

YAKEEN NEET 2.0

2026

Motion in a Plane

PHYSICS

Lecture - 01

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Today's Goal

- Postmortem of Projectile motion.

* \int based ques. $a = v \frac{dv}{dx}$. graph based \longrightarrow 1 Lecture.
1D + 2D.

* few ques on motion under gravity \longrightarrow : juggling problem
:
:
:

Projectile motion

(1D Relative. + 2D Relative)

4 Lecture

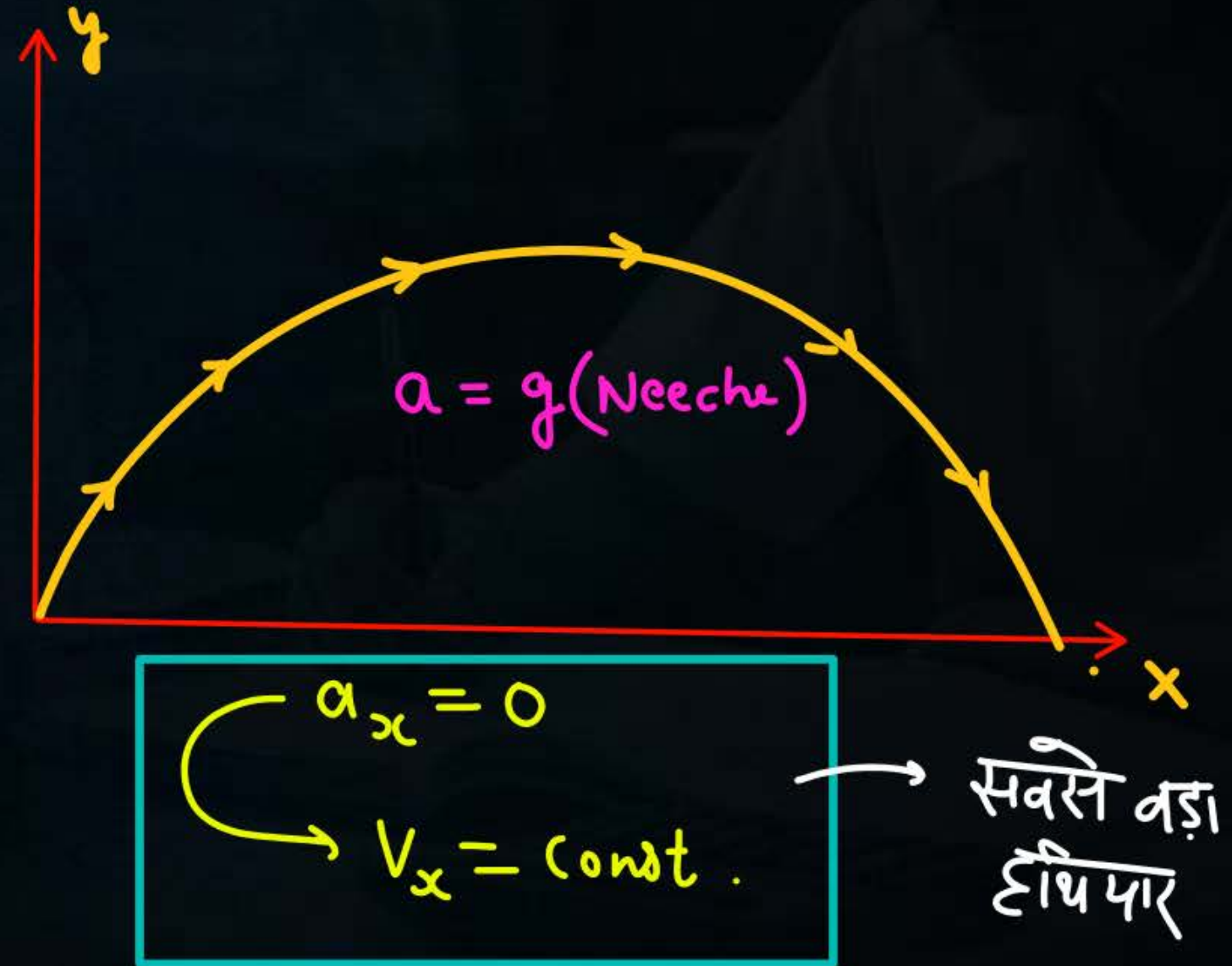
Projectile motion

* Air resistance neglected.

* अगर particle हवा में hai. तो उसका acc Neeche 'g' होगा

⇒ अगर particle hawa me hai to uska acc. neeche 'g' होगा

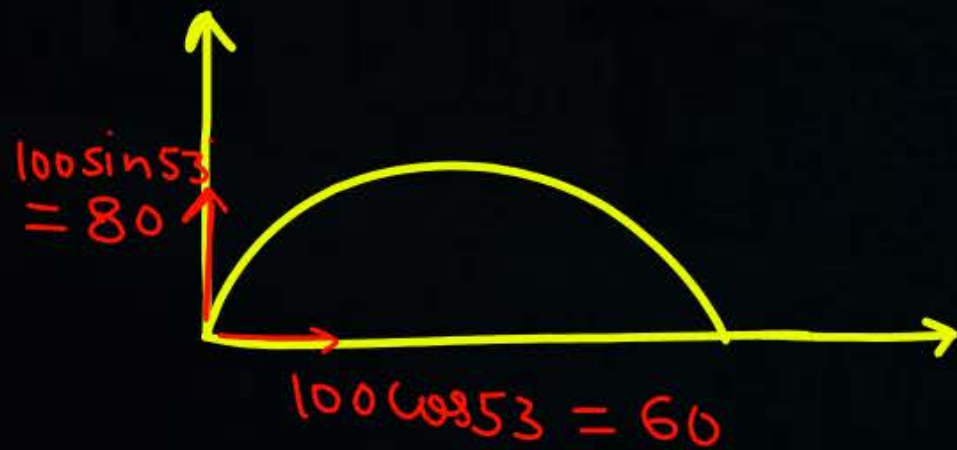
⇒



Q A particle is projected from ground with velocity 100 m/s at an angle 53° with horizontal as shown in diagram.

