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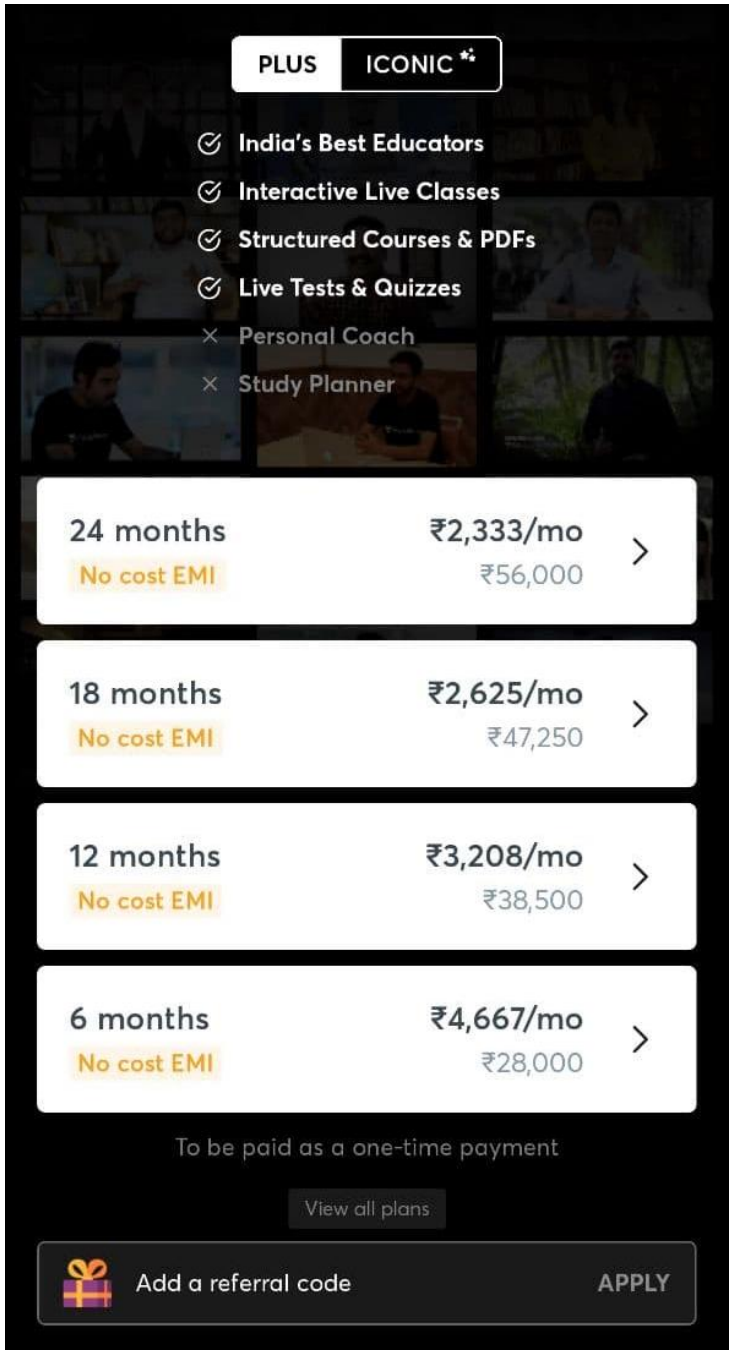
. Interviewed by International media.



