YAKEEN NEET 2.0

2026

Motion in a Plane

PHYSICS | Lecture - 10

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Todays Goal

- Relative motion (part 03)

ETP NEET 26

Revision

Q $x = A\sin t$

$y = A(1-\cos t)$

(a) $y = A - A\cos t$

$\cos t = \frac{A-y}{A}$

$\sin^2 t + \cos^2 t = 1$

$\left(\frac{x}{A}\right)^2 + \left(\frac{A-y}{A}\right)^2 = 1$

$x^2 + (y-A)^2 = A^2$

Circle

(0, A) center.

↳ Saturday वाला lecture

(b) $v_x = A\cos t$

$v_y = A\sin t$

$\vec{v} = A\cos t\,\hat{i} + A\sin t\,\hat{j}$

$\text{Speed} = \sqrt{(A\cos t)^2 + (A\sin t)^2}$

Speed = A = Const

(Uniform Circular Motion)

(c) Find distance by particle in 10sec

distance = Speed x time

$= A \times 10 = \checkmark$

(2)

Find acc. at $x = 2$

m_1 $a = V\frac{dv}{dx} = 16 \times \frac{16}{2} = 128$

m_2 $V = 8x$

$\frac{dv}{dx} = 8$

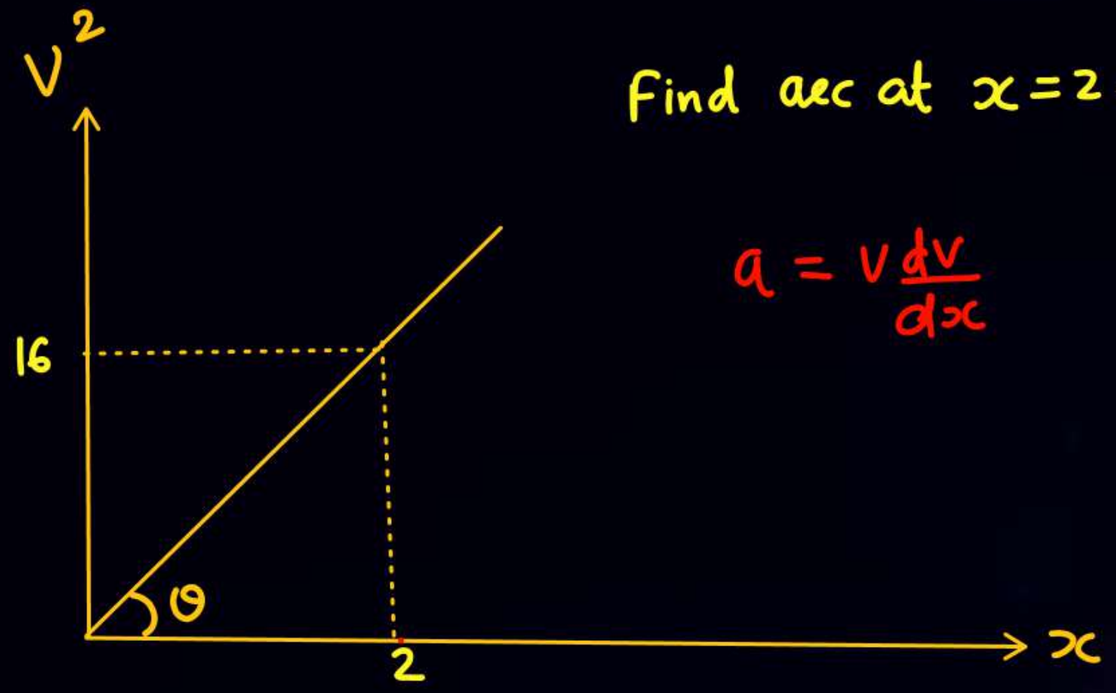
$a = V\frac{dv}{dx} = 8x \cdot 8 = 64x$

$x = 2,\ a = 64 \times 2 = 128$

		Radius	Center
$x^2+y^2=A^2$	Circle	A	$(0,0)$
$(x-x_1)^2+(y-y_1)^2=A^2$	Circle	A	(x_1, y_1)

Saturday

Q



Find acc at $x=2$, $x=10$, $x=50$

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

$y = mx$

$V^2 = 8x$

diff. wrt x

$2v.\frac{dv}{dx} = 8 \times 1$

$a = v\frac{dv}{dx} = \frac{8}{2} = 4$

$a = 4 = \text{const}$

3rd eq^n

$V^2 = 8x$

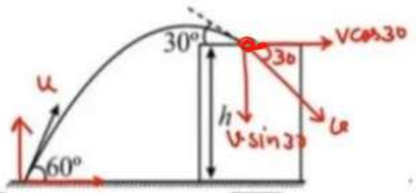
$V^2 = 0^2 + 8x$

$V^2 = 0^2 + 2 \times 4 \times x$

$V^2 = u^2 + 2ax$

Question - 08

A stone projected at an angle of 60° from the ground level strikes at an angle of 30° on the roof of a building of height 'h'. Then the speed of projection of the stone is:



(1) $\sqrt{2gh}$ (2) $\sqrt{6gh}$

(3) $\sqrt{3gh}$ (4) $\sqrt{gh}$

$(v\sin 30)^2 = (u\sin 60)^2 - 2gh$

Correction kpp

$u \times \frac{1}{2} = v\frac{\sqrt{3}}{2}$

$u = v\sqrt{3} \Rightarrow u^2 = v^2 \cdot 3$

$(-v\sin 30)^2 = (u\cos 60)^2 - 2 \times 10 \times h$

$\frac{v^2}{4} = u^2\frac{3}{4} - 20h$

$\frac{u^2}{3\times 4} - \frac{3u^2}{4} = -20h$

$-u^2 + 9u^2 = +240h$

$u = \sqrt{30h}$

Sir iska answer 4th kyu nhi hoga ...agr hm 3rd equation of motion y-axise lga rhe hai to red circle me $(u\sin 60)^2$ hona chahiye na ki ucos60

