YAKEEN NEET 2.0

2026

Vectors

PHYSICS | Lecture - 06

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Todays Goal

- magnitude of vector
- Unit vector & application

Copy

Q $|\vec{A}| = |\vec{B}| = x$

angle between $\vec{A}$ & $\vec{B}$ is θ

① Find $|\vec{A}+\vec{B}|$

⇒ Sol: $\vec{A}+\vec{B}=\vec{C}$

$|\vec{A}+\vec{B}| = |\vec{C}| = C$

$C = \sqrt{A^2+B^2+2AB\cos\theta}$

$C = \sqrt{x^2+x^2+2x\cdot x\cos\theta}$

$= \sqrt{2x^2(1+\cos\theta)} = \sqrt{2x^2\left(1+2\cos^2\frac{\theta}{2}-1\right)}$

$\boxed{C = 2x\cos\theta/2}$

② $|\vec{A}-\vec{B}| = \vec{D}$

$D = \sqrt{A^2+B^2-2AB\cos\theta}$

$C = \sqrt{x^2+x^2-2x\cdot x\cos\theta} = \sqrt{2x^2(1-\cos\theta)}$

$C = \sqrt{2x^2\left[1-(1-2\sin^2\theta/2)\right]} = 2x\sin\theta/2$

$|\vec{A}| = |\vec{B}| = x$ (Equal magnitude)

Angle b/w $\vec{A}$ & $\vec{B}$ is θ

$|\vec{A}+\vec{B}| = 2x\cos\theta/2$

$|\vec{A}-\vec{B}| = 2x\sin\theta/2$

magnitude of a vector

① $\vec{A} = 2\hat{i} + 3\hat{j} + 4\hat{k}$

$|\vec{A}| = A = \sqrt{2^2 + 3^2 + 4^2} = \sqrt{29}$

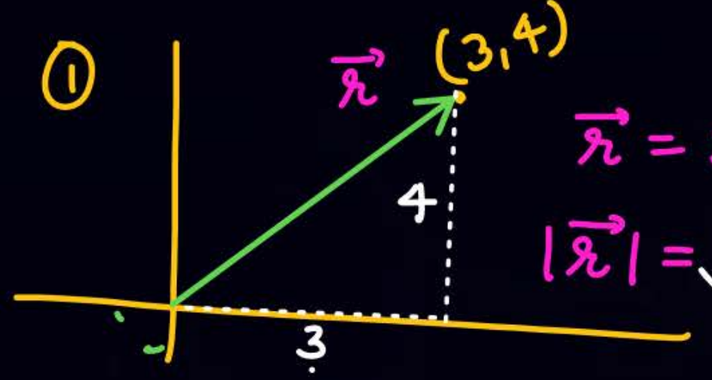
② $\vec{A} = 3\hat{i} + 4\hat{j} + 5\hat{k}$