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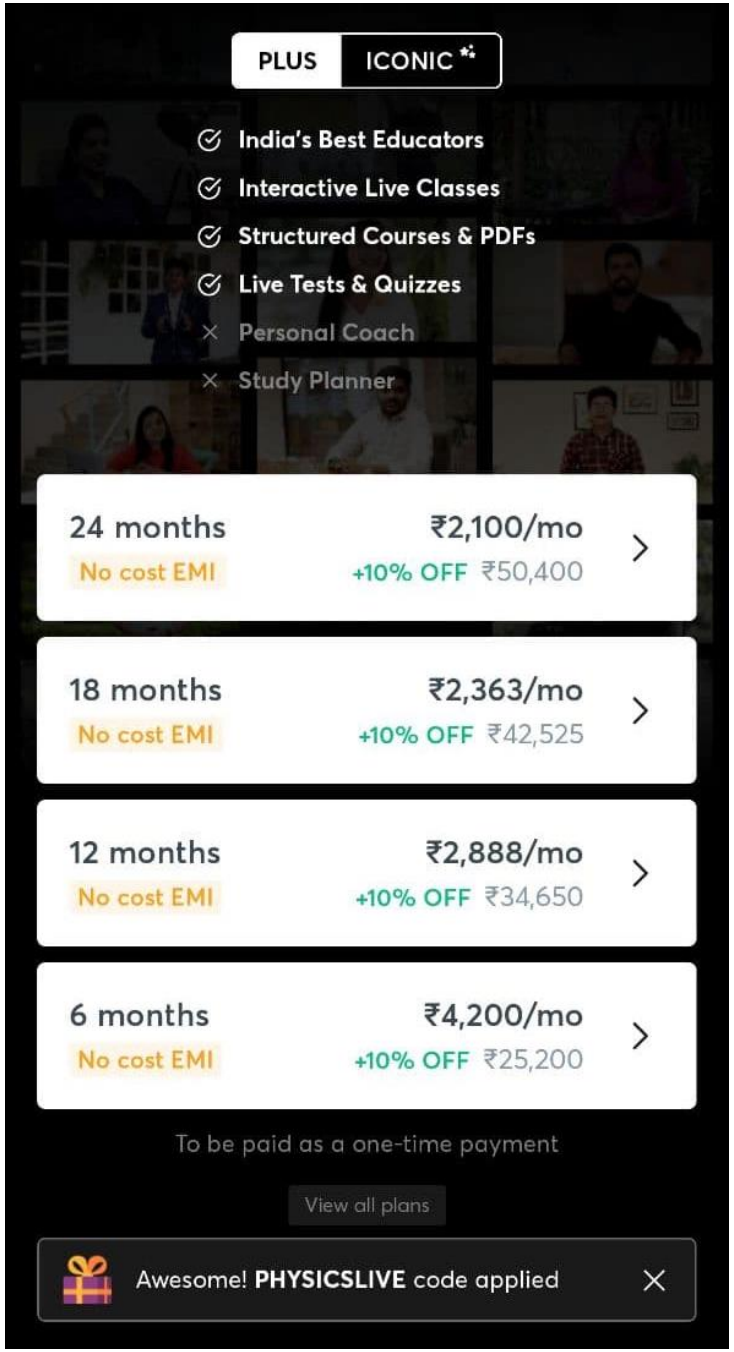

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Solution
Exercise: 1 (L-1)

Kinematics 2D

By Physicsaholics Team

1) $\vec{\Delta V} = \vec{a}\,\Delta t$

$= 10 \times 5 \downarrow$

$= 5\ m/s \downarrow$

HNS → A

2) $\vec{V} = a\hat{i} + (b - ct)\hat{j}$

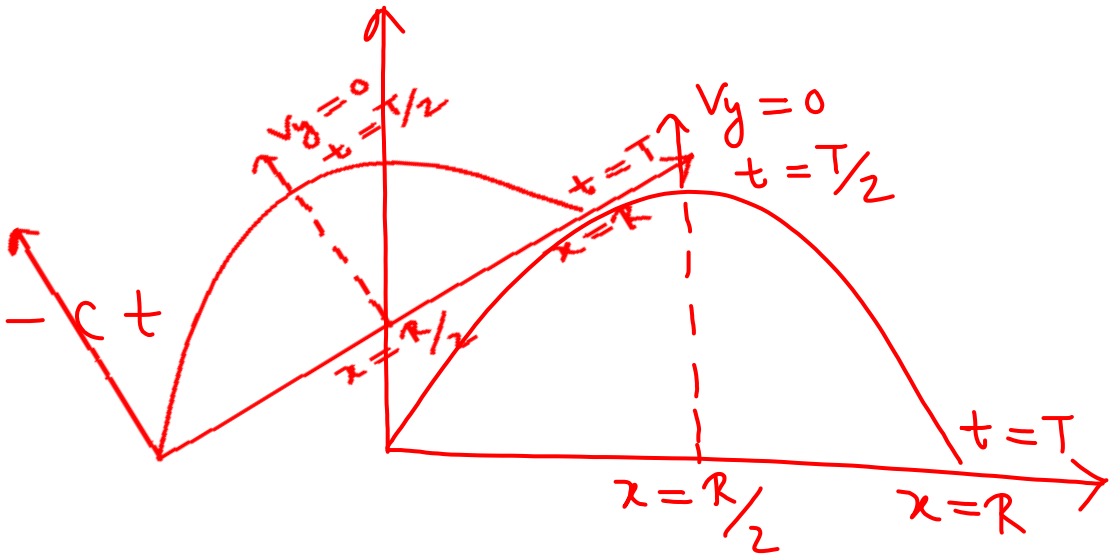
$V_x = a \quad , \quad V_y = b - ct$

at $t = T/2$, $V_y = 0$

$\Rightarrow 0 = b - c\left(\frac{T}{2}\right) \Rightarrow \frac{cT}{2} = b \Rightarrow T = \frac{2b}{c}$