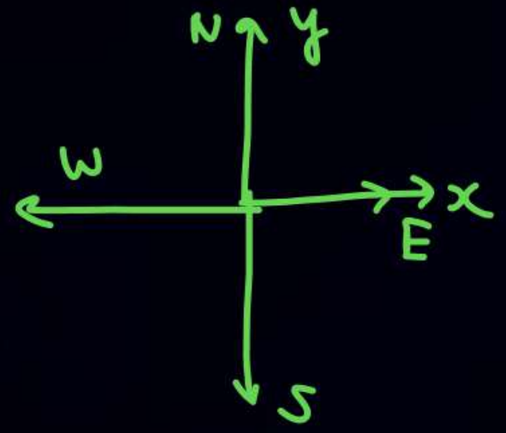
SSSQ

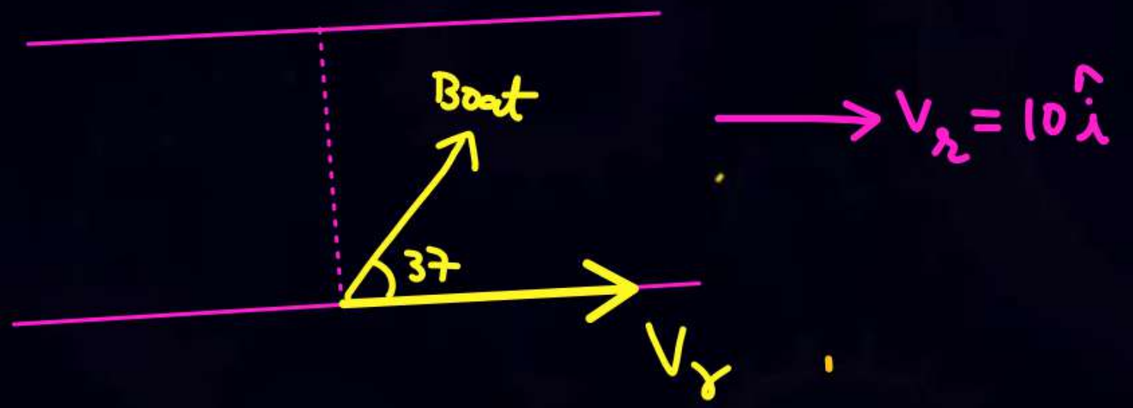
H.W

Q River is flowing along east with velocity 10 m/s. A man is inside a boat holding flag such that boat is moving with speed 20 m/s wrt river making angle 37° with dir^n of velocity of river. If air start flowing along south with speed 5 m/s. Find in which dir^n flag will flutter.

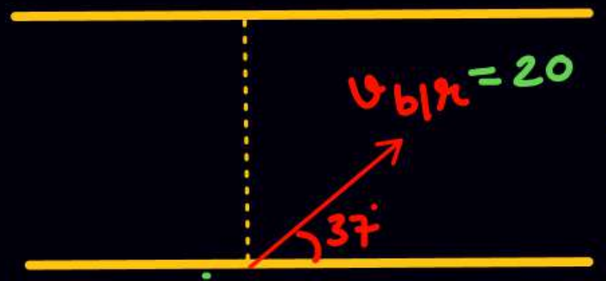
Sol^r

$v_{\text{हवा}} = -5\hat{j}$





सबसे पहले



$v_r = 10$

$\vec{v}_{b/r} = 16\hat{i} + 12\hat{j}$

$\vec{v}_b - \vec{v}_r = 16\hat{i} + 12\hat{j}$

$\vec{v}_b = 16\hat{i} + 12\hat{j} + 10\hat{i}$

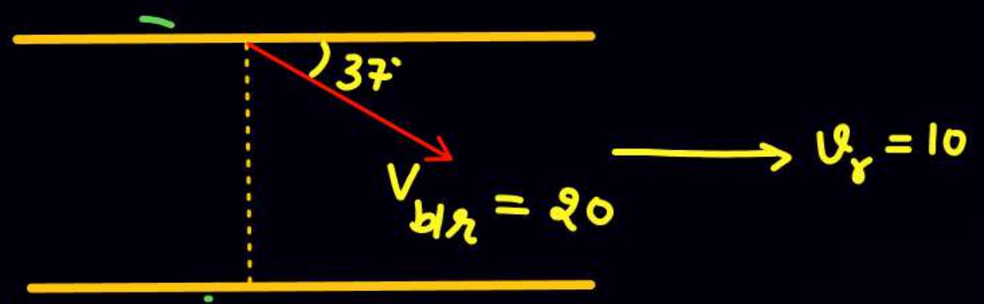
$\vec{v}_b = 26\hat{i} + 12\hat{j} = \vec{v}_{man}$

$\vec{v}_{eva/man} = \vec{v}_{eva} - \vec{v}_{man}$

$= -5\hat{j} - 26\hat{i} - 12\hat{j}$

$\vec{v}_{eva/man} = -26\hat{i} - 17\hat{j}$

$\tan\theta = \frac{17}{26}$



$$\vec{v}_{b/r} = 16\hat{i} - 12\hat{j}$$

$$\vec{v}_b - \vec{v}_r = 16\hat{i} - 12\hat{j}$$

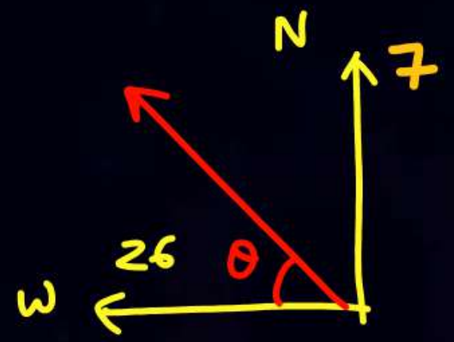
$$\vec{v}_b = 16\hat{i} - 12\hat{j} + 10\hat{i}$$

$$\vec{v}_b = 26\hat{i} - 12\hat{j} = \vec{v}_{man}$$

$$\vec{v}_{eva/man} = \vec{v}_{eva} - \vec{v}_{man}$$

$$= -5\hat{j} - 26\hat{i} + 12\hat{j}$$

$$\vec{v}_{eva/man} = -26\hat{i} + 7\hat{j}$$



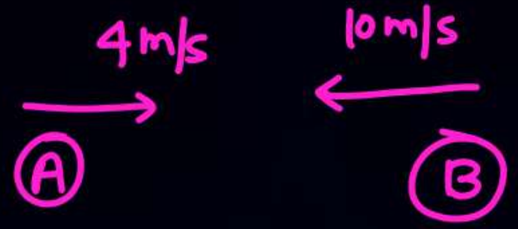
$$\tan\theta = \frac{7}{26}$$

Q

$\vec{v}_{B|A} = 10 - 4 = 6$

$v_{rel} = 6$ (magnitude)

Q



$\vec{v}_{B|A} = -10\hat{i} - 4\hat{i} = -14\hat{i}$

$V_{rel} = 14$ (magnitude)

find magnitude of v_{rel}, $|\vec{v}_{A|B}|$, $|\vec{v}_{B|A}|$

① 

$v_{rel} = 4$

② 

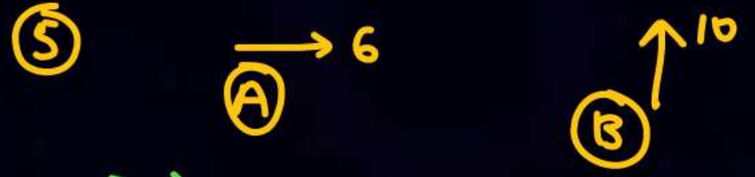
$v_{rel} = 16$

③ 

$v_{rel} = 4$

④ 

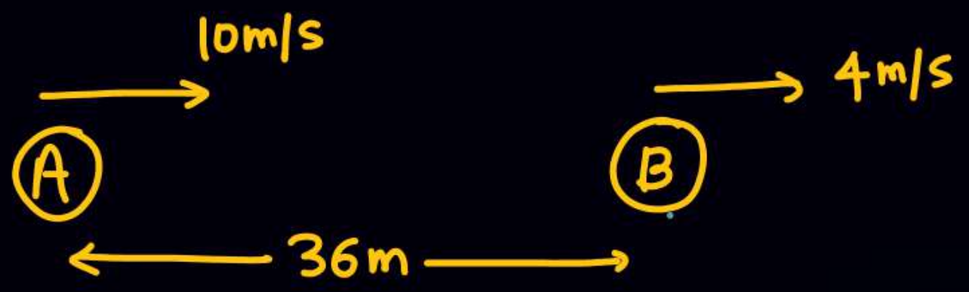
$v_{rel} = 16$

⑤ 

$\vec{v}_{B|A} = 10\hat{j} - 6\hat{i}$

magnitude $= \sqrt{6^2 + 10^2} = \sqrt{136}$

Q At t=0 daigram is given find when they will meet.



