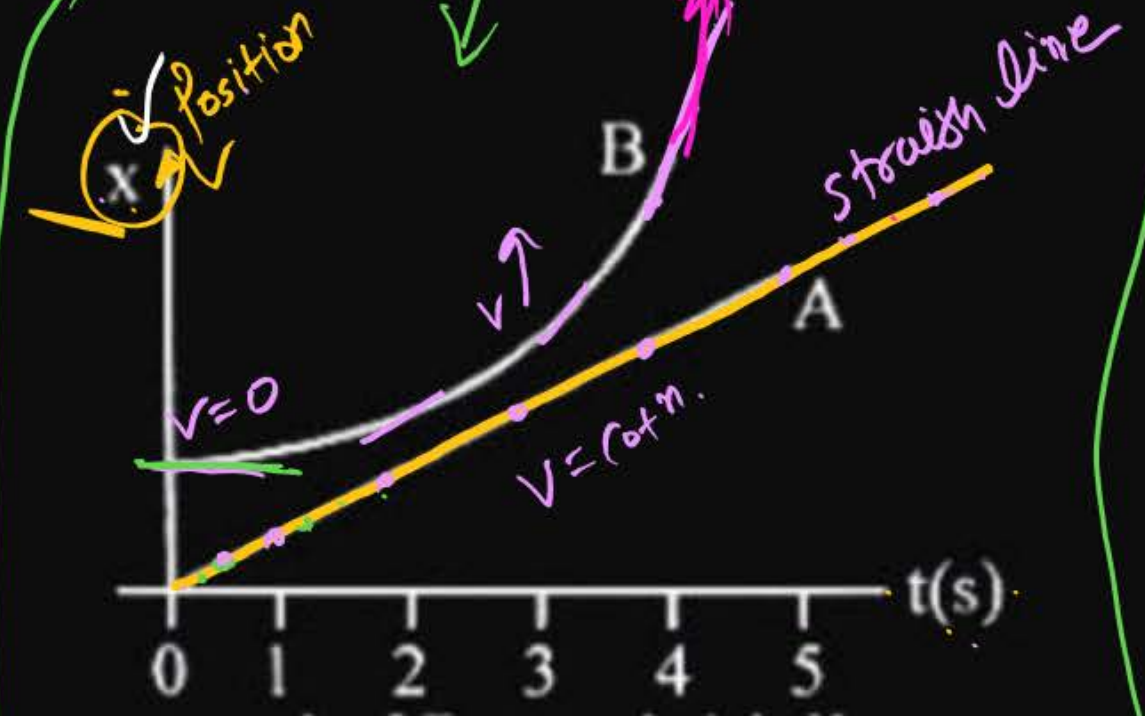
राम
जैसे निरंतर

Question

H/W

In the figure shown below, the position versus time graph of two particles A and B is shown. Select the correct statement:

- 1 The speed of B was initially greater than that of A and finally less than that of A. X
- 2 The speed of B was initially less than that of A and finally greater than that of A. ✓
- 3 The speed of B was initially as well as finally greater than that of A. X
- 4 The speed of B was initially as well as finally less than that of A. X



slope of (x-t) graph

$$\text{slope} = \frac{dx}{dt} = \text{Velocity}$$

Question



Position of object $x = 10t - 2t^2$. Find time when object comes to at rest.

H/W Not 2nd

$$x = 10t - 2t^2$$

$$\frac{dx}{dt} = 10 - 2(2t)$$

$$V = 10 - 4t$$

$$\rightarrow 0 = 10 - 4t$$

$$4t = 10$$

$$t = \frac{10}{4} = 2.5 \text{ sec}$$

$$\rightarrow V = 0 \text{ (rest)}$$

Dikha hai

MR Scam.

(Q) Position of object $x = t^2 + 2t - 3$ then find Position at
time $t = 0 \text{ sec}$, $t = 1 \text{ sec}$, $t = 2 \text{ sec}$, $t = 3 \text{ s}$, $t = 5 \text{ sec}$.

$$v = \frac{dx}{dt} = 2t + 2$$

velocity always +ve (No-U-turn)
always dist = displacement

Soln

$$x = t^2 + 2t - 3$$

$$\left\{ \begin{array}{l} x(t=0) = 0 + 2 \times 0 - 3 = -3 \text{ m} \\ x(t=1 \text{ s}) = 1 + 2 - 3 = 0 \text{ m} \\ x(t=2 \text{ s}) = (2)^2 + 2 \times 2 - 3 = 4 + 4 - 3 = 5 \text{ m} \end{array} \right.$$

$$\begin{aligned} (x)_{t=3} &= 3^2 + 2 \times 3 - 3 \\ &= 9 + 6 - 3 = 12 \text{ m} \end{aligned}$$

$$\begin{aligned} (x)_{t=5} &= 5^2 + 2 \times 5 - 3 \\ &= 25 + 10 - 3 \\ &= 32 \text{ m} \end{aligned}$$

Dikha hai
MR Scrm.