$R = V_x \cdot T = a \times \frac{2b}{c} = \frac{2ab}{c}$

ANS (b)



3) $x = 4\sin 6t$, $y = 4(1-\cos 6t)$

$\Rightarrow V_x = 24\cos 6t$, $V_y = 24\sin 6t$

$\Rightarrow V = \sqrt{V_x^2 + V_y^2} = 24\sqrt{\sin^2 6t + \cos^2 6t}$

$V = 24\ m/s$

$\Rightarrow s = Vt = 24 \times 4 = 96\ m$

ANS-(a)

4) $u_y = 40$, $F_y = -5$, $m = 5$

$\Rightarrow a_y = F_y/m = -1$

$v_y = u_y + a_y t$

$\Rightarrow 0 = 40 - 1 \times t$

$t = 40$ Sec

ANS-C

5) $\frac{dx}{dt} = \frac{dy}{dt} = c \Rightarrow V_x = V_y = c \Rightarrow a_x = a_y = 0$

$$Z = ax^3 + by^2$$

$$V_z = \frac{dZ}{dt} = 3ax^2\frac{dx}{dt} + 2by\frac{dy}{dt} = 3acx^2 + 2bcy^2$$

$$a_z = \frac{dV_z}{dt} = 6acx\frac{dx}{dt} + 2bc\frac{dy}{dt} = 6ac^2x + 2bc^2$$