Analyse the ques in **Saleem Bhaiya style**

① Find initial velocity $= \vec{u}_i = 60\hat{i} + 80\hat{j}$



② Find acc when particle is in air

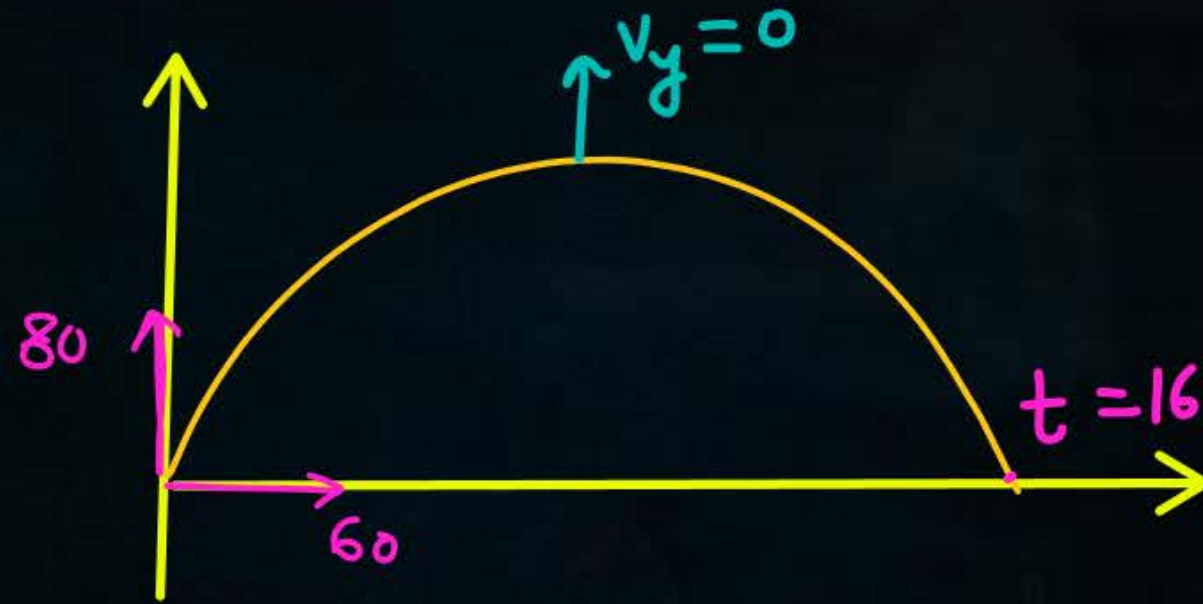
$$\vec{a} = -10\hat{j}$$

③ Time of flight
 $= 8 + 8 = 16$

④ $h_{\max} = ?$

SKC \rightarrow h_{\max} के लिए 'y' में
 3^{rd} eqⁿ लगाओ / Stopping distance.

④ $\Rightarrow 0^2 = 80^2 - 2 \times 10 \times h_{\max}$
 $h_{\max} = \frac{80^2}{20} = 320$