(Q) Position of object $x = t^2 + 2t - 3$ then (i) find disp^m in $t = 2 \text{ sec}$
and (ii) disp^m in $t_1 = 3 \text{ sec}$ to $t_2 = 5 \text{ sec}$.

$v = \frac{dx}{dt} = 2t + 2$
velocity always +ve (No-U-turn)
always $\text{dist}^n = |\text{disp}^m|$

Solⁿ

(i)

$$\text{Disp}^m = \vec{x}_f - \vec{x}_i$$

$$|\text{disp}^m|_{\text{in } 2\text{-sec}} = (x)_{t=2} - (x)_i_{t=0}$$

$$= (4 + 2 \times 2 - 3) - (-3)$$

$$= 5 + 3 = 8 \text{ m}$$

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

gsh question
me u-turn
Nahi hai

(ii) Disp^m in $t_1 = 3 \text{ sec}$ (initial)
 $t_2 = 5 \text{ sec}$ (final)

$$\text{Disp}^n = (x)_{\text{at } t_2 = 5 \text{ sec}} - (x)_{\text{at } t_1 = 3 \text{ sec}}$$

$$= (5^2 + 2 \times 5 - 3) - (3^2 + 2 \times 3 - 3)$$

$$= (25 + 10 - 3) - [9 + 6 - 3]$$

$$= 32 - 12 = 20 \text{ m}$$

Position of object $x = t^2 - 4t + 5$ then

find distance & disp^m in $t = 3 \text{ sec}$

Soln

$$x = t^2 - 4t + 5$$

$$\text{disp}^m = x_f - x_i$$

$$= (x)_{t=3} - (x)_{t=0}$$

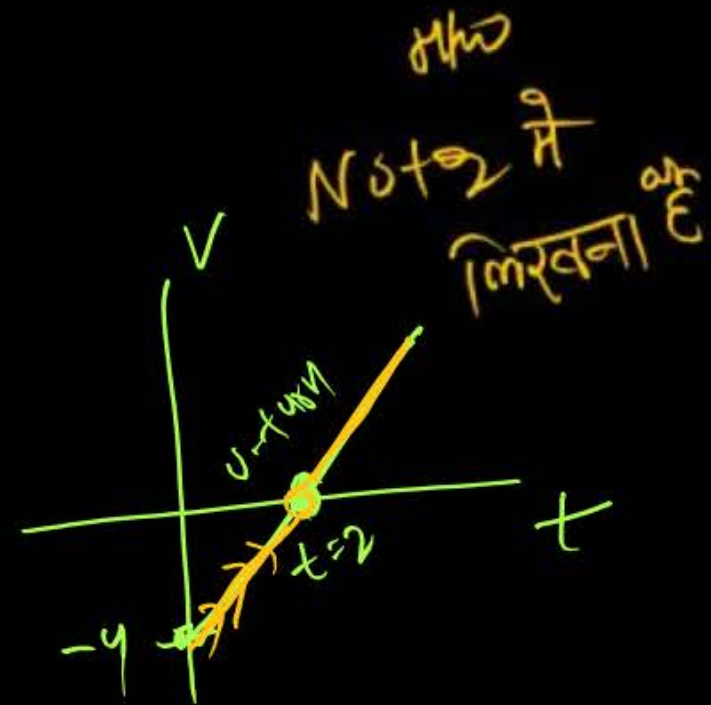
$$= (3^2 - 4 \times 3 + 5) - [5]$$

$$= 9 - 12 + 5 - 5$$

$$\text{disp}^m = -3 \text{ m}$$

→ direction

MR* disp^m U-turn
par depend Nahi
Karta. $\text{disp}^m = x_f - x_i$
But distⁿ = total
Path length U-turn
par depend hai



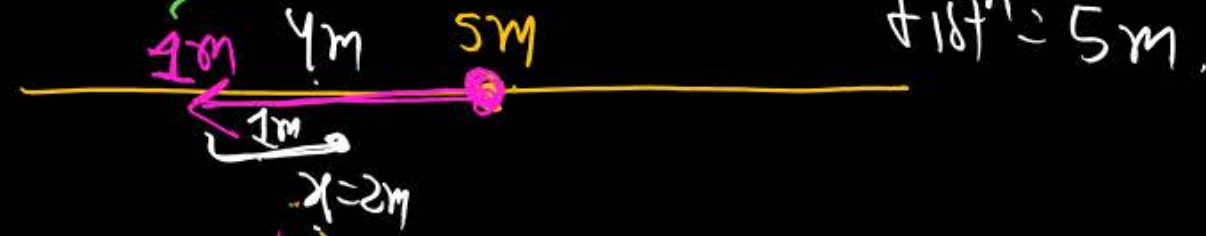
find inst-velocity
 $V = \frac{dx}{dt} = 2t - 4$

