ARJUNA NEET BATCH

momentum
G = universal
K.E.
Angular Momentum = P × r
E = hf ×

KINEMATICS

LECTURE - 4

Today's GOAL

Feel of Acceleration

question of 1-D with variable acceleration

ACCELERATION

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

$a = \frac{15-10}{1} = 5\,m/s^2$

(in time 't') At time 't'

$$\boxed{\text{Avg acc}^n = \frac{\vec{v}_f - \vec{v}_i}{\Delta t}}$$

↳ vector

↳ direction of accⁿ along the change in velocity

$t = 0$	$t = 1s$	$t = 2s$	$t = 3s$
$V = 0$	$V = 10\,m/s$	$V = 15\,m/s$	$V = 18$

\# Continuously velocity is Increasing but accⁿ is decreasing.

$$a = \frac{v_f - v_i}{\Delta t} = \frac{10 - 0}{1 - 0}$$

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

$$a_{Avg} = \frac{18-15}{3-2} = 3\,m/s^2$$

velocity (How fast object is moving)

→ direction of velocity along motion

$v = 2\,m/s$ $\quad$ $t=0$ $\quad$ $a = 198\,m/s^2$ $\quad$ $200\,m/s$ $\quad$ $t = 1\,s$

acceleration

→ How fast velocity is changing. is called acc^n

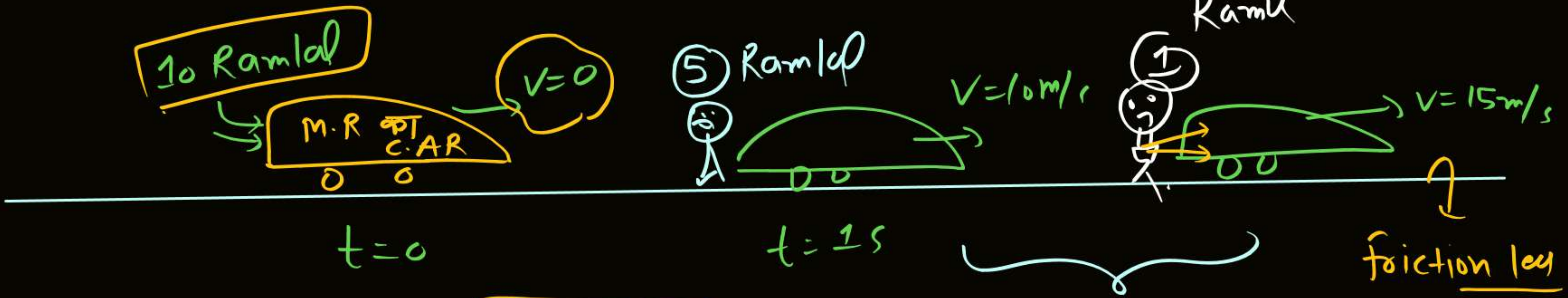
$v = 200\,m/s$ $\quad$ $201\,m/s$ $\quad$ $203\,m/s$

$t=0$ $\quad$ $t=1$ $\quad$ $t=2s$

$a = 1\,m/s^2$ $\quad$ $a = 1\,m/s^2$

$$\boxed{\vec{F} = m\vec{a}}$$ ✓

→ direction of acc^n along force



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

$\boxed{a = 5\,m/s^2}$

velocity is Increasing
and acceleratio is decreasing

At time 't'

'A'
M.R

$V = 2 m/s$

$a = 100 m/s^2$

acc^n is change in velocity per sec.

'B'
Ram lal

$V = 100 m/s$

$a = 2 m/s^2$

At time 't' CAR OF Ram lal is moving faster than M.R

after 1 sec

MR

$V = 102 m/s$

$a = 100 m/s^2$

Ram lal

$V = 102 m/s$

After 2-sec

M.R

$V = 202 m/s$

Ram lal

$104 m/$

Now CAR OF M.R is moving faster

Instantaneous acceleration

⇒ The rate of change in velocity w.r.t time is called instantaneous acc^n.

$$\lim_{\Delta t \to 0}\left(\frac{\Delta v}{\Delta t}\right) = \frac{d\vec{v}}{dt} = \frac{d\vec{v}}{dt}$$

$$\boxed{\vec{a}_{inst.} = \frac{d\vec{v}}{dt}} \rightarrow \left(\frac{dy}{dx}\right)$$