Shortcut

SKC

$V_{rel} = 6$

$t = \frac{36}{6} = 6$ sec.

Sol^n Let they meet after time 't'

$10t = 36 + 4t$

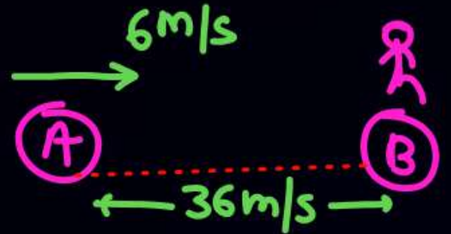
$t = 6$ sec.

(M3) proper आगे वाले के ऊपर जाके वैठ जाओ

!!!

(Next page)

① wrt B



$\vec{v}_{A/B} = 10 - 4 = 6$

$\vec{s}_{A/B} = +36$

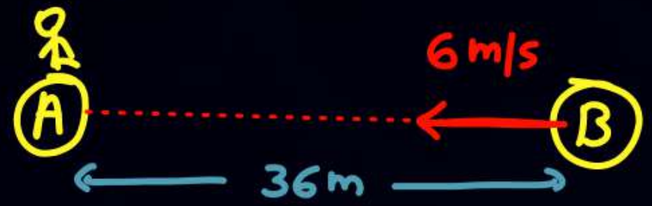
$s = vt$

$s_{A/B} = v_{A/B} \times t$

$36 = 6 \times t$

$t = 6\ sec$

② wrt A



$\vec{v}_{B/A} = \vec{v}_B - \vec{v}_A = 4\hat{i} - 10\hat{i} = -6\hat{i}$

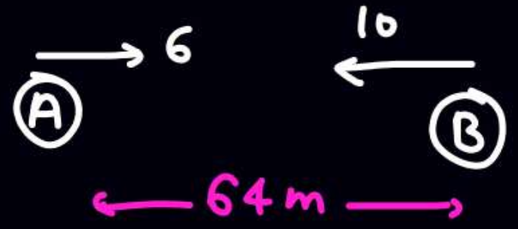
$\vec{s}_{B/A} = -36\hat{i}$

$\vec{s}_{B/A} = \vec{v}_{B/A}\, t$

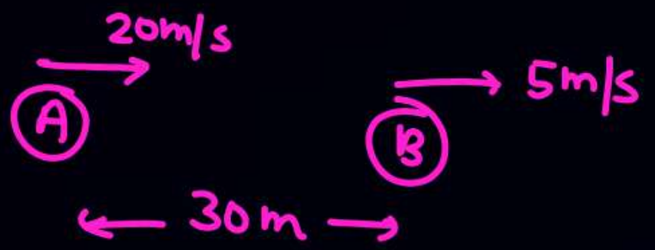
$-36\hat{i} = -6\hat{i} \times t$

$t = 6$

find when particle will meet

① 

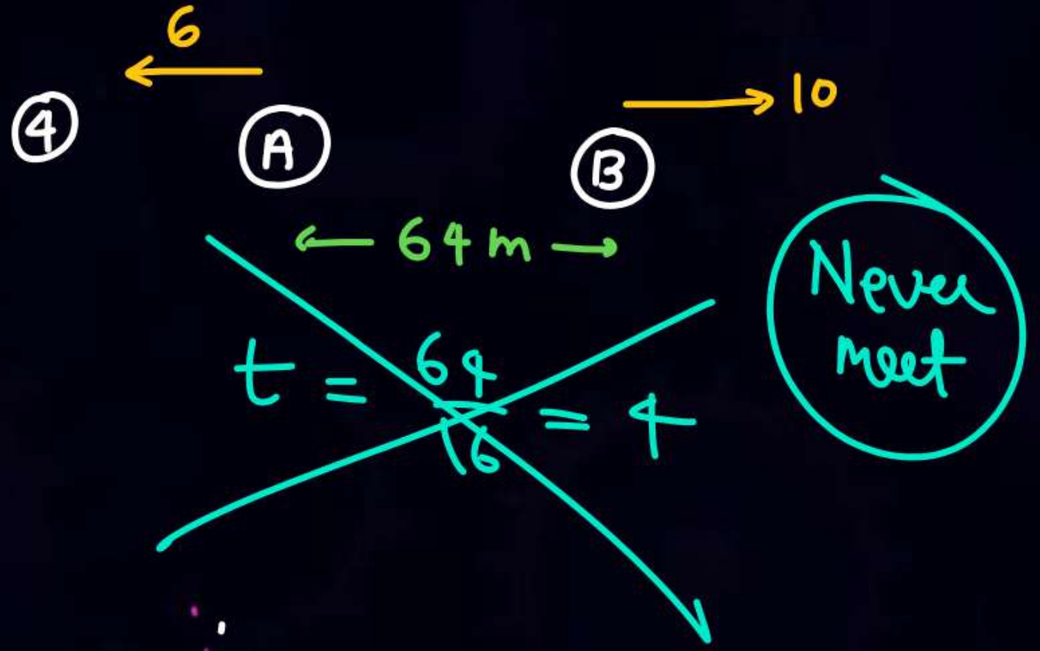
$t = \frac{64}{16} = 4$ ✓

② 

$t = \frac{30}{15} = 2$ ✓

③ 

$t = \frac{16}{4} = 4$

④ 

$t = \frac{64}{16} = 4$

Never meet

wrt Ground

* Velocity = $\frac{\text{Displacement}}{\text{time}}$

Displacement = $v \times t$

$\vec{a} = 0 \Rightarrow \vec{v} = \text{const}$ (St. line path)

* $v = u + at$

$s = ut + \frac{1}{2}at^2$

$V^2 = u^2 + 2as$

$a \rightarrow \text{const}$

Relative

* $v_{rel} = \frac{s_{rel}}{\text{time}}$

$s_{rel} = v_{rel} \times t$

$v_{rel} = u_{rel} + a_{rel}\, t$

Relative वाले formula

$$a_{rel} = \text{Const}$$

$$v_{rel} = u_{rel} + a_{rel}\, t$$

$$s_{rel} = u_{rel}\, t + \frac{1}{2} a_{rel}\, t^2$$

wrt A

If $\vec{a}_{B/A} = \text{Const}$

$$\vec{v}_{B/A} = \vec{u}_{B/A} + \vec{a}_{B/A}\, t$$

$$\vec{s}_{B/A} = \vec{u}_{B/A}\, t + \frac{1}{2} \vec{a}_{B/A}\, t^2$$

If $a = 0$

$v = \text{const}$

path is straight line.