⑤ Find range

$R = 60 \times T = 60 \times 16$

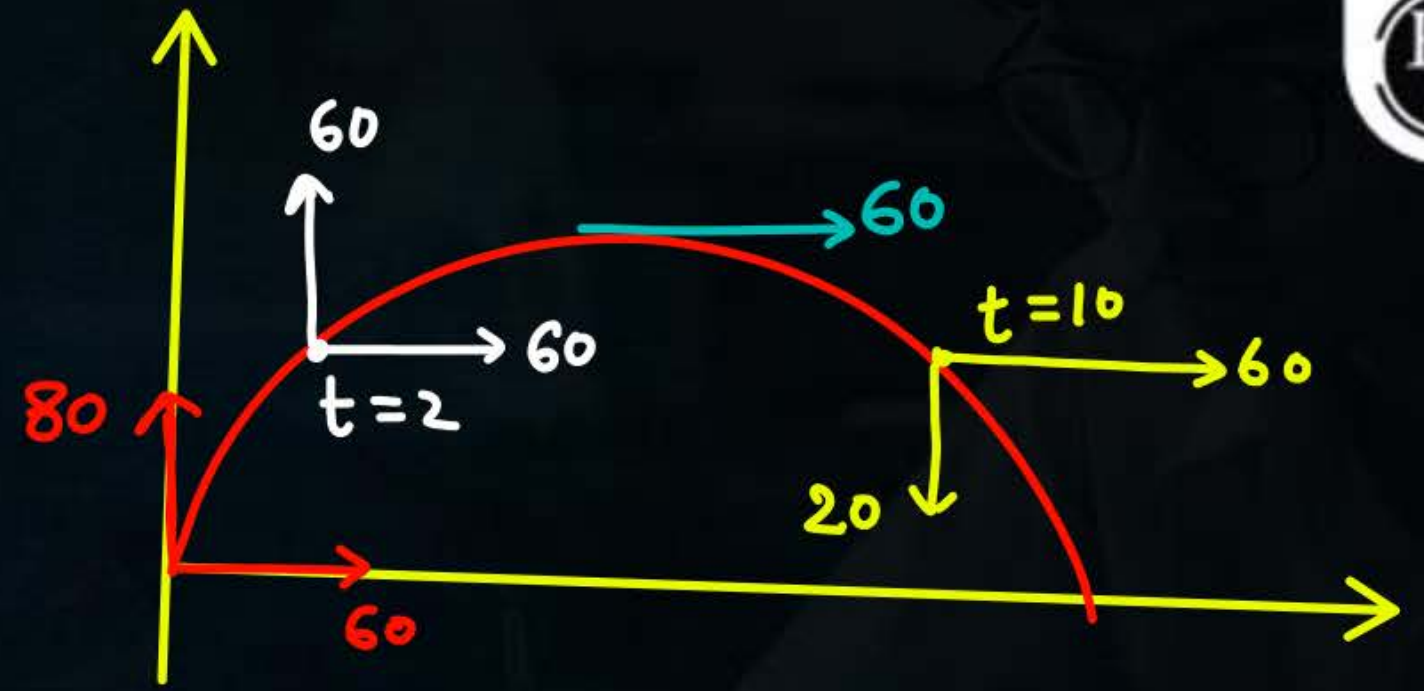
$R = 960$

⑥ $t=2, \vec{v} = 60\hat{i} + 60\hat{j}$

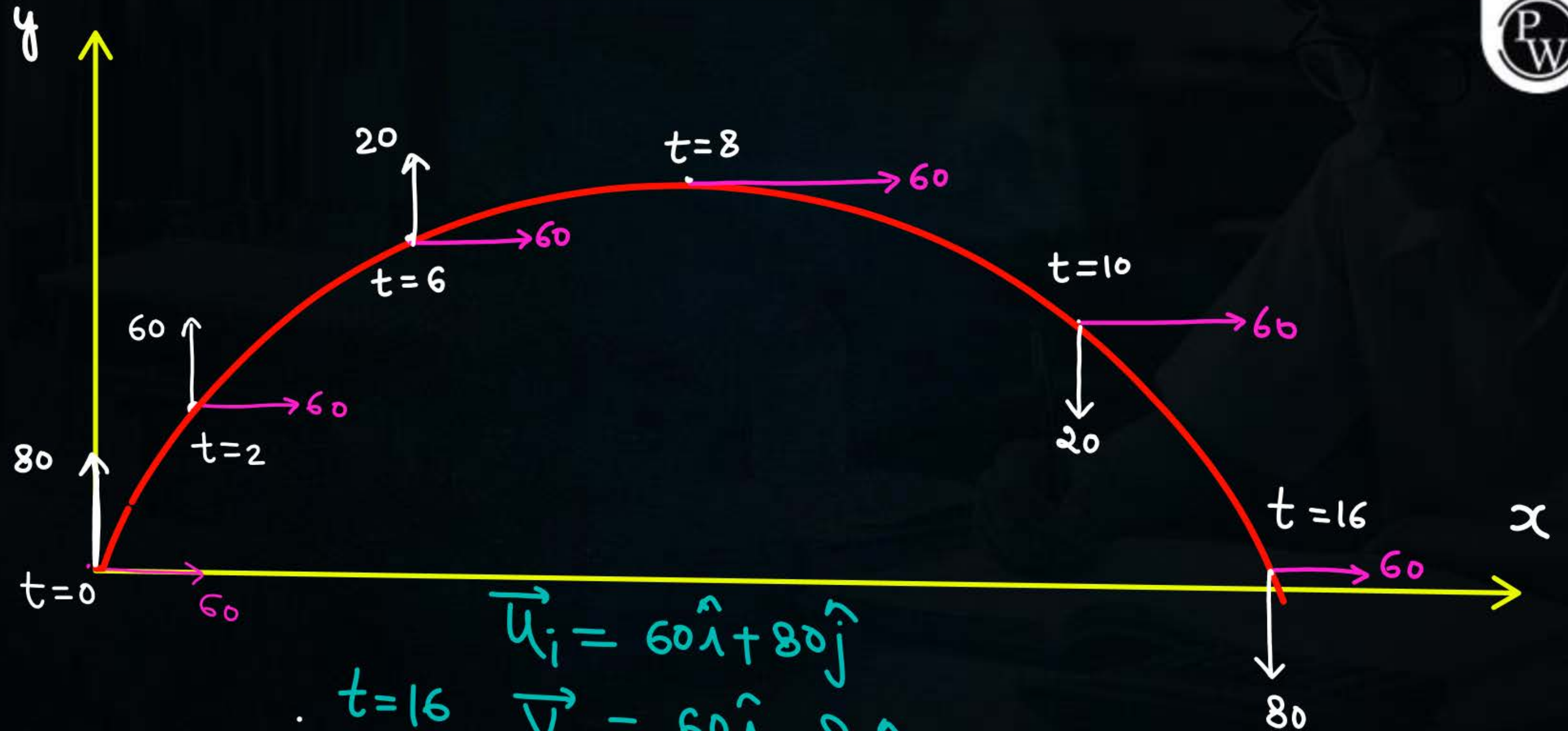
$t=10 \quad \vec{v} = 60\hat{i} - 20\hat{j}$

⑦ Find velocity at highest point
Zero \times $\vec{v} = 60\hat{i}$

⑧ $t=0 \longrightarrow t=2$ Avg velocity = $\frac{\vec{u}_i + \vec{v}}{2} = \frac{(60\hat{i} + 80\hat{j}) + (60\hat{i} + 60\hat{j})}{2}$
 $= 60\hat{i} + 70\hat{j}$



⑨



$$\vec{u}_i = 60\hat{i} + 80\hat{j}$$

$$t=16, \vec{v}_f = 60\hat{i} - 80\hat{j}$$

$$\text{Change in velocity} = \vec{v}_f - \vec{u}_i = -160\hat{j}$$

⑩ find angle made by \vec{v} with +x Axis at $t=2\text{ sec}$.

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

Vector $\tan \alpha = \frac{v_y}{v_x} = \frac{60}{60} = 1$

$$\boxed{\alpha = 45^\circ}$$

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

$$\tan \alpha = \frac{v_y}{v_x}$$



⑪ $t=2$, $\vec{v} = 60\hat{i} + 60\hat{j}$
 $t=10$, $\vec{v} = 60\hat{i} - 20\hat{j}$

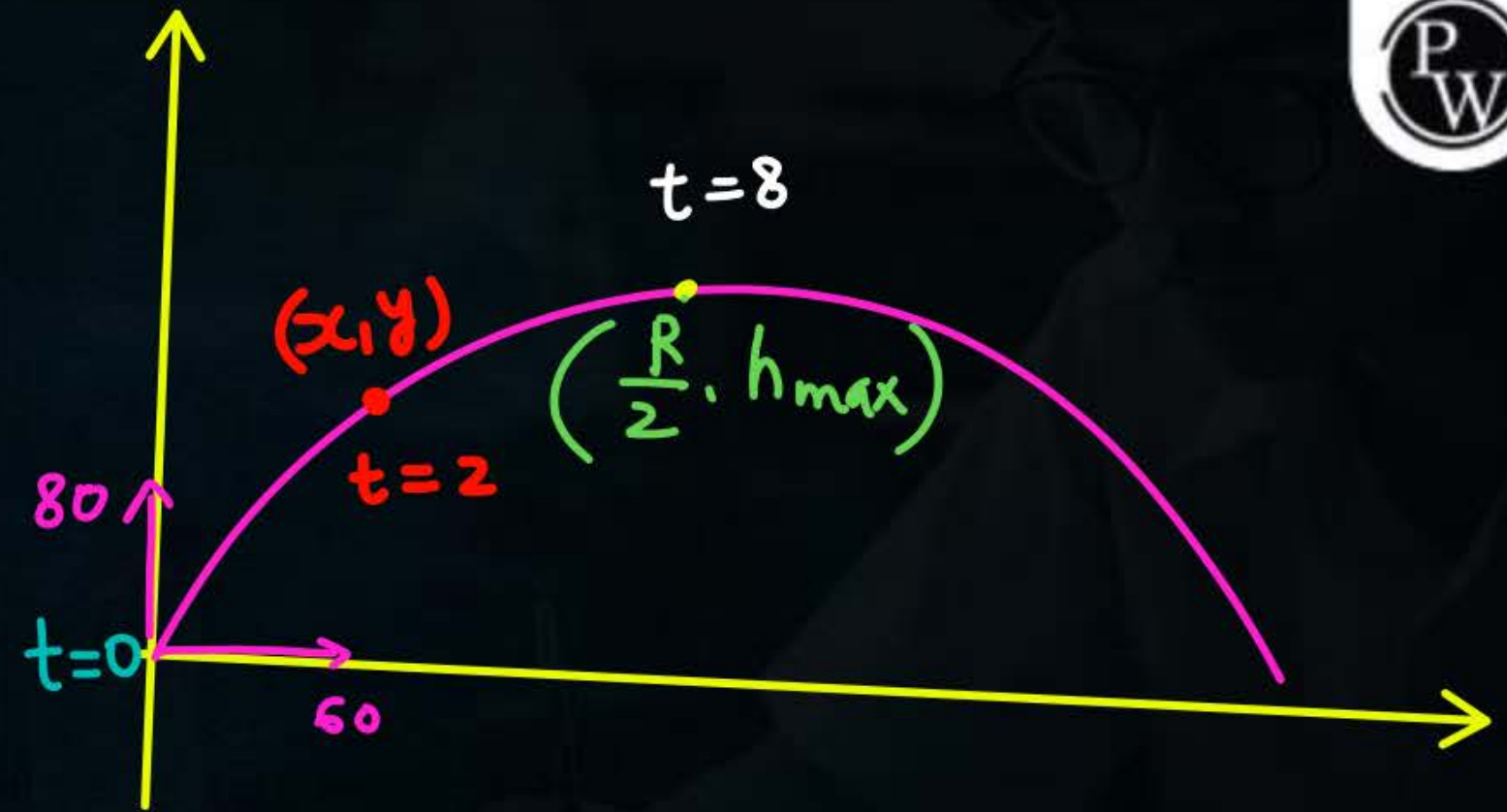
find location of particle at $t=2\text{sec}$