Slope of velocity-time graph is acceleration.

$$\boxed{\vec{a} = \frac{d\vec{v}}{dt}}$$

$$\left\{ \vec{v} = \frac{d\vec{x}}{dt} \right\}$$

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

$$\boxed{\vec{a} = \frac{d\vec{v}}{dt} = \frac{d^2\vec{x}}{dt^2} = v\frac{dv}{dx}}$$

$$\vec{a} = \frac{d\vec{v}}{dt} \times \left(\frac{d\vec{x}}{d\vec{x}}\right) = \frac{d\vec{v}}{d\vec{x}} \times \frac{d\vec{x}}{dt} = \boxed{\vec{v}\,\frac{d\vec{v}}{dx} = \vec{a}}$$

as it is

If $\boxed{V = 2t + 5}$
find accⁿ

$$\vec{a} = \frac{d\vec{V}}{dt} = \frac{d(2t+5)}{dt}$$

$$= 2\frac{dt}{dt} + \cancel{\frac{d5}{dt}}^{\,0}$$

$$\boxed{\vec{a} = 2}$$

Q. If velocity $\boxed{V = 2x+5}$
then find accⁿ

Soln

$$\boxed{\vec{a} = V\frac{dV}{dx}}$$

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

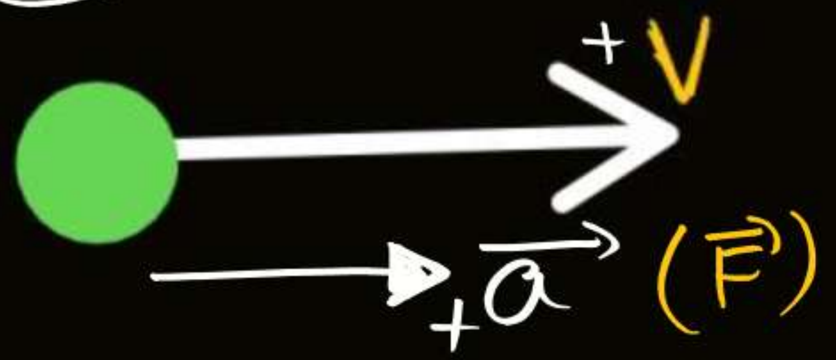
Not use

$$\vec{a} = (2x+5)\frac{d(2x+5)}{dx}$$

$$= (2x+5)\left(2\frac{dx}{dx} + \cancel{\frac{d5}{dx}}^{\,0}\right)$$

$$\vec{a} = (4x+10)\ m/s^2 = 2(2x+5)\ m/s^2$$

$\vec{F} = m\vec{a}$



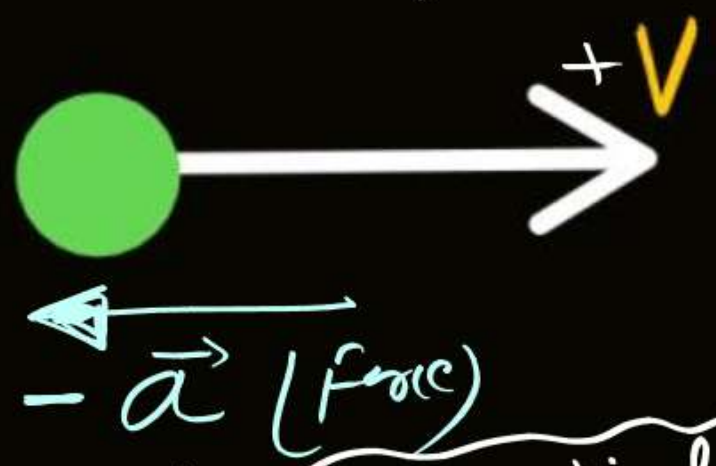
Angle b/w velocity and acc^n (0°)

then speed will [Increase]

(magnitude of velocity)

direction will not change.