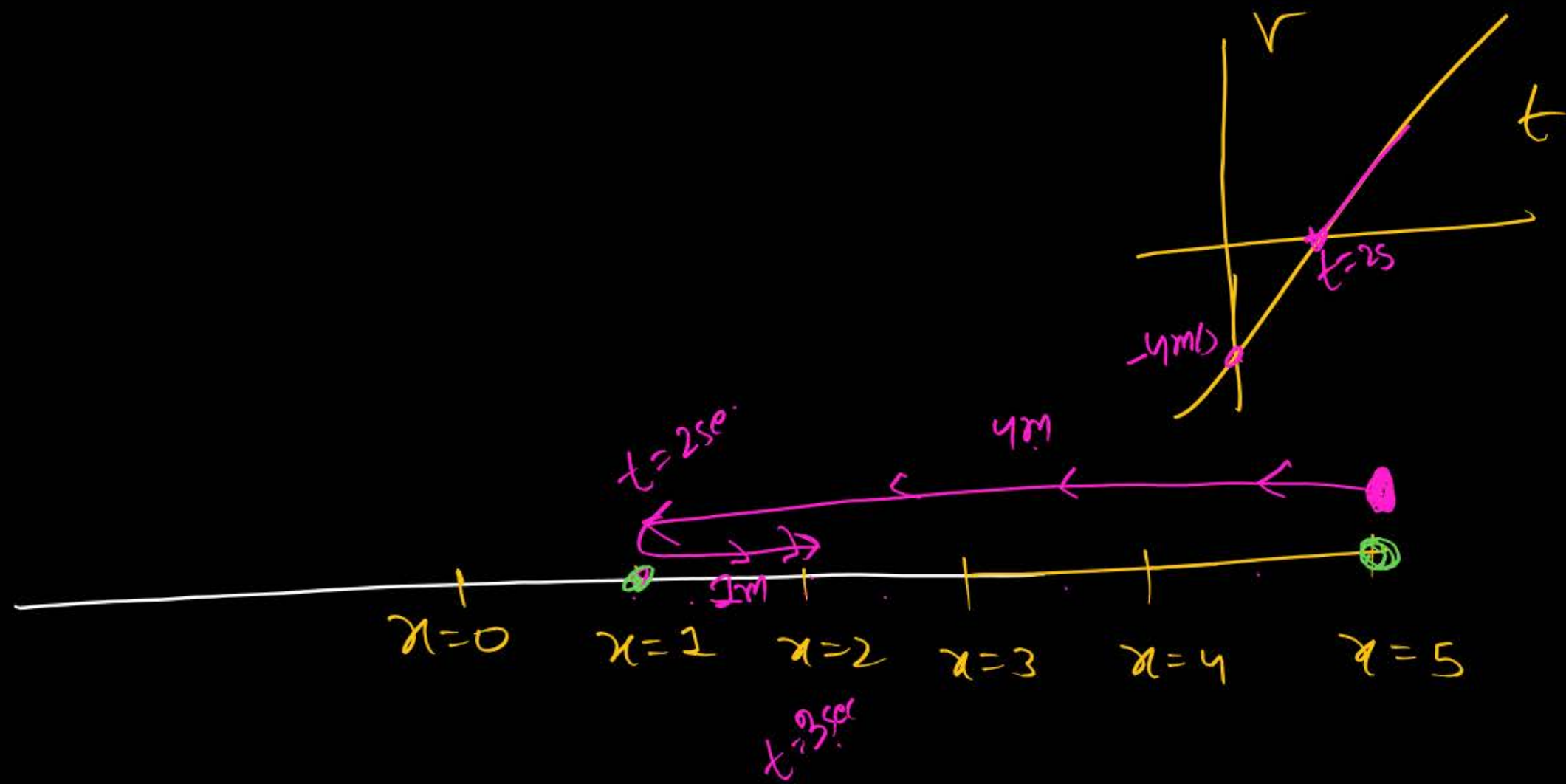
Initial ✓ $x(t=0) = 5 \text{ m}$

✓ $x(t=2 \text{ sec}) = 4 - 8 + 5 = 1 \text{ m}$

✓ $x(t=3 \text{ sec}) = 9 - 12 + 5 = 2 \text{ m}$

$0 = 2t - 4$
 $4 = 2t$
 $t = 2 \text{ sec}$
object at rest





Position of object $x = t^2 - 4t + 5$ then find Avg.
speed and Avg. velocity in $t = 3$ sec.