If $a_{rel} = 0$

$v_{rel} = \text{const}$

$\vec{a}_{B/A} = 0$

$\vec{v}_{B/A} = \text{const}$

SKC

- A की खोपड़ी पर बैठकर अगर मैं 'B' को देखूं observe करूं तो 'B' मुझे st. line path में जाता दिखेगा
- path of B observe by A is st. line (if $a_{B/A} = 0$)

Basic

$$\left\{\begin{array}{l}\vec{v}_{B/A} = \vec{v}_B - \vec{v}_A \\ \vec{a}_{B/A} = \vec{a}_B - \vec{a}_A\end{array}\right\}$$

① $a_A = 6$ → (A) $a_B = 10$ → (B)

$$\vec{a}_{B/A} = \vec{a}_B - \vec{a}_A$$

$$= 10\hat{i} - 6\hat{i} = 4\hat{i}$$

② $a_A = 12\,m/s^2$ → (A) (B) → $a_B = 20\,m/s^2$

$$\vec{a}_{B/A} = 20 - 12 = 8\hat{i}$$

$$\vec{a}_{A/B} = 12\hat{i} - 20\hat{i} = -8\hat{i}$$

③

$$\vec{a}_{A/B} = -6 - 10 = -16\,\hat{i}$$

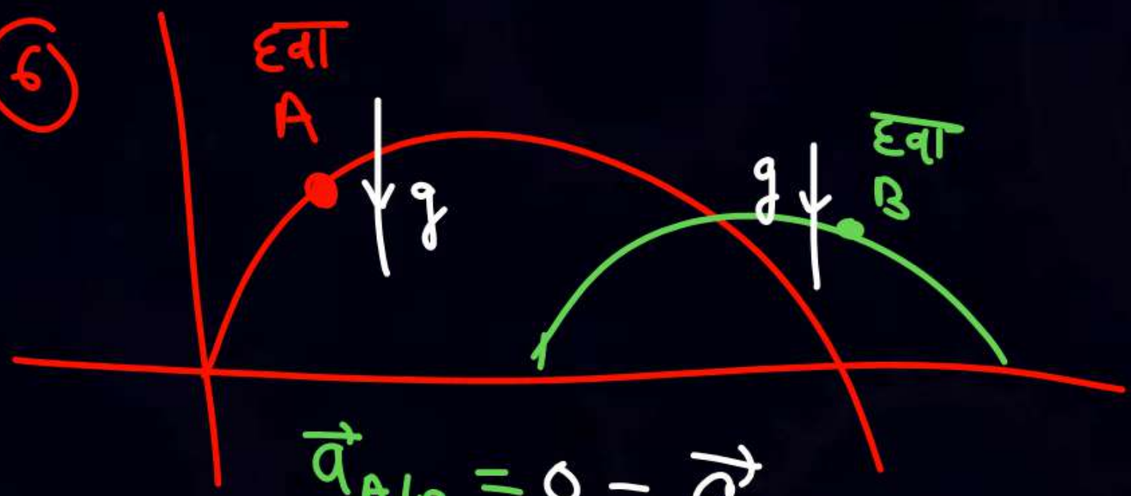
④

$a_{rel} = 0$

⑤

$a_{rel} = 0$

⑥



$\vec{a}_{A/B} = 0 = \vec{a}_{rel}$

* If two particle are in air, $(a_1 = a_2 = g)$

$\vec{a}_{rel} = 0 \Longrightarrow \vec{v}_{rel} = (const \equiv)$ path of one projectile wrt another projectile will be st. line.

$\vec{a}_{A/B} = 0$

$\vec{a}_{B/A} = 0$

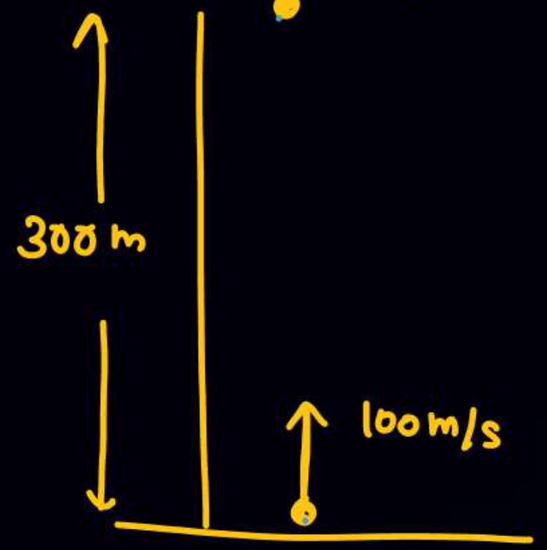
लेकिन ① when Tab tak jab tak done hawa me hai

② Ground ke respect me Parabola path.

Assume

No toofan
No air resistance

① drop

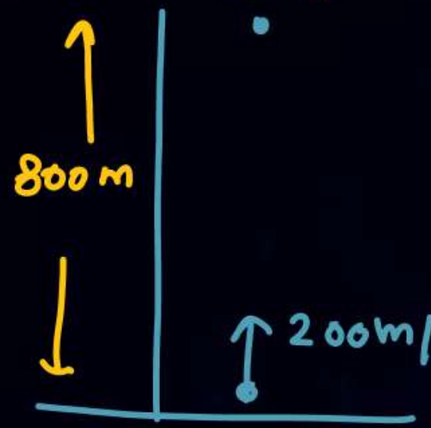


$t = \frac{300}{100} = 3$

when they will meet

$v_{rel} = s_{rel}\, t$

Q drop

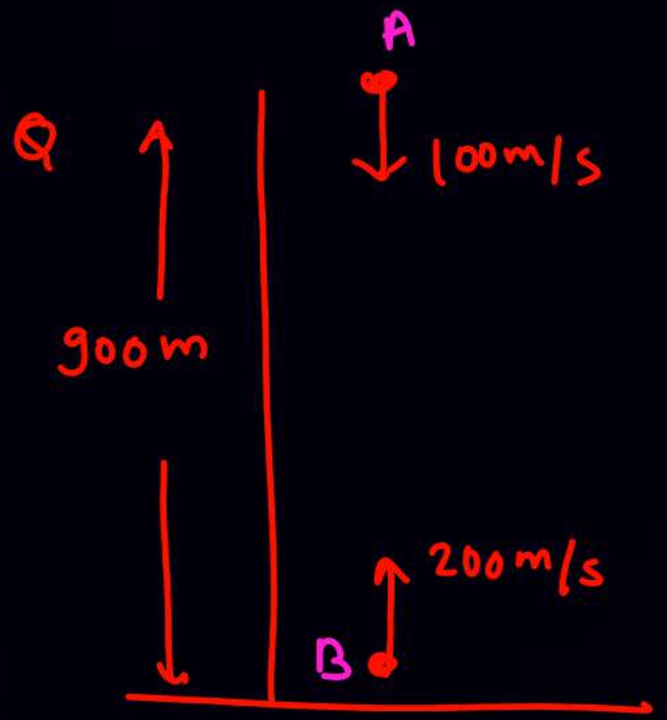


① when they will meet :

$t = \frac{800}{200} = 4$

② where they will meet.