-ve (0,y) +ve



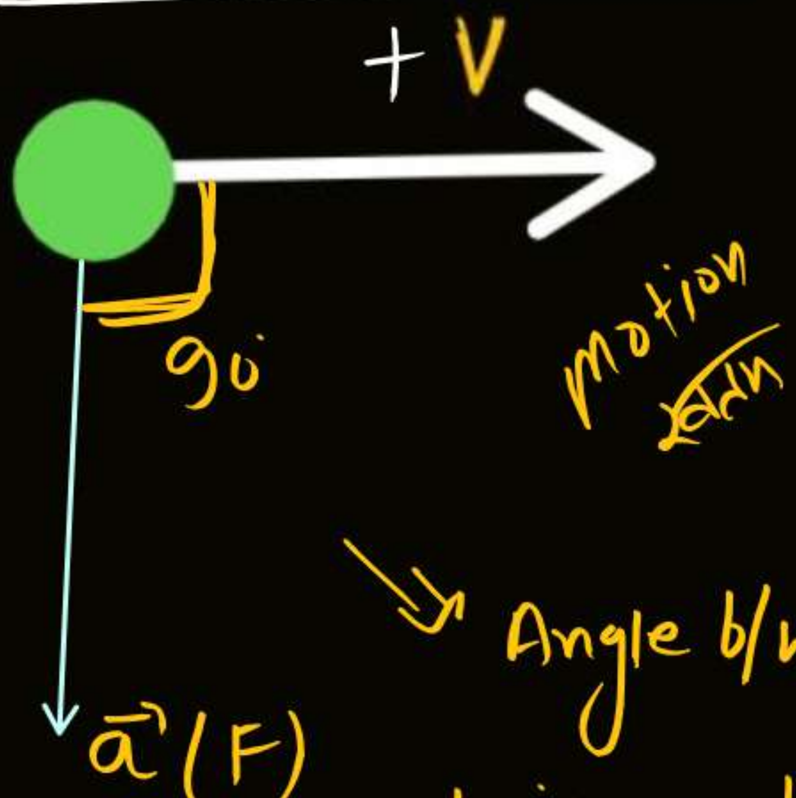
* tangential

Angle b/w velocity and acc^n is 180°

speed will decrease

direction may change after some time but at an instant direction remain same only speed will ↓

