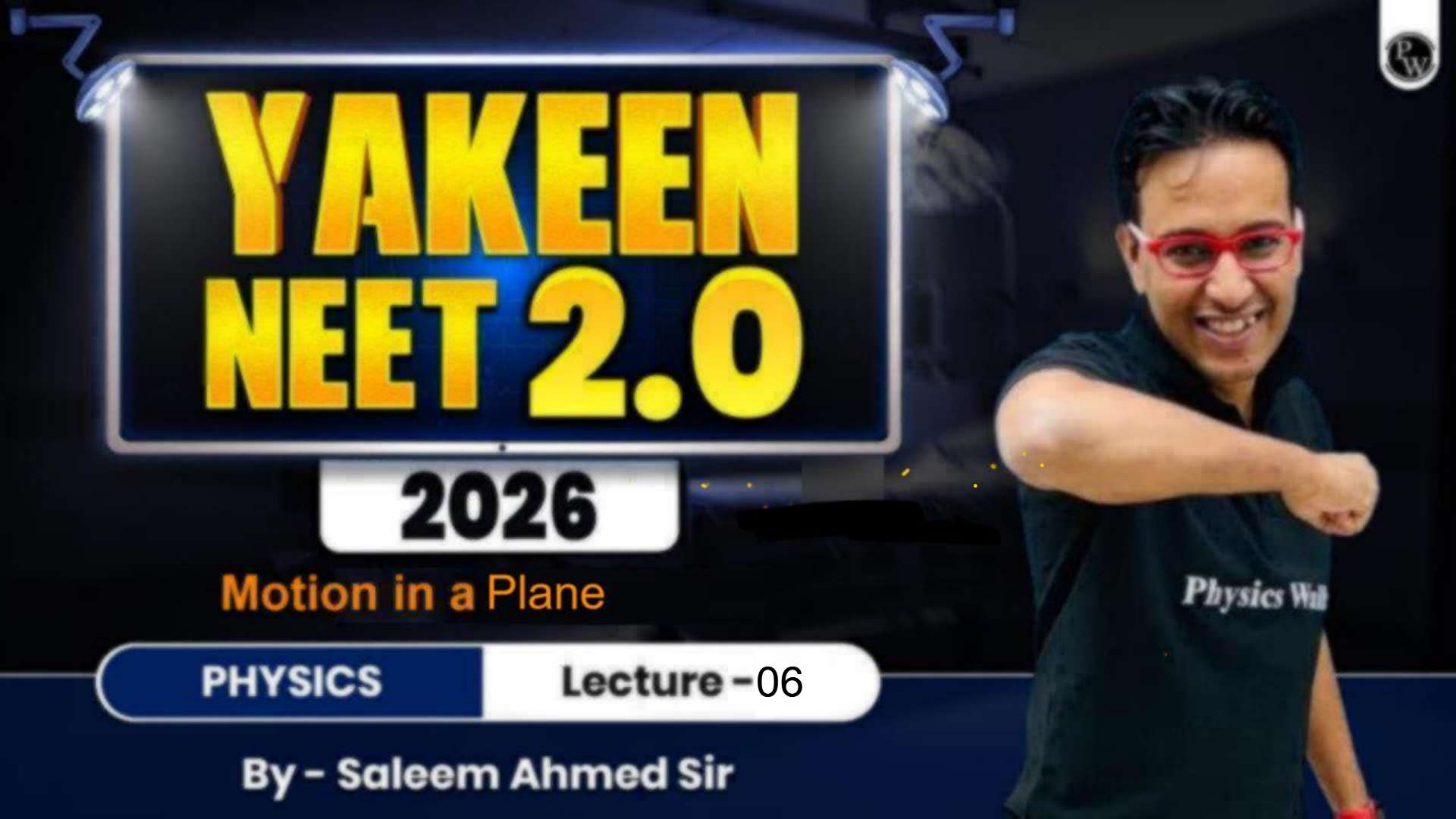

YAKEEN
NEET 2.0
2026
Motion in a Plane
PHYSICS
Lecture -06
By - Saleem Ahmed Sir

Todays Goal

- Projectile motion

- Inclined plane

Q $KE = \frac{1}{2}mv^2$

If v is increase by 3%.

KE will increase by $\longrightarrow$ 6%

$$K = \frac{1}{2}mv^2$$

$$\frac{\Delta K}{K} \times 100 = 2\frac{\Delta v}{v} \times 100$$

$$= 2 \times 3\% = 6\%$$

Q $K = \frac{1}{2}mv^2$

If v is increase by 50% $\longrightarrow$ बहुत ज्यादा है

then KE will increase by $\longrightarrow$ ~~$2 \times 50\% = 100\%$~~

$$\cancel{\frac{\Delta K}{K} = \frac{\Delta m}{m} + 2\frac{\Delta v}{v}}$$

$$\cancel{\frac{\Delta K}{K} = 0 + 2 \times 50\%} \Longrightarrow 100\%$$

Basic Method

$$KE_i = \frac{1}{2}mv^2 = K$$

$$(KE)_f = \frac{1}{2}m(1.5v)^2 = 2.25K$$

% change in K.E $= \frac{2.25K - K}{K} \times 100$

$= 1.25 \times 100$

$= 125\%$

10 का $3\% = \frac{10 \times 3}{100} = .3$

$KE = \frac{1}{2} m v^2$

Let $m = 2\,kg$, $V = 10\,m/s$ $\xrightarrow{V \uparrow \text{ by } 3\%}$ $V = 10.3\ m/s.$

$KE = \frac{1}{2} \times 2 \times 10^2 = 100$

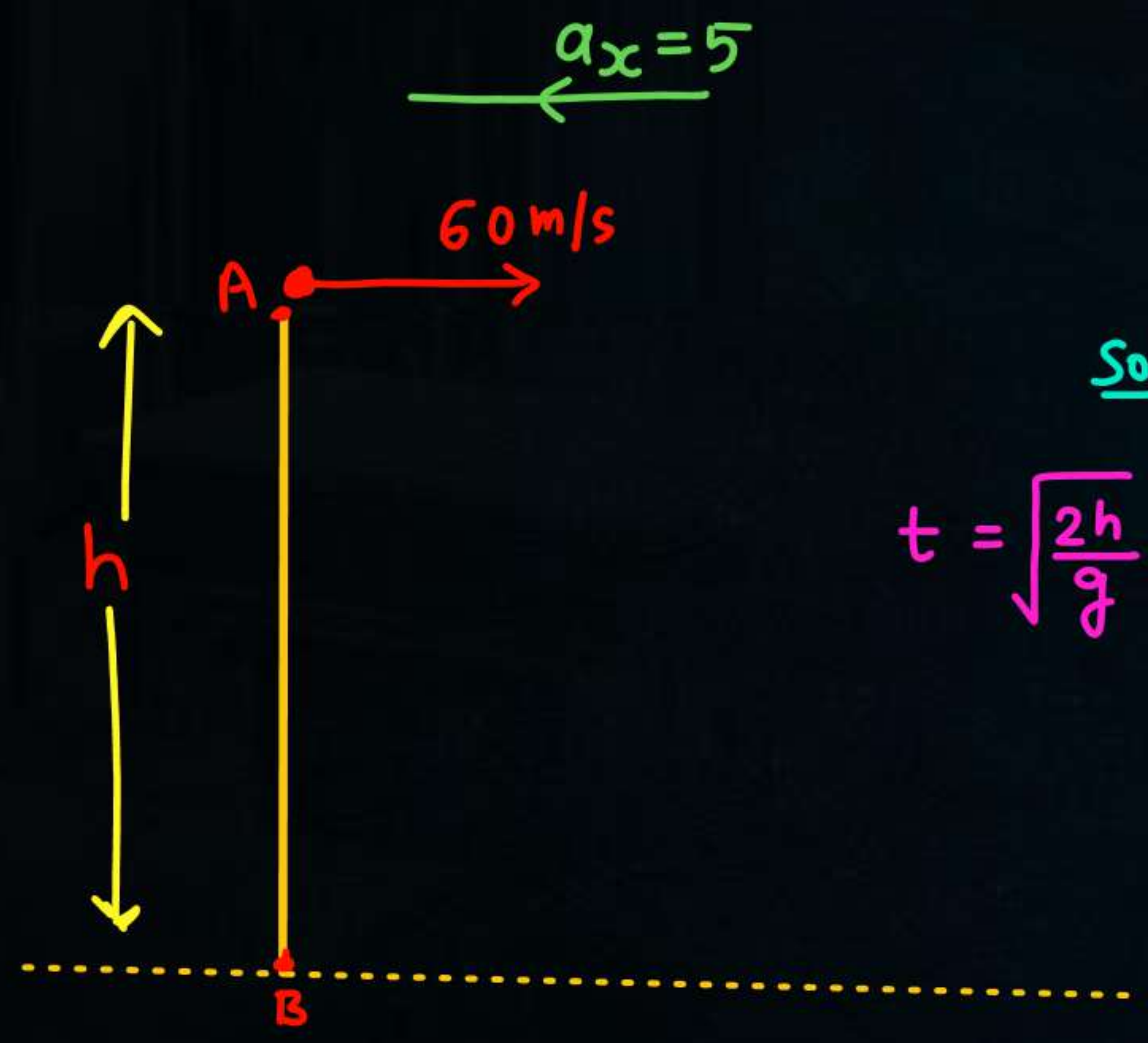
$KE = \frac{1}{2} m v^2 = \frac{1}{2} \times 2 \times (10.3)^2$

$= 106.09$

% increase in K.E. $= \frac{K_f - K_i}{K_i} \times 100$ $= \frac{106.09 - 100}{100} \times 100$

$= 6.09 \approx \underline{\underline{6\%}}$

Q

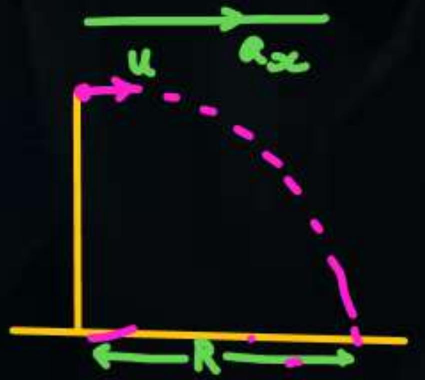


If particle strike at point 'B'. find 'h'.