$y = 200 \times 4 - \frac{1}{2} \times 10 \times 4^2$

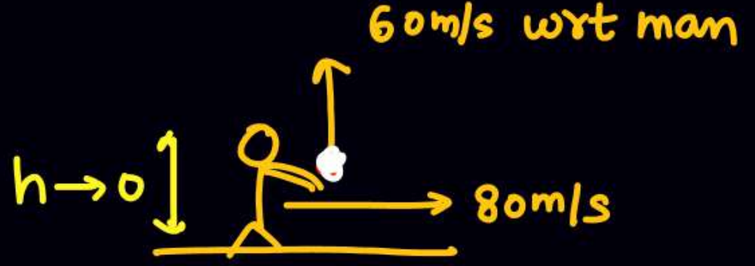


find when & where they will meet.

Sol^n $t = \frac{900}{300} = 3$

$y = 200 \times 3 - \frac{1}{2} \times 10 \times 3^2 =$ Above ground.

Q



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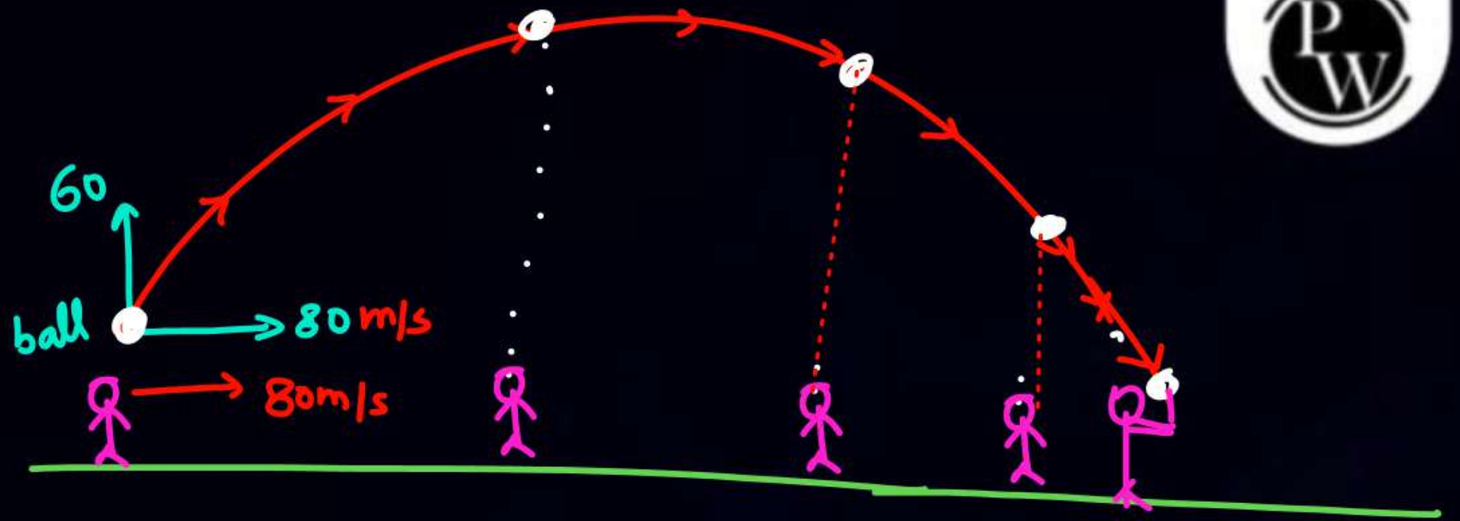


$v_{ball/man} = 60\hat{j}$

$v_{ball} - 80\hat{i} = 60\hat{j}$

$\vec{v}_{ball} = 80\hat{i} + 60\hat{j}$

$T = 12$

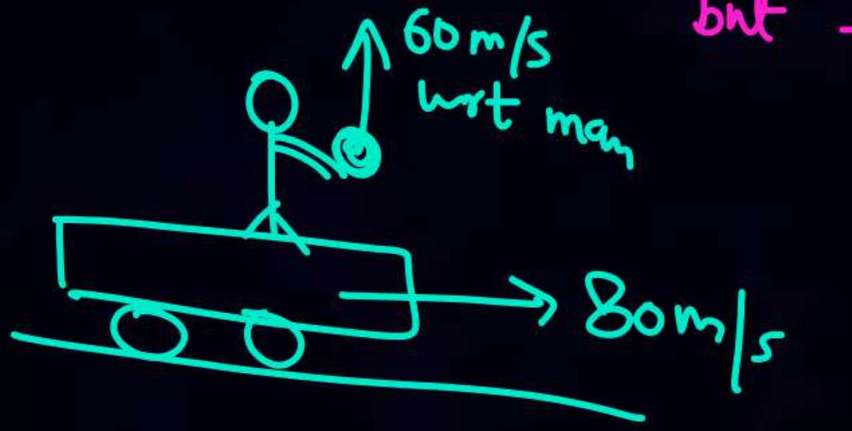
$R = 12 \times 80 = 960$

$(v_{ball/man})_x = 0$

Path of ball ⟶ Parabola wrt ground

but ⟶ st. line wrt man

Or



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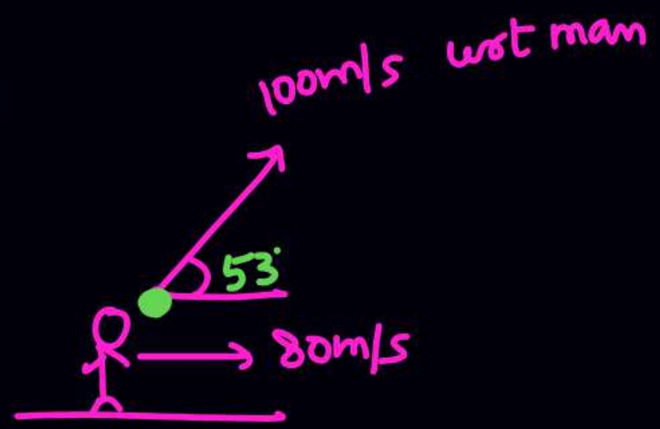
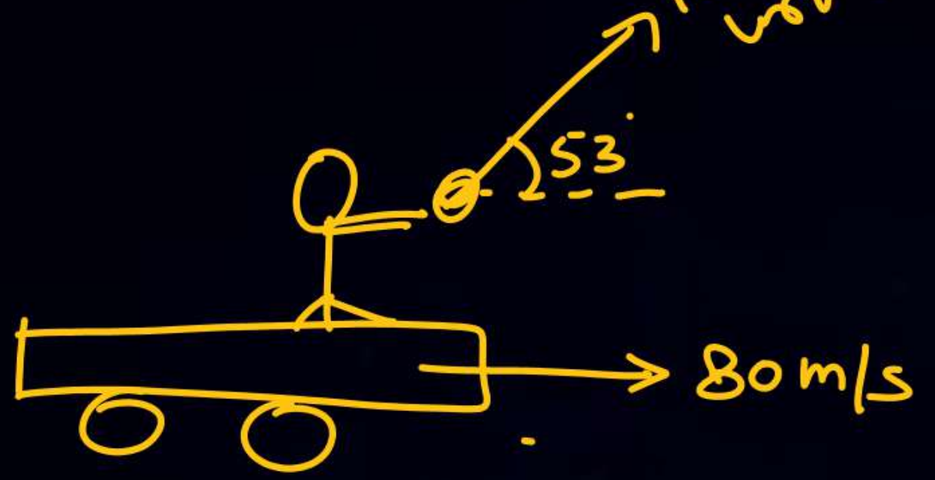