$$\Rightarrow \vec{a} = a_z\hat{k} = (6ac^2x + 2bc^2)\hat{k}$$

Ans – A

6) $V_x = 3$, $V_y = 4$, $a_x = 2$, $a_y = 1$

$\vec{V} = 3\hat{i} + 4\hat{j}$, $\vec{a} = 2\hat{i} + \hat{j}$

Rate of change of speed = Component of $\vec{a}$ along $\vec{v}$

$= \vec{a}\,\hat{v}$

$= (2\hat{i} + \hat{j}) \cdot \dfrac{(3\hat{i} + 4\hat{j})}{\sqrt{3^2 + 4^2}}$

$= \dfrac{10}{5} = 2\ m/sec^2$

ANS-D

7) $u = 30\ m/sec$, $T = 4.8\ Sec$

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

$$\Rightarrow 4.8 = \frac{2 \times 30 \sin\theta}{10}$$

$$\Rightarrow \sin\theta = .8 = 4/5$$

$$\Rightarrow \theta = 53^\circ$$

Ans → C

8) at $t = t$

$V_x = 10$

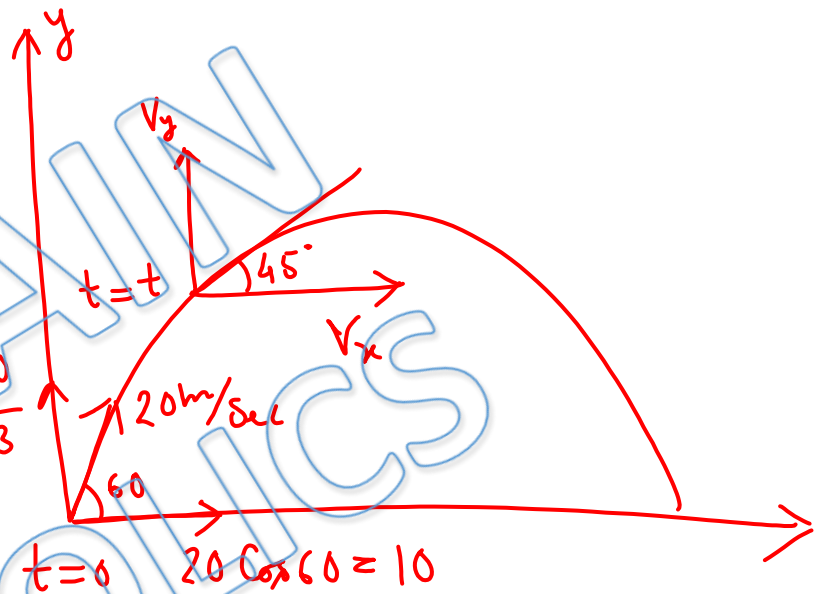
$V_y = 10\sqrt{3} - gt$

$= 10\sqrt{3} - 10t$

$\tan 45^\circ = \frac{V_y}{V_x} = 1$

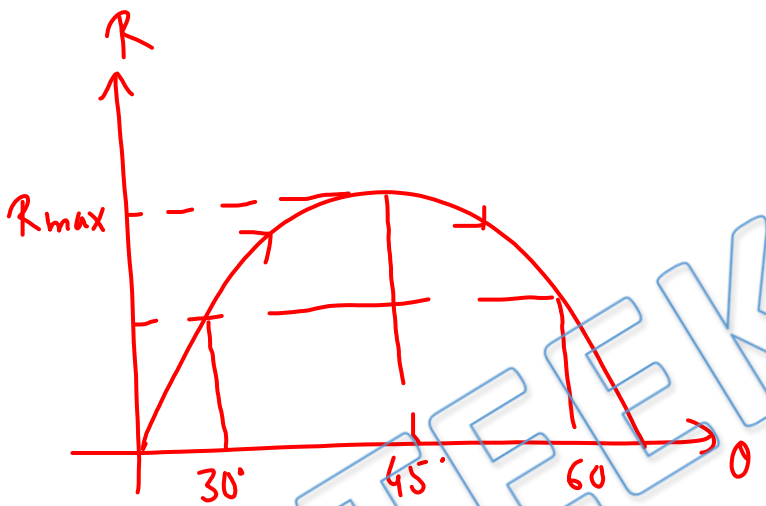
$\Rightarrow V_x = V_y \Rightarrow 10\sqrt{3} - 10t = 10$

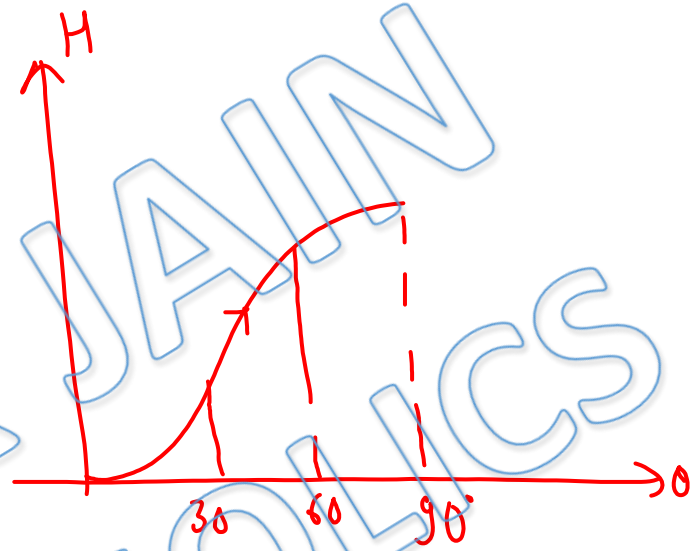
$\Rightarrow t = (\sqrt{3} - 1)$ Sec

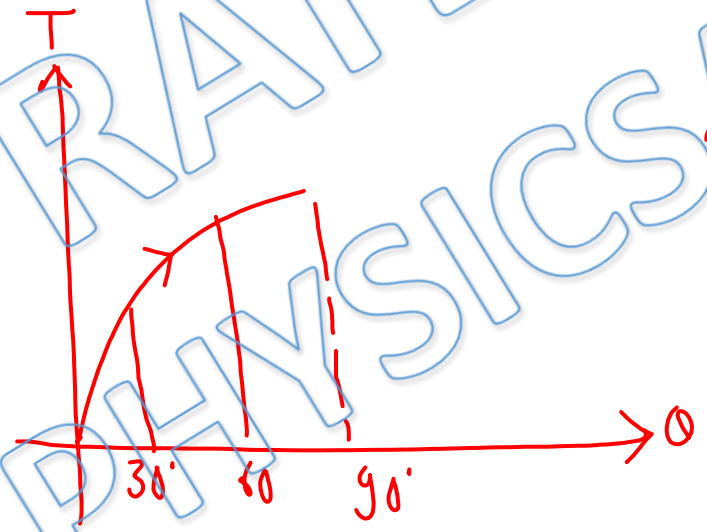


Ans (c)

9)







from 30 to 60

R first increases then decreases

H increases

T increases

ANS – B

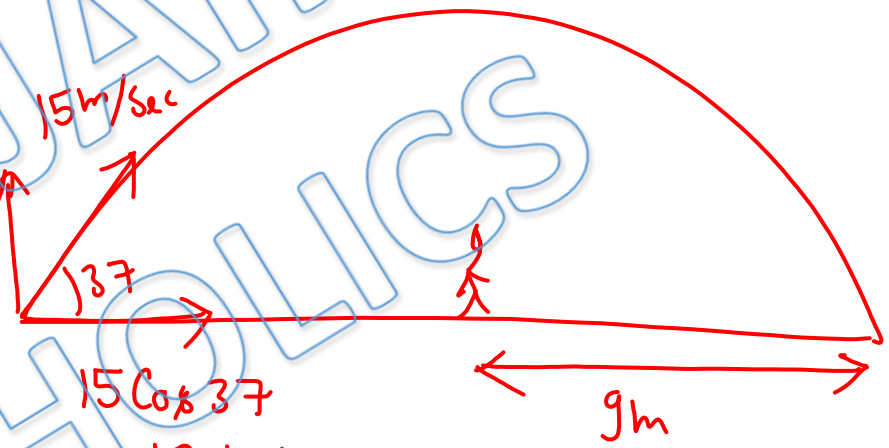
10)

$$T = \frac{2u_y}{g} \quad , \quad H = \frac{u_y^2}{2g}$$

Highest $H \Rightarrow$ Highest $v_y \Rightarrow$ Highest T

Ans – B

11)

