YAKEEN NEET 2.0

2026

Circular Motion

PHYSICS | Lecture 02

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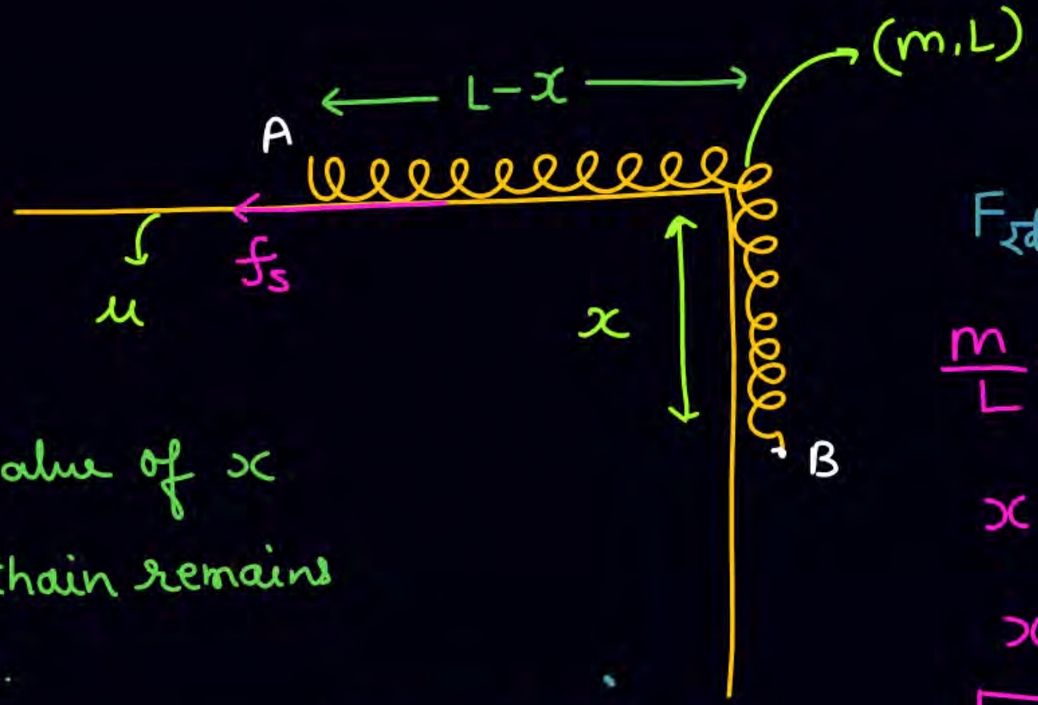
Topics to be covered

1. Circular Motion(part 2)
2.
3.
4.
5.

Q



find max value of x

So that chain remains at rest.

$F_{\text{खींचने}} = F_{\text{रोकने}}$

$\frac{m}{L} x g = \mu \frac{m}{L}(L-x) g$

$x = \mu(L-x)$

$x = \mu L - x\mu$

$$\boxed{x = \frac{\mu L}{\mu+1}}$$

$L \longrightarrow m$

$1 \longrightarrow \frac{m}{L}$

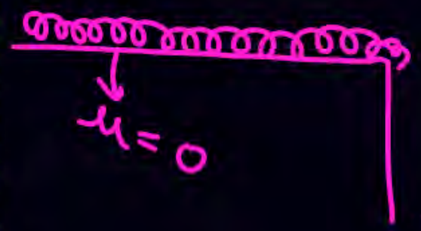
$x \longrightarrow \frac{m}{L} x$

$L-x \longrightarrow \frac{m}{L}(L-x)$

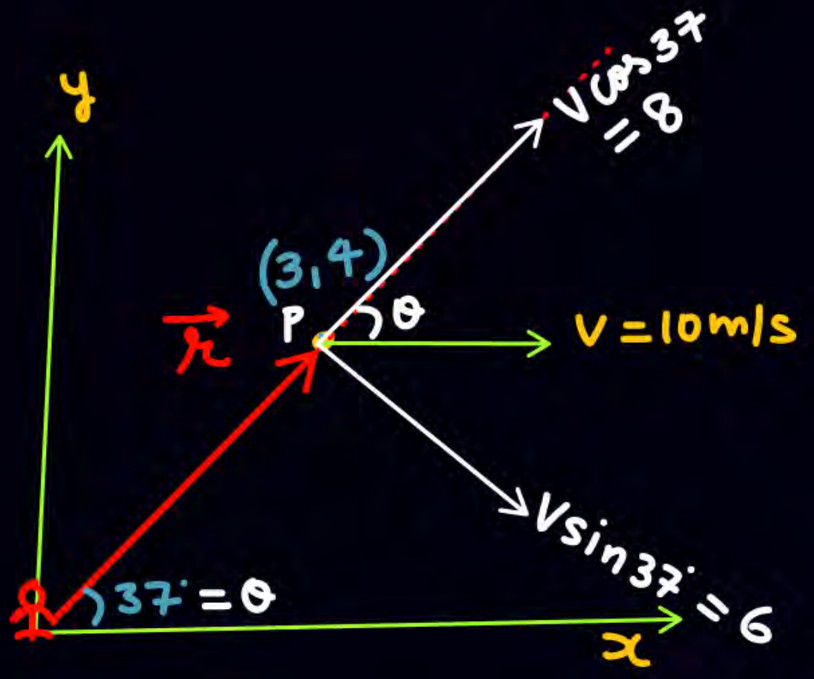
(b)

If chain is slightly displaced s.t. it start moving find the speed of end A when it just comes to in air (take $\mu = 0$)

hint ≡ WET or COM



Q



$\vec{r} = 3\hat{i} + 4\hat{j}$

$(\omega_p)_{\text{origin}} = \frac{V\sin\theta}{r} = \frac{6}{5}$ (cw)

Rate of change of separation from origin $= V\cos\theta = 8$

$\frac{d|\vec{r}|}{dt} = V\cos\theta = 8 =$ Rate of change of sep^{r}

$\vec{r} \longrightarrow$ P.V.

$\frac{d\vec{r}}{dt} =$ Velocity $= 10\hat{i}$

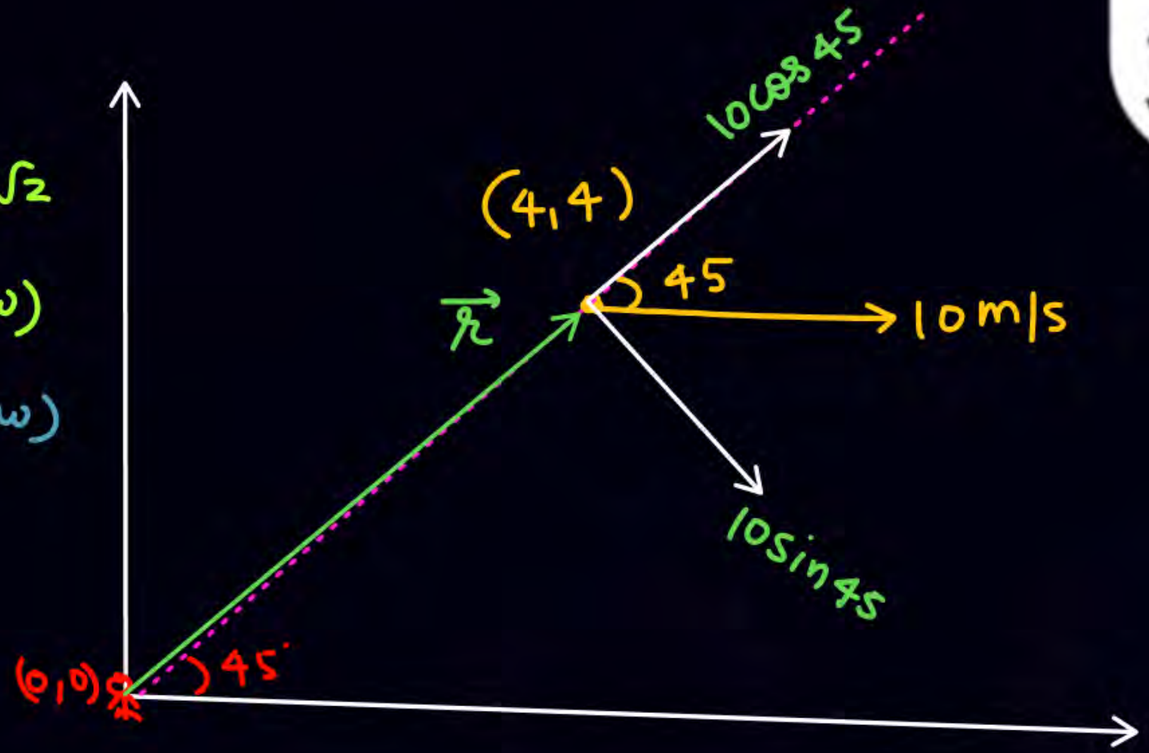
$\left|\frac{d\vec{r}}{dt}\right| =$ speed $= 10$

Q $(\omega_P)_{\text{wrt origin}} = \frac{10\sin 45^\circ}{r} = \frac{10}{\sqrt{2}\times 4\sqrt{2}}$

$= \frac{5}{4}(\text{cw})$

$= 1.25(\text{cw})$

Rate of change of sep^n from origin $= 10\cos 45 = \frac{10}{\sqrt{2}}$



Q

$(\omega_P)_{wrt\ 's'} = ?$ (In terms of d)