or

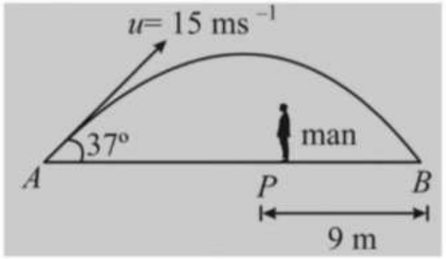


$$v_{ball/man} = 60\hat{i} + 80\hat{j}$$

$$v_{ball} - 80\hat{i} = 60\hat{i} + 80\hat{j}$$

$$v_{ball} = 140\hat{i} + 80\hat{j}$$

48. A ball is hit by a batsman at an angle of 37° as shown in figure. The man standing at P should run at what minimum velocity so that he catches the ball before it strikes the ground? Assume that height of man is negligible in comparison to maximum height of projectile.



(a) 3 ms^{-1} (b) 5 ms^{-1}

(c) 9 ms^{-1} (d) 12 ms^{-1}

4. A projectile is given an initial velocity of $(\hat{i}+2\hat{j})$ m/s, where $\hat{i}$ is along the ground and $\hat{j}$ is along the vertical. If $g = 10\ m/s^2$, the equation of its trajectory is : **[AIEEE - 2013]**

एक प्रक्षेप्य को एक प्रारम्भिक वेग $(\hat{i}+2\hat{j})$ m/s दिया जाता है, जहाँ $\hat{i}$ पृथ्वी के साथ है और $\hat{j}$ ऊर्ध्वाधर पर। यदि $g = 10\ m/s^2$, तब प्रक्षेप पथ का समीकरण है:

(1) $y = x - 5x^2$ (2) $y = 2x - 5x^2$ (3) $4y = 2x - 5x^2$ (4) $4y = 2x - 25x^2$

Ans. (2)

HW

2. A water fountain on the ground sprinkles water all around it. If the speed of water coming out of the fountain is v, the total area around the fountain that gets wet is :- **[AIEEE - 2011]**

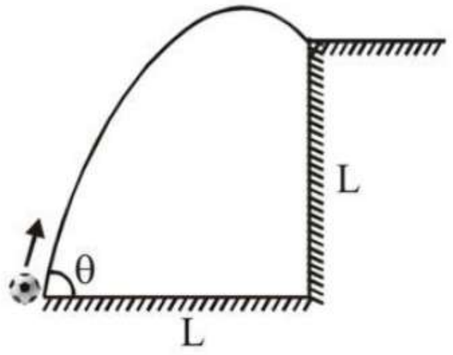
पानी का एक फव्वारा धरती पर चारों तरफ पानी छिड़कता है। यदि फव्वारे से निकल रहे पानी की चाल v है, तब फव्वारे के चारों तरफ गीला होने वाला कुल क्षेत्रफल है :-

(1) $\frac{\pi}{2}\frac{v^4}{g^2}$ (2) $\pi\frac{v^2}{g^2}$ (3) $\pi\frac{v^2}{g}$ (4) $\pi\frac{v^4}{g^2}$

Ans. (4)

HW

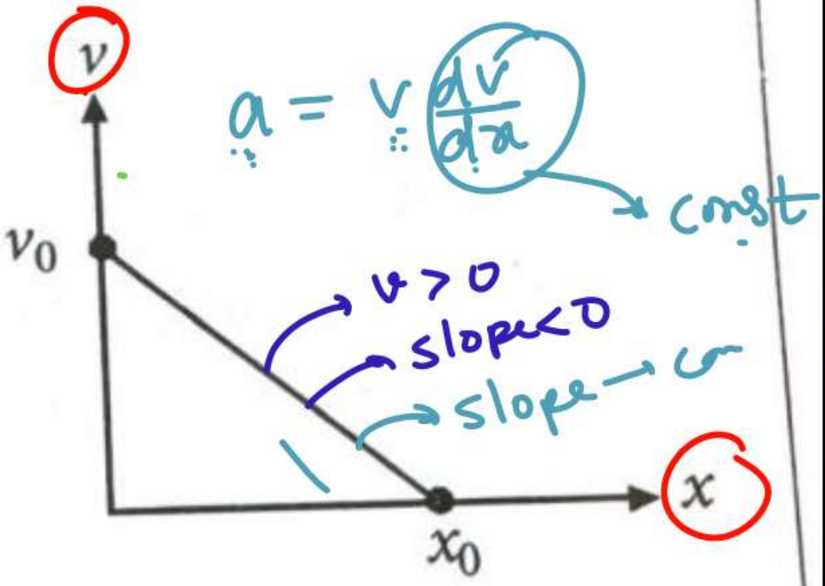
A ball is thrown at an angle θ up to the top of a cliff of height L, from a point at a distance L from the base, as shown in figure. Assuming that one of the following quantities is the initial speed required to make the ball hit right at the edge of the cliff, which one is it :-



(A) $\sqrt{\frac{gL}{2(\tan\theta-1)}}$ (B) $\frac{1}{\cos\theta}\sqrt{\frac{gL}{2(\tan\theta-1)}}$ (C) $\frac{1}{\cos\theta}\sqrt{\frac{gL}{2(\tan\theta+1)}}$ (D) $\sqrt{\frac{gL\tan\theta}{2(\tan\theta+1)}}$

Ans. (B)

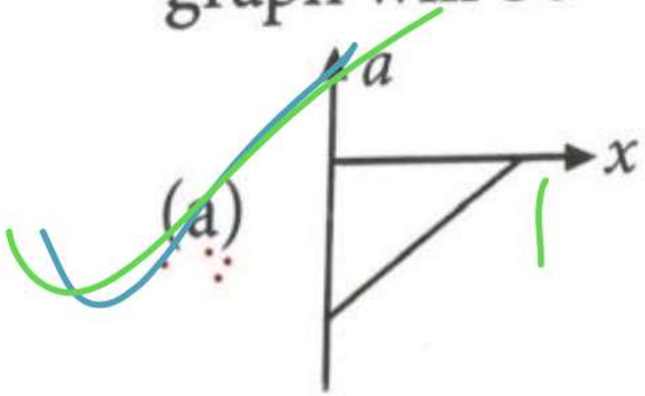
15. The velocity displacement graph of a particle moving along a straight line is shown. The most suitable acceleration-displacement graph will be