$|\vec{A}| = \sqrt{3^2 + 4^2 + 5^2} = 5\sqrt{2}$

③ $\vec{A} = 3\hat{i} - 4\hat{j} - 5\hat{k}$

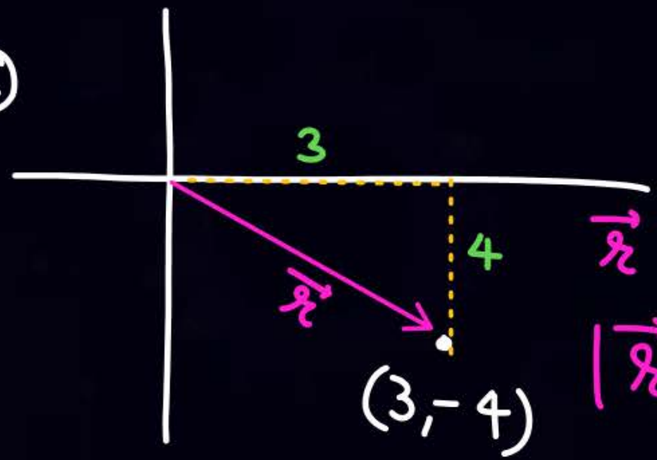
$|\vec{A}| = \sqrt{3^2 - 4^2 - 5^2}$ ✗

$|\vec{A}| = \sqrt{3^2 + 4^2 + 5^2}$

① 

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

$|\vec{r}| = \sqrt{3^2 + 4^2} = 5$

② 

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

$|\vec{r}| = \sqrt{3^2 + 4^2}$

④ $\vec{A} = 3\hat{\imath} - 4\hat{j} + 5\hat{k}$

$A = \sqrt{3^2+4^2+5^2} = 5\sqrt{2}$

⑤ $\vec{A} = \hat{\imath} + \hat{j} + \hat{k}$

$A = \sqrt{1^2+1^2+1^2} = \sqrt{3}$

⑥ $\vec{A} = \hat{\imath} - \hat{j} - \hat{k}$

$A = \sqrt{1^2+1^2+1^2} = \sqrt{3}$

⑦ $\vec{A} = \hat{\imath} + \hat{j}$

$A = \sqrt{1^2+1^2} = \sqrt{2}$

⑧ $\vec{A} = \hat{\imath} - \hat{j}$

$A = \sqrt{1^2+1^2} = \sqrt{2}$

⑨ $\vec{A} = 3\hat{j} + 4\hat{k} \Rightarrow A = \sqrt{0^2+3^2+4^2}$

$A = 5$

⑩ Unit vecto

$\vec{A} = \frac{\hat{\imath}}{\sqrt{2}} - \frac{\hat{j}}{\sqrt{2}} \Rightarrow A = \sqrt{\left(\frac{1}{\sqrt{2}}\right)^2 + \left(\frac{1}{\sqrt{2}}\right)^2} = 1$

⑪ Unit vect

$\vec{A} = \frac{\hat{\imath}}{\sqrt{3}} + \frac{\hat{j}}{\sqrt{3}} + \frac{\hat{k}}{\sqrt{3}}$ $\quad A = \sqrt{\left(\frac{1}{\sqrt{3}}\right)^2 + \left(\frac{1}{\sqrt{3}}\right)^2 + \left(\frac{1}{\sqrt{3}}\right)^2}$

$A = 1$

⑫ Unit Vector

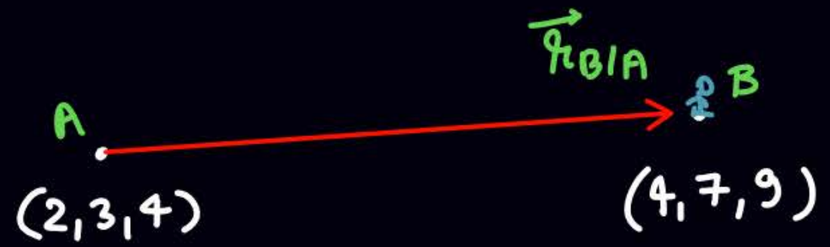
$\vec{A} = \frac{\hat{\imath}}{\sqrt{3}} - \frac{\hat{j}}{\sqrt{3}} - \frac{\hat{k}}{\sqrt{3}}$

$\boxed{A = 1}$

⑬ $\vec{A} = -5\hat{\imath}$

$\boxed{A = 5}$

#



$$\vec{r}_{B/A} = (4-2)\hat{i} + (7-3)\hat{j} + (9-4)\hat{k}$$

$$\vec{r}_{B/A} = 2\hat{i} + 4\hat{j} + 5\hat{k}$$

$$|\vec{r}_{B/A}| = \sqrt{2^2 + 4^2 + 5^2} = \sqrt{45}$$

$$|\vec{r}_{B/A}| = \sqrt{(4-2)^2 + (7-3)^2 + (9-4)^2}$$

$$AB = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2 + (z_2-z_1)^2}$$

$$AB = \sqrt{(4-2)^2 + (7-3)^2 + (9-4)^2}$$

$$AB = \sqrt{2^2 + 4^2 + 5^2} = \sqrt{45}$$

* $\vec{A}$ = (magnitude) (Direction)