$$x = 60 \times 2 = 120$$

$$y = 80 \times 2 - \frac{1}{2} \times 10 \times 2^2 = 140$$

$$t=2, (x, y) = (120, 140)$$

$$\vec{r} = 120\hat{i} + 140\hat{j}$$



⑫ Co-ordinate of highest point $t=8$

$$x = 60 \times 8 = 480$$

$$y = 80 \times 8 - \frac{1}{2} \times 10 \times 8^2 = 320$$

⑬ find $\vec{v} = f(t)$

y में $v_y = u_y + a_y t$

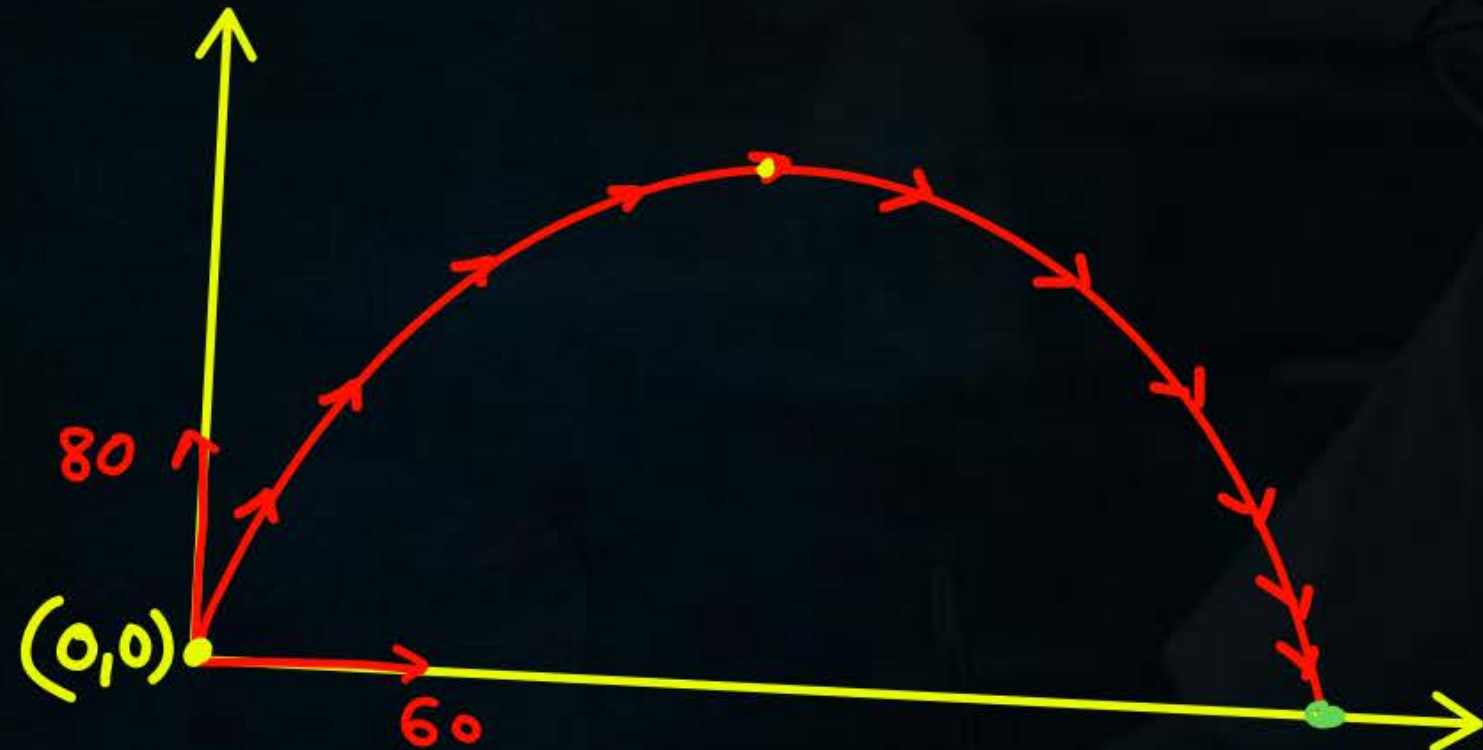
$$v_y = 80 - 10t$$

$$\vec{v} = 60\hat{i} + (80 - 10t)\hat{j}$$

⑭ find x & y co-ordinate at time 't'

$$x = 60 \times t$$

$$y = 80t - \frac{1}{2} \times 10 \times t^2$$



⑮ Find eqⁿ of trajectory.

*SKC \equiv time को eliminate करके
x & y में Relation निकालो

⑮

$$x = 60t$$

$$\rightarrow t = \frac{x}{60}$$

$$y = 80t - \frac{1}{2} \times 10 \times t^2$$

$$y = 80 \frac{x}{60} - 5 \left(\frac{x}{60} \right)^2$$

$$y = \frac{4}{3}x - \frac{x^2}{720}$$

you may skip

(16)