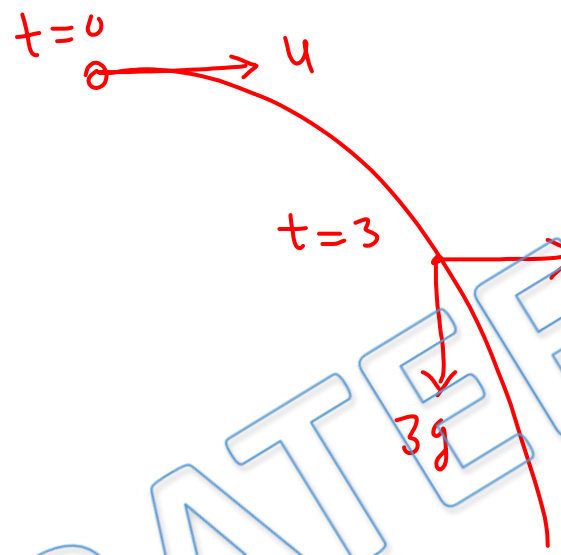


$$T = \frac{2u_y}{g} = \frac{2 \times 9}{10} = 1.8 \text{ Sec}$$

$$\text{Velocity of man} = \frac{dx}{dt} = \frac{9}{1.8} = 5 \text{ m/Sec}$$

ANS (B)

12)



$$\sqrt{u^2+9g^2} = 1.25u$$

$$\Rightarrow u^2+9g^2 = \frac{25u^2}{16}$$

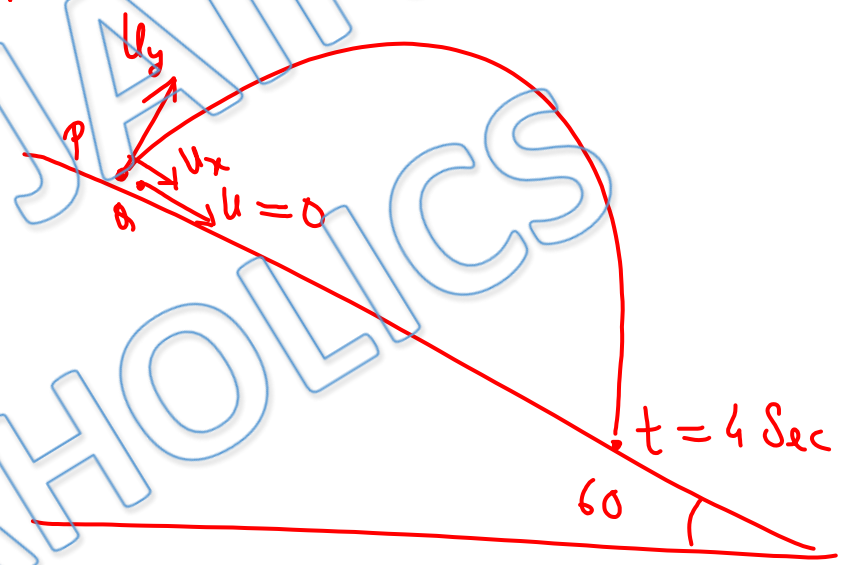
$$\Rightarrow 9g^2 = \frac{9u^2}{16}$$

$$\Rightarrow u^2 = 16g^2$$

$$\Rightarrow u = 4g = 40\ m/sec$$

ANS - D

13) acceleration of P along inclined
= " " Q " " = $g\sin 60$



They have same displacement
along x axis in 4 Sec
$\Rightarrow u_x = u = 0$

time of flight of P $= \frac{2u_y}{g_y} = 4$

$\Rightarrow \frac{2u_y}{g\cos 60} = 4 \Rightarrow u_y = 2g \times \frac{1}{2} = 10\ m/sec$