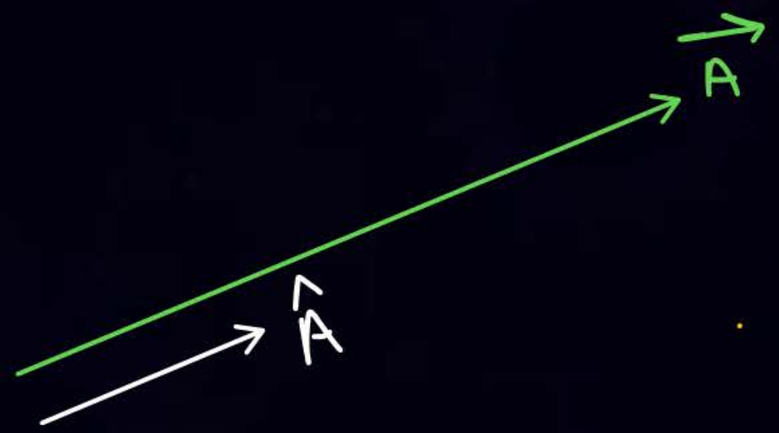
$\vec{A} = |\vec{A}|\,\hat{A}$

$\hat{A} = \dfrac{\vec{A}}{|\vec{A}|} = \dfrac{\vec{A}}{\text{(magnitude)}}$

① $\vec{A} = 3\hat{i} + 4\hat{j}$

$|\vec{A}| = \sqrt{3^2+4^2} = 5$

$\hat{A} = \dfrac{\vec{A}}{|\vec{A}|} = \dfrac{3\hat{i}+4\hat{j}}{5} = \dfrac{3}{5}\hat{i} + \dfrac{4}{5}\hat{j}$



find $\hat{A}$ (Unit vector along $\vec{A}$)

① $\vec{A} = 3\hat{i} + 4\hat{j} + 5\hat{k}$

$$\hat{A} = \frac{3\hat{i} + 4\hat{j} + 5\hat{k}}{5\sqrt{2}}$$

② $\vec{A} = 3\hat{i} - 4\hat{j} + 5\hat{k}$

$$\hat{A} = \frac{3\hat{i} - 4\hat{j} + 5\hat{k}}{5\sqrt{2}}$$

③ $\vec{A} = \hat{i} + \hat{j} - \hat{k}$

$$\hat{A} = \frac{\hat{i} + \hat{j} - \hat{k}}{\sqrt{3}}$$

④ $\vec{A} = \hat{j} - \hat{k}$

$$\hat{A} = (\hat{j} - \hat{k})/\sqrt{2}$$

⑤ $\vec{A} = \hat{i} + \hat{j}$

$$\hat{A} = (\hat{i} + \hat{j})/\sqrt{2}$$

⑥ $\vec{A} = \hat{i} - \hat{j} + \hat{k}$

$$\hat{A} = \frac{\hat{i} - \hat{j} + \hat{k}}{\sqrt{3}}$$

Q A bird is flying with speed 10m/s along $\vec{A} = 3\hat{i} + 4\hat{j}$
Find its velocity

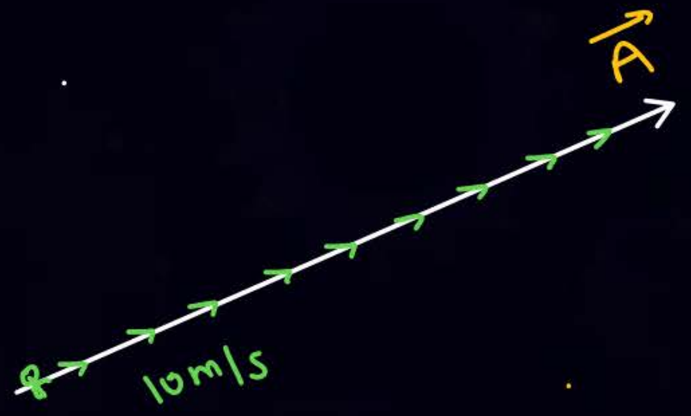
A bird is flying with speed 10m/s parallel to $\vec{A} = 3\hat{i} + 4\hat{j}$
Find its velocity