Rate of change of sep^{n} from 's'

$\Rightarrow$

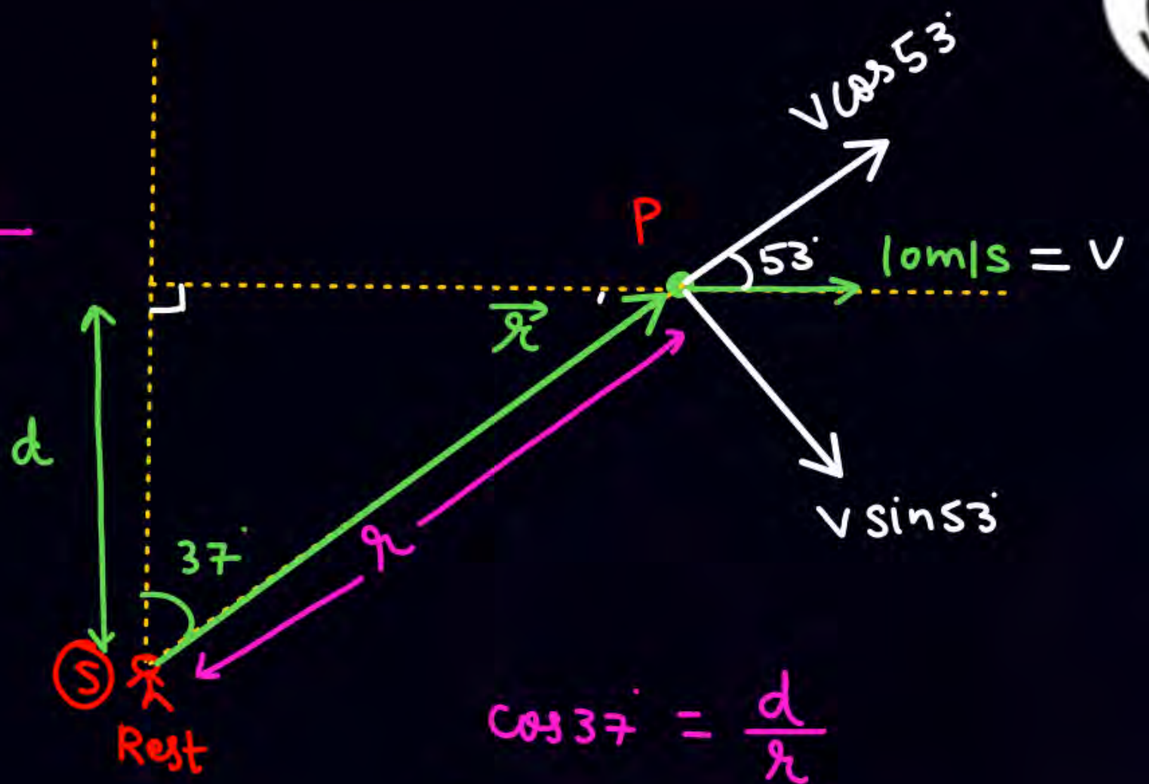
Q

$$(\omega_P)_{\text{wrt 's'}} = \frac{V\sin 53^\circ}{r} = \frac{V(4/5)}{\left(\frac{5d}{4}\right)} = \frac{160}{25d} = \frac{32}{5d}$$

Rate of change of sep^n from 's'

$$= V\cos 53 = 10 \times \frac{3}{5} = 6$$

$\Rightarrow$



$$\cos 37^\circ = \frac{d}{r}$$

$$r = \frac{d}{\cos 37} = \frac{5d}{4}$$

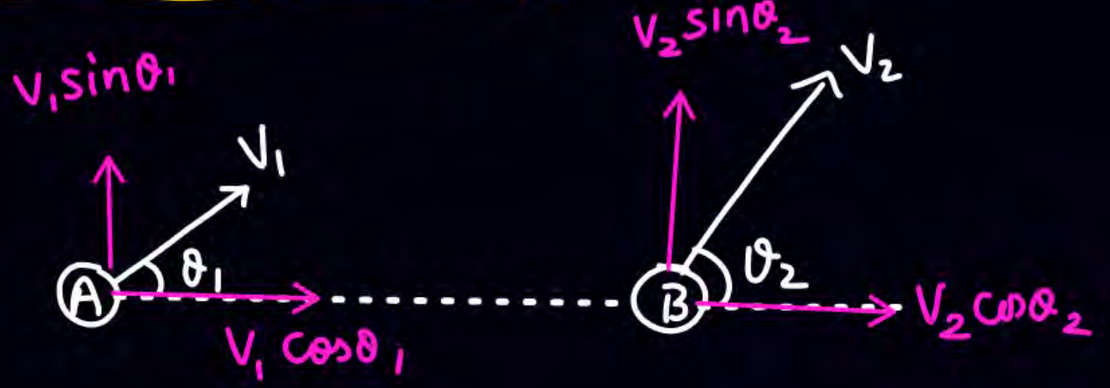
$w_{A|B}$ or $w_{B|A}$ when both particle are moving.

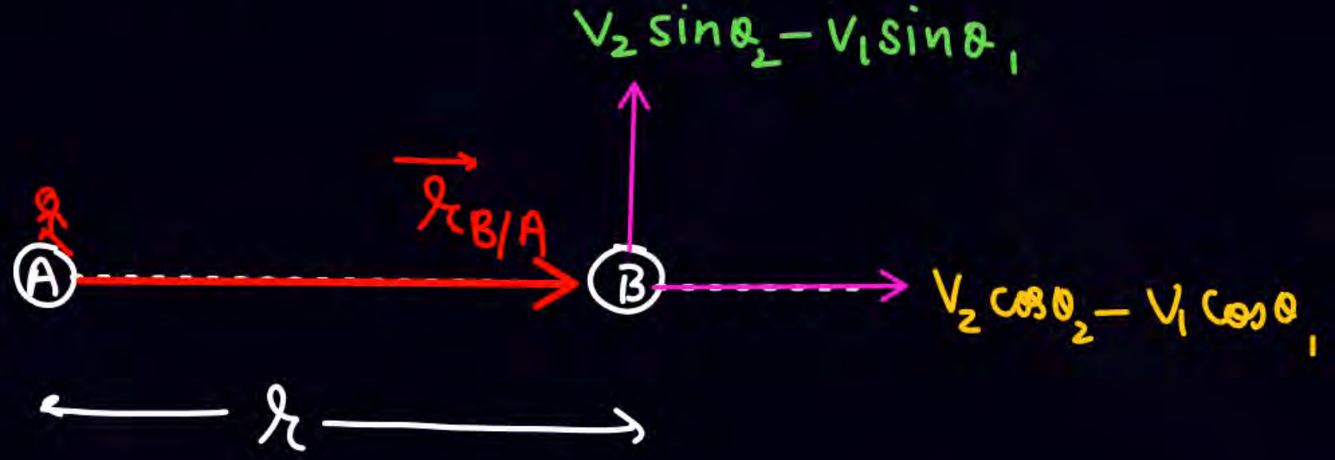
$w_{B|A} = ?$

(A की खोपड़ी पर बैठकर B को ताड़ रहे हैं)

$$w_{B|A} = \frac{V_2 \sin\theta_2 - V_1 \sin\theta_1}{r}$$

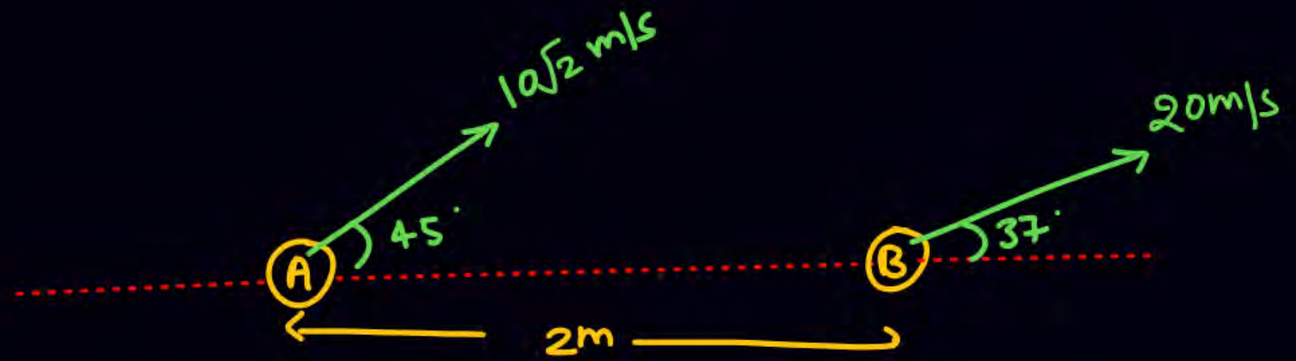
Rate of change of sep^{r} $= V_2\cos\theta_2 - V_1\cos\theta_1$