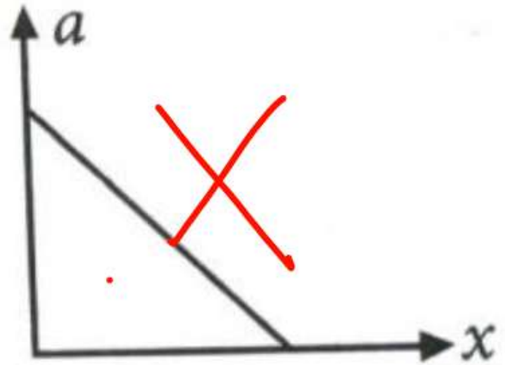
$a = v\frac{dv}{dx}$

positive negative

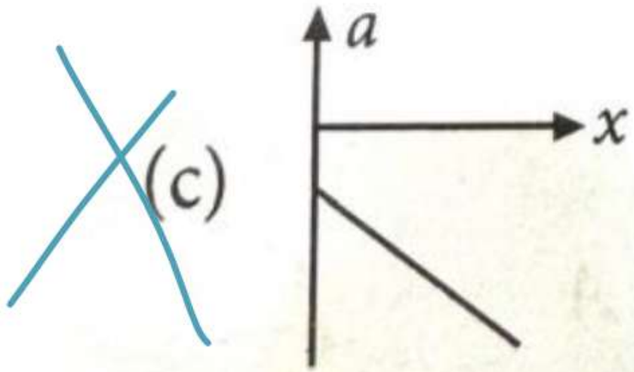
(a)



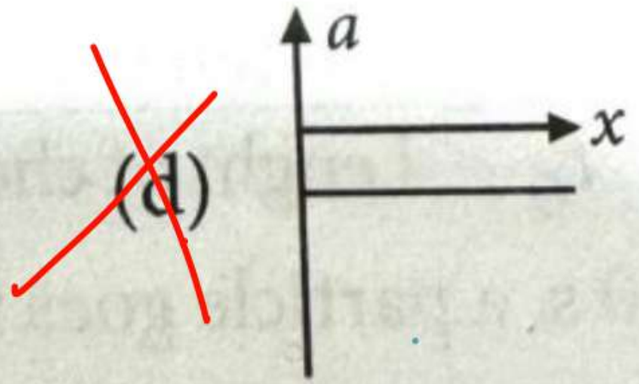
(b)



(c)

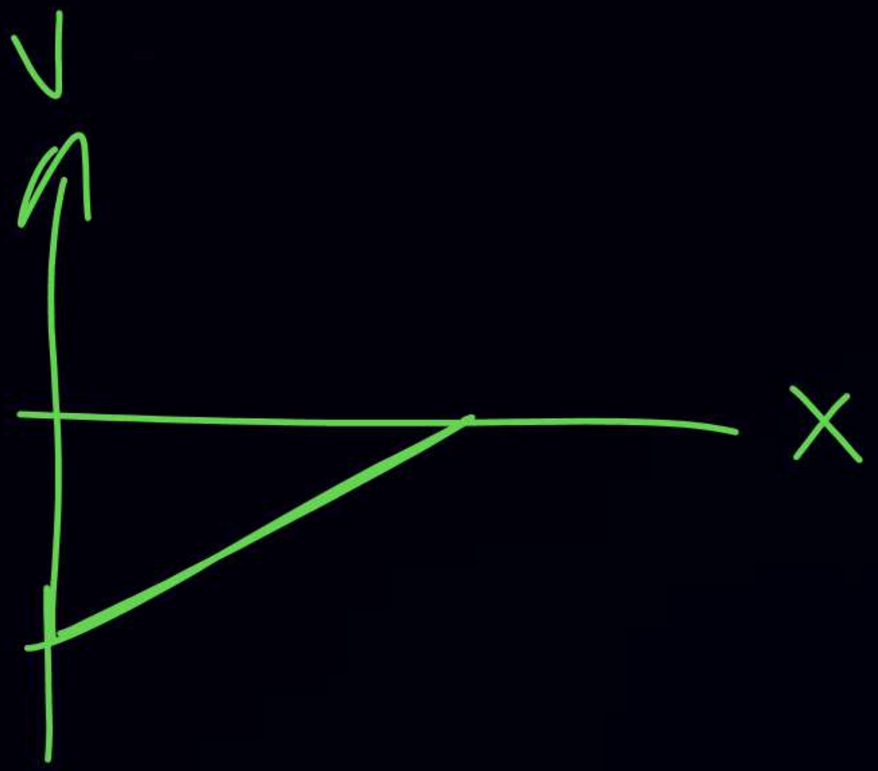


(d)



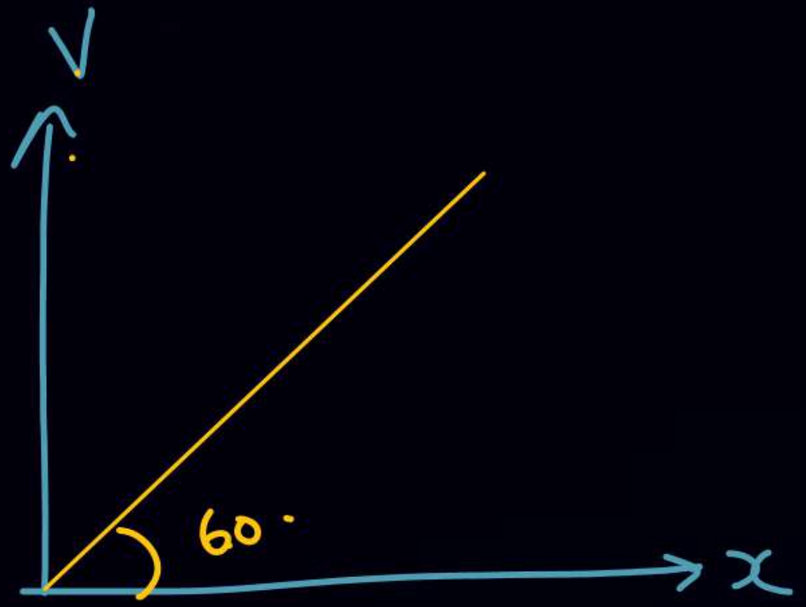
JEE screening

(2005)



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

$$a = 10V$$



$V = \sqrt{3}x$

$a = V\left(\frac{dv}{dx}\right)$

+ve Const

$a = (\sqrt{3}x)\sqrt{3}$

$a = 3x$

$y = 3x + 4$

$y = -6x + 4$

14. A small block slides, without friction, down an inclined plane starting from rest. Let S_n be the distance travelled from $t = (n-1)$ to $t = (n)$. Then $\frac{S_n}{S_{n+1}}$ is