Sol" $\vec{v} = (\text{magnitude})(\text{Direction})$

$\vec{v} = (10\text{m/s})\,\hat{A}$

$\vec{v} = 10 \times \left(\frac{3\hat{i}+4\hat{j}}{5}\right)$

$\boxed{\vec{v} = 6\hat{i} + 8\hat{j}}$



$\hat{A} = \frac{3\hat{i}+4\hat{j}}{5}$

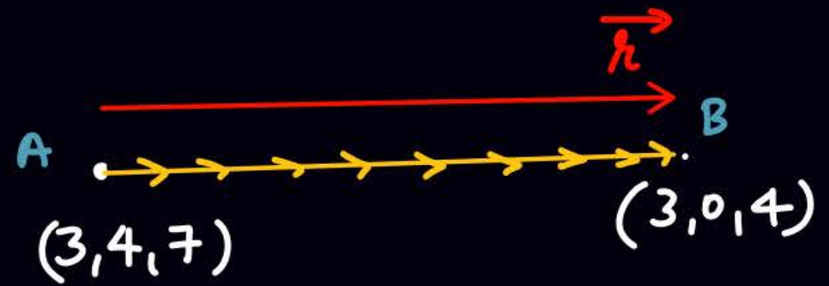
Q Find a vector $\vec{B}$ of magnitude 20 N whose direction is parallel to $\vec{A} = 3\hat{i} - 4\hat{j}$

Sol: $\vec{B} = 20\,\hat{A} = 20\left(\frac{3\hat{i} - 4\hat{j}}{5}\right) = 12\hat{i} - 16\hat{j}$

Q Find a vector of magnitude 20 N whose direction is opposite to $\vec{A} = 3\hat{i} - 4\hat{j}$.

Sol: $\vec{B} = 20\,(-\hat{A}) = -20\left(\frac{3\hat{i} - 4\hat{j}}{5}\right) = -12\hat{i} + 16\hat{j}$

Q



A bird is flying with speed 50 m/s from point A directly to point B find its velocity.