• direction will change



↘ Angle b/w velocity and acceleration is 90°

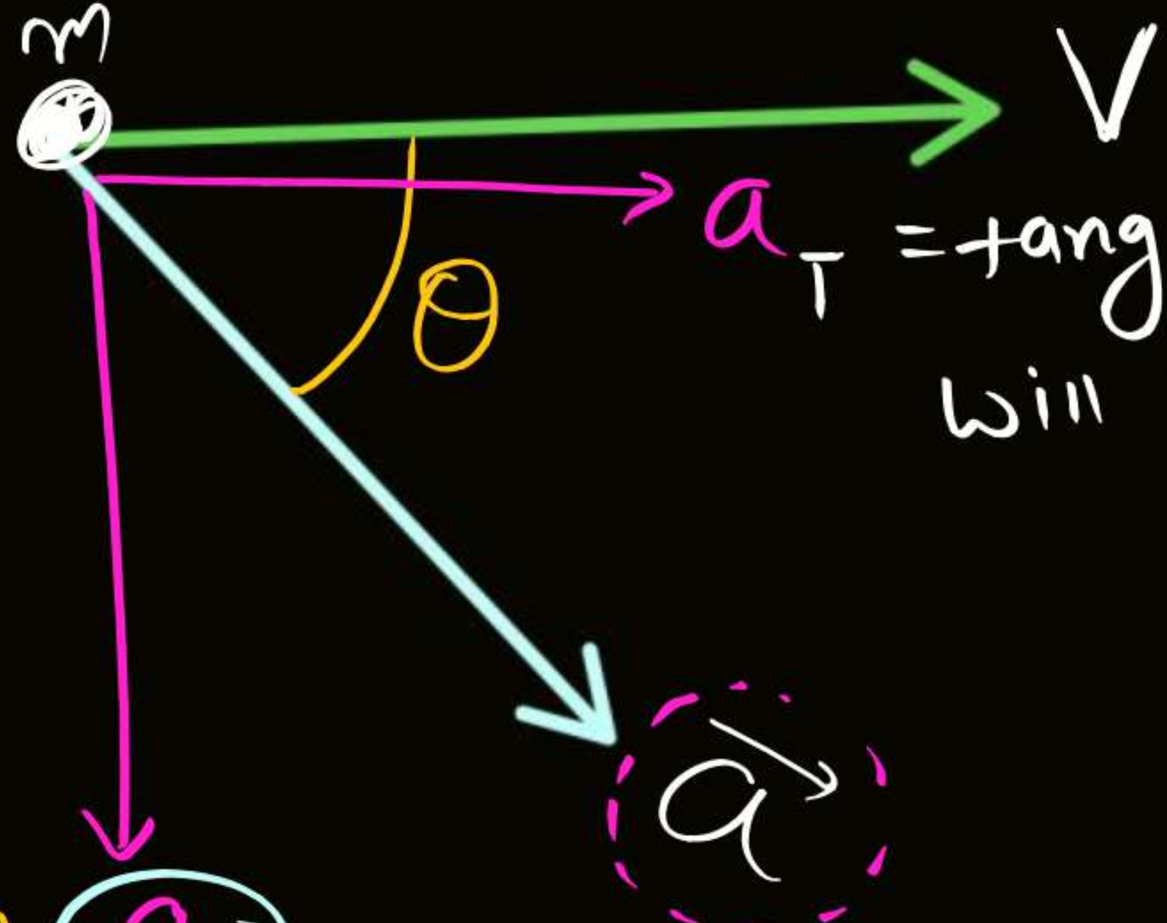
Speed at this instant const^n

$\vec{v}$ →, $\vec{a}$ → } speed ↑

$\vec{v}$ →, $\vec{a}$ ← } speed ↓

$\boxed{\text{In 1-D motion}}$

$\boxed{a_c = 0}$



a_T = tangential accⁿ will responicible to change speed.
⇒ speed ↑

\# a_c = centrepetal accⁿ
↳ accⁿ which ⊥r to the direction of motion (velocity) which is responcible to change direction.

velocity $\rightarrow$ speed / direction

Tangential ac^n

Which is responcible to Change speed

centripedal ac^n

↳ which is $\perp r$ to velocity

↳ respon to change dir^n only

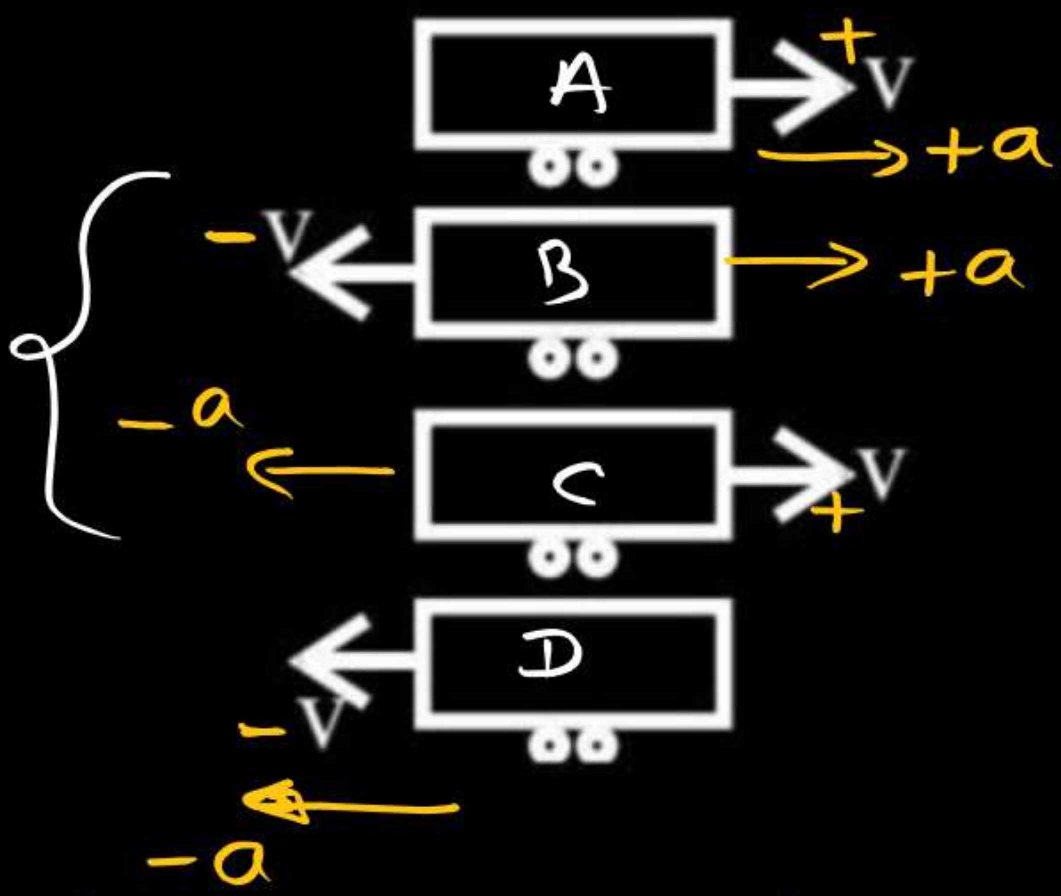
a_T (tangential ac^n) $\rightarrow$ always $\parallel r$ or anti-Parallel to the velocity