Sol^n

$t = \sqrt{\frac{2h}{g}}$

360
180



$R = 0$

$0 = \cancel{R} = 60t - \frac{1}{2} \times 5 \times t^2$

$60t = \frac{5}{2} t^2$

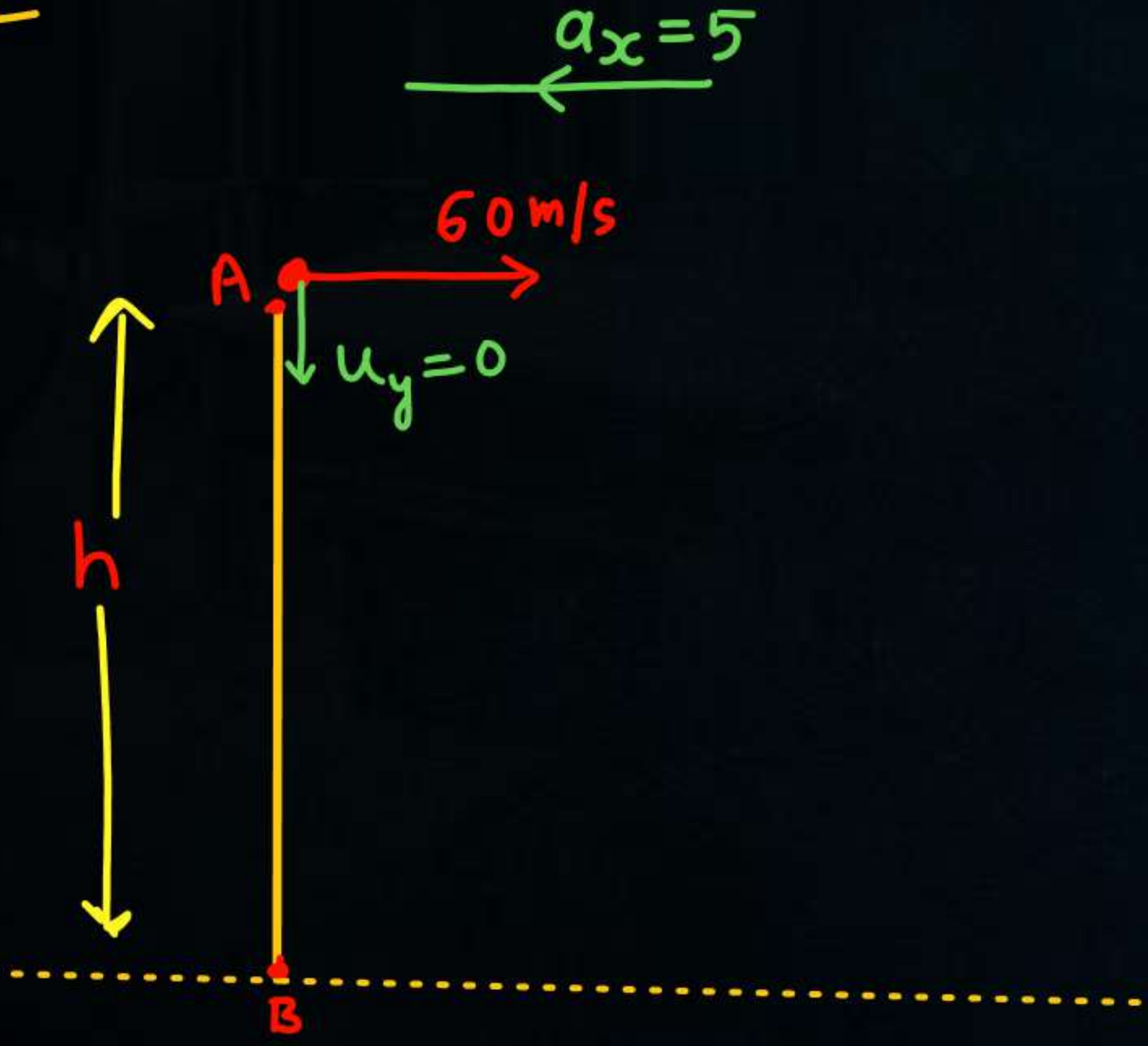
$\frac{120}{5} = t = \sqrt{\frac{2h}{g}}$

