



ARJUNA NEET BATCH



KINEMATICS

LECTURE - 03

To Days goal

- * Question on speed velocity
- * Feel of acceleration.

^{gnst} velocity \Rightarrow speed (How fast)
 (vector)
 (\vec{v})
 +
 Direction

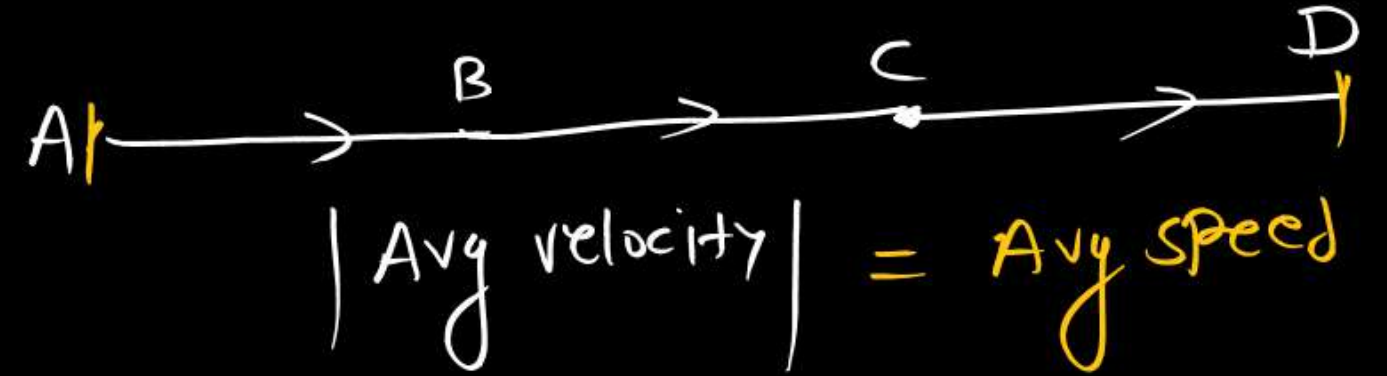
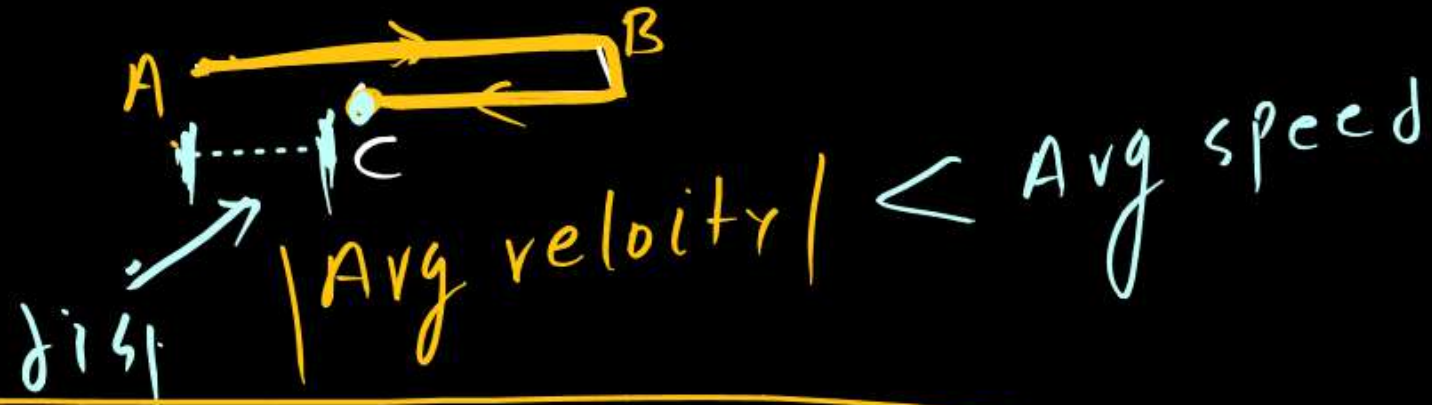
^{gnst} Speed \Rightarrow (How fast) $\Rightarrow \sqrt{\quad}$ or $|\vec{v}|$
 (No direction)

\swarrow mod of velocity
 \searrow magnitude of velocity
 \swarrow +ve or -ve direction
 ଯଦି ଗୁଣକ ଧନାତ୍ମକ ହେଉଛି ତେବେ ଯାହା ଦିଗକୁ ଯାଏ

$$|\text{Average Velocity}| = \text{Avg Speed}$$

Not always but may be equal
 ① When object is moving in 1-D without change in direction.

(two possible case)



$$|\text{Inst. Velocity}| = \text{Ins. Speed} \Rightarrow \underline{\text{always}}$$