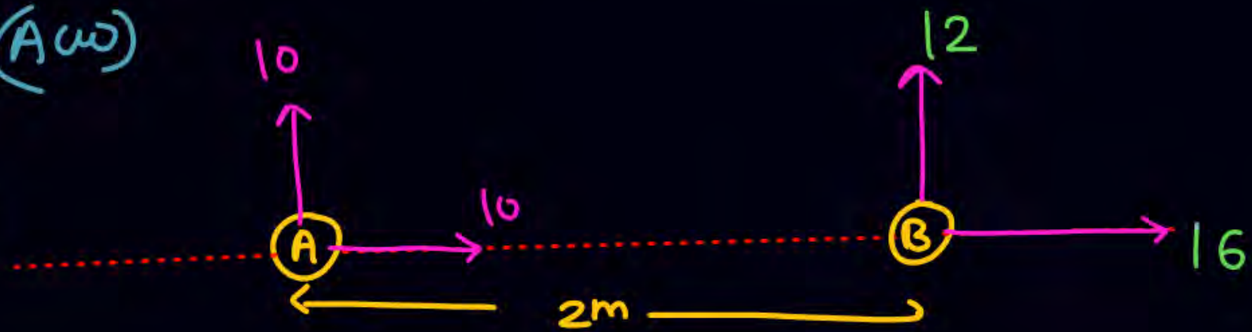
Q

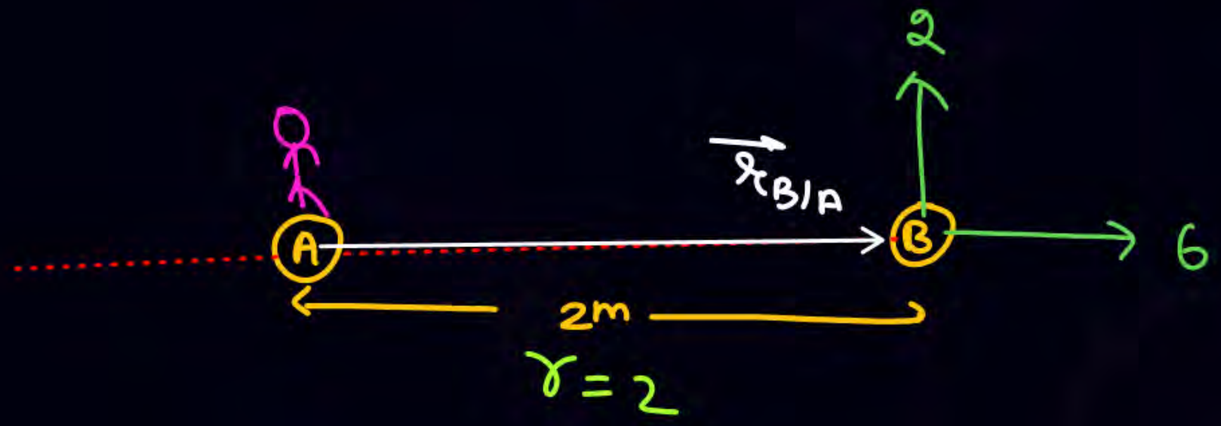
$\omega_{B/A} = ?$



$$\omega_{B/A} = \frac{2}{2} = 1 \text{ rad/sec} \quad (A\omega)$$

Rate of change of sep^{r} = +6





$r = 2$

SKC ① A ko B se st. line se connect kar lo

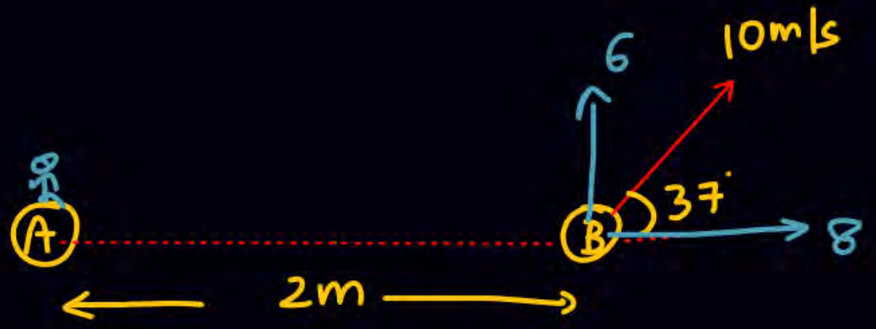
② V_A, V_B ko tod lo..... line ki taraf & line ke perpendicular.

③ $\omega_{B/A} \Rightarrow$

$\omega_{B/A} =$ ✓

④ $\omega_{B/A} = \frac{(V_{rel})\ \text{चुनो}}{r}$

①



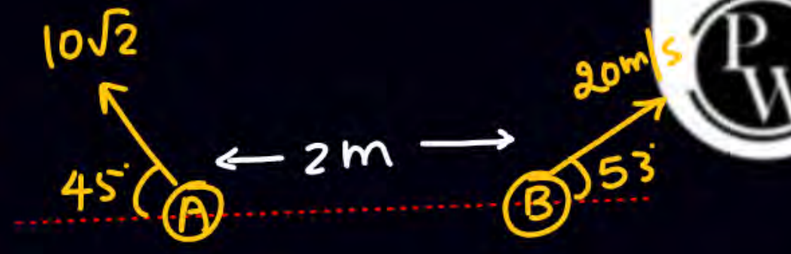
$\omega_{B|A} = \frac{6}{2} = 3$ (A(w)

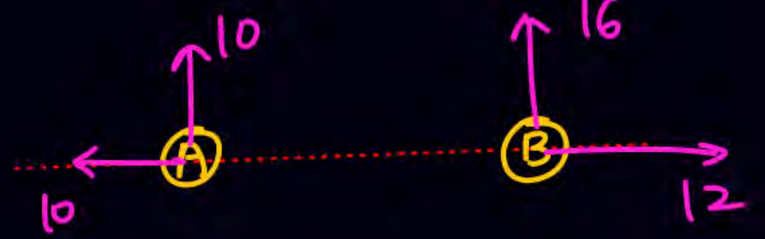
Rate of chage of sep^{n} = 8

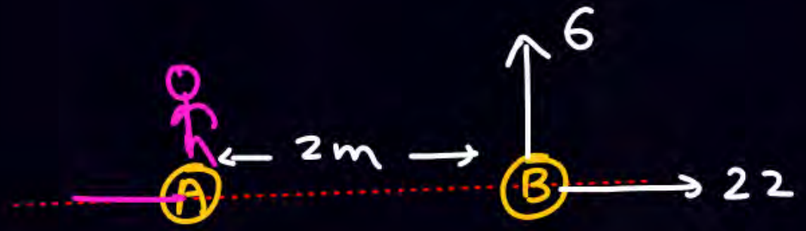
②

$\omega_{B/A} = \frac{1}{2}$ (A(w)

③



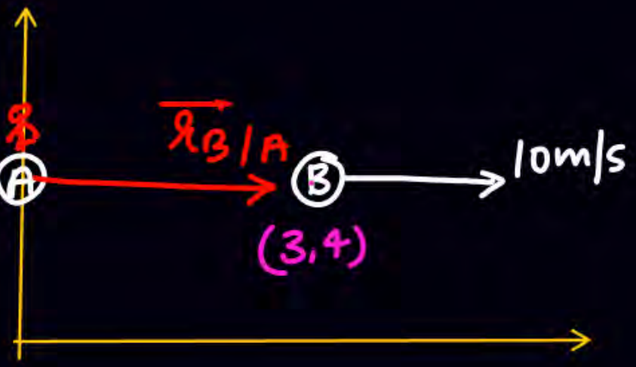




$\omega_{B/A} = \frac{6}{2} = 3$ (A(w)