$-ve \longleftarrow \longrightarrow +ve$

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

Retardation

~~-ve acc^n is retardation~~



- A $\Rightarrow$ speed $\uparrow$
- B $\Rightarrow$ speed $\downarrow$
- C $\Rightarrow$ speed $\downarrow$
- D $\Rightarrow$ speed $\uparrow$

B and C: retardation

retardation (To slow down) speed decreasing $\Rightarrow$ retardation in (B) & (C)

↳ retardation due to +ve or -ve acc^n; -ve acc^n does not mean retardation.

Q Which of the following is may correct.

(a) $\boxed{a = +ve}$ & $\boxed{v = -ve}$

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

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

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

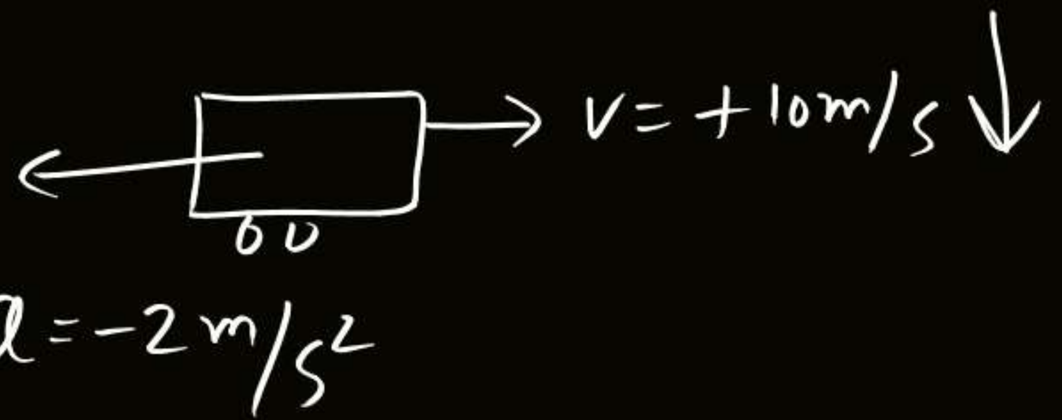
(e) $\boxed{a = 0 \quad \& \quad v \uparrow}$ $\Rightarrow$

↳ change in velocity $= 0$

$V =$ must const^n.

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

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



Which of the following is possible : (may correct)

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

(b) $V\uparrow$ & $a = \cos t^n$ → Ex If $a = 5m/s^2 = \underline{\underline{\cos t^n}}$

(c) $V\uparrow$ & $a = 0$

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

(e) $V\downarrow$ & $a\uparrow$

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

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

$\boxed{\text{Tangential acc}^n \text{ does not mean magnitude of acc}^n}$

$\vec{a} = \dfrac{d\vec{V}}{dt}$ = The Rate of chang in $\overset{\text{velocity}}{\boxed{\vec{v}}}$ w.r.t. time = acc^n

$\vec{a}_T = \dfrac{d|\vec{V}|}{dt}$ = The Rate of chang in $\underset{\text{speed}}{\boxed{|\vec{v}|}}$ w.r.t. time = Tangential acc^n

$|\vec{a}| = \left|\dfrac{d\vec{V}}{dt}\right|$ = magnitude of acc^n

$|\vec{a}| = \left|\text{diff of veloci}\right|$

Constant acceleration

→ Uniform acc^n (fixed acc^n)

Ex = $\boxed{a = 2\,m/s^2}$

$a = 2t\ m/s^2$

→ variable acc^n

$\boxed{a = 5x^2}$

Q: If Position $\boxed{x = t^2 + 6t}$ then find acc^n.