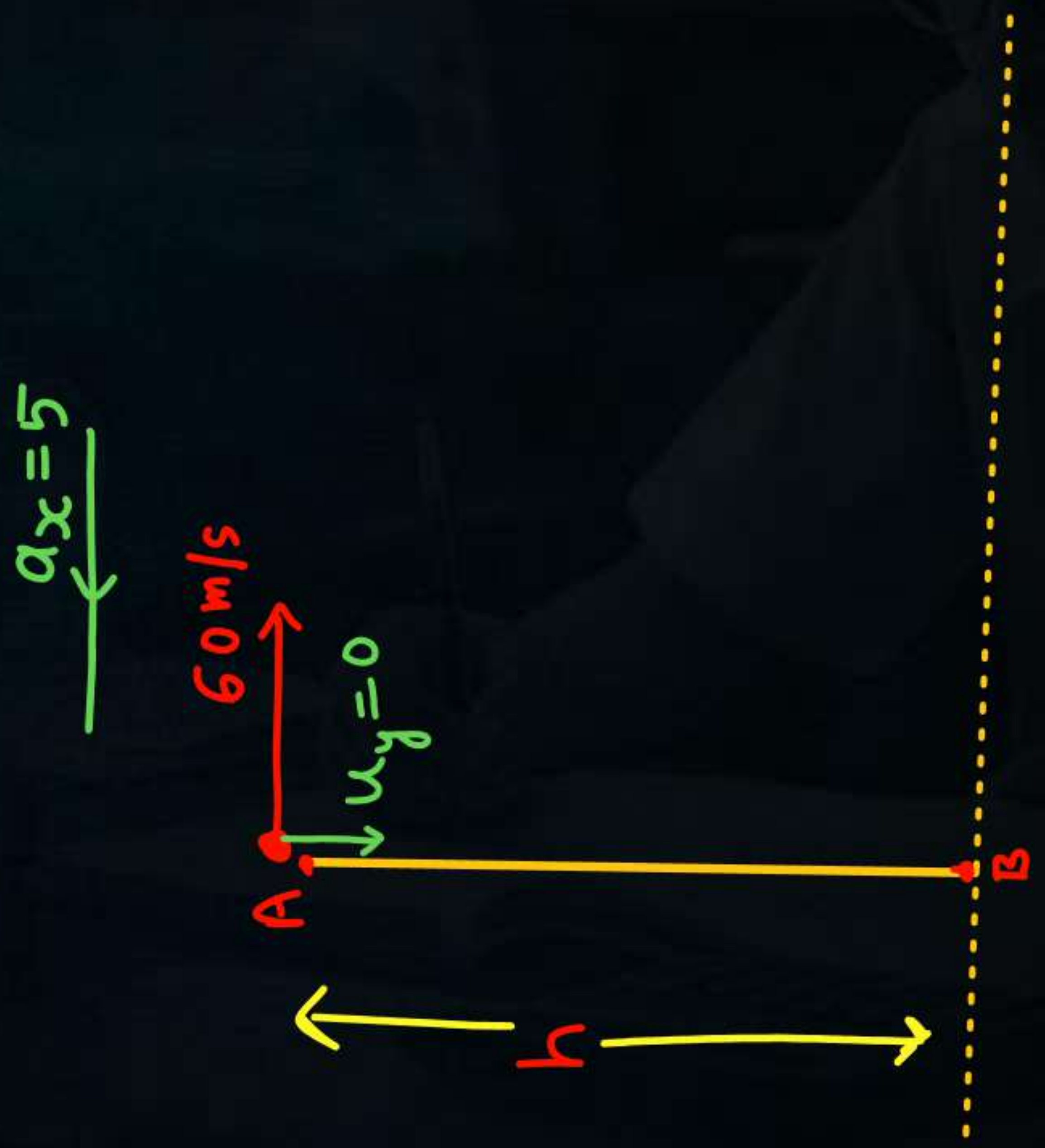
$24 = \sqrt{\frac{2h}{10}}$

$h = \frac{5760}{2}$

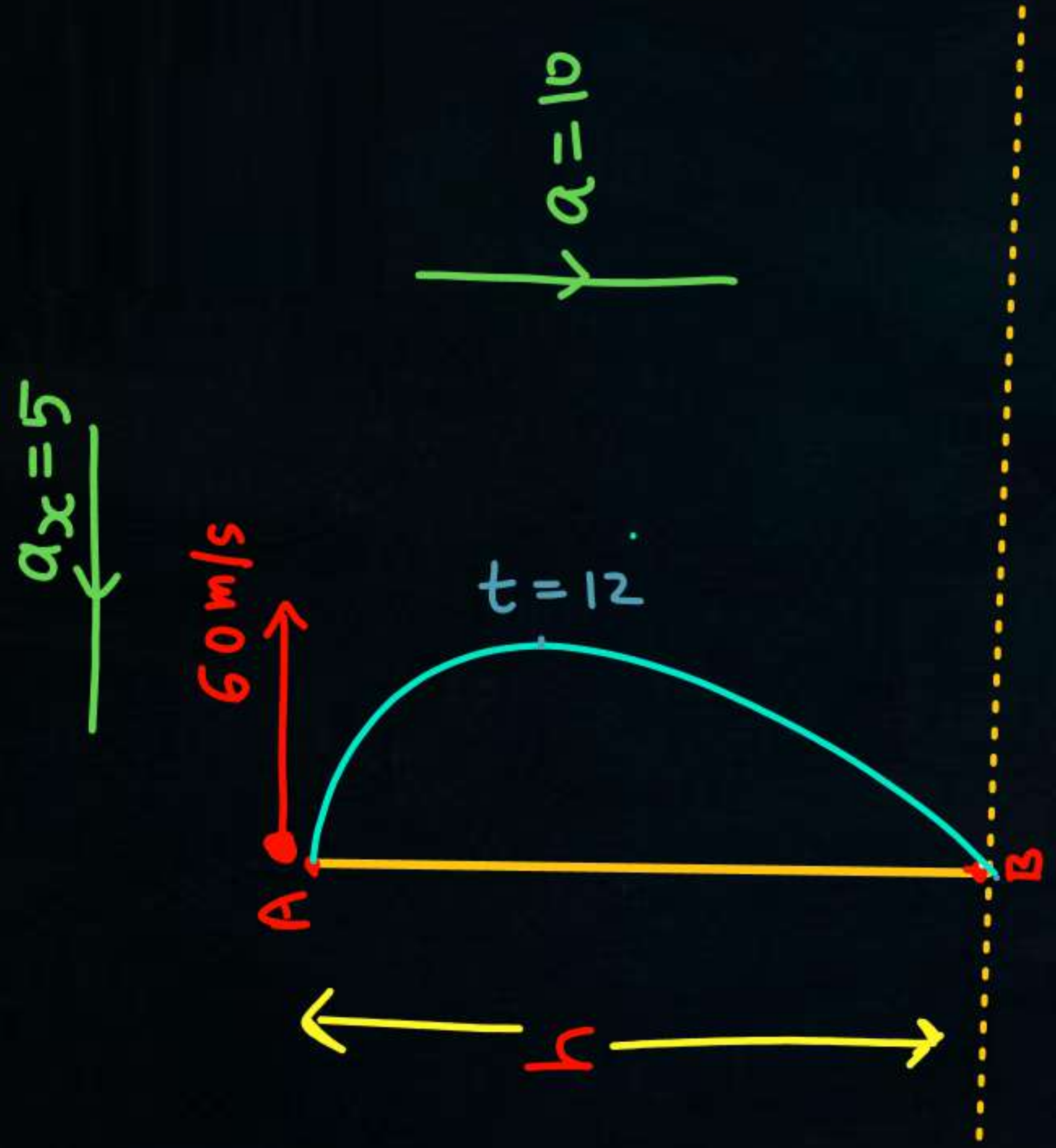
$h = 2880$

Q





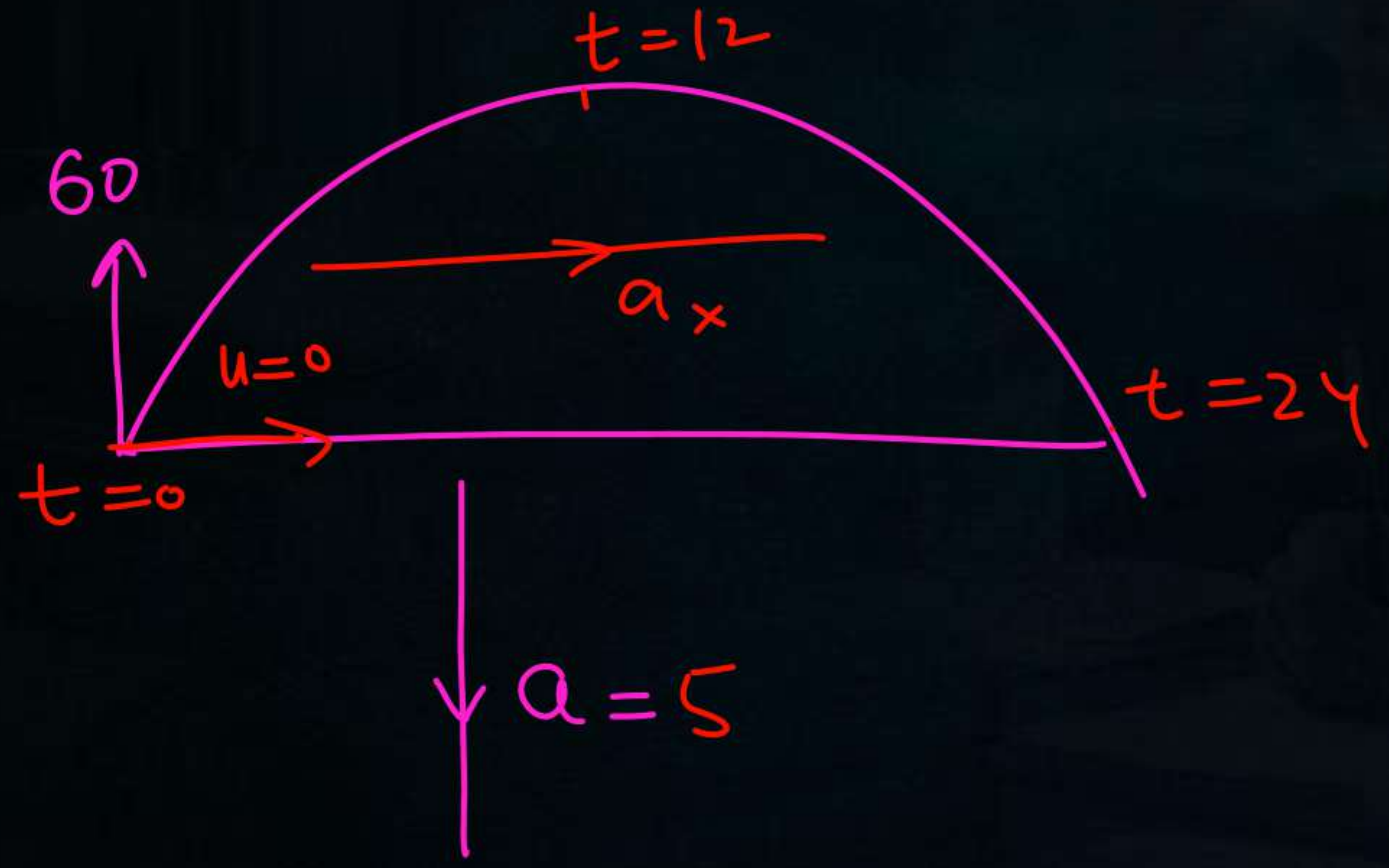
Q M-3



$T = 24$ sec.

$h = 0 + \frac{1}{2} \times 10 \times (24)^2$

$h = 5 \times 576 = \underline{2880}$


t=12
60
a_x
u=0
t=24
t=0
a=5

or

$x \Rightarrow \quad x = u_x t + \frac{1}{2} a_x t^2$

$0 = 60t - \frac{1}{2} 5 \cdot t^2$ —— ①

$y \Rightarrow \quad y = u_y t + \frac{1}{2} a_y t^2$

$h = 0 + \frac{1}{2} \times 10 \times t^2$ — ②

Solve & get

$$T = \frac{2u\sin\theta}{g}$$

$$h_{max} = \frac{u^2\sin^2\theta}{2g}$$

$\rightarrow$ max, $\theta = 90^\circ$

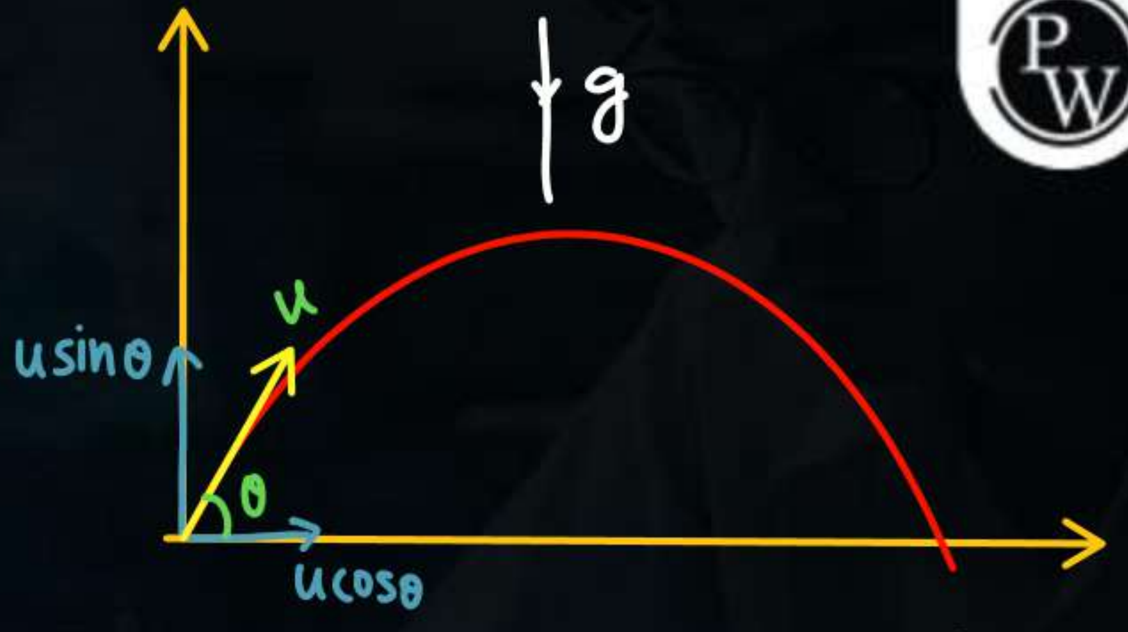
$\rightarrow$ Agar kisi do particle का $u\sin\theta$ same hai To unka h_{max}, T bhi Same hoga.

$$R = \frac{u^2\sin 2\theta}{g}$$

U(fix) $\rightarrow$ At $\theta = 45^\circ$, R_{max}

$$R_{max} = \frac{u^2}{g}$$

U(fix) $\rightarrow$ $\theta, (90-\theta) \rightarrow$ Same Range



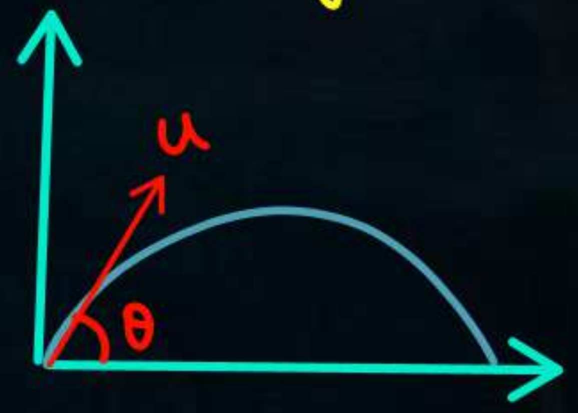
		Range
$\theta = 10^\circ$,	$\theta = 80$	Same
$\theta = 20^\circ$	$\theta = 70$	Same
$\theta = 30$	$\theta = 60^\circ$	Same
$\theta = 37$	$\theta = 53$	Same