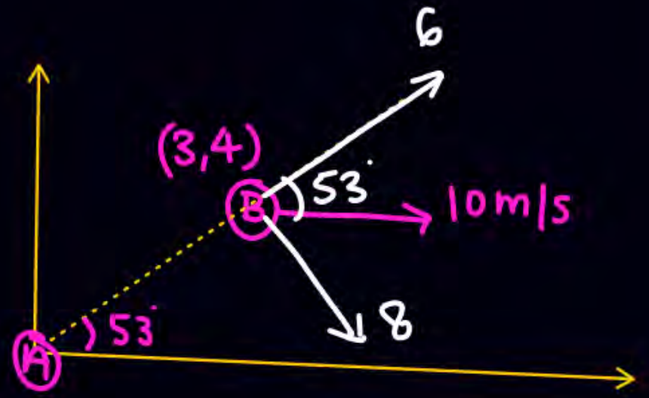
Rate of chage of sep^{n} = 22

④ Rest



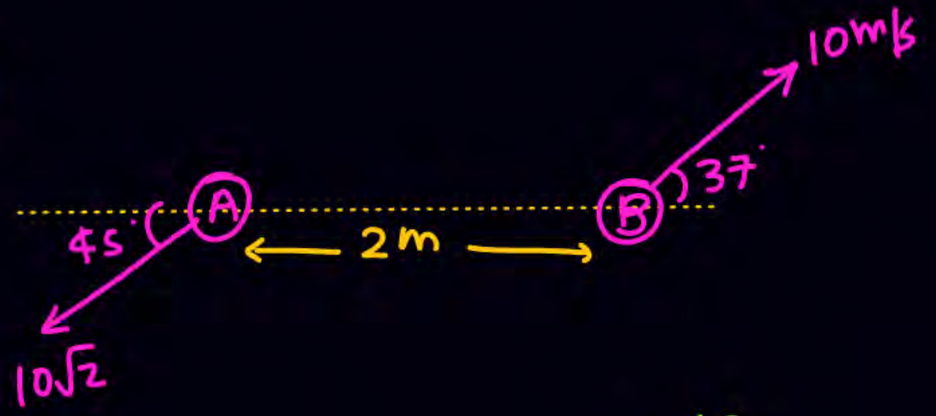
$\omega_{B/A} = 0$

⑤

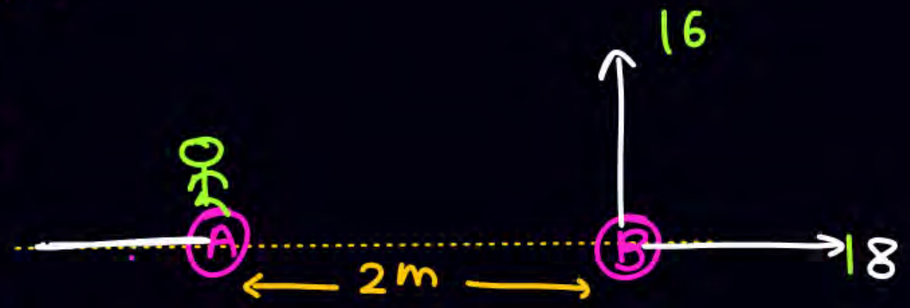


$$\omega_{B/A} = \frac{8}{5} \text{ (cw)}$$

⑥

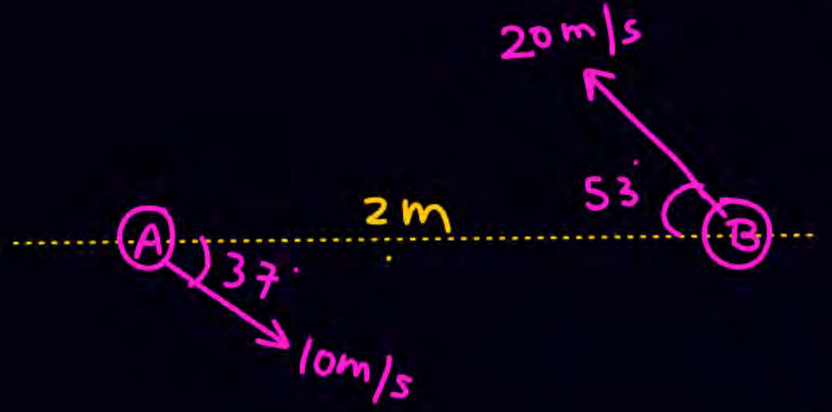


⑥



$\omega_{B/A} = \frac{16}{2} = 8$ (A$\circlearrowleft$)

⑦

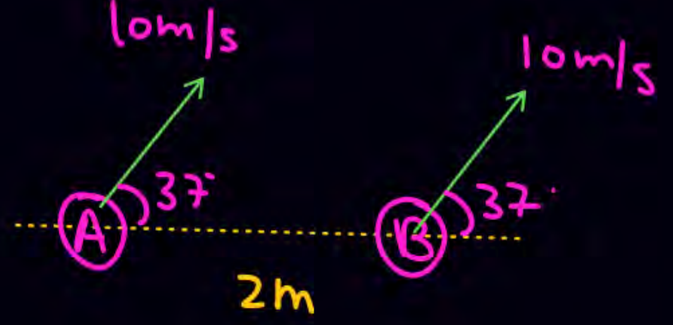


⑦

$\omega_{B/A} = \frac{22}{2} = 11$ (A$\circlearrowleft$)

Rate of chge of sepⁿ $= -20$

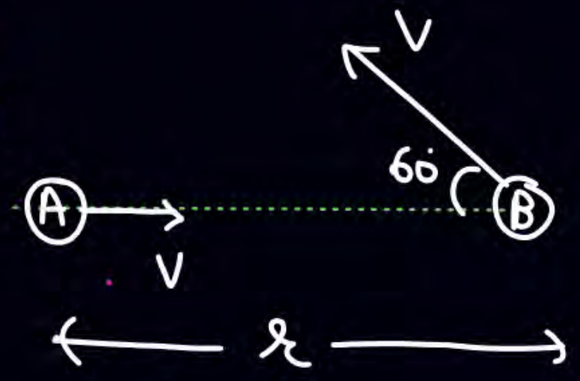
(8)

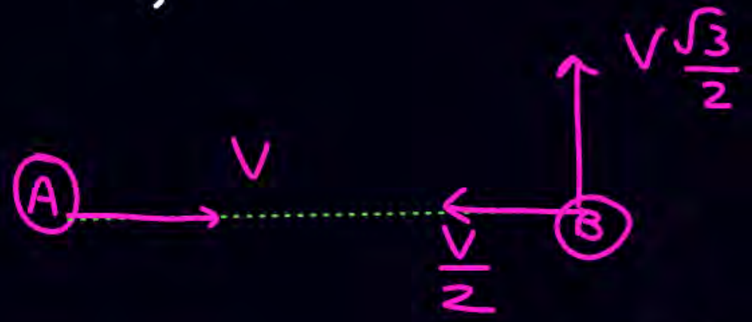


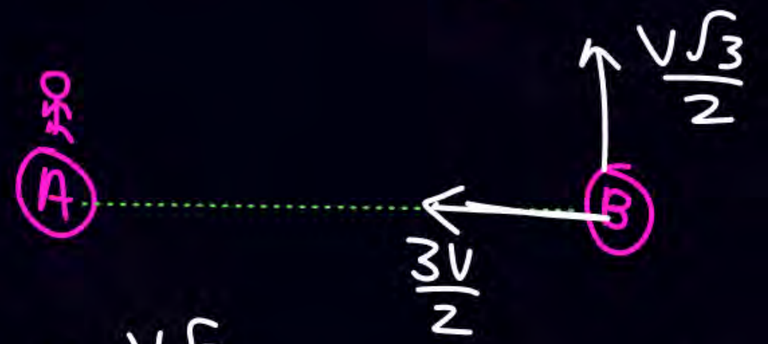
$$\omega_{B/A} = 0$$

$$t = \frac{2}{3V/2}$$

(9)



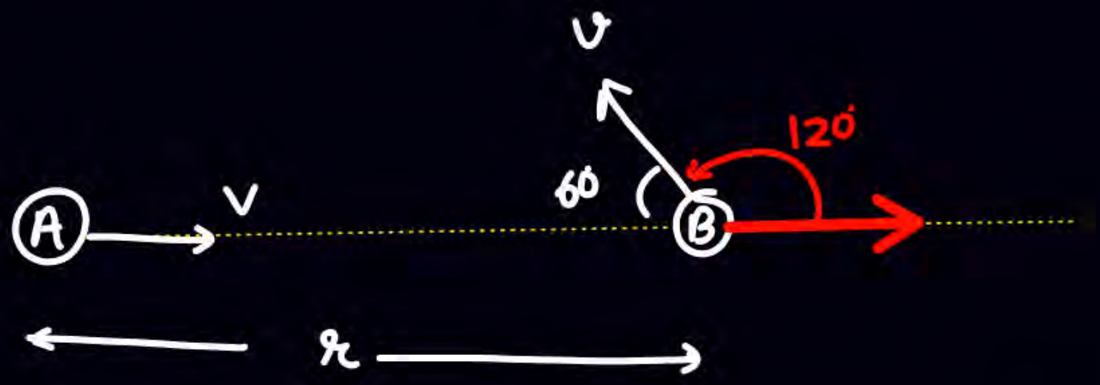




$$\omega_{B/A} = \frac{V\sqrt{3}}{2\ell}$$

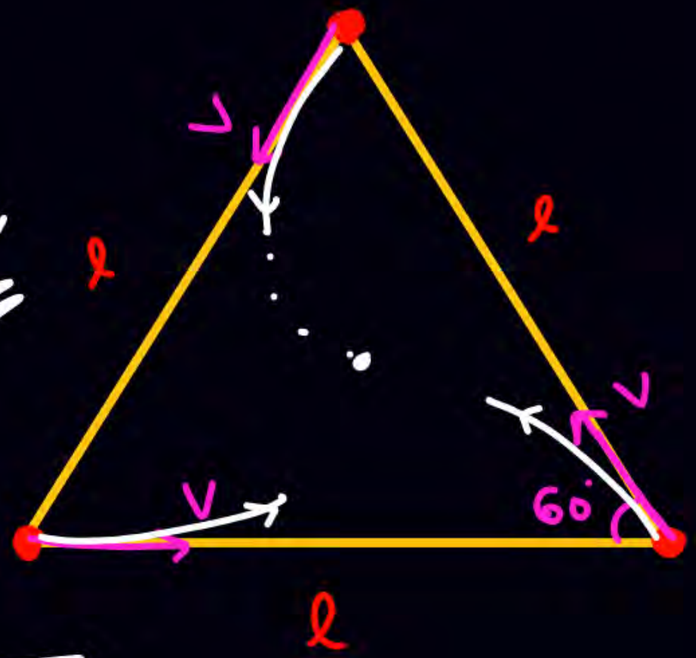
Rate of Chg. of sep^{n} $= \frac{-3V}{2}$

Q



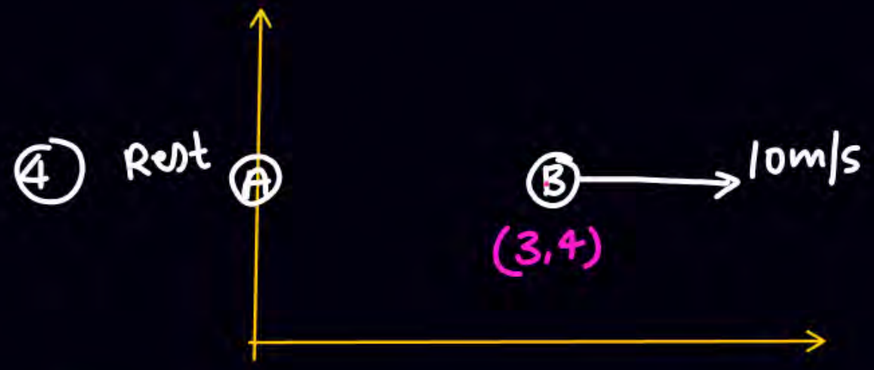
Velocity of A is always toward B with constant magnitude v and velocity of B is always making angle 120° with v of A having constant speed v.