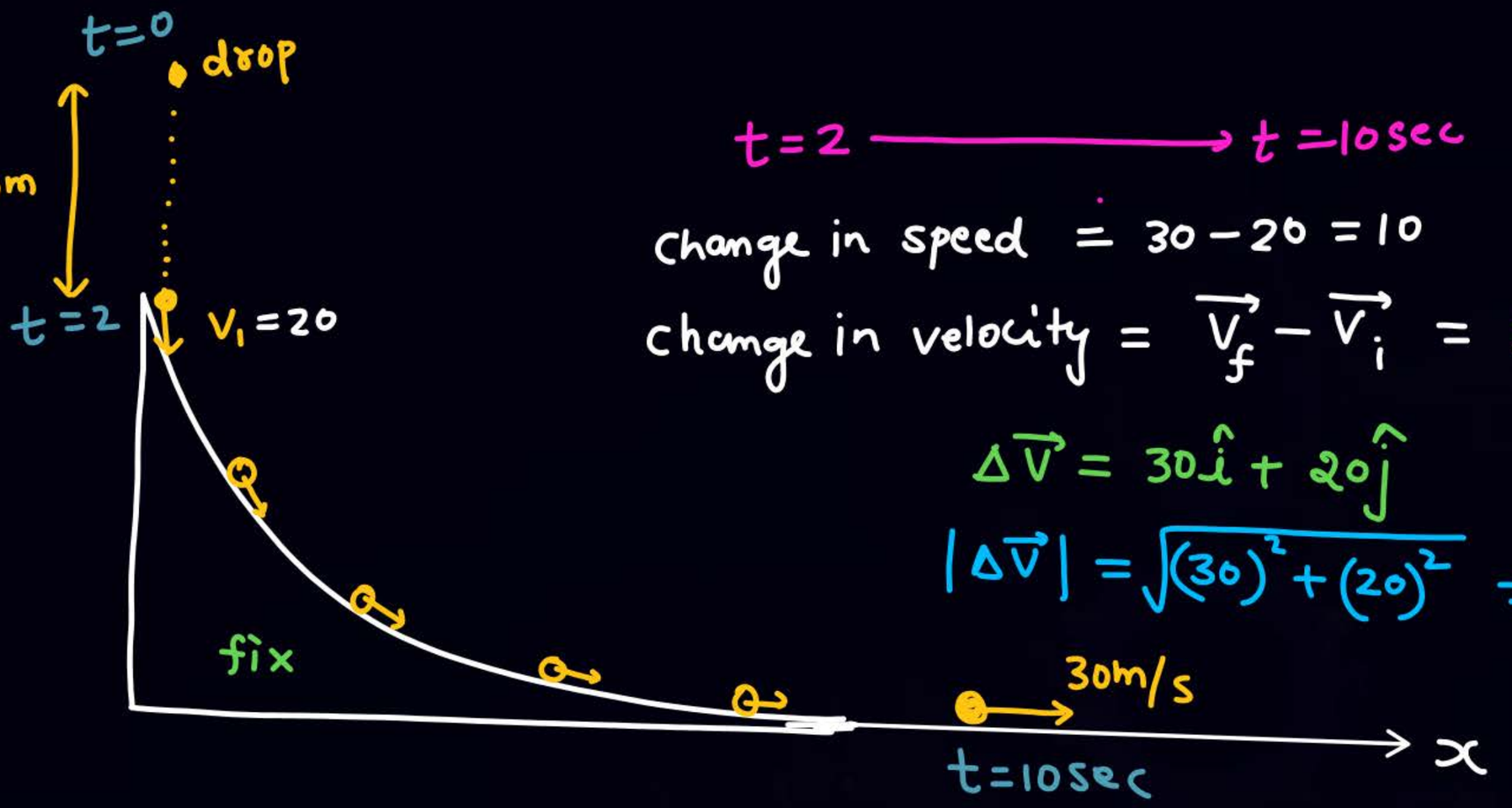
$$\vec{r} = -4\hat{j} - 3\hat{k}$$

Sol $\quad \vec{v} = 50 \times \hat{r}$

$$= 50\left(\frac{-4\hat{j} - 3\hat{k}}{5}\right) = -40\hat{j} - 30\hat{k}$$

SSSQ

Q



$V_1=\sqrt{2gh}$

$V_1=\sqrt{2\times10\times20}$

$V_1=20$

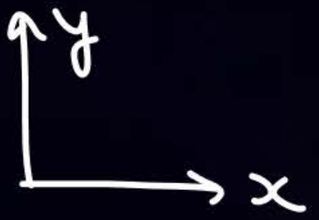
$t=2 \longrightarrow t=10\,sec$

Change in speed $= 30-20=10$

Change in velocity $= \vec{V}_f-\vec{V}_i = 30\hat{i}-(-20\hat{j})$

$\Delta\vec{V}=30\hat{i}+20\hat{j}$

$|\Delta\vec{V}|=\sqrt{(30)^2+(20)^2}=10\sqrt{13}$



$\text{Avg. Acc.} = \dfrac{\text{Change in Velocity}}{\text{time}} = \dfrac{10\sqrt{13}}{8}$