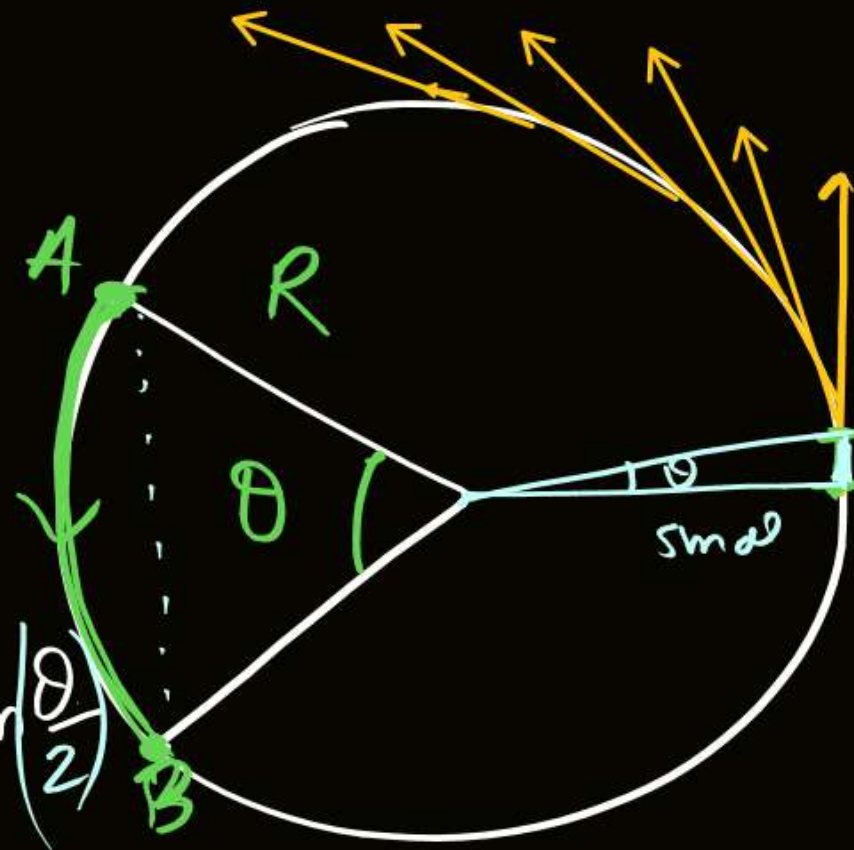
"In infinitely small time dist" and displacement will be Same

~~*~~ Change in direction is not possible at an instant in 1-D (U-turn)



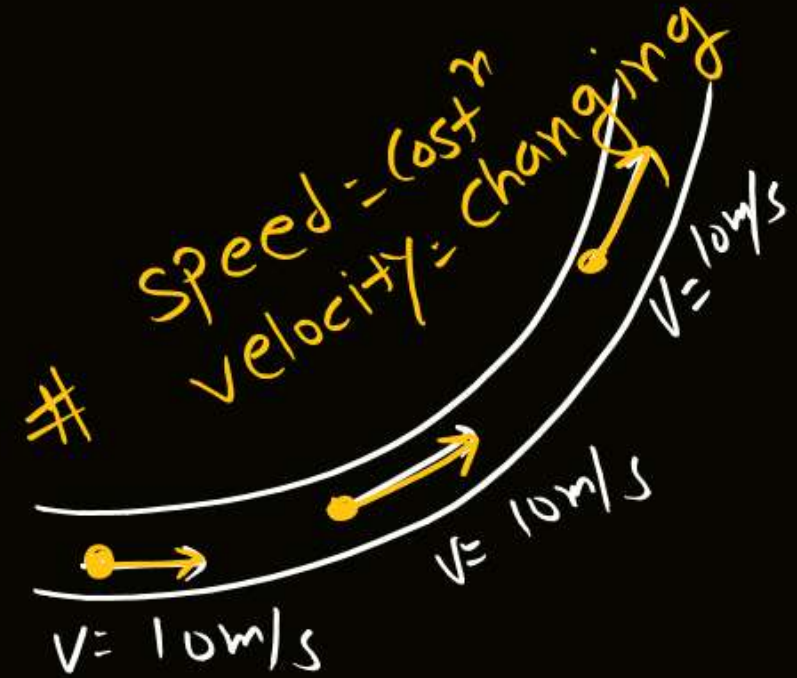
circular motion (2-D)

(distance)_{AB} = $R\theta$



$dx = \text{dist}^m$
 $= \text{dist}^m$

(displacement)_{AB} = $2R \sin\left(\frac{\theta}{2}\right)$



11 for small angle

$$\sin \theta = \theta$$

$$\sin\left(\frac{\theta}{2}\right) = \frac{\theta}{2}$$

$\Rightarrow \underline{\underline{displacement}}$

$= \cancel{2R \frac{\theta}{2}} = R\theta = \underline{\underline{distance}}$
 (at an instant θ will be very small)

A object is moving with constant velocity then what about speed ?
(Velocity = How Fast/where)

velocity = How fast / direction
 \downarrow \downarrow
 const^n const^n

velocity const^n

- must be 1-D motion without change in $\text{dir}^n(T)$
- Uniform Motion (Uniform velocity) (T)
- $|\text{Avg velocity}| = \text{Avg speed}$ if velocity is $\text{const}^n(T)$



If object is moving with constant speed then what about Velocity?



Costⁿ Speed

dirⁿ is not given

Ans \Rightarrow then velocity may be Costⁿ
or Variable



If object is moving with variable then what about Speed ?



velocity

$$\text{velocity} = \frac{\text{speed}}{\text{dir}^n}$$

If velocity is variable then Speed may
or may not variable



If object is moving with variable then what about Velocity?