Q

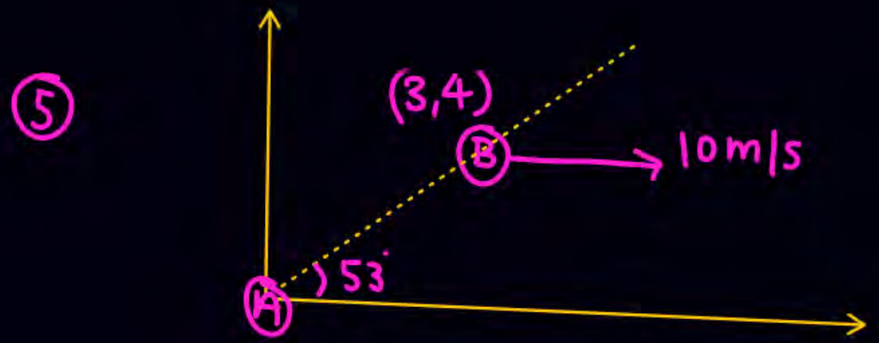


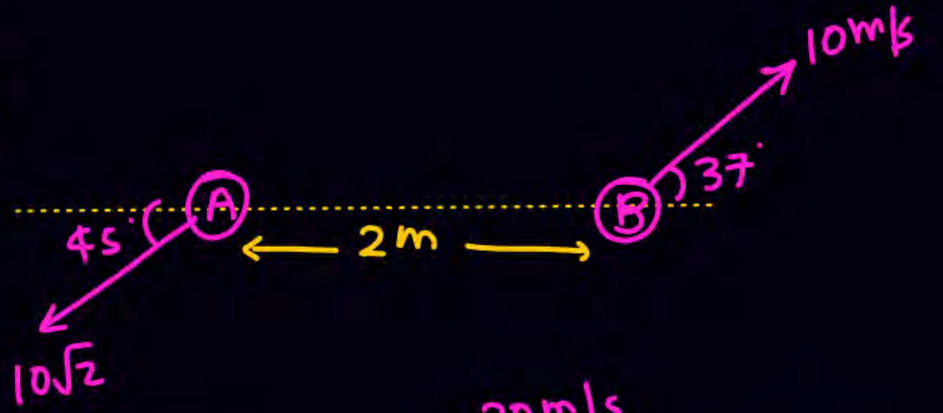
Attached

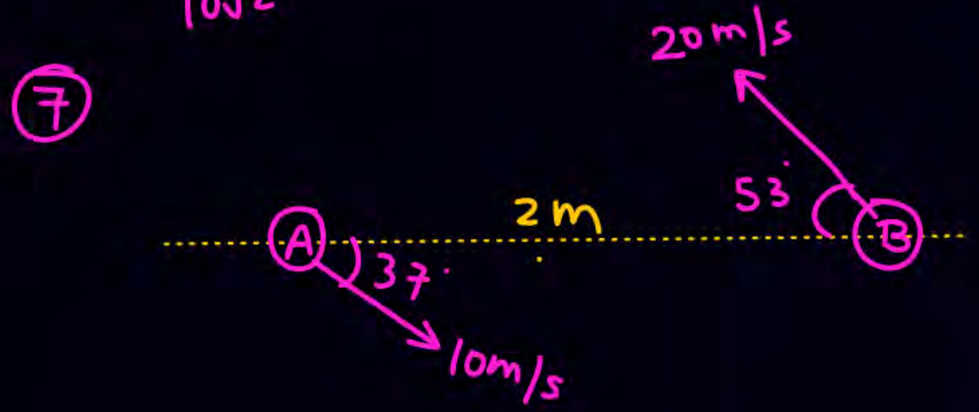
hcv

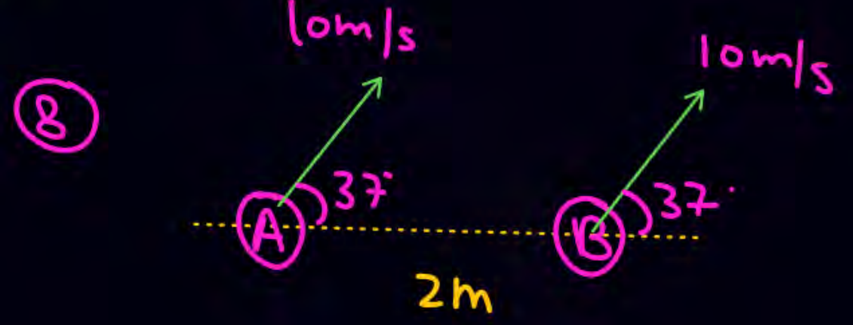

④ Rest
A
B
10m/s
(3,4)

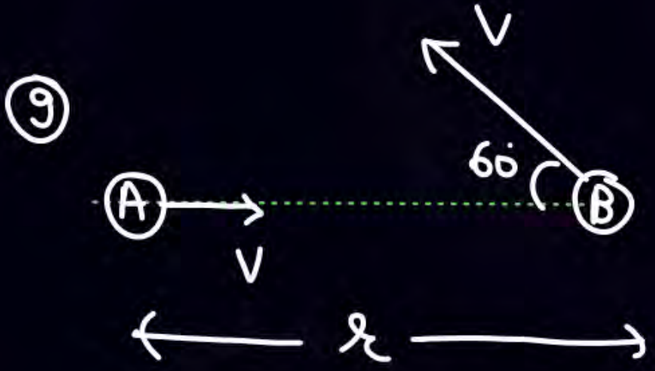
$w_{B/A}$ =


⑤
(3,4)
B
10m/s
A
53°


⑥
10m/s
37°
A
B
45°
2m
10√2


⑦
20m/s
53°
2m
A
B
37°
10m/s


⑧
10m/s
10m/s
37°
37°
A
B
2m


⑨
V
60°
A
B
V
ℓ

jiski kasam . . . . . Tumne khai thi.

Component of A along B

$\vec{A} \cdot \vec{B} = AB\cos\theta$

Q $\vec{A} = 3\hat{i} + 4\hat{j}$

$\vec{B} = \hat{i} + \hat{j}$

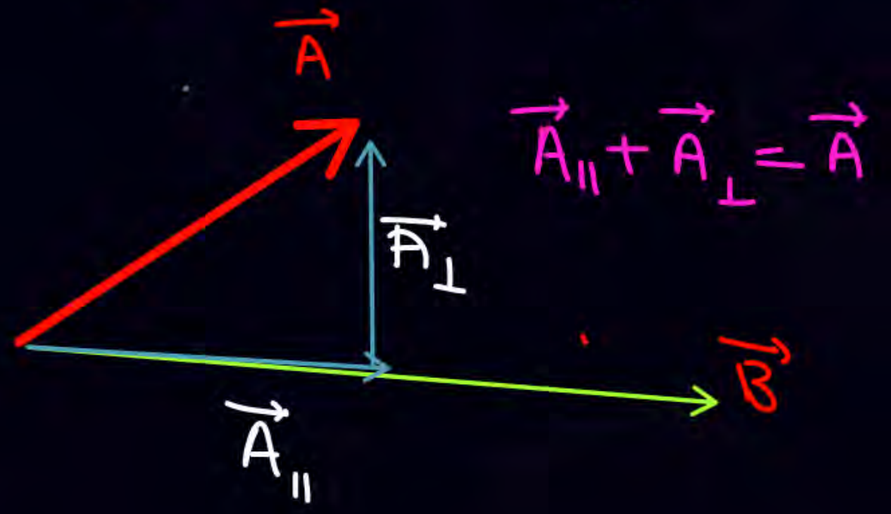
① projection component of $\vec{A}$ along $\vec{B} = A\cos\theta = \frac{\vec{A}\cdot\vec{B}}{B} = \frac{7}{\sqrt{2}}$

② " " " Vector $= \frac{7}{\sqrt{2}}\hat{B} = \frac{7}{\sqrt{2}}\frac{\hat{i}+\hat{j}}{\sqrt{2}} = \frac{7}{2}\hat{i} + \frac{7}{2}\hat{j} = \vec{A}_{\parallel}$

③ Component of $\vec{A}$ perpendicular to $\vec{B}$ $= \vec{A} - \vec{A}_{\parallel}$