$$y = -\frac{x^2}{720} + \frac{4}{3}x$$

$$\frac{dy}{dx} = -\frac{2x}{720} + \frac{4}{3} = 0$$

$$-\frac{x}{360} + \frac{4}{3} = 0$$

$$\frac{x}{360} = \frac{4}{3}$$

$$x = 480$$

maje
Lens
ke
liye
hai

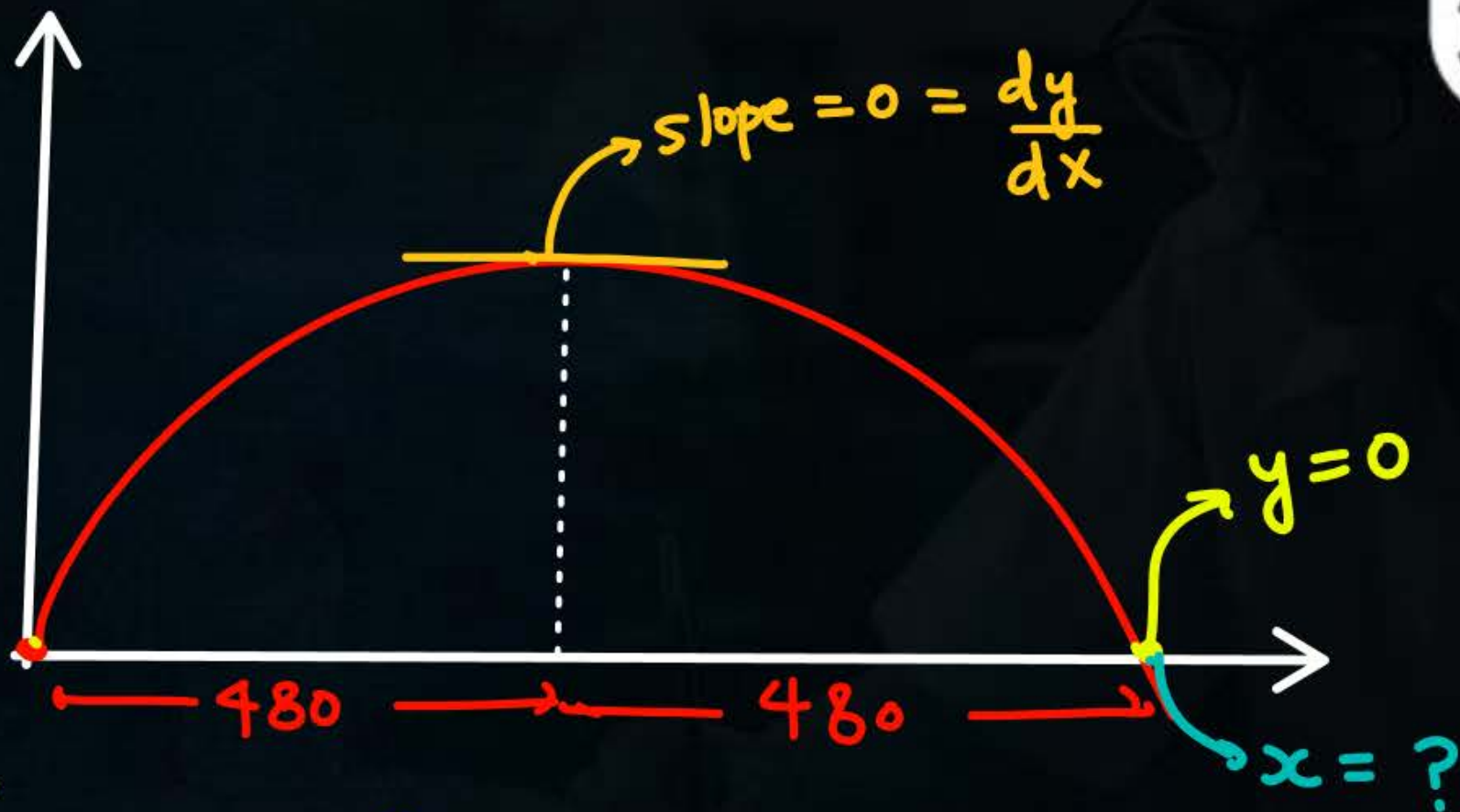
$$y = -\frac{x^2}{720} + \frac{4x}{3}$$

$$y=0,$$

$$-\frac{x^2}{720} + \frac{4x}{3} = 0$$

$$\frac{x}{720} = \frac{4}{3}$$

$$x = \frac{720 \times 4}{3} = 960 = \text{Range}$$



(17) Find when particle velocity become perpendicular to initial velocity.

Sol $\vec{v} \cdot \vec{u} = 0$

$$\vec{u} = 60\hat{i} + 80\hat{j}$$

$$\vec{v} = 60\hat{i} + (80 - 10t)\hat{j}$$

$$\vec{v} \cdot \vec{u} = 3600 + 80(80 - 10t) = 0$$

$$3600 + 6400 - 800t = 0$$

$$\boxed{t = \frac{100}{8}}$$



find when particle move perpendicular to its initial velocity.



⑮ find when velocity of particle become perpendicular to acc.