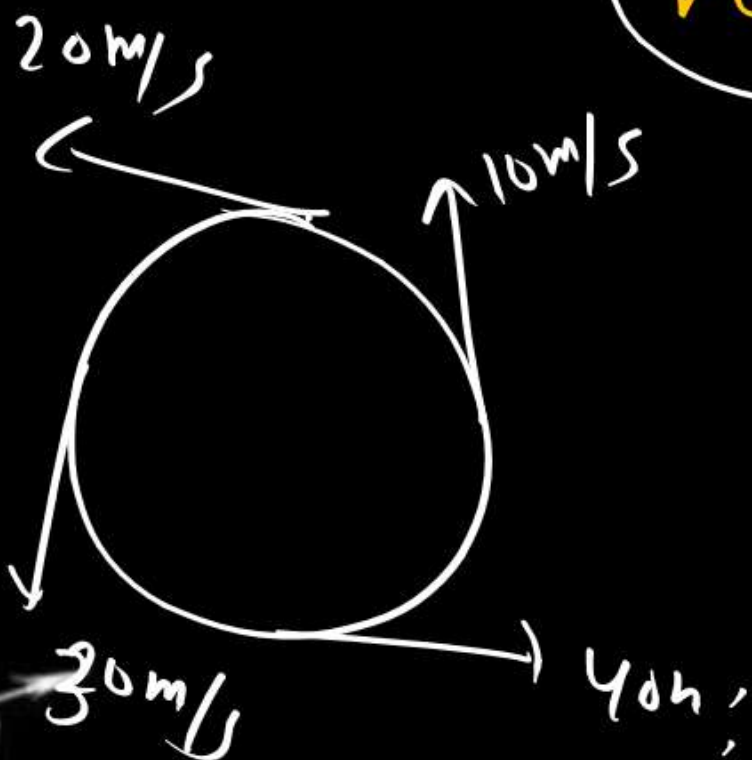
↓
speed

dirⁿ

$$\text{velocity} = \text{Speed} \times \text{dir}^n$$

↓
Variable

Must be Variable (Ans)



Object moves with speed V_1 for time t_1 and with speed V_2 for time t_2 then find Average Speed.

$$\text{Avg speed} = \frac{\text{total distance}}{\text{total time}}$$

→ always correct

$$\text{Avg speed} = \frac{x_1 + x_2}{t_1 + t_2}$$

← V_1, t_1 → ← V_2, t_2 →

$$S_{\text{Avg}} = \frac{V_1 t_1 + V_2 t_2}{t_1 + t_2}$$

distⁿ = speed × time

gf $t_1 = t_2 = t$ equal time interval

$$\text{Avg speed} = \frac{V_1 + V_2}{2}$$



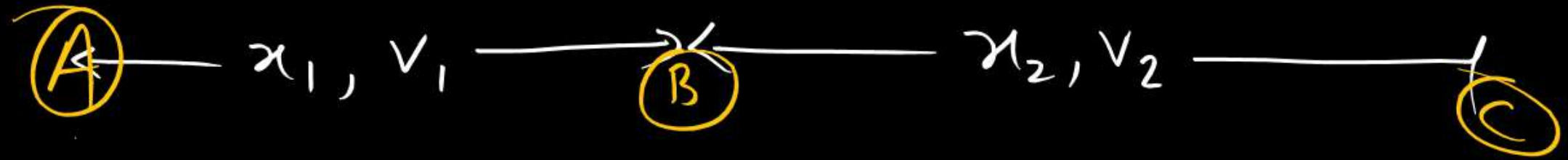


three equal time interval.

$$\text{Avg speed} = \frac{x_1 + x_2 + x_3}{t_1 + t_1 + t_1} = \frac{(v_1 + v_2 + v_3) \cancel{t_1}}{3 \cancel{t_1}}$$

$$v_{\text{Avg}} = \frac{v_1 + v_2 + v_3}{3}$$

Object moves X_1 distance with speed V_1 & X_2 distance with speed V_2 then Average Speed of the total Journey.



$$\text{Avg speed} = \frac{X_1 + X_2}{t_1 + t_2} = \frac{X_1 + X_2}{\frac{X_1}{V_1} + \frac{X_2}{V_2}}$$

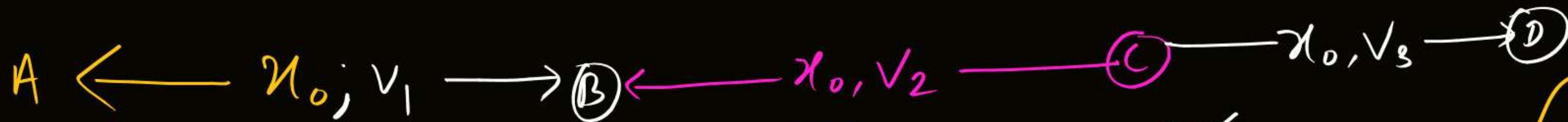
gf equal distance interval. ($X_1 = X_2 = X$)

$$\text{Avg speed} = \frac{2X}{X\left(\frac{1}{V_1} + \frac{1}{V_2}\right)} = \frac{2V_1V_2}{V_1 + V_2} \quad \#$$