धन
Note में
लिखना है

Same as last ques

$$\text{Avg speed} = \frac{\text{total dist}}{\text{time}} = \frac{5}{3} = \frac{5}{3} \text{ m/s}$$

$$\text{Avg vel} = \frac{\text{dis}}{t} = \frac{-3}{3} = -1 \text{ m/s}$$

NOTE me likho

Q

gf

$$x = t^2 - 6t + 4$$

find distⁿ

and disp^m in

t = 4 sec

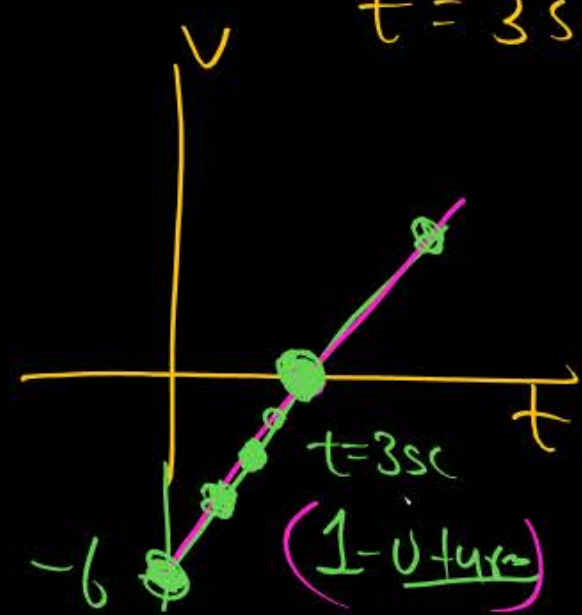
final time

Solⁿ

$$V = 2t - 6 = 0$$

$$2t - 6 = 0$$

$$t = 3 \text{ sec} \left(\text{rest} \right)$$

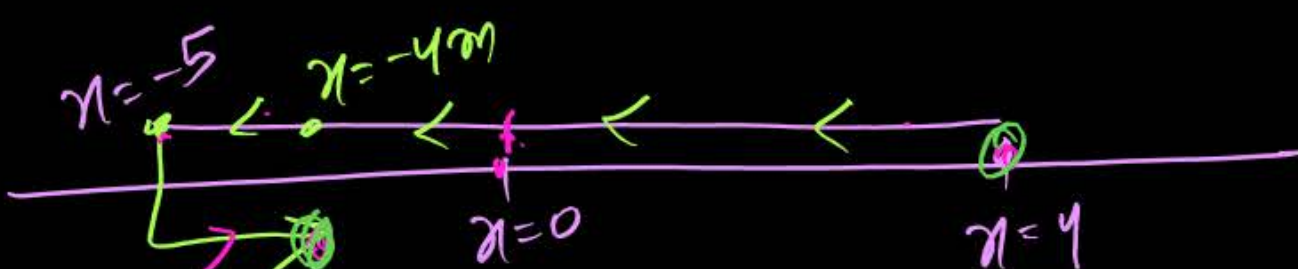


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$$(x)_{t=0} = 4$$

$$(x)_{t=3} = 9 - 6 \times 3 + 4 = -5 \text{ m}$$

$$(x)_{t=4} = 16 - 6 \times 4 + 4 = -4 \text{ m}$$



$$10 \text{ m} = \text{dist}$$

$$\text{disp}^n = -4 - 4 = -8 \text{ m}$$

likho

⑦ $x = t^2 + 4t + 6 \longrightarrow$ No turn.
 $v = 2t + 4$

⑧ $x = -t^2 - 8t + 18 \longrightarrow$ No turn.
 $v = -2t - 8$

$x = t^2 + 4t - 18$
 \longrightarrow No turn
 $v = 2t + 4$

Position

mp 5cm

$$x = \frac{t^3}{3} - 2t^2 + 4t$$

find

distance and displacement in

3-sec.

H/W Note
A mirror
ex.

initial position

$$(x)_{t=0} = 0m$$

$$(x)_{t=2} = \frac{8}{3} - 2(2)^2 + 4 \times 2$$
$$= \frac{8}{3} - 8 + 8 = \frac{8}{3} = 2.6m$$

$$(x)_{t=3} = \frac{3^3}{3} - 2(3)^2 + 4 \times 3$$
$$= 9 - 2(9) + 12$$
$$= 9 - 18 + 12 = 3m$$