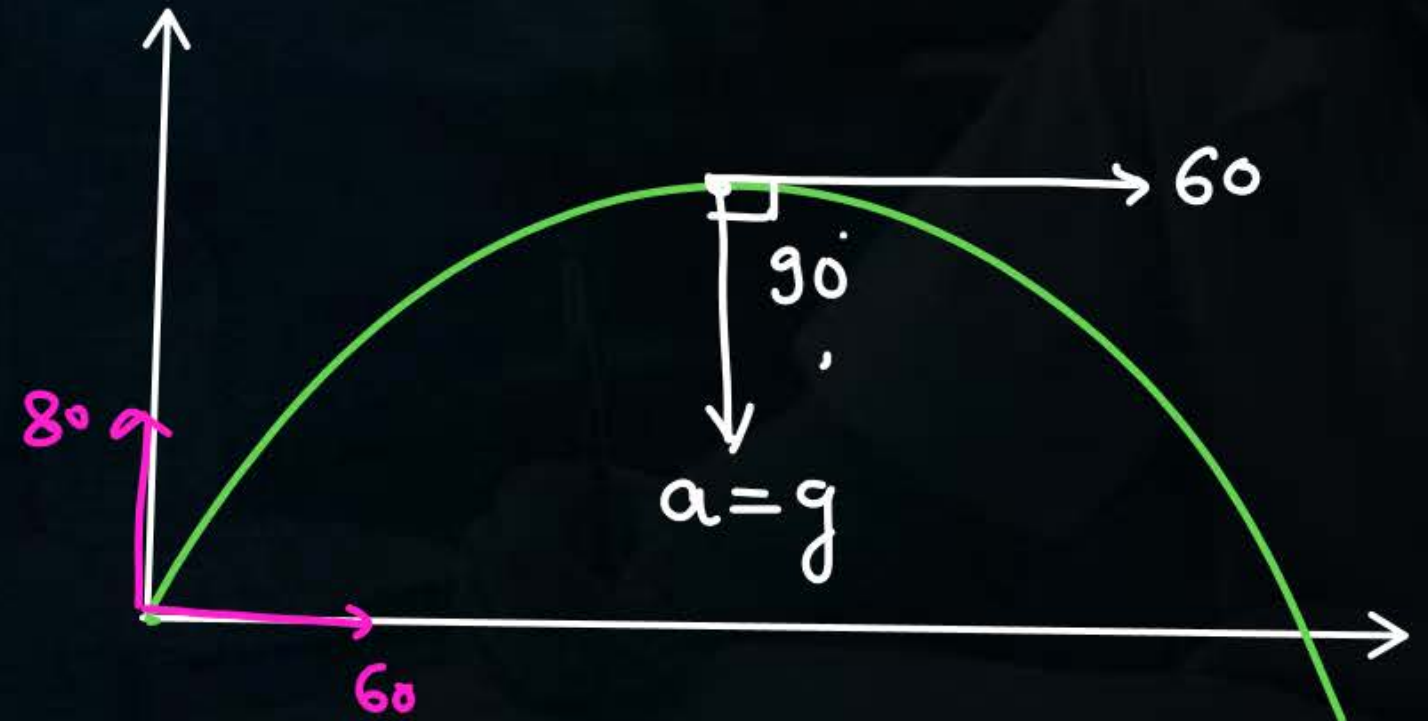
$$\vec{v} \cdot \vec{a} = 0$$

$$\vec{v} = 60\hat{i} + (80 - 10t)\hat{j}$$

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

$$\vec{v} \cdot \vec{a} = 0 - 10(80 - 10t) = 0$$

$$\boxed{t=8} \text{ (highest point)}$$



19

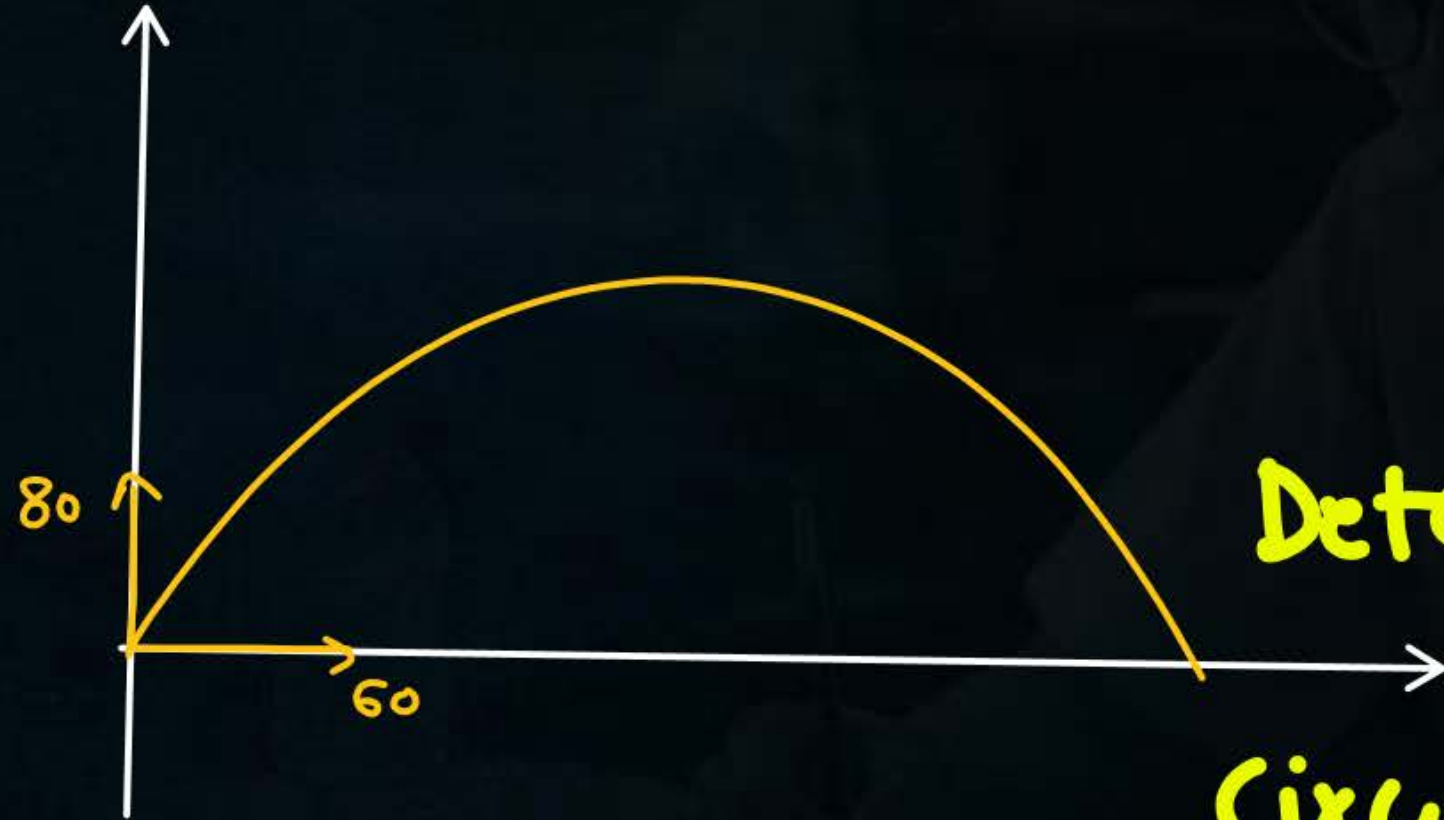
$$t=2, \vec{v} = 60\hat{i} + 60\hat{j}$$

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

Component of acc along velocity

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

$$\text{Vector} \Rightarrow (a \cos \theta) \hat{v} = \checkmark$$



Detail में

Circular
Motion
में

Pachange

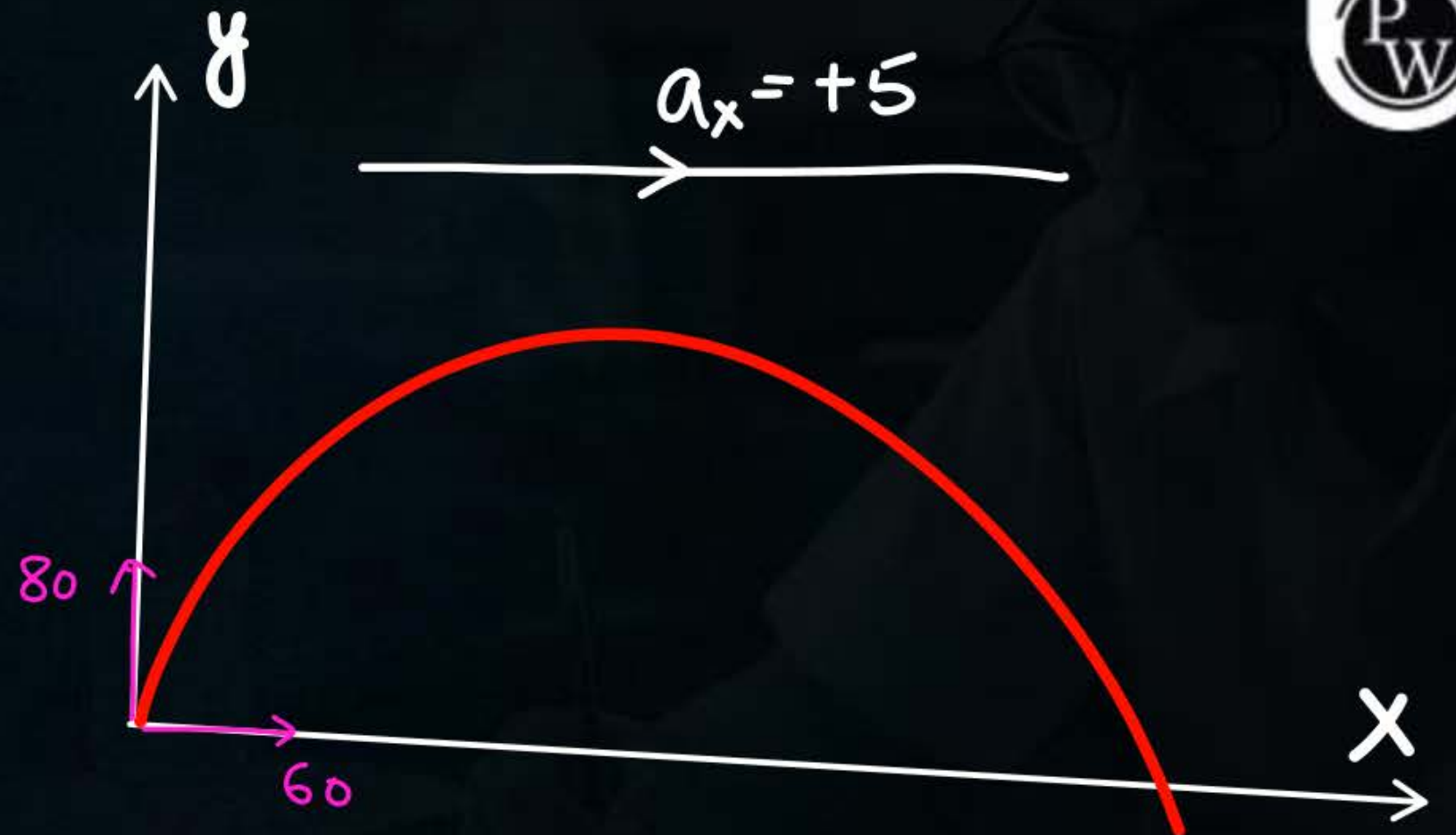
20 Let air start flowing such that net horizontal acc. of the particle become $a_x = 5$
find