$$S = \frac{\text{distance}}{\text{time}}$$

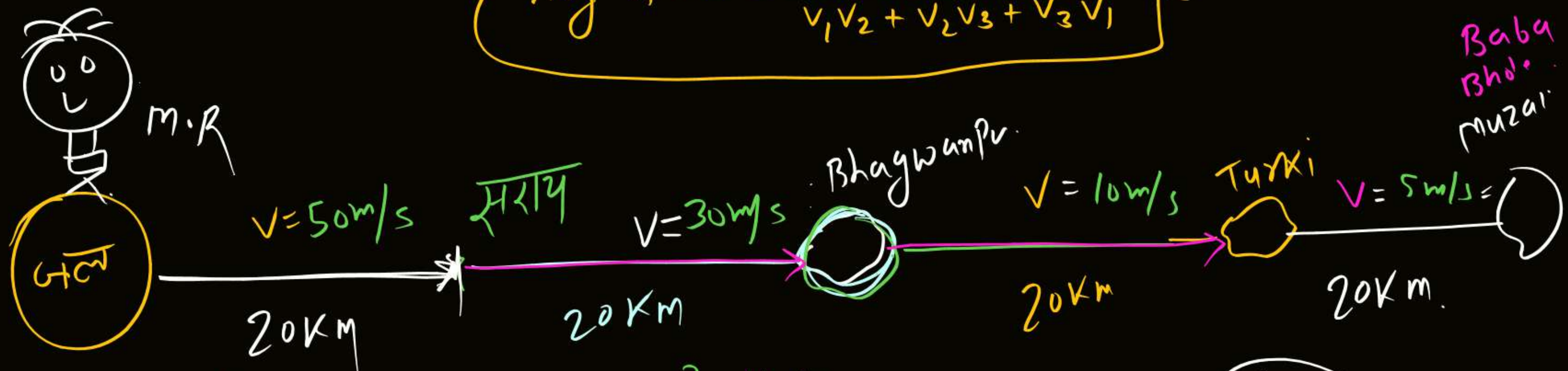
$$t = \frac{d}{S}$$





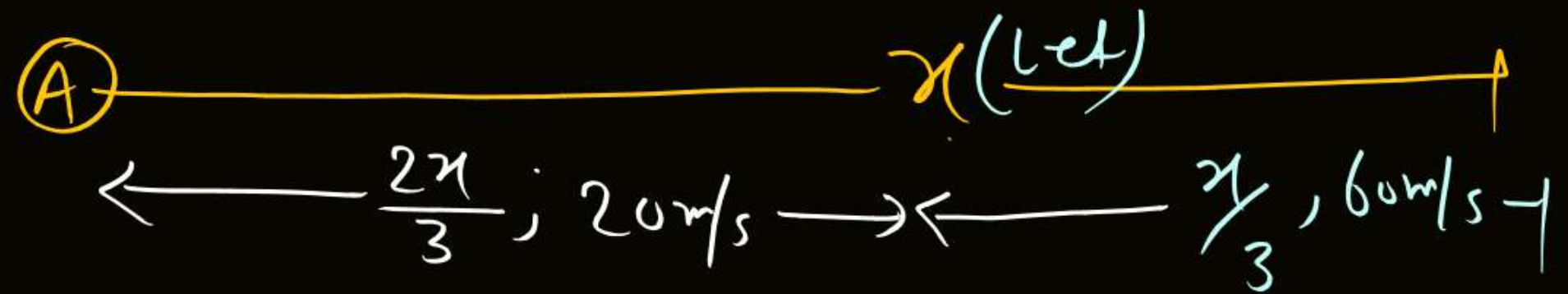
$$\text{Avg speed} = \frac{3x_0}{t_1 + t_2 + t_3} = \frac{3x_0}{\frac{x_0}{v_1} + \frac{x_0}{v_2} + \frac{x_0}{v_3}} = \frac{3}{\frac{1}{v_1} + \frac{1}{v_2} + \frac{1}{v_3}}$$

$$\text{Avg speed} = \frac{3v_1 v_2 v_3}{v_1 v_2 + v_2 v_3 + v_3 v_1}$$



$$\text{(Avg speed) M.R} = \frac{80 \text{ km}}{20 \text{ km} \left[\frac{1}{50} + \frac{1}{30} + \frac{1}{10} + \frac{1}{5} \right]} = 4$$

⑨ Ram is moving with speed 20 m/s upto $\frac{2}{3}$ rd of total journey and then it moves 60 m/s for the remaining part then find Avg speed.



$$\text{Avg speed} = \frac{x}{t_1 + t_2} = \frac{x}{\frac{2x}{3 \times 20} + \frac{x}{3 \times 60}} = \frac{1}{\left(\frac{1}{30} + \frac{1}{180}\right)}$$

$$\text{Avg spe} = \frac{1}{\frac{6+1}{180}} = \left(\frac{180}{7}\right) \text{ m/s}$$

Object is moving on circular path with constant speed then find Average Velocity when it completed half revolution.

$$\Rightarrow \text{Avg velocity} = \frac{\text{total disp}^m}{\text{total time}} = \frac{2R}{\frac{2\pi R}{v}} = \frac{2v}{\pi}$$