$u_P = u_y = 10\ m/sec$

ANS-B

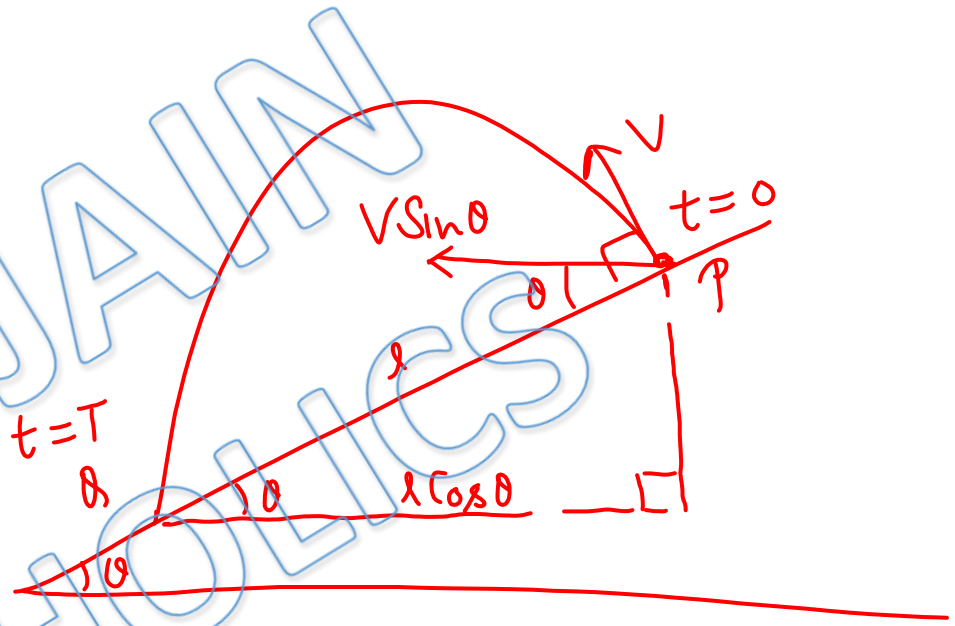
14)

Horizontal velocity of projectile = $V\sin\theta$

Horizontal displacement $= u_x \cdot t$

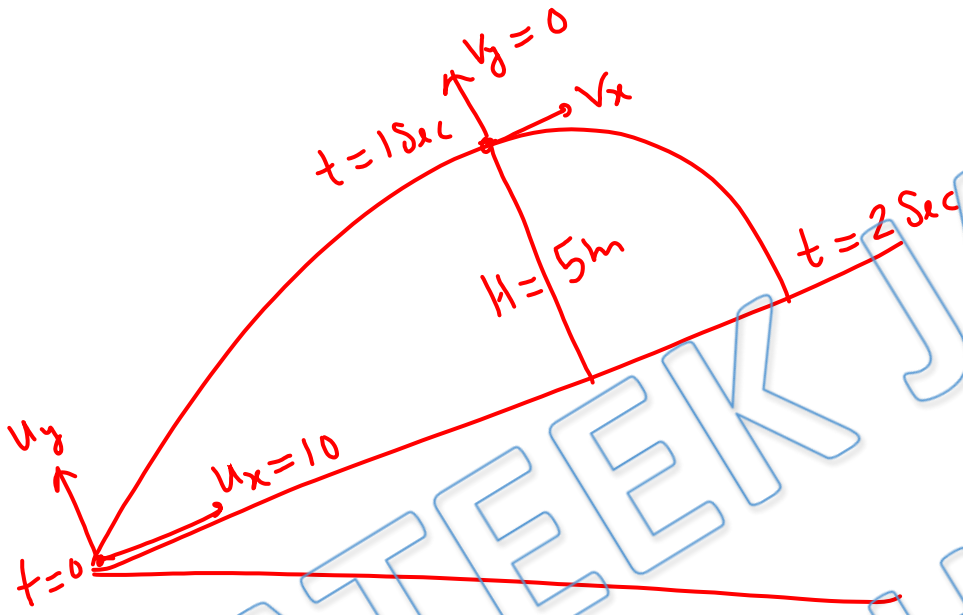
$\Rightarrow \quad l\cos\theta = V\sin\theta\, T$

$\Rightarrow \quad PQ = l = VT\tan\theta$



ANS - D

15)