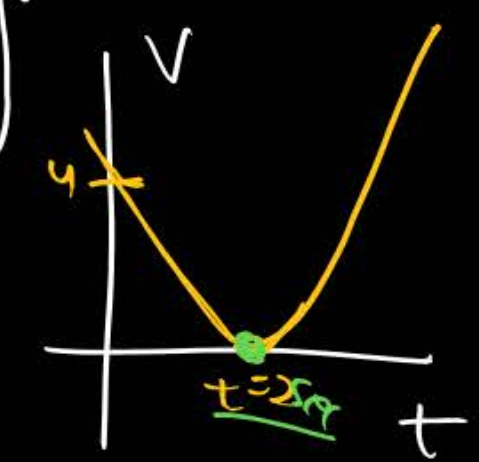


$$v = \frac{dx}{dt} = \frac{1}{3} 3t^2 - 2(2t) + 4$$

$$v = (t-2)^2$$

always +ve

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



one time

t=2sec
but No. of

$$0 = t^2 - 4t + 4$$
$$= t^2 - 2t - 2t + 4$$
$$= t(t-2) - 2(t-2) = 0$$
$$(t-2)(t-2) = 0$$

Question



If object is moving with speed $v = 3t^2$; then find avg. speed in 2-sec.
Inst. speed

$$t_i = 0 \quad t_f = 2$$

H/W (Not on H)

\star

$$\text{Avg speed} = \frac{\text{Total dist}^n}{\text{total time}}$$
$$\langle v \rangle_{\text{Avg speed}} = \frac{\int_{t_i}^{t_f} v dt}{\int dt}$$

$$\text{Avg speed} = \frac{\int_0^2 3t^2 dt}{\int_0^2 dt} = \frac{3 \left(\frac{t^3}{3} \right)_0^2}{(t)_0^2} = \frac{4-0}{2} = \underline{\underline{4 \text{ m/s}}}$$

Position of object $x = 5 + 2t^2$ then find Avg velocity in $t_1 = 2\text{sec}$ to $t_2 = 5\text{sec}$.

Soln

$$\text{Avg velocity} = \frac{\text{total disp}^n}{\text{total time}} = \frac{(x_f)_{t=5\text{sec}} - (x_i)_{t=2\text{sec}}}{5-2} = \frac{5+2(5)^2 - (5+2(2)^2)}{3}$$

$$= \frac{(5+50) - [5+8]}{3}$$

$$= \frac{55-13}{3}$$

$$= \frac{42}{3} = 14 \text{ m/s}$$

$$= \frac{2 \left((5)^2 - (2)^2 \right)}{5-2} = \frac{2 \times (25-4)}{3} = \frac{42}{3} = 14 \text{ m/s}$$

$$x = 5 + 2t^2$$

$$u = \frac{dx}{dt} = 0 + 2(2t)$$

$$\text{Inst}^n \text{ velong } V = 4t \quad \text{--- (1)}$$

$$\langle V \rangle = \frac{\int_2^5 V dt}{\int_2^5 dt} = \frac{\int_2^5 4t dt}{\int_2^5 dt} = \frac{4 \left[\frac{t^2}{2} \right]_2^5}{[t]_2^5} = \frac{2 \left((5)^2 - (2)^2 \right)}{5-2} = \frac{2 \times (25-4)}{3} = \frac{42}{3} = 14 \text{ m/s}$$

MR Slam

Accelⁿ

$$\vec{a}_{Avg} = \frac{\vec{v}_f - \vec{v}_i}{\Delta t}$$

$$\vec{a}_{inst} = \left(\frac{dv}{dt} \right) = \frac{d}{dt} \left(\frac{dx}{dt} \right) = \frac{d^2x}{dt^2}$$

Acceleration

accⁿ kisi bhi instant par motion (How fast or slow)
ka feel nahi hai.

→ How fast velocity is changing.

$t = 1 \text{ sec}$	$t = 2 \text{ sec}$	$t = 3 \text{ sec}$	$t = 4 \text{ sec}$	$t = 5 \text{ sec}$
$\rightarrow V = 10 \text{ m/s}$	$\rightarrow V = 10 \text{ m/s}$	$\rightarrow V = 10 \text{ m/s}$	$\rightarrow V = 10 \text{ m/s}$	$\rightarrow V = 10 \text{ m/s}$
$\rightarrow V = 10 \text{ m/s}$	$\rightarrow V = 20 \text{ m/s}$ $a = 10 \text{ m/s}^2$	$\rightarrow V = 30 \text{ m/s}$ $a = 10 \text{ m/s}^2$	$\rightarrow 40 \text{ m/s}$ $a = 10 \text{ m/s}^2$	$\rightarrow V = 50 \text{ m/s}$ $a = 10 \text{ m/s}^2$
$\rightarrow V = 10 \text{ m/s}$	$\rightarrow V = 26 \text{ m/s}$ $a = 10 \text{ m/s}^2$	$\rightarrow V = 28 \text{ m/s}$ $a = 8 \text{ m/s}^2$	$\rightarrow V = 32 \text{ m/s}$ $a = 4 \text{ m/s}^2$	$\rightarrow V = 34 \text{ m/s}$ $a = 2 \text{ m/s}^2$