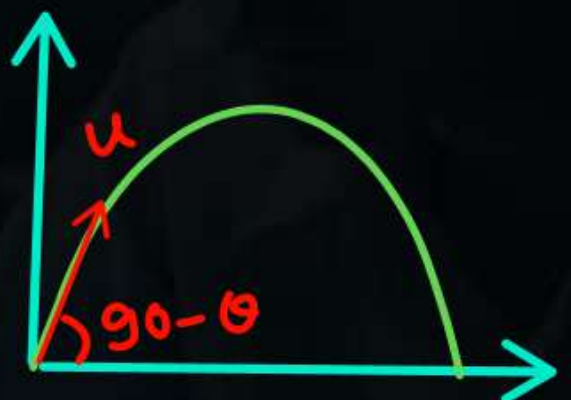
$$R = \frac{u^2 \sin 2\theta}{g}$$

1. $R_{max} \Longrightarrow (\sin 2\theta)_{max} \Longrightarrow 2\theta = 90$

$$\theta = 45^\circ$$

$$R = \frac{u^2 \sin 2\theta}{g}$$





$$R = \frac{u^2 \sin 2\theta}{g}$$

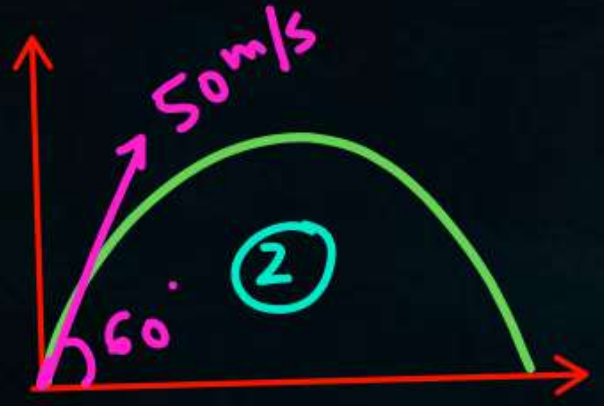
$$R = \frac{u^2 \sin 2(90-\theta)}{g}$$

$$R = \frac{u^2 \sin(180-2\theta)}{g}$$

$$R = \frac{u^2 \sin 2\theta}{g}$$

same

(1)



(1) Ratio of time of flight $\Rightarrow$ $\dfrac{T_1}{T_2} = \dfrac{u_1 \sin\theta_1}{u_2 \sin\theta_2} = \dfrac{100 \sin 45^\circ}{50 \sin 60} = \checkmark$

(2) $\dfrac{(H_1)_{max}}{(H_2)_{max}} = \left(\dfrac{u_1 \sin\theta_1}{u_2 \sin\theta_2}\right)^2 = \left(\dfrac{100 \sin 45}{50 \sin 60}\right)^2 = \checkmark$

$T \propto u \sin\theta$

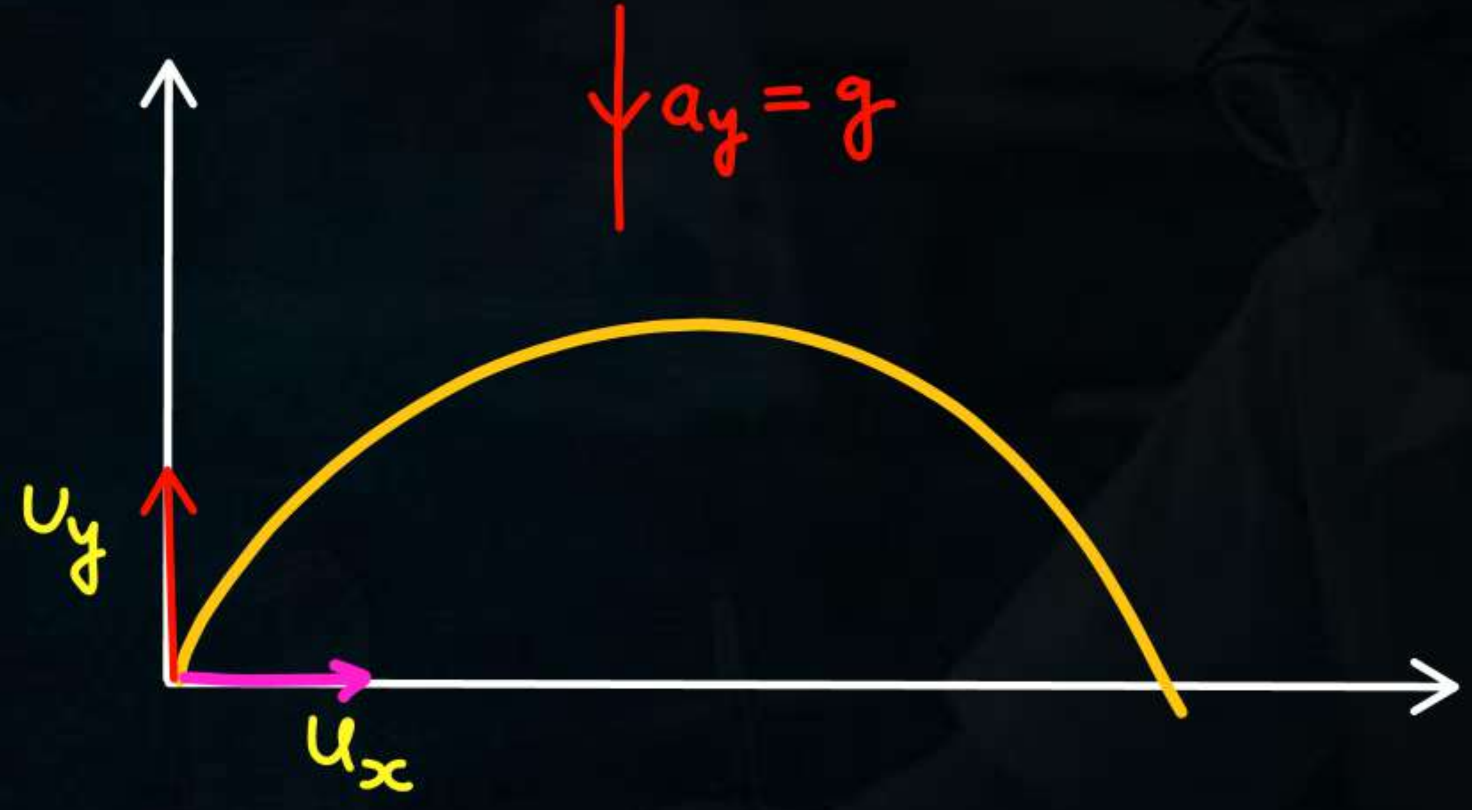
$H_{max} \propto u^2 \sin^2\theta$

$$T = \frac{2u_y}{a_y}$$

$$h_{max} = \frac{u_y^2}{2a_y}$$

$$R = \frac{2u_x u_y}{a_y}$$

$$a_x = 0$$



$$R = u_x \cdot T = u_x \times \frac{2u_y}{a_y}$$

रटना नहीं है

Q

$h_{max} \Rightarrow 1 = 2 > 3$

$U_y = u\sin\theta \Rightarrow 1 = 2 > 3$

$T \Rightarrow 1 = 2 > 3$

$\text{Range} \Rightarrow 1 = 3 < 2$

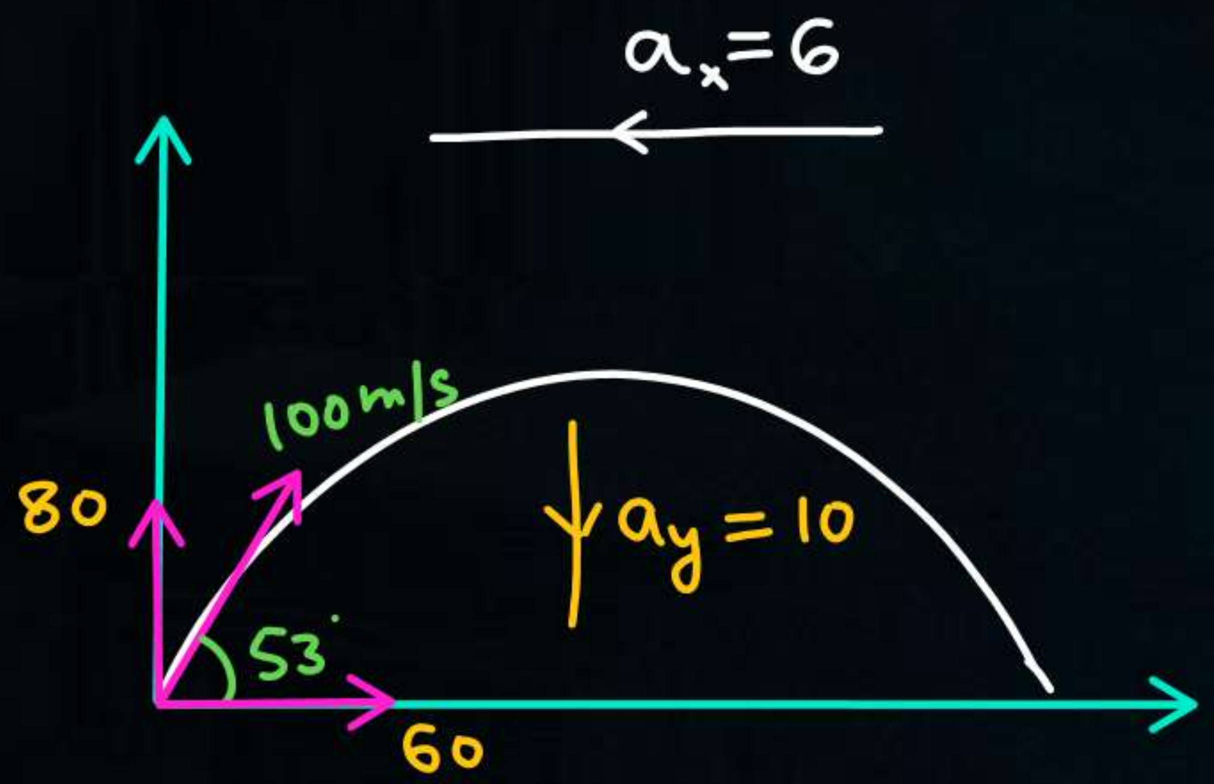
1 & 2 $\Rightarrow T, H_{max}, U_y \longrightarrow$ same