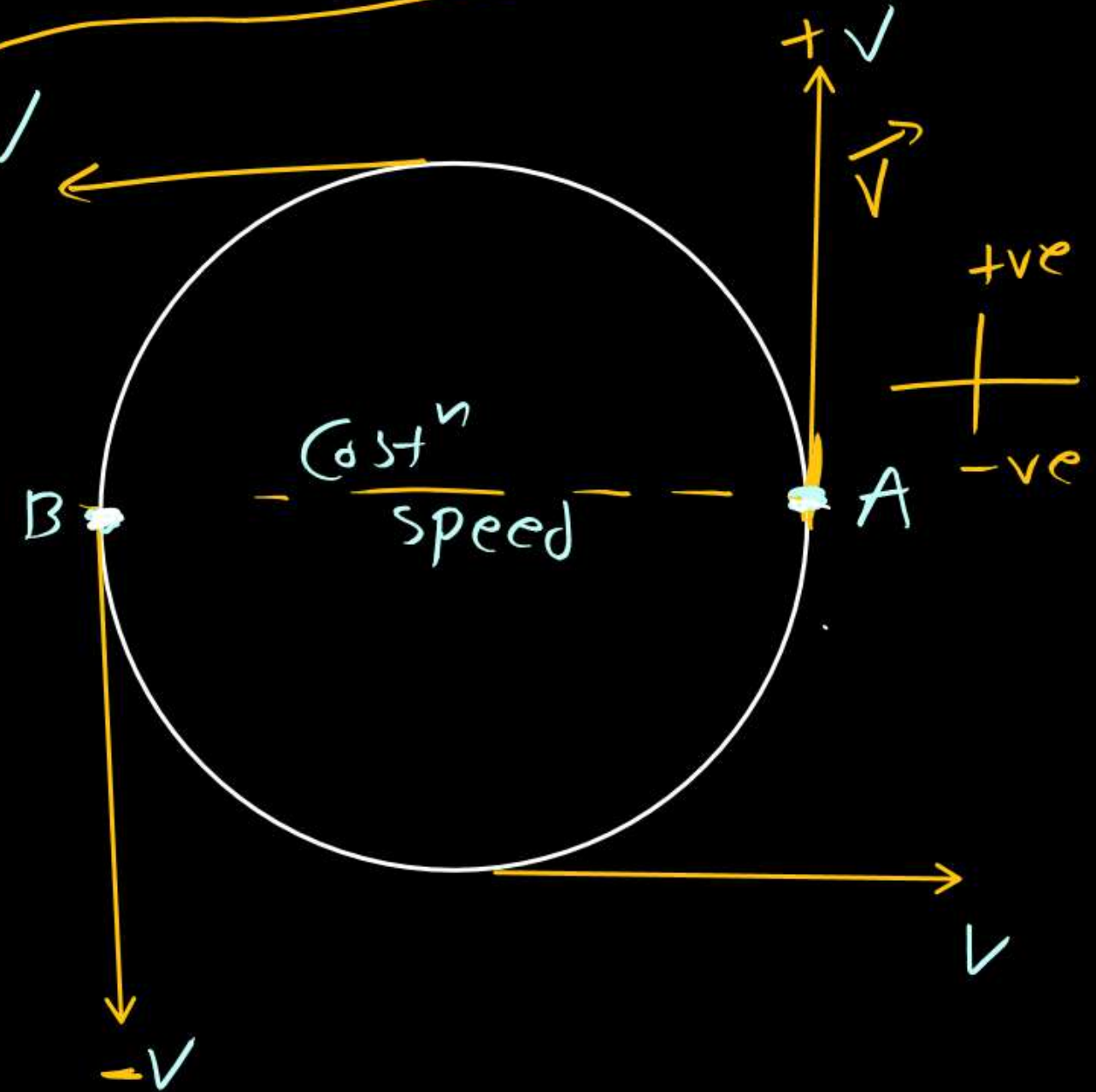
DPP

$$(\text{change in speed}) = v - v = 0$$

$$\text{Change in velocity} = \vec{v}_f - \vec{v}_i$$

$$= -v - (+v)$$

$$= -2v$$



① $\vec{V}_i \rightarrow V(\text{east})$ - - - - -

$\vec{V}_f \uparrow V(\text{North})$

$$\text{Change in velocity} = \vec{V}_f - \vec{V}_i$$

$$= V(\text{North}) - V(\text{east})$$

A $V_A = +20 \text{ m/s}$



(change in velocity)_{AB}

$$= \vec{V}_B - \vec{V}_i$$

$$= -10 - (20) = -30 \text{ m/s}$$

$V_B = -10 \text{ m/s}$

⊗ change in speed

$$= V_B - V_A$$

$$= 10 - 20 = -10 \text{ m/s}$$

A car travels from Kota to Jaipur with speed 30 km/h, and it returns along the same path with speed 60 km/h. Calculate average speed of the car.



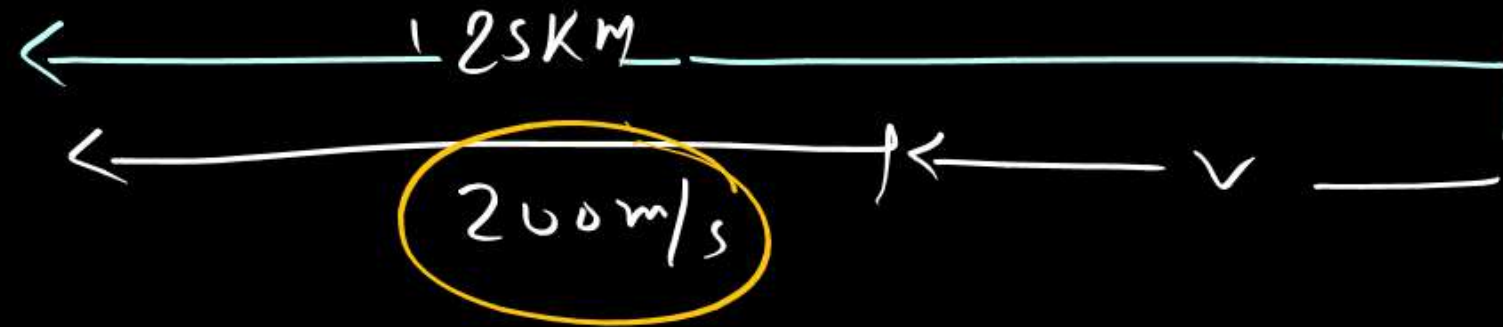
$$\text{Avg speed} = \frac{2v_1v_2}{v_1+v_2} = \frac{2 \times 30 \times 60}{30+60}$$

$$= \frac{3600}{90}$$

$$= 40 \text{ m/s}$$



A truck moves a distance of 50 km. It covers first half to the distance at speed of 200 m/s and second half at speed v . If average speed of truck is 100 m/s then value of v is



$$V_{Avg} = \frac{V_1 V_2 \times 2}{V_1 + V_2}$$

$$\cancel{100} = \frac{2 \times \cancel{200} \times V_2}{200 + V_2}$$

$$4V_2 = 200 + V_2$$

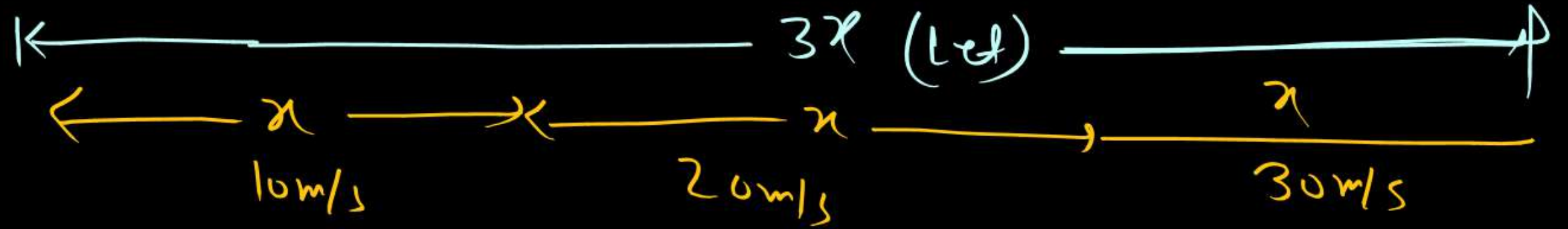
$$3V_2 = 200$$

$$V_2 = \frac{200}{3}$$



A body covers first one-third of the distance with velocity 10 ms^{-1} in same direction, the second one-third with a velocity 20 ms^{-1} and last one-third with a velocity of 30 ms^{-1} . The average velocity of body is