$\Rightarrow a = 0 \quad V = \text{const}^n$

$\Rightarrow V = \text{Increasing}$
 $a = 10 \text{ m/s}^2 \text{ const}^n$

$\Rightarrow v \uparrow \quad a \downarrow$

Q3c-4

$t=0$
 $\text{O} \rightarrow V=10\text{m/s}$

$t=2\text{sec}$
 $\text{O} \rightarrow V=20\text{m/s}$

$t=4\text{sec}$
 $\text{O} \rightarrow V=32\text{m/s}$

$t=6\text{sec}$
 $\text{O} \rightarrow V=50\text{m/s}$

$$a_{\text{Avg}} = \frac{\vec{V}_f - \vec{V}_i}{\Delta t}$$

$$= \frac{20-10}{2-0}$$

$$= \frac{10}{2}$$

$$a = +5\text{m/s}^2$$

$$a = \frac{32-20}{4-2}$$

$$= \frac{12}{2}$$

$$a = 6\text{m/s}^2$$

$$a = \frac{50-32}{6-4}$$

$$a = \frac{18}{2} = 9\text{m/s}^2$$

① acceleration \uparrow → Increasing (velocity Increase hone ka ruke bath raha hai)
② Velocity \uparrow

Ques-5

$$t=0$$

$$\odot \rightarrow v=20\text{m/s}$$

$$t=2\text{sec}$$

$$\odot \rightarrow v=16\text{m/s}$$

$$t=4\text{sec}$$

$$\odot \rightarrow v=10\text{m/s}$$

$$t=6\text{sec}$$

$$\odot \rightarrow v=2\text{m/s}$$

$$a = \frac{16-20}{2-0}$$

$$a = \frac{-4}{2}$$

$$\# \boxed{a = -2\text{m/s}^2} \checkmark$$

dirⁿ (opposite)