$R_2 > R_1$

$(u_x)_2 > (U_x)_1$

$u_2\cos\theta_2 > u_1\cos\theta_1$

Q

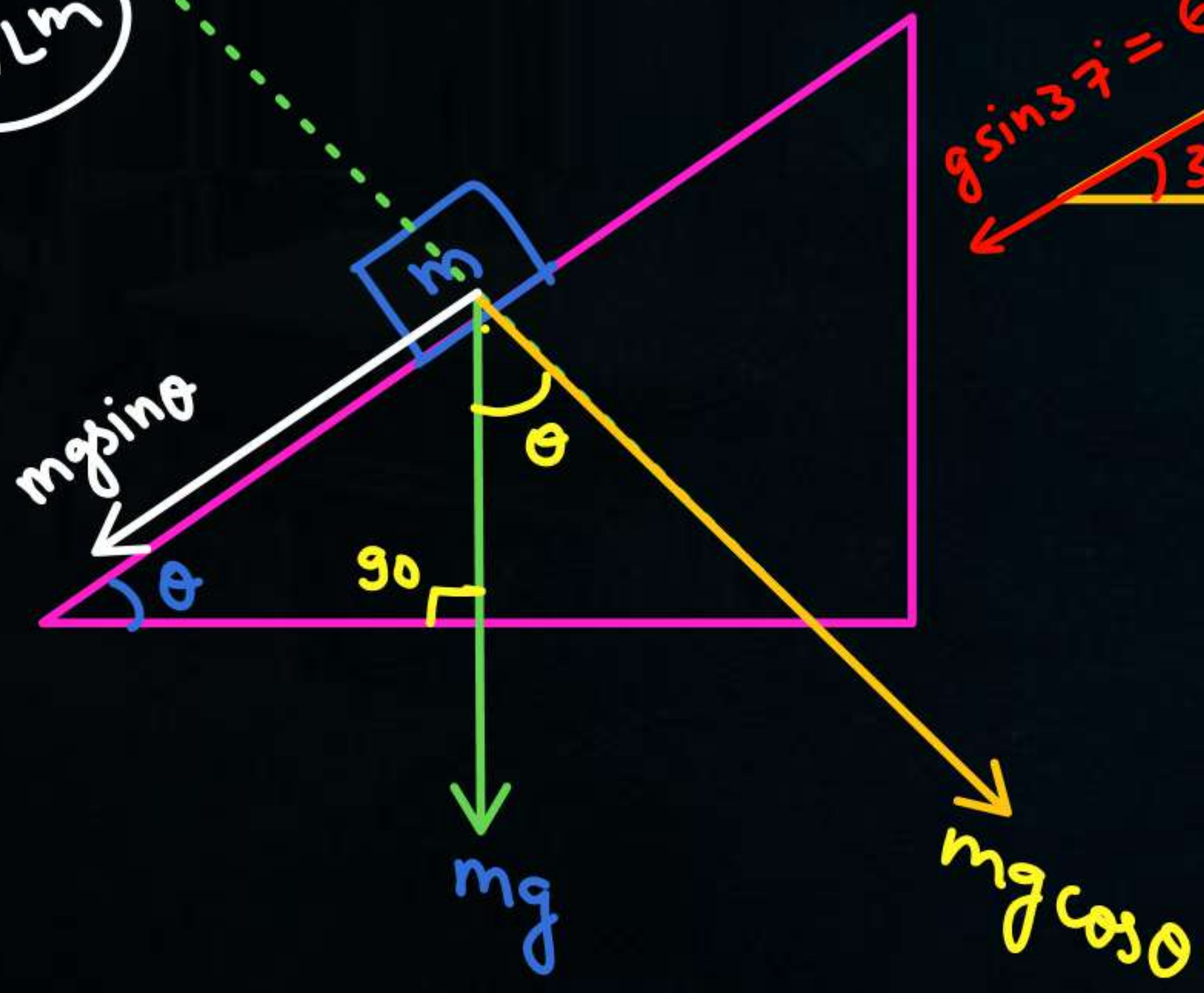


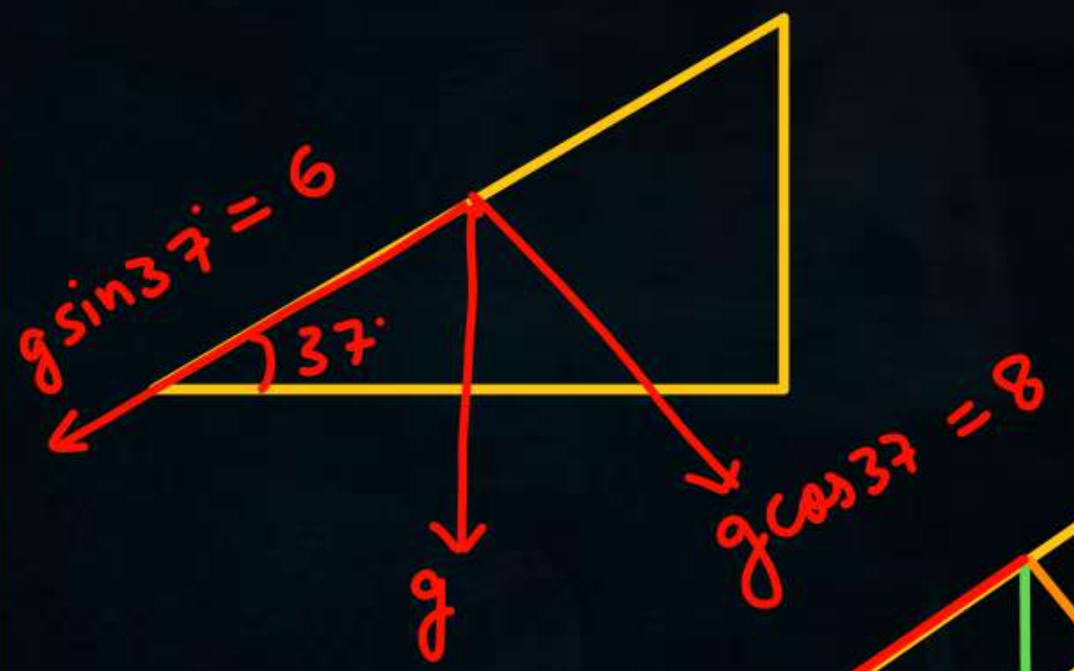
$T = 8 + 8 = 16$

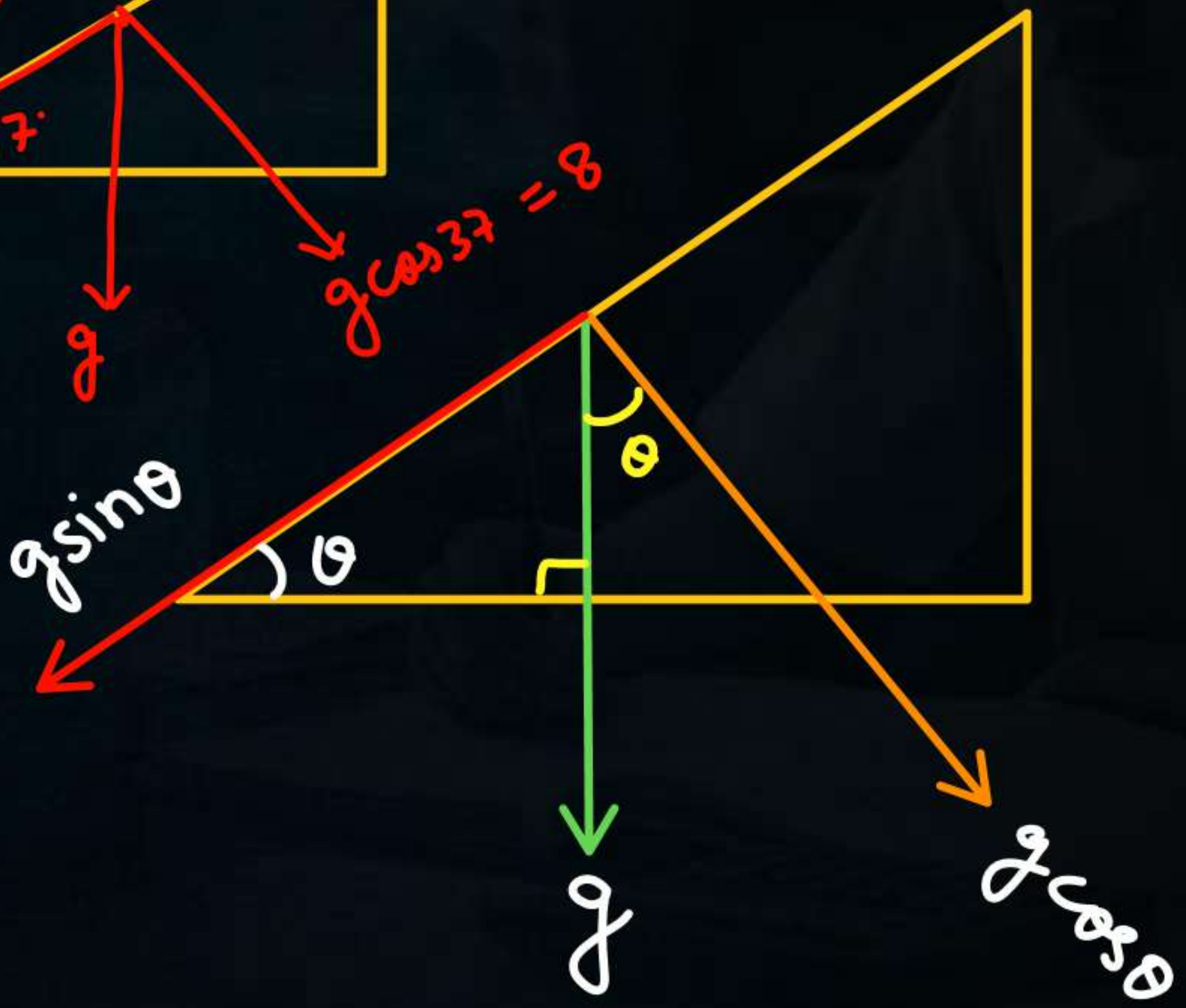
$R = 60 \times 16 - \frac{1}{2} \times 6 \times 16^2 = 192$