- (A) 17.8 ms^{-1} (B) 16.4 ms^{-1}
(C) 18.3 ms^{-1} (D) 20.2 ms^{-1}



$$\text{Avg speed} = \frac{3x}{\frac{x}{10} + \frac{x}{20} + \frac{x}{30}} = \frac{3}{\left(\frac{1}{10} + \frac{1}{20} + \frac{1}{30}\right)}$$

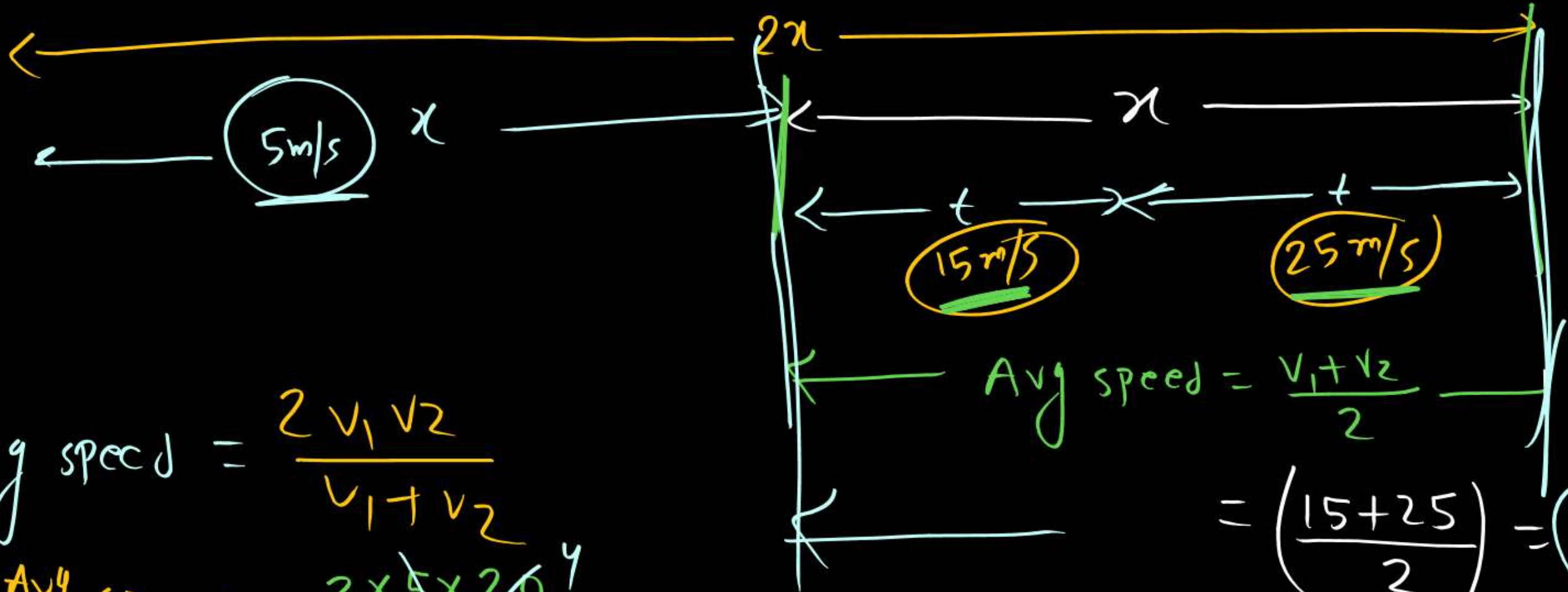


NEET



A bus travels its half distance of journey with speed 5 m/s . It covers remaining distance in two equal time intervals with speed 15 m/s . Calculate average speed of the bus for the whole journey.

8 25 m/s



$$\text{Avg speed} = \frac{2v_1v_2}{v_1 + v_2}$$

$$\text{Avg speed} = \frac{2 \times 5 \times 20}{25} = 8 \text{ m/s}$$

$$= \left(\frac{15 + 25}{2} \right) = 20 \text{ m/s}$$



Position of object $x = t^2 + 6t + 5$ then find speed / Inst. Velocity at

(1) $t = 0$

(2) $t = 1 \text{ sec}$

(3) $t = 3 \text{ sec}$

$$x(\text{Position}) = t^2 + 6t + 5$$

$$\left\{ V_{\text{inst}} = \frac{dx}{dt} \right\} = \frac{d(t^2 + 6t + 5)}{dt} = 2t + 6$$

$$V_{\text{inst}} = 2t + 6$$

$$V_{t=0} = 2 \times 0 + 6 = 6 \text{ m/s}$$

$$V_{t=1s} = 2 \times 1 + 6 = 8 \text{ m/s}$$

$$V_{t=3} = 2 \times 3 + 6 = 12 \text{ m/s}$$



ACCELERATION

The rate of change in velocity due to change in speed or change in direction or change in both is called acceleration.