$$a = \frac{10-16}{4-2}$$

$$= \frac{-6}{2}$$

$$\# \boxed{a = -3\text{m/s}^2} \checkmark$$

$$a = \frac{2-10}{6-4}$$

$$a = -8/2$$

$$\# \boxed{a = -4\text{m/s}^2} \checkmark$$

#

Value. (Magnitude) of accⁿ \uparrow
Velocity \downarrow

Case-1

$$v = \cot \theta$$
$$a = 0$$

Case-4

$$v \uparrow$$
$$a \uparrow$$

Case-2

$$v \uparrow$$
$$a = \cot \theta$$

Case-3

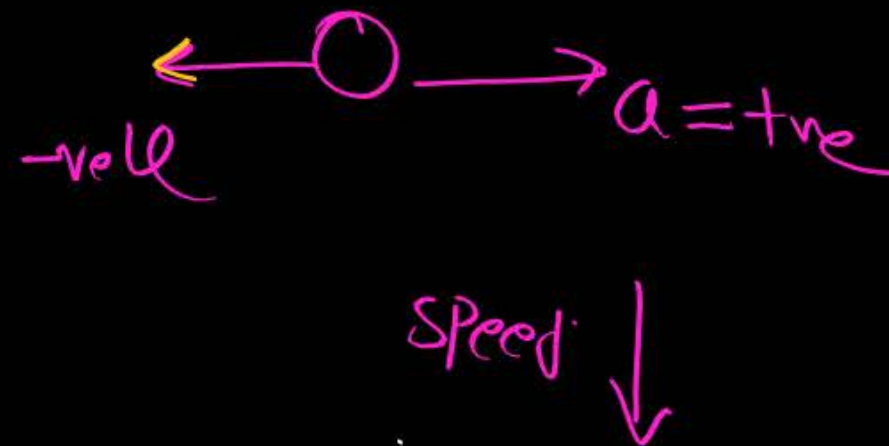
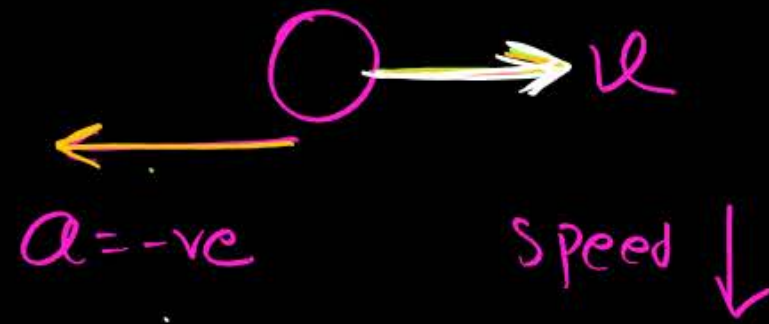
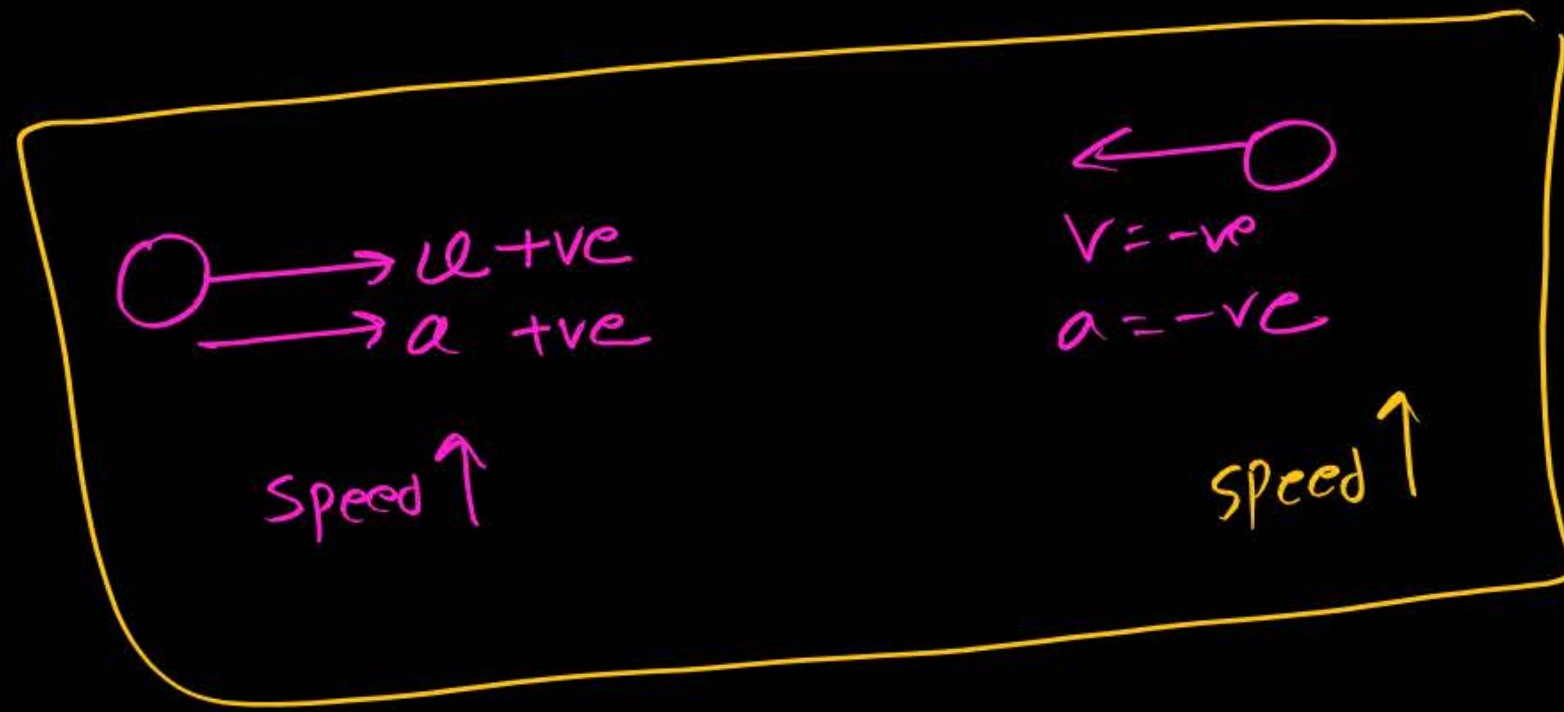
$$v \uparrow$$
$$a \downarrow$$

Case-5

$$v \downarrow$$
$$a \uparrow$$

Just 5 - sense
already discussed

All are possible



Retardation \rightarrow accⁿ which is opposite to the velocity.
 \rightarrow Retardation may be positive or -ve.