$= (3\hat{i} + 4\hat{j}) - \left(\frac{7}{2}\hat{i} + \frac{7}{2}\hat{j}\right)$

$= -\frac{1}{2}\hat{i} + \frac{1}{2}\hat{j}$

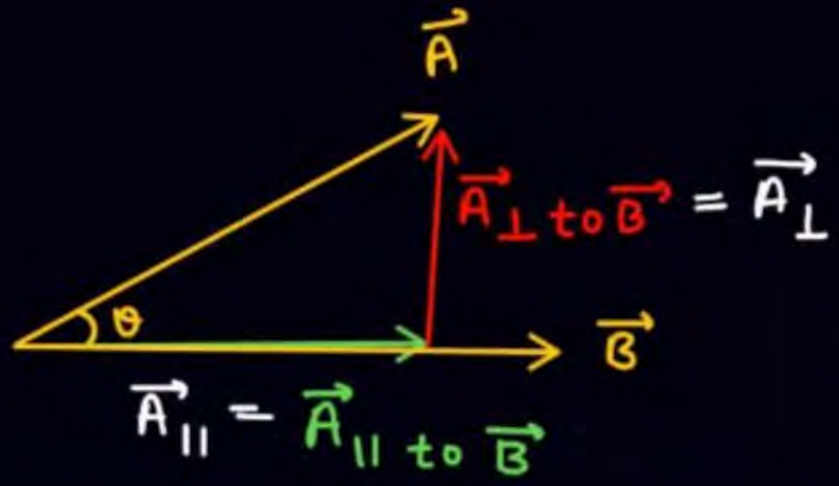


$\vec{A}_{\parallel} + \vec{A}_{\perp} = \vec{A}$

Purane Notes

$\vec{A}_{\parallel} + \vec{A}_{\perp} = \vec{A}$

$\boxed{\vec{A}_{\perp} = \vec{A} - \vec{A}_{\parallel}}$



Minus kar do

** Agar $\vec{A}_{\perp}$ wallah component nikalna hai to $\vec{A}$ me se $\vec{A}_{\parallel}$

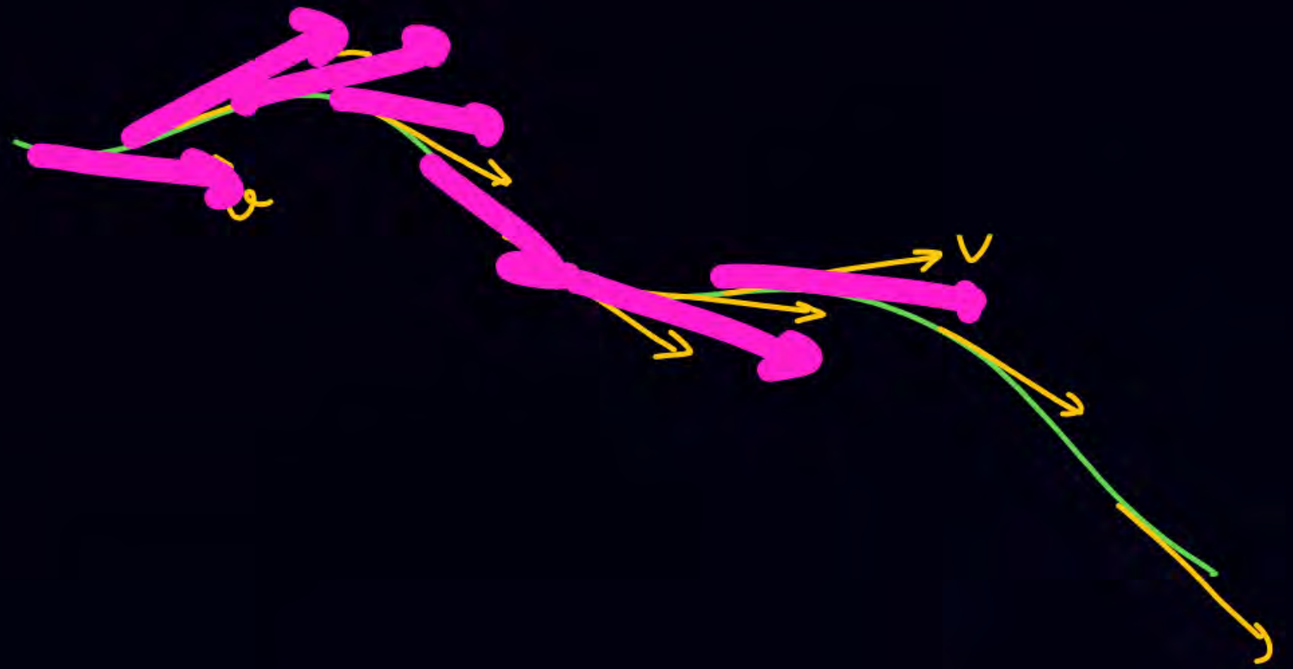
अगर $\vec{A}_{\perp}$ वाला component निकालना हो तो $\vec{A}$ में से $\vec{A}_{\parallel}$ घटा दो

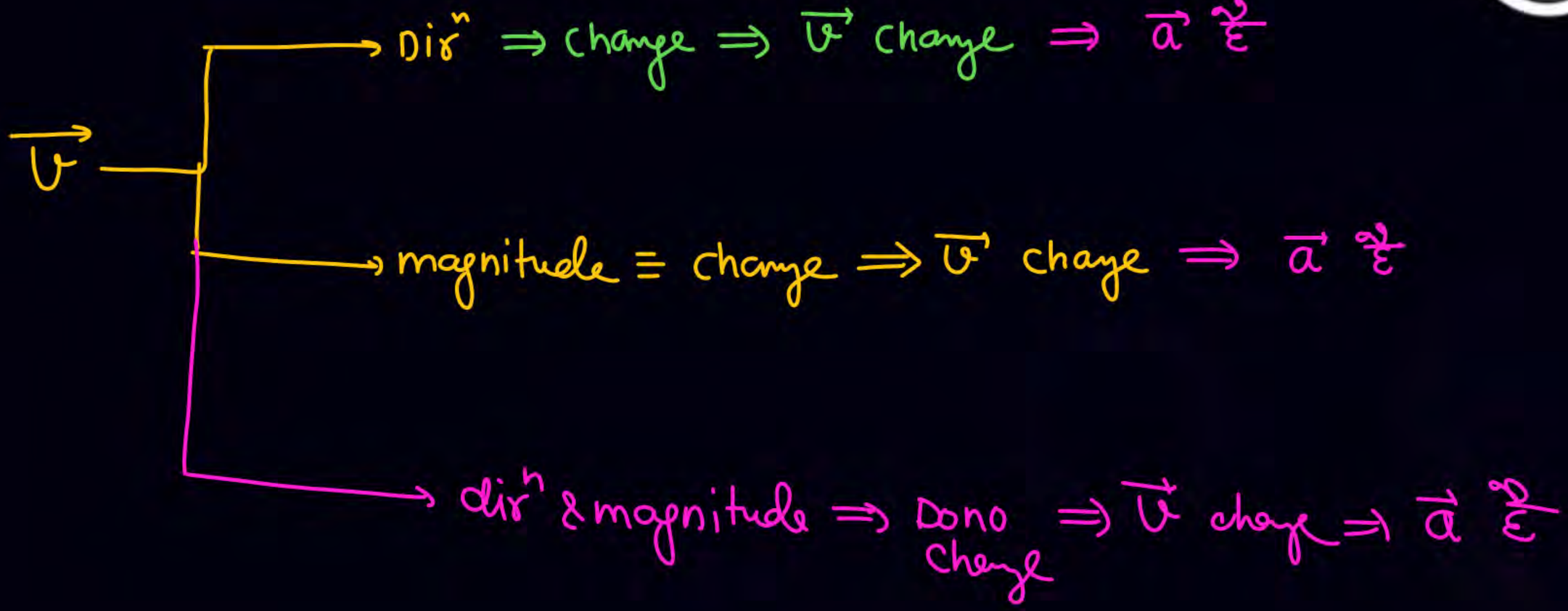
$\vec{A} = 4\hat{i} - 2\hat{j}$

$\vec{B} = 3\hat{i} + 4\hat{j}$

Compont of $\vec{A}$ along $\vec{B}$ =

$\therefore$ $\therefore$ $\perp$ to B =




$\vec{v}$
Dir^n ⇒ change ⇒ $\vec{v}$ change ⇒ $\vec{a}$ ≠ 0
magnitude ≡ change ⇒ $\vec{v}$ chaye ⇒ $\vec{a}$ ≠ 0
dir^n & magnitude ⇒ Dono change ⇒ $\vec{v}$ chaye ⇒ $\vec{a}$ ≠ 0

Tangential acc $\longrightarrow$ $a_t = a\cos\theta$

- Component of acc along velocity.
- It is responsible to change the magnitude of velocity (Speed)

- $\frac{d(\text{speed})}{dt} = a_t$ = Rate of chage of speed.
- $a_t = a\cos\theta = \frac{\vec{a}\cdot\vec{v}}{v}$

$\vec{a}\cdot\vec{v} = av\cos\theta$

- $\vec{a}_t \uparrow\uparrow \vec{v}$ $\xrightarrow{\text{parallel}}$ speed up
- $\vec{a}_t \uparrow\downarrow \vec{v}$ $\xrightarrow{\text{Antiparallel}}$ speeddown

Normal Acc.