$$T = \text{Same} = 16$$

$$H_{\max} = 320$$

$$\begin{aligned} \text{Range} &= u_x t + \frac{1}{2} a_x t^2 \\ &= 60 \times 16 + \frac{1}{2} \times 5 \times 16^2 \end{aligned}$$

$$\begin{aligned} t=2, \quad \vec{v} &= 70\hat{i} + 60\hat{j} \\ \vec{a} &= 5\hat{i} - 10\hat{j} \end{aligned}$$



$$\begin{aligned} t=2, \text{ location } x &= 60 \times 2 + \frac{1}{2} \times 5 \times 2^2 \\ y &= 80 \times 2 - \frac{1}{2} \times 10 \times 2^2 \end{aligned}$$

$$\vec{r} = x\hat{i} + y\hat{j}$$

(21)

$$\vec{r} = \checkmark$$

$$\vec{v} = \checkmark$$

$$\text{Angular momentum} = \vec{r} \times m\vec{v}$$

$$\tau_{mg} = \vec{r} \times \vec{F}$$

Rotation motion

Q $T = 12$

$$h_{\max} = \frac{60^2}{2 \times 10} = 180$$

$$R = 12 \times 40 = 480$$

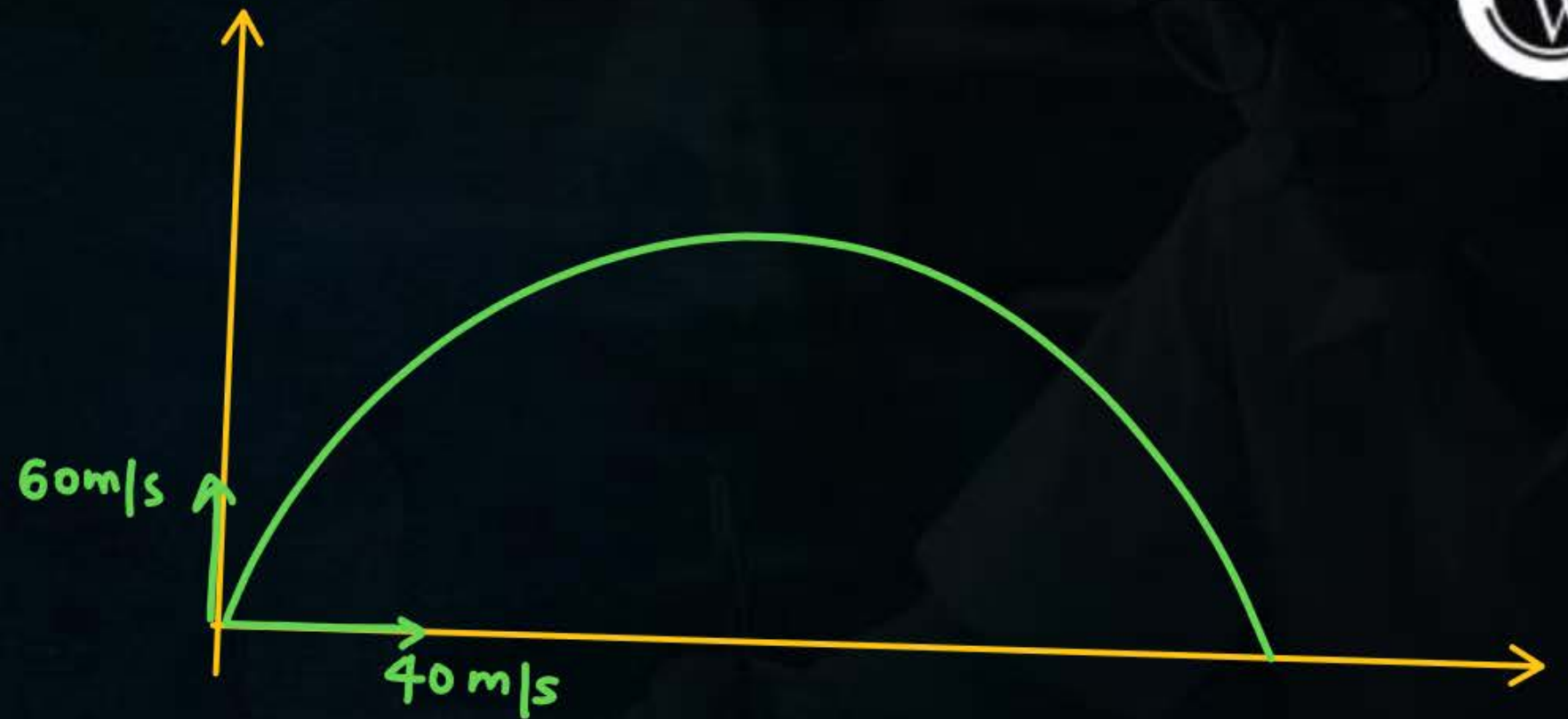
$$t = 2, \quad \vec{v} = 40\hat{i} + 40\hat{j}$$