Sol^n

$$V = \frac{dx}{dt} = 2t^1 + 6$$

$$\boxed{a = \frac{dV}{dt} = 2\ m/s^2}$$

→ Const^n acc^n

Q) If Position $\boxed{x = t^3}$ then find accⁿ.

$\Rightarrow V = \frac{dx}{dt} = \frac{dt^3}{dt} = 3t^2$

$$\boxed{a = \frac{dv}{dt} = 3\frac{dt^2}{dt} = 6t} \rightarrow \text{varible}$$

Q) If velocity $\boxed{V = K\sqrt{x}}$ then find acceleration

$a = \frac{dv}{dt}$ not use

$a = v\frac{dv}{dx}$ use

$$= K\sqrt{x}\,\frac{d(K\sqrt{x})}{dx} = K^2\sqrt{x}\left(\frac{K^{\frac{1}{2}-1}}{2}\right)$$

$$= \frac{K^2 \cancel{\sqrt{x}}}{2\cancel{\sqrt{x}}} = \frac{K^2}{2} = \text{Cost}^n$$

$$v = kx$$

$$a = v\frac{dv}{dx}$$

$$= kx\frac{d(kx)}{dx}$$

$$\boxed{a = k^2 x}$$

Varibls

(Position) $x = t^2$

(velocity) $V = t^1$

(velocity) $V = \sqrt{x}$

acc^n cost^n

Ratta

MR*

Q In which case acceleration is constant

(1) $x = t^3 + 2t$

(2) $x = \frac{1}{t^2} = t^{-2}$

(3) $x = t^2 + 6$

(4) $x = t + 1$ $(a=0)$

(5) $x = A\sin(t)$

(6) $x = e^t$

(7) $V = 2t$

(8) $V = 2t^2$

(9) $V = 3\sqrt{t}$

(10) $V = \frac{3}{t}$

(11) $x = \frac{1}{t^2}$

(12) $V = \sin(t)$

(13) $V = Kx$

(14) $V = Kx^2$

(15) $V = K\sqrt{x}$

(16) $V = Kx^3$

(17) $V = \sin(Kx)$

(18) $a = Kx$

(19) $a = 2t$

(20) $a = \sqrt{x}$

(21) $a = 5\,m/s^2$

(22) $a = Kt^2$

$\vec{x}$ (Position) $\qquad \vec{v}$ (velocity) $\qquad \vec{a}$ (acc^n)

diff^n $\vec{v} = \frac{d\vec{x}}{dt}$

$\vec{a} = \frac{d\vec{v}}{dt}$

$a = \vec{v}\frac{d\vec{v}}{dx}$

DPP-3

DPP-4 $\rightarrow$ solve नहीं करना

$a = 0$	$a = \text{Cost}^n$	$a = \text{variable}$

Object is moving such that its position given as a function of time

$$x = \alpha t^2 + \beta t + \gamma$$

then find initial velocity, initial acceleration and initial position.

Object is moving with velocity $V = 4t^2 + 2t + 4$ then find velocity and acceleration at $t = 1$ sec.

If $V = kx$ then find acceleration at $x = 2$m.

If Position of object $x = t^2 - 4t + 5$ then find instant when velocity becomes zero and displacement when object comes to at rest.

If velocity of object $V = 3t^2$ then find distance in 2 sec.

Velocity of object $V = \beta x^{2n}$ then find acceleration.

The position of a particle moving along X-axis in given by $x = 10t - 2t^2$. Then the time (t) at which it will momently come to rest is

(a) 0

(b) 2.5 s

(c) 55

(d) 10 s

If the displacement of a particle varies with time as $\sqrt{x} = t + 7$, then

(a) Velocity of the particle is inversely proportional t

(b) Velocity of the particle is proportional to t^2

(c) Velocity of the particle is proportional to $\sqrt{t}$

(d) The particle moves with constant acceleration

The initial velocity of a particle is u (at $t = 0$) and the acceleration a is given by $\alpha t^{3/2}$. Which of the following relations is valid?