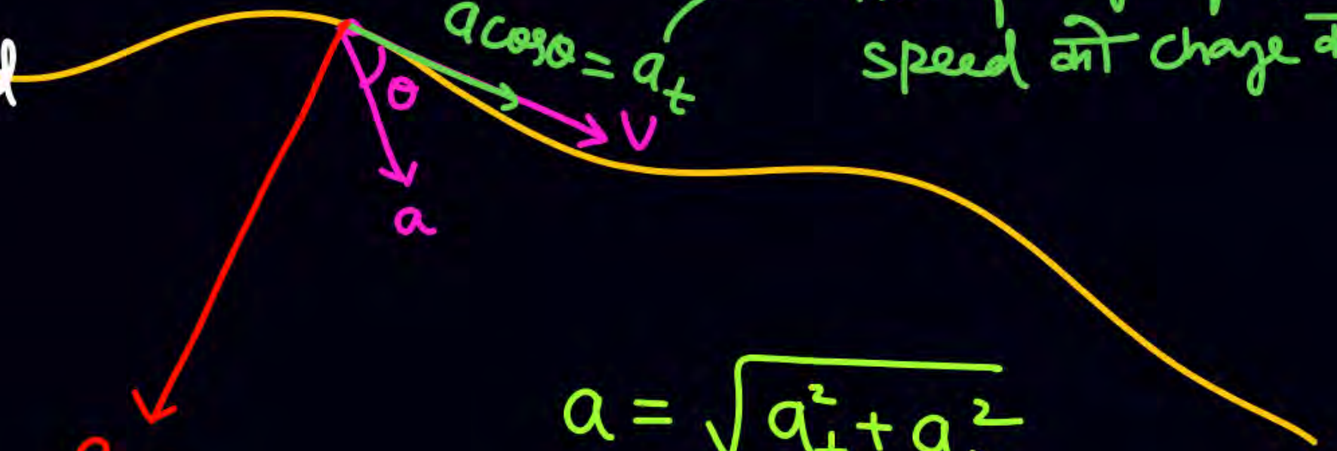
- Component of acc perpendicular to $\vec{v}$
- Component of $\vec{a}$ normal to $\vec{v}$
- It is responsible to chage the dirn of velocity.

$\vec{a}_N = \vec{a} - \vec{a}_t$

$\vec{a}_\perp = \vec{a} - \vec{a}_\parallel$

SKC box

- $a_t \rightarrow$ Rate of chage of speed
- $\frac{d(\text{speed})}{dt} = a_t$
- $\frac{d(\text{velocity})}{dt} = a_{net}$



- If $a_t = 0 \Rightarrow$ speed = const
- If $a_N = 0 \Rightarrow$ velocity dir^n = const

- Agar Speed Badli $\Rightarrow a_t$ Hai
- Agar Direction Badli $\Rightarrow a_N$ hai

i.e. speed का ठेका a_t ने
dir^n का ठेका a_N ने
ले रखा है

Q $\vec{A} = 3\hat{i} + 4\hat{j} = \vec{a}$

$\vec{B} = \hat{i} + \hat{j} = \vec{v}$

Component of $\vec{A}$ along $\vec{B}$ $= A\cos\theta$

$= \frac{\vec{A}\cdot\vec{B}}{v} = \frac{7}{\sqrt{2}}$

$\therefore$ Vector $= \frac{7}{\sqrt{2}}\hat{B} = \frac{7}{2}(\hat{i} + \hat{j})$

Component of $\vec{A}$ perpendicular to $\vec{B}$

$= \vec{A} - \vec{A}_{\parallel}$

$= -\frac{\hat{i}}{2} + \frac{\hat{j}}{2}$

Q $\vec{a} = 3\hat{i} + 4\hat{j}$

$\vec{v} = \hat{i} + \hat{j}$

Component of $\vec{a}$ along $\vec{v}$ $= a\cos\theta$

$= \frac{\vec{A}\cdot\vec{B}}{v} = \frac{7}{\sqrt{2}} = a_t$

$\therefore$ Vector $= \frac{7}{\sqrt{2}}\hat{v} = \frac{7}{2}(\hat{i} + \hat{j}) = \hat{a}_t$

Component of $\vec{A}$ perpendicular to $\vec{v}$

$= \vec{a} - \vec{a}_t$

$= -\frac{\hat{i}}{2} + \frac{\hat{j}}{2} = \vec{a}_N$

Q $\vec{A} = 4\hat{i} - 2\hat{j} = \vec{a}$

$\vec{B} = 3\hat{i} + 4\hat{j} - \vec{v}$

Component of $\vec{A}$ parallel (Along) to $\vec{B}$ $= \frac{\vec{A}\cdot\vec{B}}{B} = \frac{4}{5} = a_t$

Vector $= \frac{4}{5}\left(\frac{3\hat{i}+4\hat{j}}{5}\right) = \frac{12\hat{i}+16\hat{j}}{25} = \vec{a}_t$

Component of perpendicular to $\vec{B} = \vec{A} - \vec{A}_{||} = (4\hat{i}-2\hat{j}) - \left(\frac{12\hat{i}+16\hat{j}}{25}\right)$

$= \frac{88\hat{i}-66\hat{j}}{25} = \vec{a}_2$

Q $\vec{a} = 4\hat{i} - 3\hat{j}$

$\vec{v} = \hat{i} + \hat{j}$

$\vec{a} = \vec{a}_t + \vec{a}_N$

① a_t = Component of acc along velocity = Rate of change of speed.

$$a_t = a\cos\theta = \frac{\vec{a}\cdot\vec{v}}{v} = \frac{1}{\sqrt{2}}$$

Vector $\vec{a}_t = \frac{1}{\sqrt{2}}\cdot\hat{v} = \frac{\hat{i}+\hat{j}}{2}$

② Normal acc $\vec{a}_N = \vec{a} - \vec{a}_t = (4\hat{i} - 3\hat{j}) - \left(\frac{\hat{i}+\hat{j}}{2}\right) =$ ✓

① 

$$a = -10\hat{j}$$

$t = 2,\ \vec{v} = 60\hat{i} + 60\hat{j}$

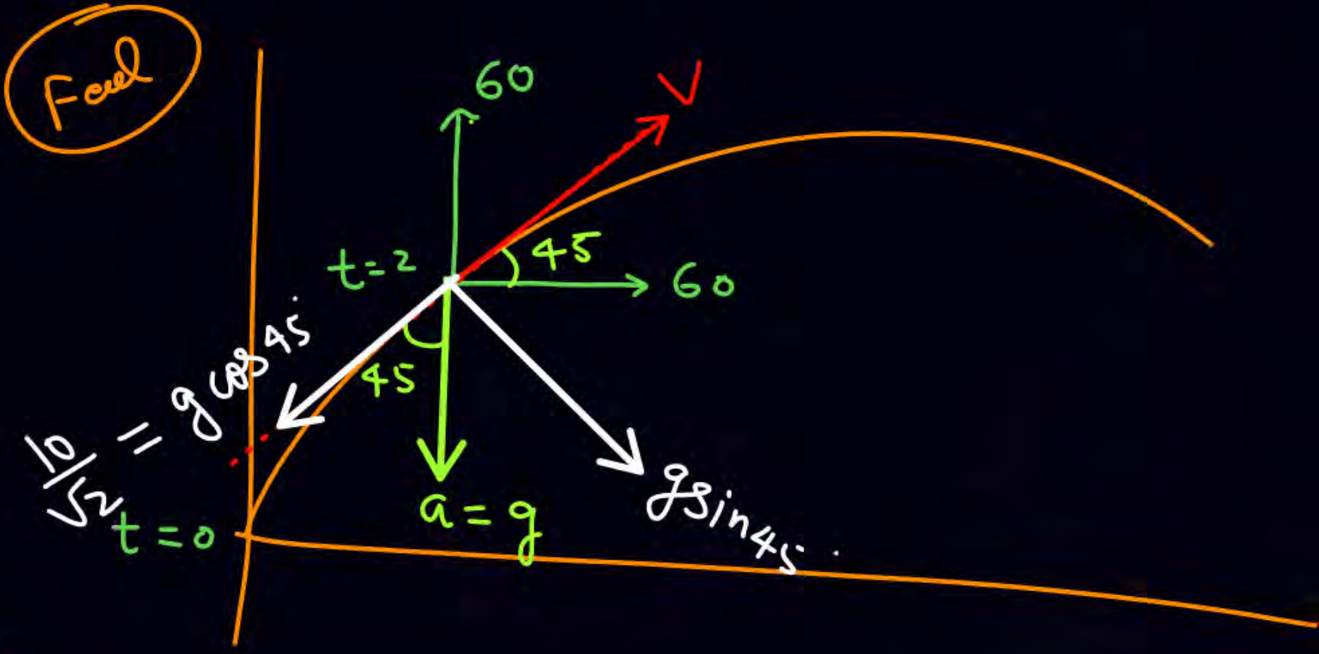
① At $t = 2$, a_t = Comp. of acc along v