Q $\vec{A} = 3\hat{i} + 7\hat{j} + 6\hat{k}$

$\vec{B} = 2\hat{i} + 3\hat{j} + 5\hat{k}$

$\vec{A}+\vec{B} = 5\hat{i} + 10\hat{j} + 11\hat{k}$

$\vec{A}-\vec{B} = \hat{i} + 4\hat{j} + \hat{k}$

Q $\vec{A} = 5\hat{i} - 6\hat{j} + 8\hat{k}$

$\vec{B} = -2\hat{i} + 3\hat{j} - 2\hat{k}$

$\vec{A}+\vec{B} = 3\hat{i} - 3\hat{j} + 6\hat{k}$

$|\vec{A}+\vec{B}| = \sqrt{3^2+3^2+6^2} = \sqrt{54}$

Q $\vec{A} = 5\hat{i} - 6\hat{j} + 8\hat{k}$

$\vec{B} = -2\hat{i} + 3\hat{j} - 2\hat{k}$

$\vec{A}-\vec{B} = 7\hat{i} - 9\hat{j} + 10\hat{k}$

$|\vec{A}-\vec{B}| = \sqrt{7^2+9^2+10^2} =$

Q $\vec{A} = 3\hat{i} + 4\hat{j} + 5\hat{k}$

$3\vec{A} = 9\hat{i} + 12\hat{j} + 15\hat{k}$

Q $\vec{A} = 3\hat{i} - 2\hat{j} + 4\hat{k}$

$2\vec{A} = 6\hat{i} - 4\hat{j} + 8\hat{k}$

$-3\vec{A} = -9\hat{i} + 6\hat{j} - 12\hat{k}$

$3\vec{A} \equiv (6, 9, 12)$

$2\vec{B} \equiv (6, 8, 12)$

Q $\vec{A} = 2\hat{i} + 3\hat{j} + 4\hat{k}$

$\vec{B} = 3\hat{i} + 4\hat{j} + 6\hat{k}$

① $3\vec{A} + 2\vec{B} = 12\hat{i} + 17\hat{j} + 24\hat{k}$

② $|3\vec{A} + 2\vec{B}| = \sqrt{12^2 + 17^2 + 24^2}$

③ $3\vec{A} - 2\vec{B} = \hat{j}$

④ $|3\vec{A} - 2\vec{B}| = 1$

R