$h_{max} = \frac{(80)^2}{2 \times 10} = 320$

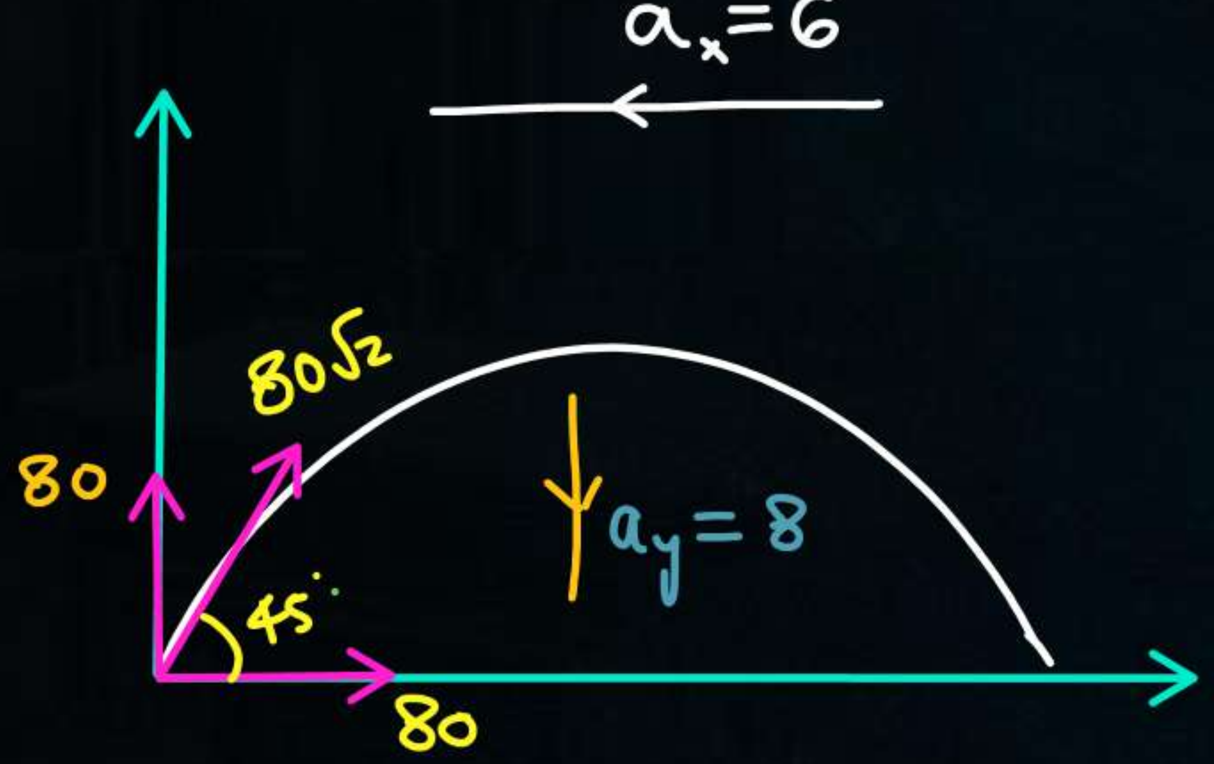
NLM







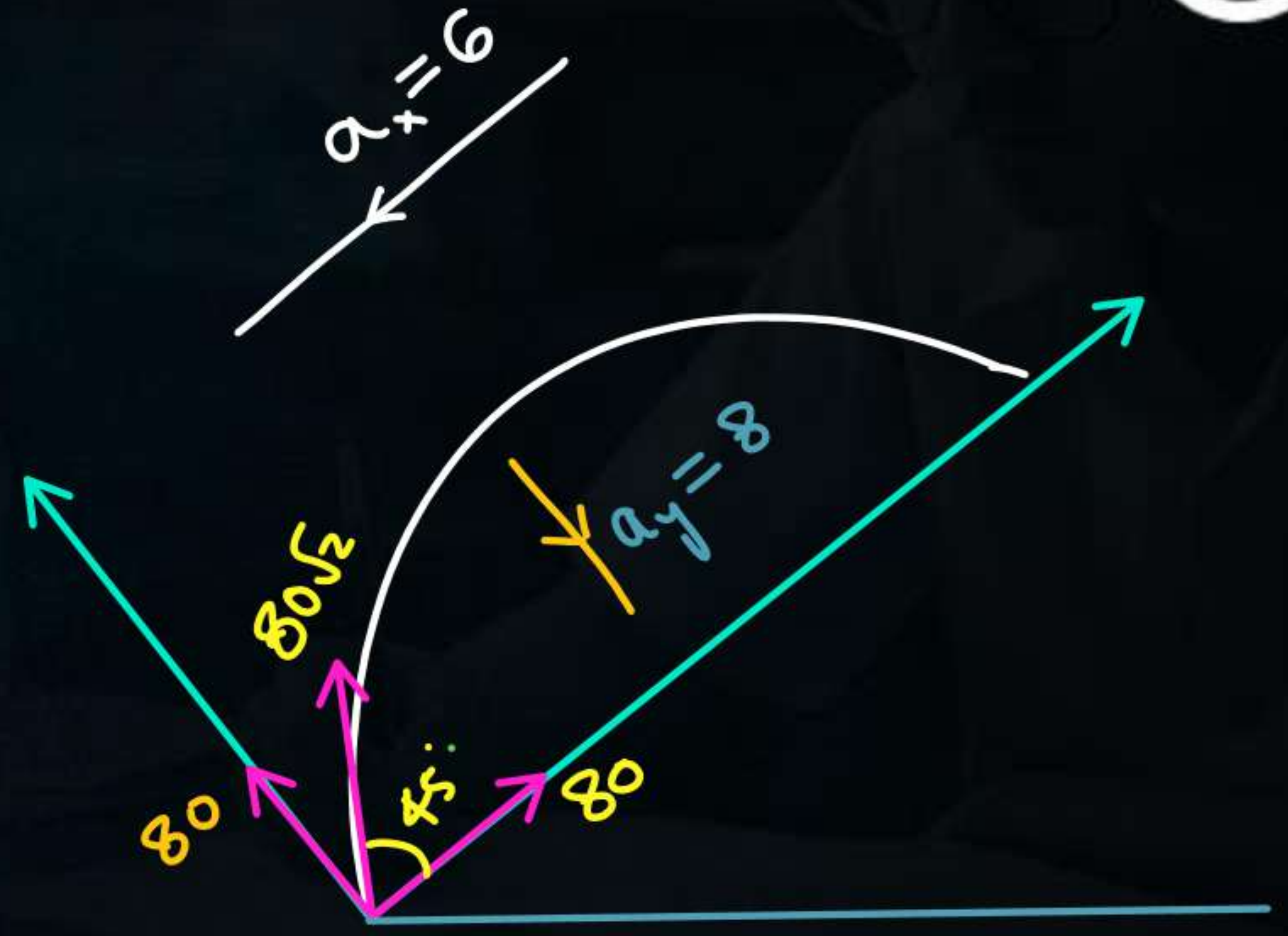
Q



$T = 10 + 10 = 20$

$R = 80 \times 20 - \frac{1}{2} \times 6 \times (20)^2 = 400$

$h_{max} = \frac{(80)^2}{2 \times 8} = 400$

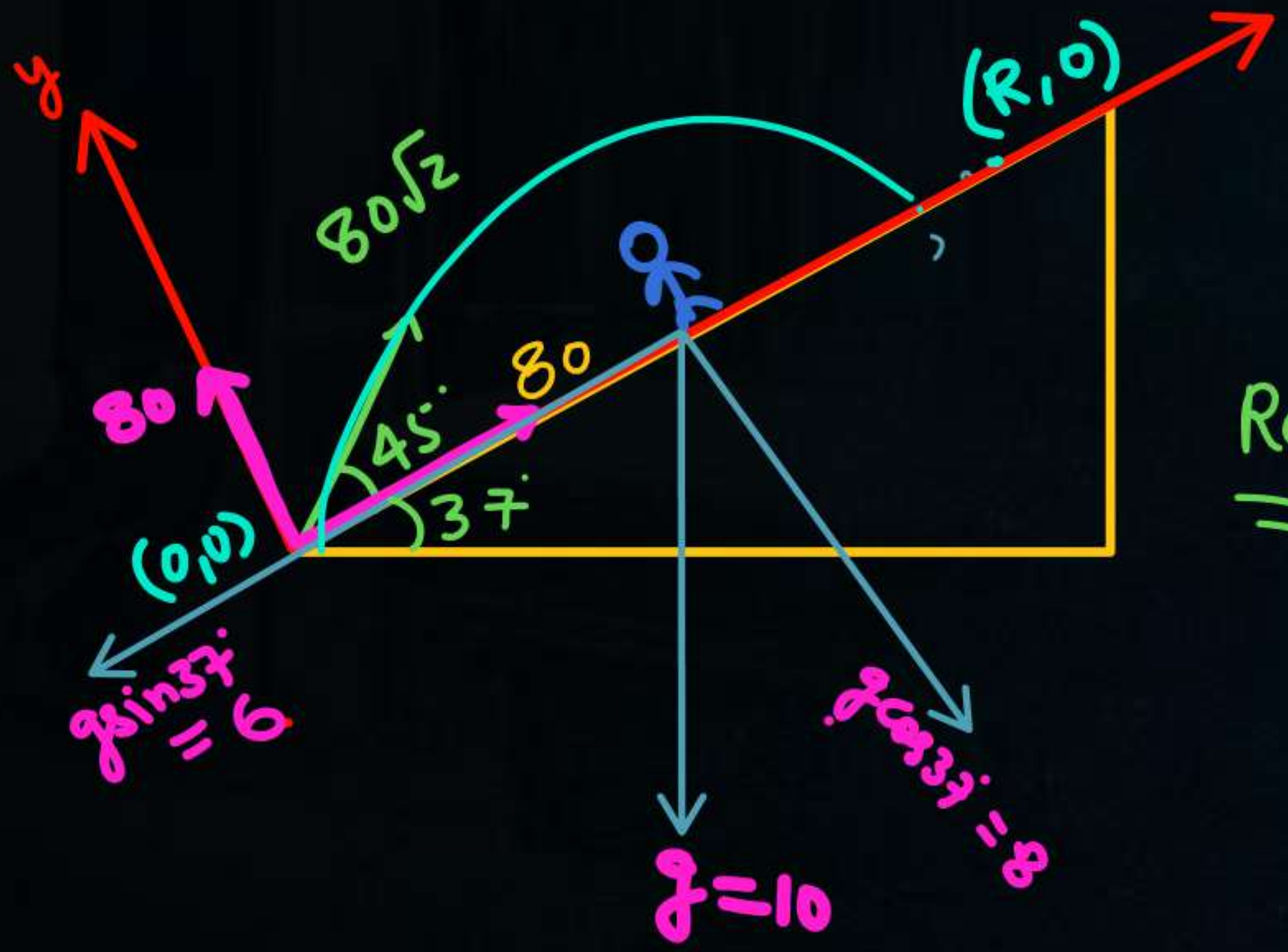


Q

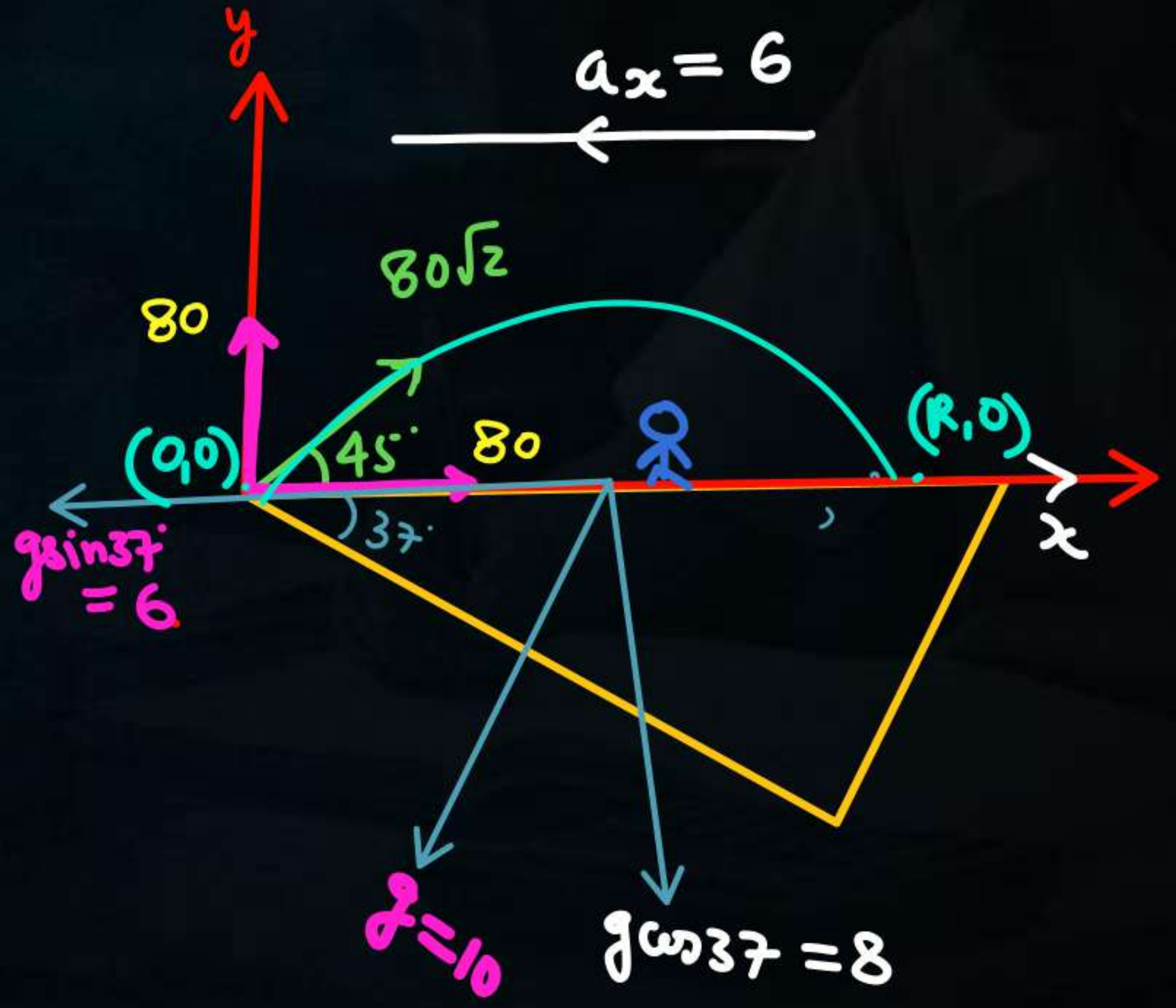
① Find when particle will hit the inclined plane

② Range.

$t = 5 \quad \vec{v} = 50\hat{i} + 40\hat{j}$



Rotate

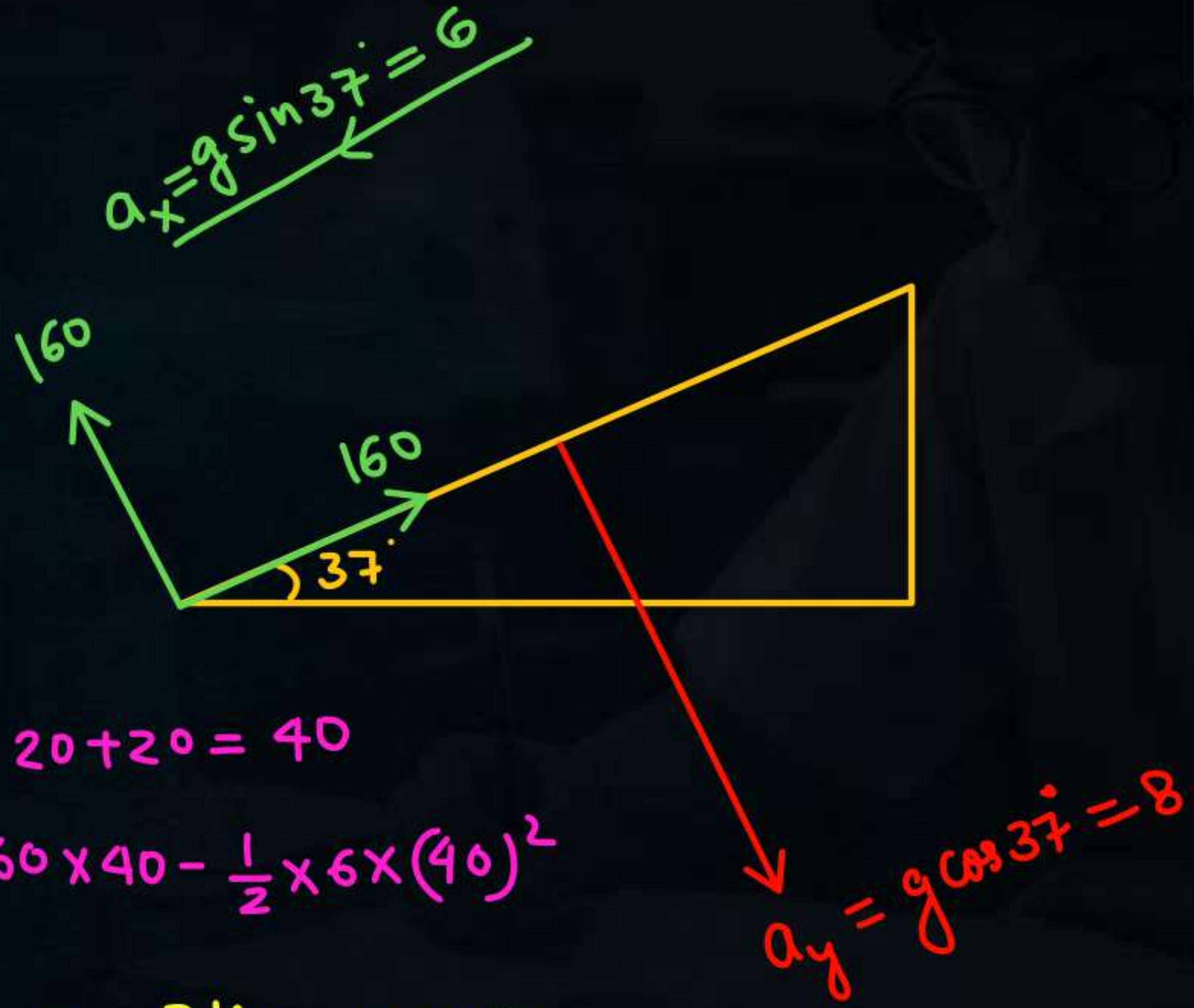


- $T = 10 + 10 = 20$
- $R = 80 \times 20 - \frac{1}{2} \times 6 \times 20^2$

Q

find when & where particle will hit the floor.

Sol^n.



$T = 20 + 20 = 40$

$R = 160 \times 40 - \frac{1}{2} \times 6 \times (40)^2$

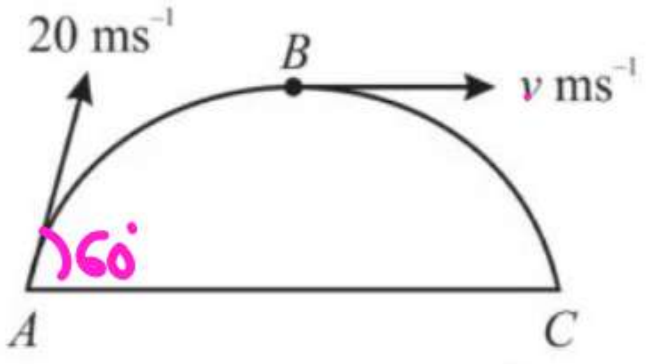
or $\quad T = \frac{2u_y}{a_y} = \frac{2 \times 160}{8}$

PROJECTILE MOTION:

20. A ball is projected from point A with velocity $20\ \text{ms}^{-1}$ at an angle $60°$ to the horizontal direction. At the highest point B of the path (as shown in figure), the velocity $v\ \text{ms}^{-1}$ of the ball will be:

[2023-Manipur]

$20\cos 60 = V$



(1) 20 (2) $10\sqrt{3}$

(3) Zero (4) 10

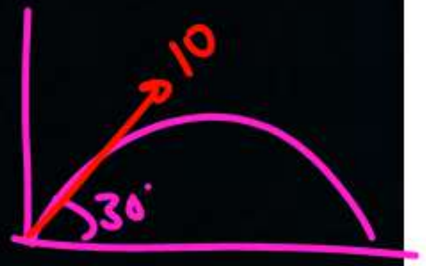
21. A bullet is fired from a gun at the speed of 280 m/s in the direction 30º above the horizontal. The maximum height attained by the bullet is: ($g = 9.8\ \text{ms}^{-2}$, $\sin 30º = 0.5$)

$\frac{(280 \sin 30)^2}{2 \times 10}$

[2023]

(1) 1000 m (2) 3000 m

(3) 2800 m (4) 2000 m



22. A ball is projected with a velocity, $10\ \text{ms}^{-1}$, at an angle of $60°$ with the vertical direction. Its speed at the highest point of its trajectory will be:

[2022]

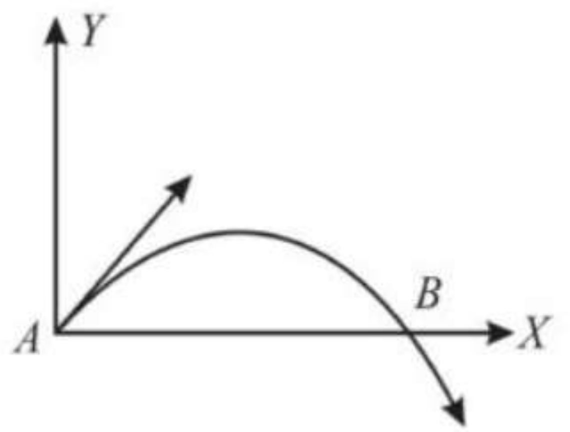
$10\cos 30.$

(1) Zero (2) $5\sqrt{3}\ \text{ms}^{-1}$

(3) $5\ \text{ms}^{-1}$ (4) $10\ \text{ms}^{-1}$

$(2\hat{i}+3\hat{j})$ m/s. Its velocity (in m/s) at point B is:

[NEET 2013]