(a) $v = u + \alpha t^{3/2}$

(b) $v = u + \frac{3\alpha t^3}{2}$

(c) $v = u + \frac{2}{5}\alpha t^{5/2}$

(d) $v = u + \alpha t^{5/2}$

The position x of particle moving along x-axis varies with time t as $x = A \sin(\omega t)$ where A and w are 127 positive constants. The acceleration a of particle varies with its position (x) as

(a) $a = Ax$

(b) $a = -\omega^2 x$

(c) $a = A\omega x$

(d) $a = \omega^2 x A$

A particle moves in a straight line and its position x at time t is given by $x^2 = 2 + t$. Its acceleration is given by

(a) $\frac{-2}{x^3}$

(b) $-\frac{1}{4x^3}$

(c) $-\frac{1}{4x^2}$

(d) $\frac{1}{x^2}$

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A body is moving with variable acceleration (a) along a straight line. The average acceleration of body in time interval t_1 to t_2 is

(a) $\frac{a[t_2 + t_1]}{2}$

(b) $\frac{a[t_2 - t_1]}{2}$

(c) $\frac{\int_{t_1}^{t_2} a\,dt}{t_2 + t_1}$

(d) $\frac{\int_{t_1}^{t_2} a\,dt}{t_2 - t_1}$

ARJUNA

A particle of unit mass undergoes one-dimensional motion such that its velocity varies according to $v(x) = bx^{-2n}$, where b and n are constants and x is the position of the particle. The acceleration of the particle as a function of x, is given by [AIPMT-2015]

(a) $-2n\beta^2 e^{-4n+1}$

(b) $-2n\beta^2 x^{-2n-1}$

(c) $-2n\beta^2 x^{-4n-1}$

(d) $-2\beta^2 x^{-2n+1}$

A stone falls freely under gravity. It covers distances h_1, h_2 and h_3 in the first 5 seconds, the next 5 seconds and the next 5 seconds respectively. The relation between h_1, h_2 and h_3 is [2013]

(a) $h_1 = 2h_2 = 3h_3$

(b) $h_1 = \frac{h_2}{3} = \frac{h_3}{5}$

(c) $h_2 = 3h_1$ and $h_3 = 3h_2$

(d) $h_1 = h_2 = h_3$

A particle moving along x-axis has acceleration f, at time t, given $f = f_0 \left(1 - \frac{t}{T}\right)$, Where f_0 and T are constants. The particle at $t = 0$ has zero velocity. At the instant when $f = 0$, the particle's velocity is

(a) $\frac{1}{2} f_0 T$

(b) $f_0 T$

(c) $\frac{1}{2} f_0 T^2$

(d) $f_0 T^2$

[AIPMT (Prelims)-2007]

The position x of a particle varies with time, (t) as $x = at^2 - bt^3$. The acceleration will be zero at time t equal to

(a) $\frac{a}{3b}$

(b) zero

(c) $\frac{2a}{3b}$

(d) $\frac{a}{b}$

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

(a) $10\ m/s^2$

(b) $32\ m/s^2$

(c) $23\ m/s^2$

(d) $16\ m/s^2$

A particle moves along a straight line such that its displacement at any time t is given by $s = (t^3 - 6t^2 - 3t + 4)$ metres. The velocity when the acceleration is zero is

(a) 3 m/s

(b) 42 m/s

(c) – 9 m/s

(d) – 15 m/s

The initial velocity of a particle moving along x-axis is u (at $t = 0$ and $x = 0$) and its acceleration a is given by $a = kx$. Which of the following equation is correct between its velocity (v) and position (x)?

(a) $v^2 - u^2 = 2kx$

(b) $v^2 = u^2 + 2kx^2$

(c) $v^2 = u^2 + kx^2$

(d) $v^2 + u^2 = 2kx$

The velocity of a body depends on time according to the equation $v = \frac{t^2}{10} + 20$. The body is undergoing

(a) Uniform acceleration

(b) Uniform retardation

(c) Non-uniform acceleration

(d) Zero acceleration

A body starts from origin and moves along x-axis so that its position at any instant is $x = 4t^2 - 12t$ where t is in second and v in m/s. What is the acceleration of particle?

(a) $4\ m/s^2$

(b) $8\ m/s^2$

(c) $24\ m/s^2$

(d) $0\ m/s^2$

NEET

THANK YOU ☺