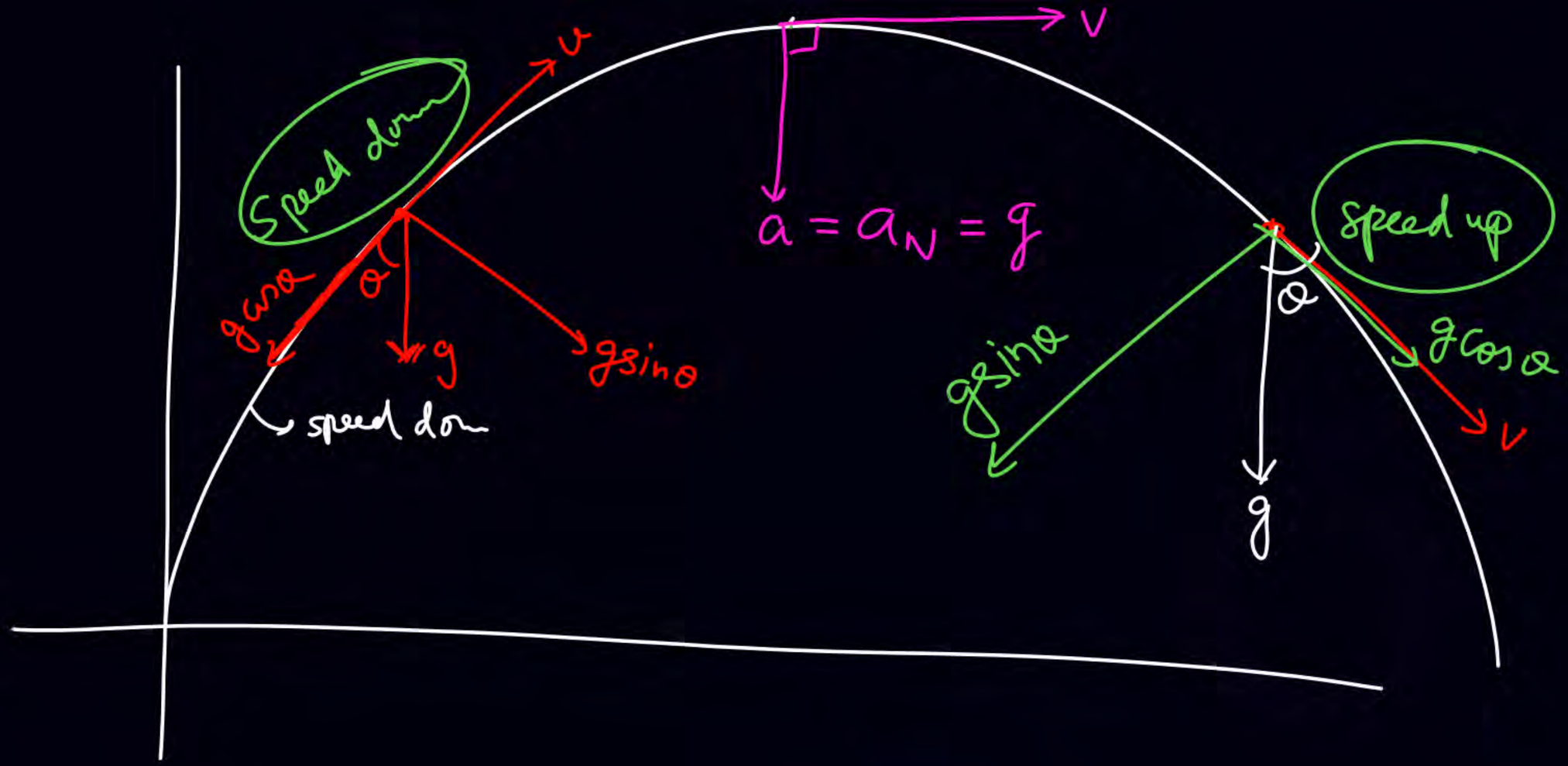
$$= a\cos\theta = \frac{\vec{a}\cdot\vec{v}}{v} = \frac{-600}{60\sqrt{2}} = \frac{-10}{\sqrt{2}}$$

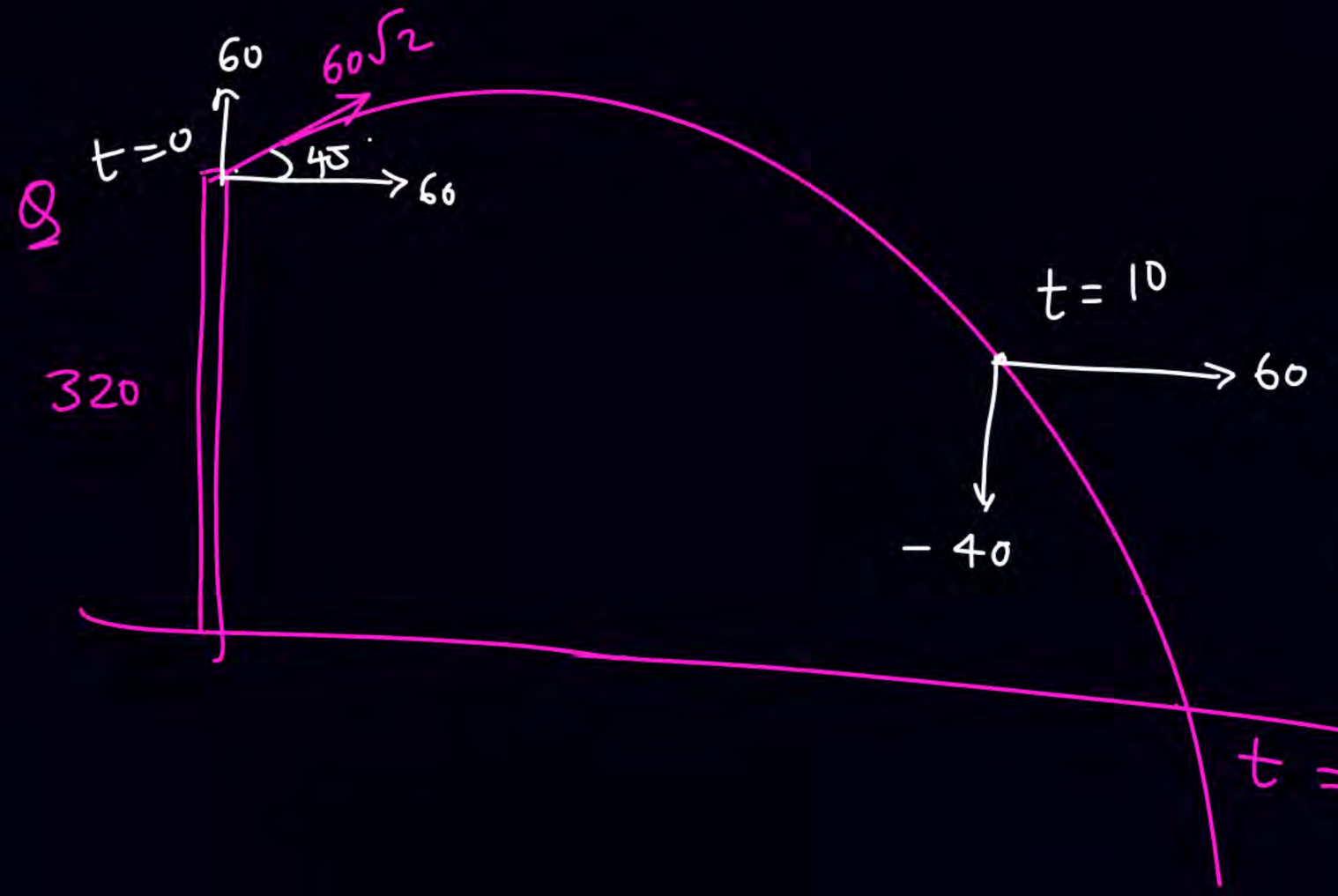
$$\vec{a}_t = \frac{-10}{\sqrt{2}} \times \left(\frac{60\hat{i} + 60\hat{j}}{60\sqrt{2}}\right) = -5\hat{i} - 5\hat{j}$$

② $\vec{a}_N = \vec{a} - \vec{a}_t = \checkmark$

Feel




v
Speed down
u
$a = a_N = g$
$g\cos\theta$
θ
g
$g\sin\theta$
speed down
speed up
θ
$g\sin\theta$
$g\cos\theta$
v
g



$\vec{v} = 60\hat{i} - 40\hat{j}$

$\vec{a} = -10\hat{j}$

$a_t =$

Q $\vec{v} = 6t^2\hat{i} + 10t\hat{j}$

find $\vec{a}_t$ & $\vec{a}_N$ at $t = 2$ sec.

Sol^n $\vec{v} = 6t^2\hat{i} + 10t\hat{j}$ $\xrightarrow{t=2}$ $\vec{v} = 24\hat{i} + 20\hat{j}$

$\vec{a} = 12t\hat{i} + 10\hat{j}$ $\xrightarrow{t=2}$ $\vec{a} = 24\hat{i} + 10\hat{j}$

$\vec{a}_t$ = ✓

$\vec{a}_N$ = ✓

∴

$$\begin{cases} \vec{a} = \\ \vec{v} = \\ a_t = \dfrac{\vec{a}\cdot\vec{v}}{v} \\ \vec{a}_t = (\ )\,\hat{v} \end{cases}$$

$$\vec{a}_N = \vec{a} - \vec{a}_t$$


@SALEEMSIR_PW

THANK YOU