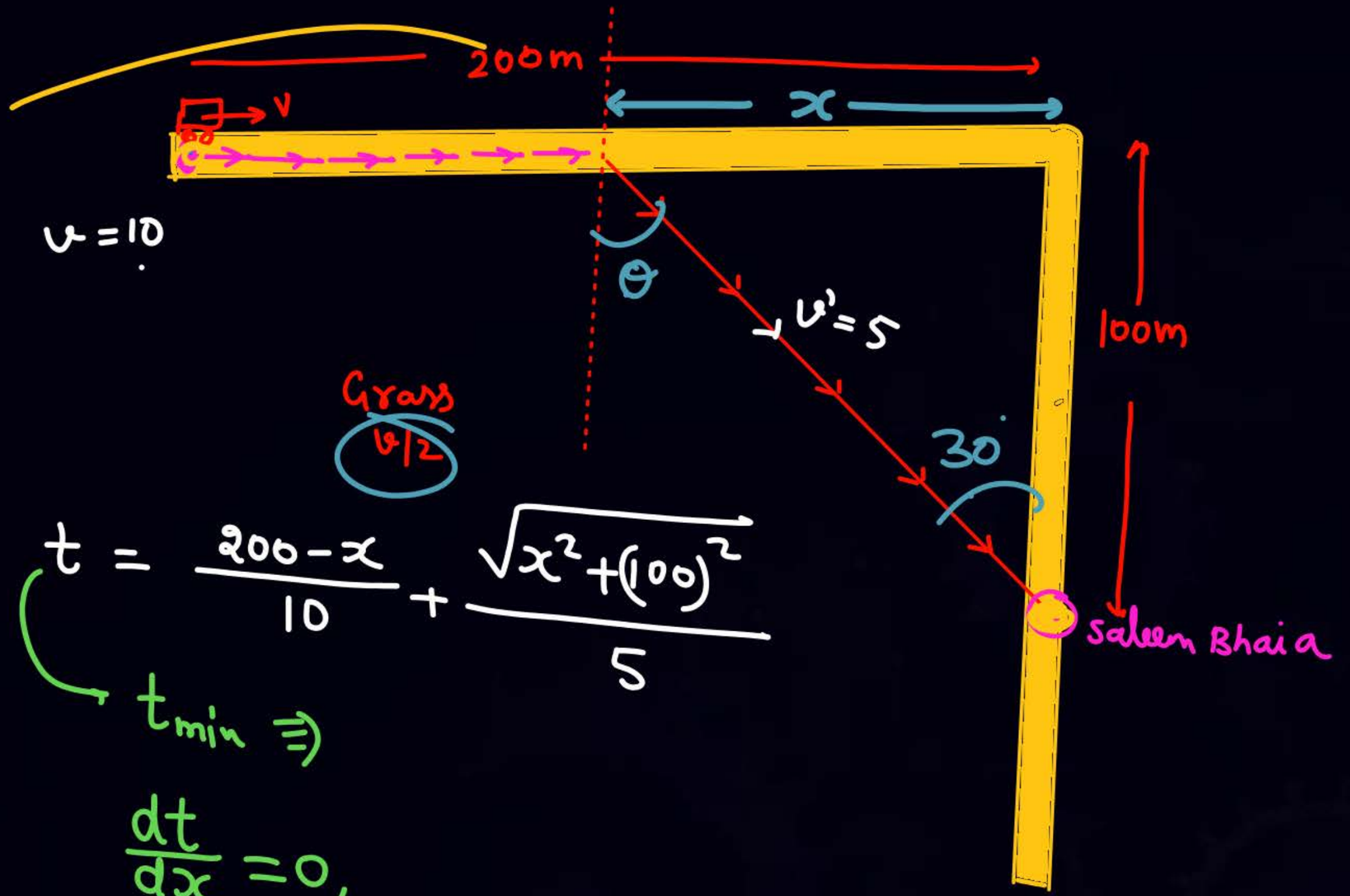
⑤ If a bird start flying with speed 10m/s in the direction of $3\vec{A} - 2\vec{B}$ find its velocity.

$\vec{v} = 10\hat{j}$

⑥ If a bird start flying with speed 10m/s in the direction of $3\vec{A} + 2\vec{B}$ find its velocity.

$\vec{v} = 10 \times \dfrac{12\hat{i} + 17\hat{j} + 24\hat{k}}{\sqrt{12^2 + 17^2 + 24^2}}$

Beast mode



$$t = \frac{200 - x}{10} + \frac{\sqrt{x^2 + (100)^2}}{5}$$

$t_{min} \Rightarrow$

$$\frac{dt}{dx} = 0,$$

$$t = \frac{200-x}{10} + \frac{\left(x^2+(100)^2\right)^{\frac{1}{2}}}{5}$$

$$\frac{dt}{dx} = \frac{1}{10}(0-1) + \frac{1}{5}\left[\frac{1}{2}\times\left[x^2+(100)^2\right]^{\frac{1}{2}-1}\times 2x\right] = 0$$

$$\left[\frac{1}{\sqrt{x^2+10000}}\right]2x = 1$$

$$3x^2 = (100)^2$$

$$x = \frac{100}{\sqrt{3}}$$

$$\sqrt{x^2+10000} = 2x$$

$$x^2+(100)^2 = 4x^2$$

$$\cos 2\theta = \cos^2\theta - \sin^2\theta = 2\cos^2\theta - 1 = 1 - 2\sin^2\theta$$

$$\cos\theta = \cos^2\frac{\theta}{2} - \sin^2\frac{\theta}{2} = 2\cos^2\frac{\theta}{2} - 1 = 1 - 2\sin^2\frac{\theta}{2}$$

Join it

Homework

- KPP - 09
- DPP

module page 114 (motion in plane)

Aarambh → 1, 2, 4,

Prarombh → (1 - 7)

Thank You