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

$g_y \rightarrow$ Component of g along y axis

$$\frac{2u_y}{g_y} = 2 \Rightarrow u_y = g_y \text{----(1)}$$

$$H = \frac{u_y^2}{2g_y} = 5$$

$$\Rightarrow u_y = 10$$

$$u_x = 10$$

$$u = \sqrt{u_x^2 + u_y^2} = 10\sqrt{2}$$

Ans – B

16) A & B have same vertical displacement in same time

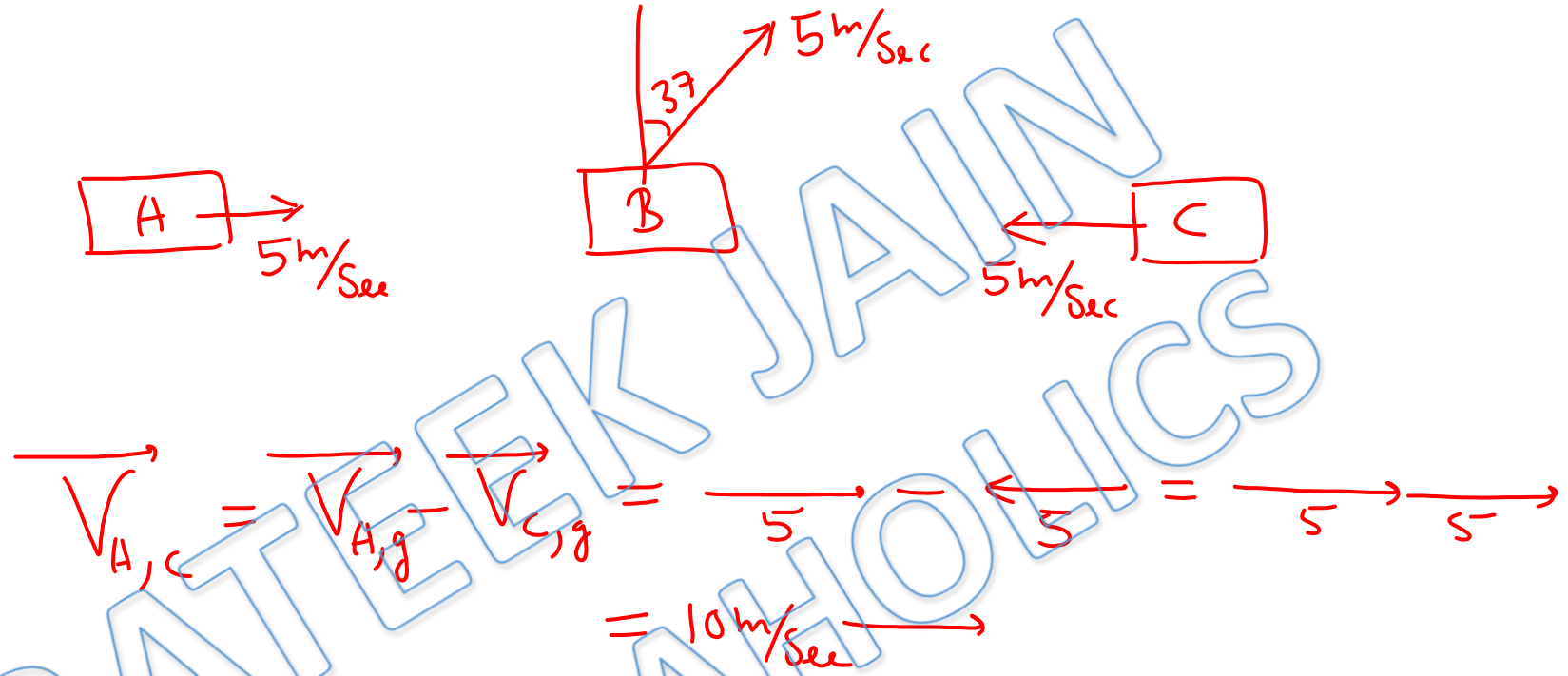
$\Rightarrow$ They have same initial vertical velocity

$\Rightarrow$ $V_A \sin 60 = V_B$

$\Rightarrow$ $\frac{V_A}{V_B} = \frac{1}{\sin 60} = \frac{2}{\sqrt{3}}$

Ans (B)

17)

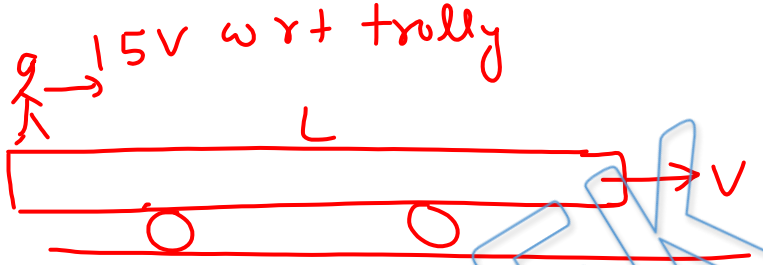


$$\vec{V}_{A,C} = \vec{V}_{A,g} - \vec{V}_{C,g} = \overrightarrow{5} - \overleftarrow{5} = \overrightarrow{5} + \overrightarrow{5}$$

$$= 10\,m/Sec \rightarrow$$

ANS - A

18)