Motion under gravity

$t = 0$

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

$t = 1 \text{ sec}$

$v = 10 \text{ m/s}$

$t = 2 \text{ sec}$

$v = 20$

$v = 0$

$v = 50 \text{ m/s}$

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

$T = 5 \text{ sec}$

Max speed
at
5th sec

341 मिर्का

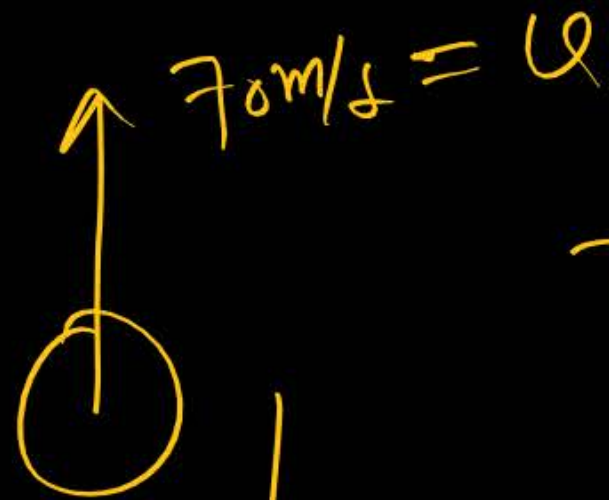


$$a = \underline{\underline{-10 \text{ m/s}^2}}$$

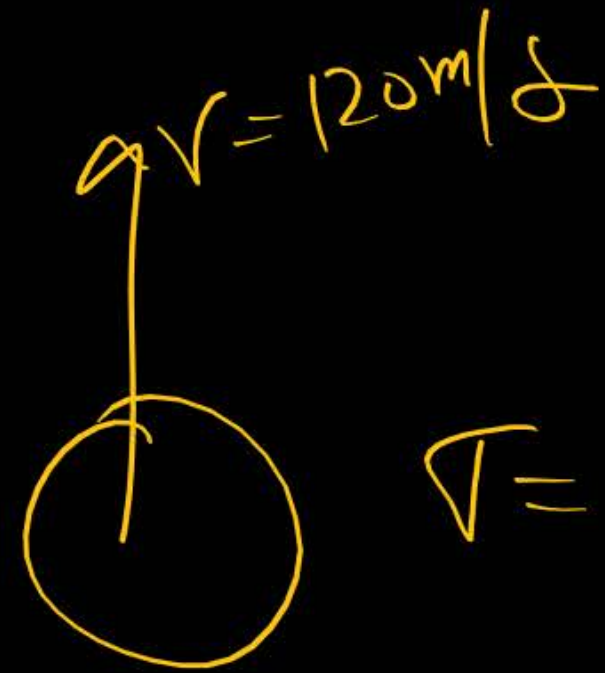
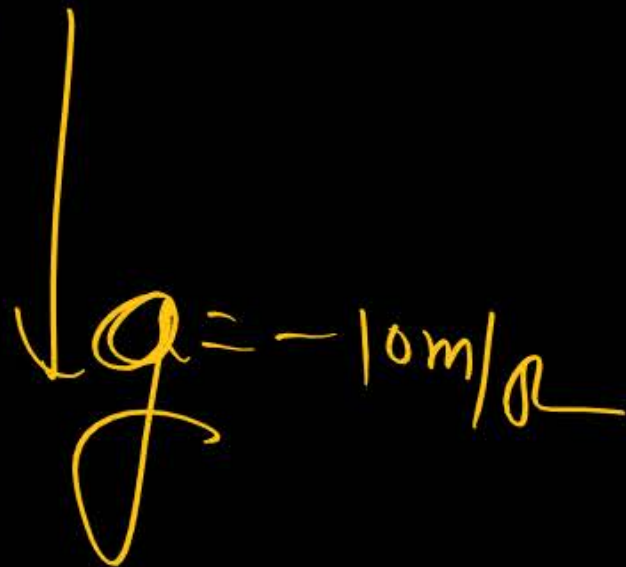
(+)
धुक्ने के लिए

6 sec

गती मित्र



$T = 7 \text{ sec}$ में
रुक जायगा



$T = 12 \text{ sec}$ में

रुक

Which of the following option is correct:

- 1** Velocity of object increasing and acceleration may decreasing.
- 2** Velocity of object decreasing and acceleration may increasing.
- 3** Acceleration may be non-zero when velocity of object is zero.
- 4** All of these.

Object is moving such that its velocity and acceleration is in opposite direction then

- ① Speed may constant.
- ② Speed may increasing.
- ③ Speed must be decreasing.
- ④ Speed may be increasing or decreasing.

An object is moving with constant velocity then which of the following option is correct

- 1** Acceleration may be increasing.
- 2** Acceleration is zero.
- 3** Acceleration is decreasing.
- 4** Acceleration is non-zero.

Question



Object is moving with acceleration 2 m/s^2 its velocity at $t = 0$ is 10 m/s then find its velocity at $t = 4 \text{ sec}$.

Question



Velocity at $t = 0$ sec is 10 m/s its velocity becomes 40 m/s after 6 sec then find acceleration.

Question



Velocity at $t = 2$ sec is 20 m/s its $t = 5$ sec it becomes 32 m/s then velocity at 7 sec will be:

Question



Find acceleration in each term:

$$x = 4t^2 + 6$$

$$x = 3t^2 + 4t + 6$$

$$x = 2t^3 + 5t$$

$$x = t^4 + 4t$$

$$v = 3t^2 + 4$$

$$v = 3t^2 + 4$$

$$v = t^3 + 4$$

n/w

THANK
YOU