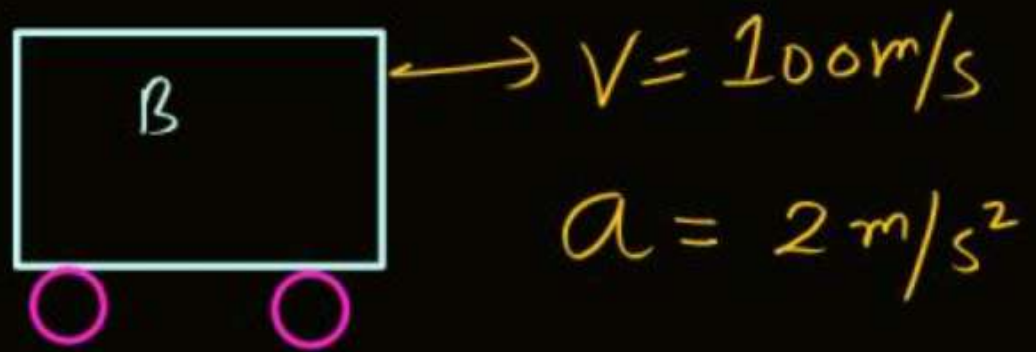
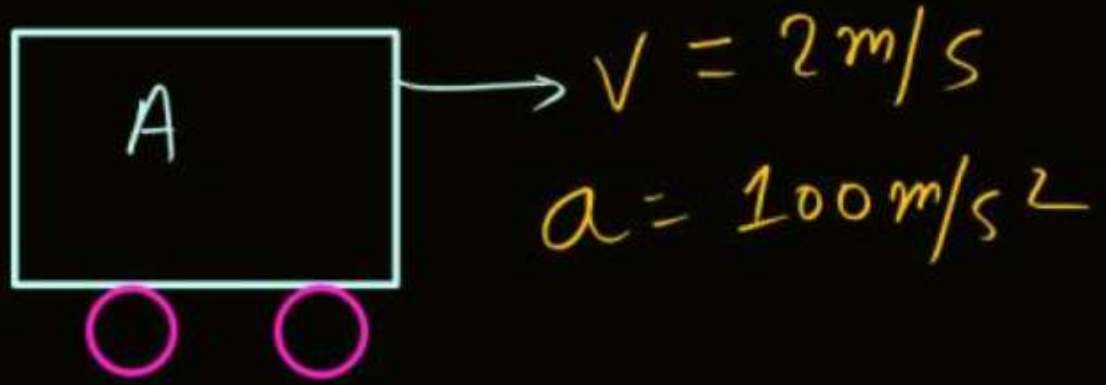
At time t'
At time t

Avg accⁿ =

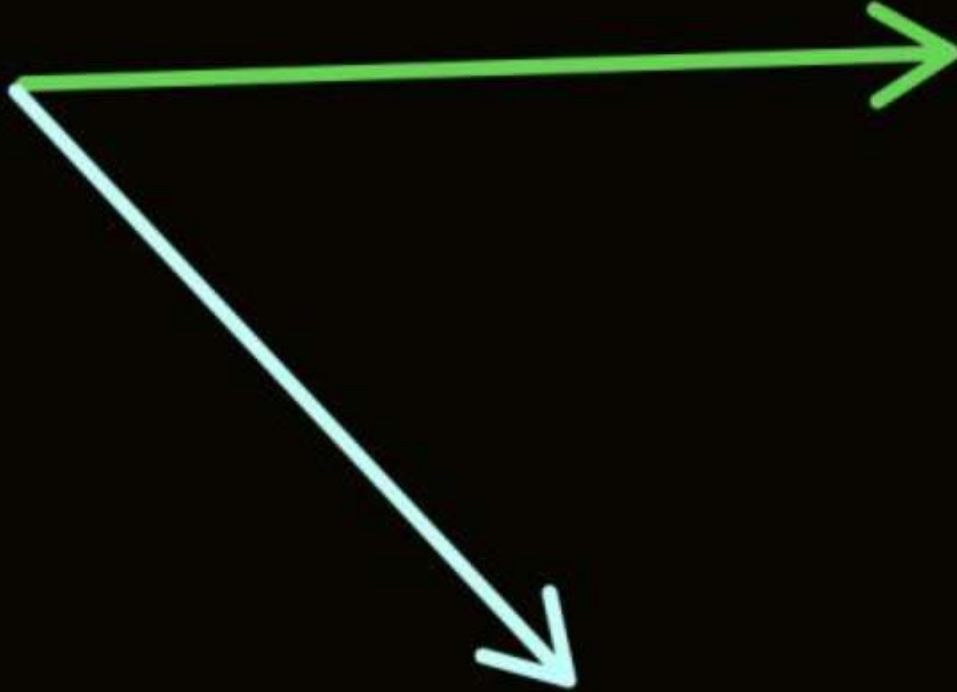
$t = 0$	$t = 1s$	$t = 2s$	$t = 3s$
● → $V = 0$	● → $V = 10m/s$	● → $V = 15m/s$	● → $V = 18$