(1) $2\hat{i}-3\hat{j}$ (2) $2\hat{i}+3\hat{j}$ 2

3

(3) $-2\hat{i}-3\hat{j}$ (4) $-2\hat{i}+3\hat{j}$

26. The horizontal range and the maximum height of a projectile are equal. The angle of projection of the projectile is:

[2012]

notes

(1) $\theta=\tan^{-1}\left(\frac{1}{4}\right)$ (2) $\theta=\tan^{-1}(4)$

(3) $\theta=\tan^{-1}(2)$ (4) $\theta=45^\circ$

$\theta = 45^\circ$

27. A missile is fired for maximum range with an initial velocity of 20 m/s. If $g = 10$ m/s^2, the range of the missile is:

$R = \frac{(20)^2 \times 1}{10} = 40$

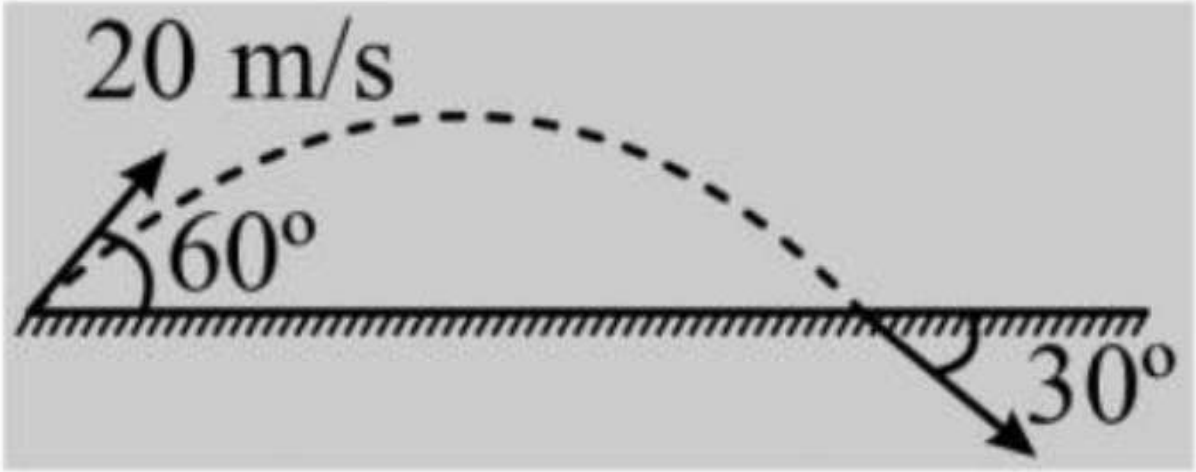
[2011]

(1) 40 m (2) 50 m

(3) 60 m (4) 20 m

32. A particle is projected from a horizontal surface with a velocity of 20 m/s at an angle of 60° with the horizontal. When it hits the horizontal surface, its velocity makes an angle of 30° with the horizontal. Apart from gravity, a horizontal force acts on the particle during the motion. The speed of the particle when it hits the ground is

HW



(a) 20 m/s

(b) $20\sqrt{3}$ m/s

(c) 10 m/s

(d) $10\sqrt{3}$ m/s

40. Find the angle of projection of a projectile for which the horizontal range and maximum height are equal.

(a) 45° (b) $\tan^{-1}(4)$

(c) $\tan^{-1}(2)$ (d) None of these

$$\frac{u^2 \sin 2\theta}{g} = \frac{u^2 \sin^2\theta}{2g}$$

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

$$4 = \tan\theta$$

43. A projectile is thrown with a speed v at an angle θ with the vertical. Its average velocity between the instants it crosses half the maximum height is

(*a*) $v \sin \theta$, horizontal and in the plane of projection

(*b*) $v \cos \theta$, horizontal and in the plane of projection

(*c*) $2v \sin \theta$, horizontal and perpendicular to the plane of projection

(*d*) $2v \cos \theta$, vertical and in the plane of projection.

44. During projectile motion, acceleration of a particle at the highest point of its trajectory is

(*a*) g

(*b*) zero

(*c*) less than g

(*d*) dependent upon projection velocity

[redacted]

45. The maximum range of a projectile is 22 m. When it is thrown at an angle of 15° with the horizontal, its range will be-

(*a*) 22 m (*b*) 6 m (*c*) 15 m (*d*) 11 m

$$R = \frac{u^2 \sin 2\theta}{g}$$

$$R_{max} = \frac{u^2}{g} = 22$$

$$R = \frac{u^2 \sin(2 \times 15^\circ)}{g} = 22 \times \sin 30$$

50. A particle is projected from the ground with velocity u at angle θ with horizontal. The horizontal range, maximum height and time of flight are R, H and T respectively. They are given by,

*

HW

$$R = \frac{u^2 \sin 2\theta}{g}, H = \frac{u^2 \sin^2 \theta}{2g} \text{ and } T = \frac{2u \sin \theta}{g}$$

Now keeping u as fixed, θ is varied from 30° to 60°. Then,

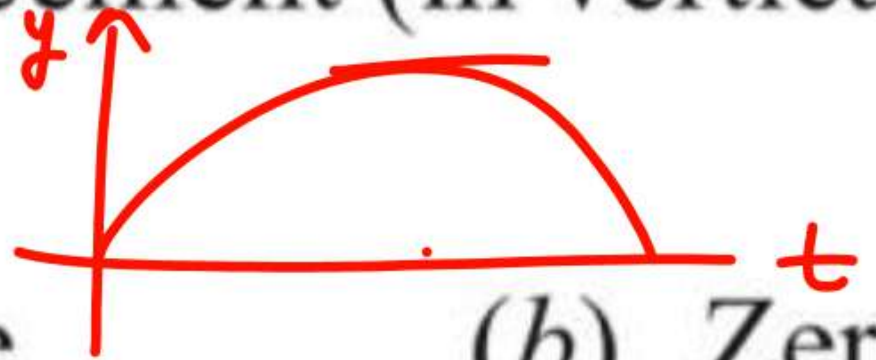
(a) R will first increase then decrease, H will increase and T will decrease

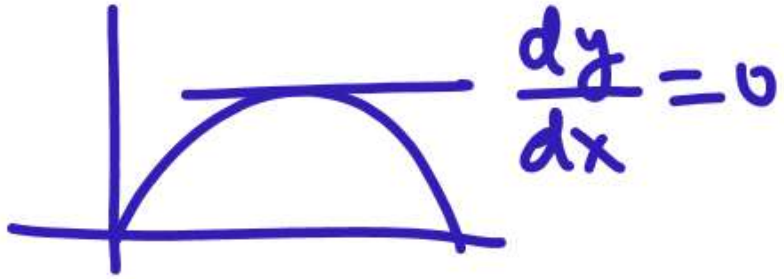
(b) R will first increase then decrease while H and T both will increase

(c) R will decrease while H and T will increase

(d) R, H and T will increase

35. A particle reaches its highest point when it has covered exactly one half of its horizontal range. The corresponding point on the displacement (in vertical direction) time graph is characterised by





(*a*) Negative slope (*b*) Zero slope

(*c*) Positive slope (*d*) either (*a*) or (*c*)

$$V_y = \frac{dy}{dt} = 0$$

$$y = u\sin\theta\, t - \frac{1}{2} g t^2$$

$$\frac{dy}{dt} = u\sin\theta - \frac{1}{\cancel{2}} g \cancel{2} t = 0$$

$$t = \frac{u\sin\theta}{g}$$

32. The range of a particle when launched at an angle of 15° with the horizontal is 1.5 km. What is the range of the projectile when launched at an angle of 45° to the horizontal?

(*a*) 1.5 km (*b*) 3.0 km (*c*) 6.0 km (*d*) 0.75 km

$$R = \frac{u^2 \sin 2\theta}{g}$$

$$\frac{1.5}{R_2} = \frac{\sin 30}{\sin 90}$$

$$R_2 = 3$$

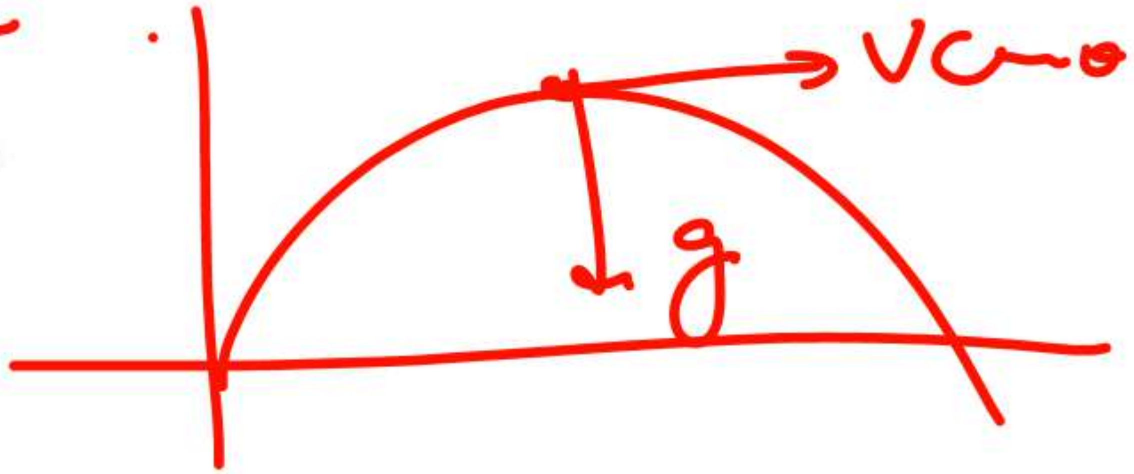
31. At the top of the trajectory of a projectile, the directions of its velocity and acceleration are

(*a*) perpendicular to each other

(*b*) parallel to each other

(*c*) inclined to each other at an angle of 45°

(*d*) antiparallel to each other



29. A projectile fired with initial velocity u at some angle θ has a range R. If the initial velocity be doubled at the same angle of projection, then the range will be

(*a*) 2R $R = \frac{u^2 \sin 2\theta}{g}$

(*b*) $R/2$

(*c*) R

(*d*) $4R$

30. If the initial velocity of a projectile be doubled, keeping the angle of projection same, the maximum height reached by it will

$u \longrightarrow$ $h_{max} = \frac{u^2 \sin^2\theta}{2g}$

(*a*) remain the same (*b*) be doubled

(*c*) be quadrupled (*d*) be halved

Example 28: A ball projected with speed 'u' at angle of projection 15° has range R. The other angle of projection at which the range with same initial speed 'u' will be R, is:

(*a*) 45°

(*b*) 35°

(*c*) 75°

(*d*) 90°

@SALEEMSIR_PW

Home Work

- Solve all ques of today class
- KPP - 17

THANK
YOU