$$t = 11, \quad \vec{v} = 40\hat{i} - 50\hat{j}$$

$$t = 2, \quad x = 40 \times 2 = 80$$

$$y = 60 \times 2 - \frac{1}{2} \times 10 \times 2^2 = 100$$

$$\vec{r} = 80\hat{i} + 100\hat{j}$$



$$x = 40t$$

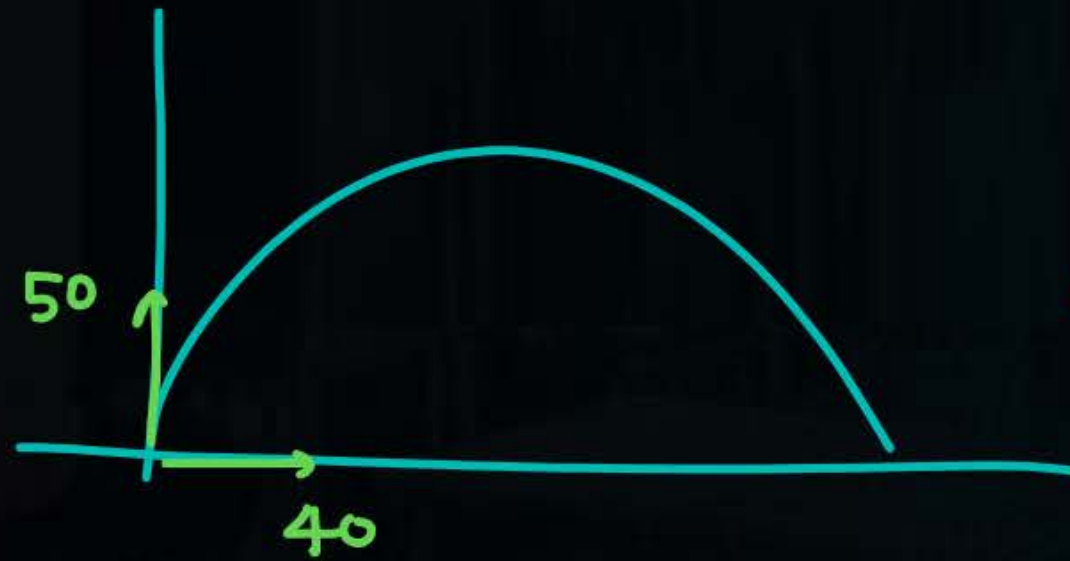
$$v = f(t)$$

$$y = 60t - \frac{1}{2} \times 10 \times t^2$$

$$v = 40\hat{i} + (60 - 10t)\hat{j}$$

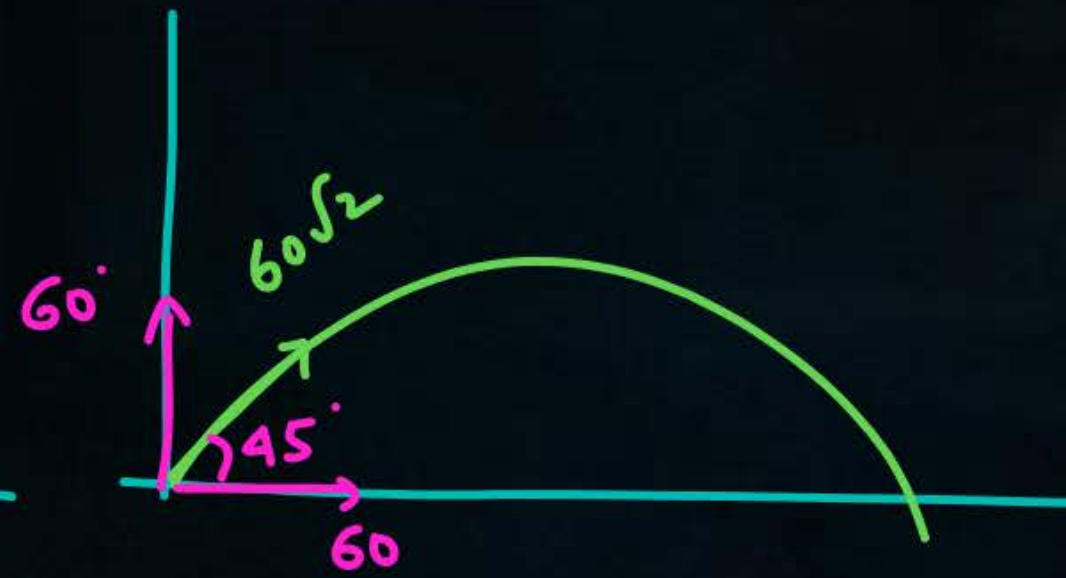
Eqⁿ of trajectory

$$t = \frac{x}{40}, \quad y = 60 \times \frac{x}{40} - 5 \frac{x^2}{1600}$$



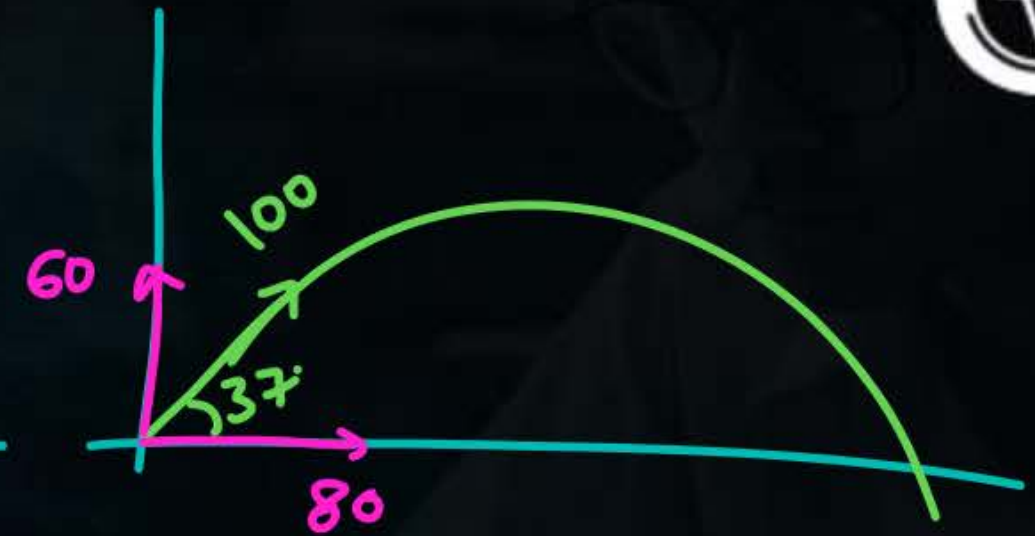
$$T = 10$$

$$R = 40 \times 10 = 400$$



$$T = 12$$

$$R = 720$$



$$T = 12$$

$$R = 80 \times 12 = 960$$



Homework

- KPP-16 kal kar lena.... isme H.W wale ques add karwa raha hu sham tak will upload.
- Revise vector & today lecture.
- KPP-15 (level-1) \Rightarrow video will be uploaded tonight
- PYQ KPP (level-1) one liner 1 min ques. will be uploaded 7pm.

THANK
YOU