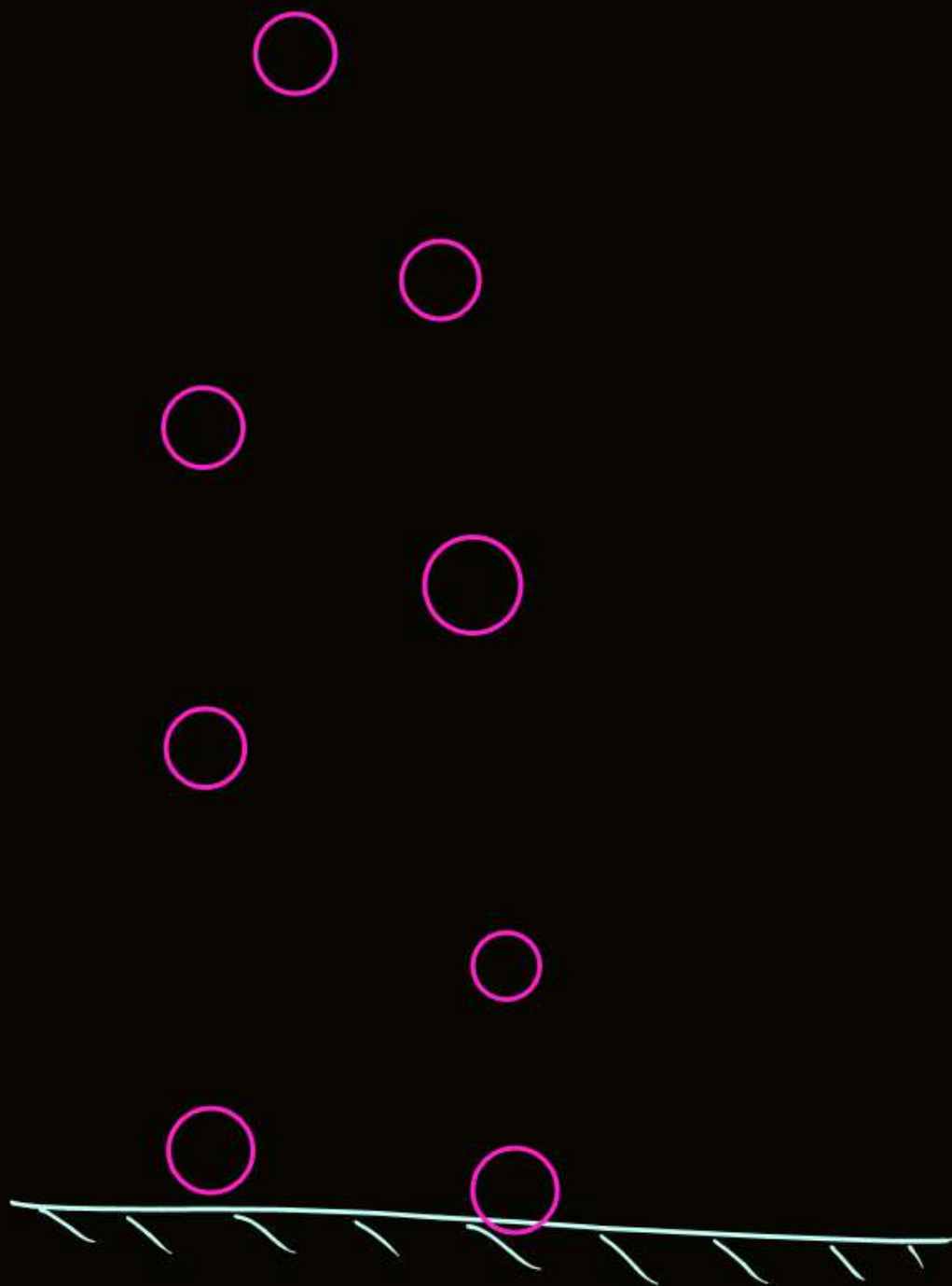


At time t'



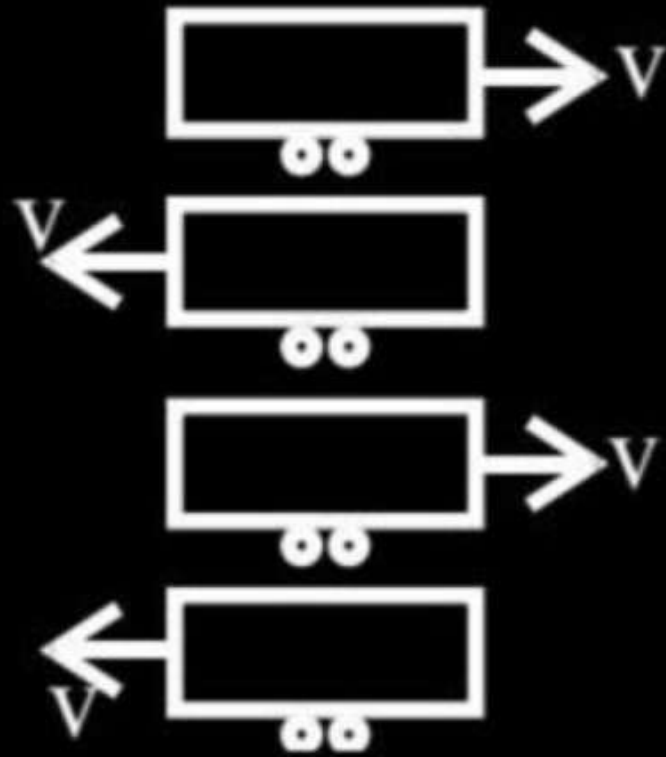






The rate of change in velocity due to change in speed or change in direction or change in both is called acceleration.

Retardation



Which of the following is may correct

(a) $a = +ve$ & $v = -ve$

(b) $a = -ve$ & $v = +ve$

(c) $a \uparrow$ & $v \downarrow$

(d) $a \downarrow$ & $v \uparrow$

(e) $a = 0$ & $v \uparrow$

(f) $v = \text{const}^n$ & $a \neq 0$

(g) $v \uparrow$ & $a = 0$

Which of the following is possible :

(a) $\vec{V} = \cos t^n$ $\vec{a} = \cos t^n$

(b) $v \uparrow$ $a = \cos t^n$

(c) $v \uparrow$ $a = 0$

(d) $v \uparrow$ $a \downarrow$

(e) $v \downarrow$ $a \uparrow$

(f) $V = \cos t^n$ $a \uparrow$

(g) $V = \cos t^n$ $a = \cos t^n$

$$\frac{d\vec{V}}{dt} =$$

$$\frac{d|\vec{V}|}{dt} =$$

$$\left| \frac{d\vec{V}}{dt} \right| =$$



κ

\vee

α

$a = 0$

$a = \text{cost}^n$

$a = \text{variable}$



*thanks
for watching*