(a) $\frac{2n-1}{2n}$

(b) $\frac{2n+1}{2n-1}$

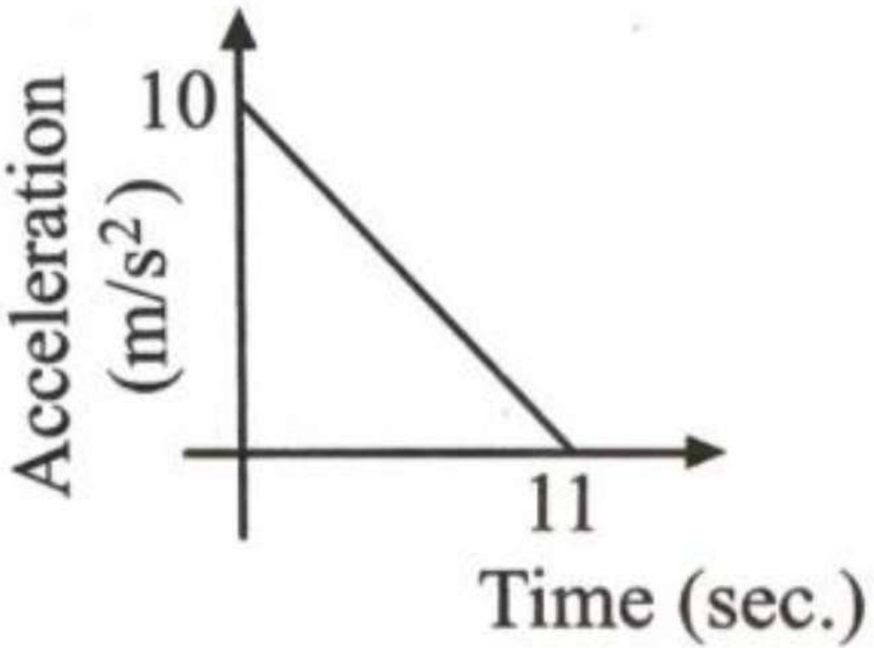
(c) $\frac{2n-1}{2n+1}$

(d) $\frac{2n}{2n+1}$ *(2004)*

Hw

Ans (c)

13. A body starts from rest at time $t = 0$, the acceleration time graph is shown in the figure. The maximum velocity attained by the body will be



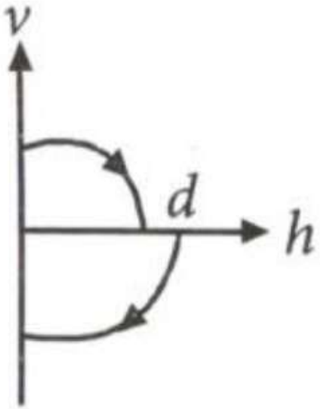
(a) 110 m/s (b) 55 m/s

(c) 650 m/s (d) 550 m/s *(2004)*

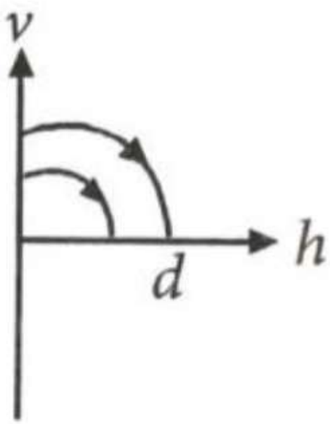
12. A ball is dropped vertically from a height d above the ground. It hits the ground and bounces up vertically to a height $d/2$. Neglecting subsequent motion and air resistance, its velocity v varies with the height h above the ground as

HW

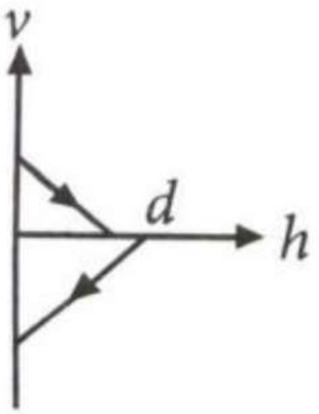
(a)



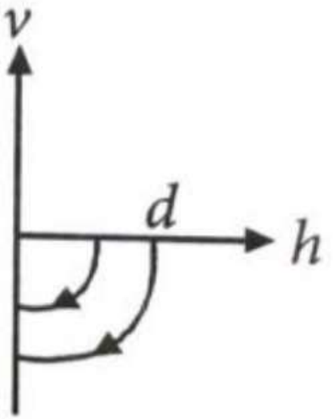
(b)



(c)



(d)



Ans (a)

(2000)

30. Trajectory of particle in a projectile motion is given as $y = x - x^2/80$. Here, x and y are in metres and considered along horizontal and vertical direction respectively ($g = 10\ m/s^2$). For this projectile motion.

(a) angle of projection is 45°

(b) angle of velocity with horizontal after 4s is $\tan^{-1}(1/2)$

(c) maximum height is 80 m

(d) horizontal range is 20 m

HW

Ans (a)

46. The equation of projectile is $y = 16x - \frac{5x^2}{4}$. The horizontal range is:

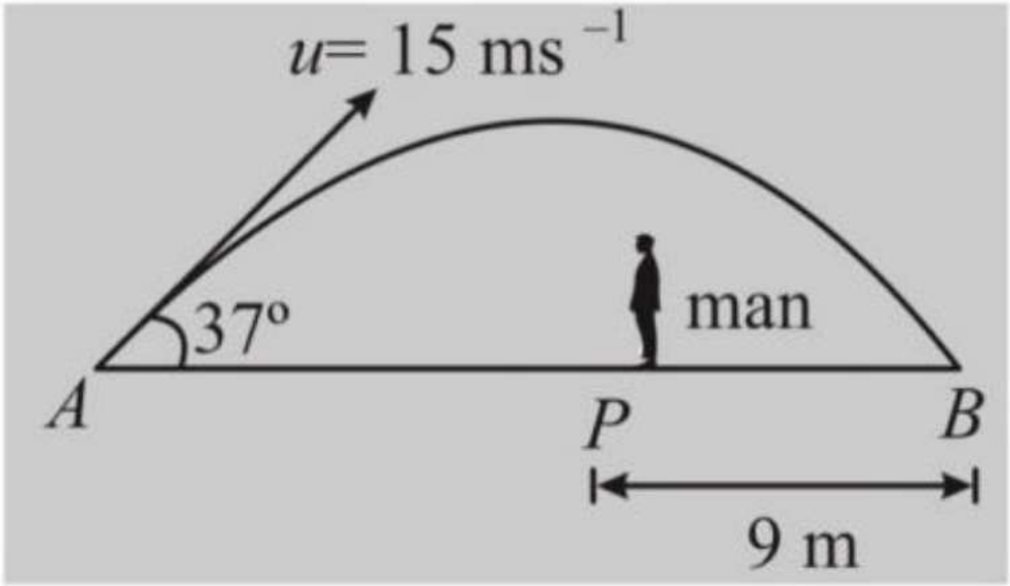
(*a*) 16 m (*b*) 8 m (*c*) 3.2 m (*d*) 12.8 m

HW Ans (d)

48. A ball is hit by a batsman at an angle of 37° as shown in figure. The man standing at P should run at what minimum velocity so that he catches the ball before it strikes the ground? Assume that height of man is negligible in comparison to maximum height of projectile.

HW

Ans (b)



(a) $3\ ms^{-1}$

(b) $5\ ms^{-1}$

(c) $9\ ms^{-1}$

(d) $12\ ms^{-1}$

Home Work

- Ques attached in this ppt
- KPP-19 (Solve all ques)
- DPP
- yes i checked 27 July test Unit & measurement is coming.
  we will complete befor that.
  (Dont worry)

THANK YOU