Speed of man w.r.t trolly = 1.5V

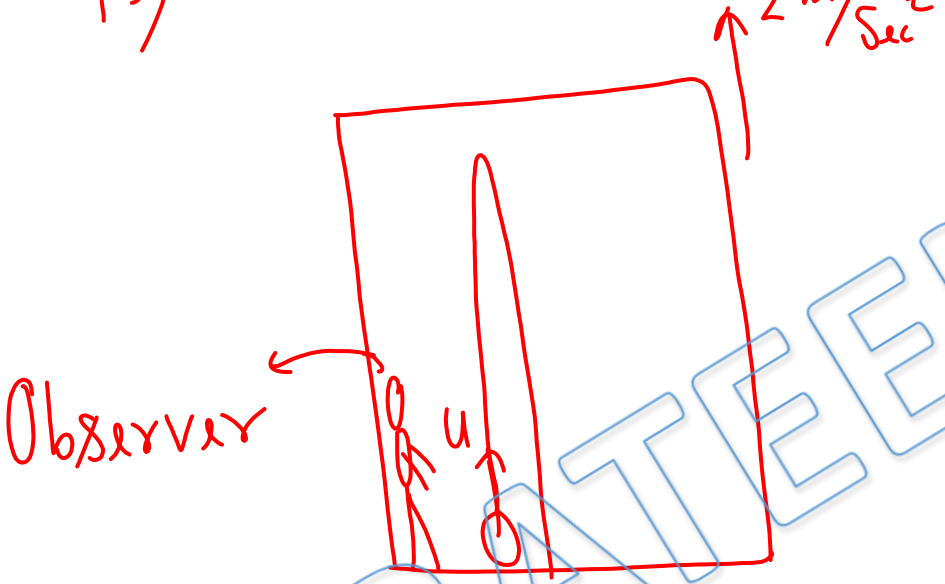
distance travelled " " = 2L

time of motion $= \frac{2L}{1.5V} = \frac{4L}{3V}$

$$D_{m,g} = D_{m,T} + D_{T,g} = 0 + V \times \frac{4L}{3V} = \frac{4L}{3}$$

ANS-D

19)



w.r.t observer in lift

initial velocity of ball = u

acceleration of ball = ↓ = 12 m/Sec²

↓ g+2

Displacement of ball = 0

$T = \frac{2u}{g_{eff}} \Rightarrow 2 = \frac{2u}{12}$

$\Rightarrow u = 12\ m/Sec^2 \uparrow$

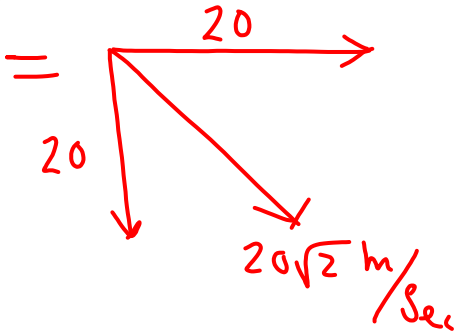
ANS-(c)

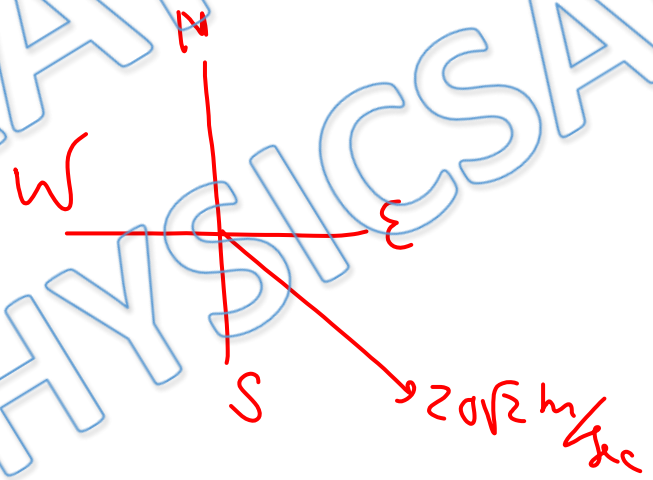
20)

direction of fluttering of flag will be along the

velocity of wind w.r.t flag

$$\vec{V}_{w,f} = \vec{V}_w - \vec{V}_f = 20\hat{i} - 20\hat{j}$$



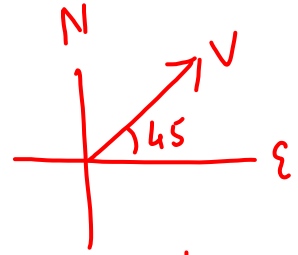


flag will point in South east direction

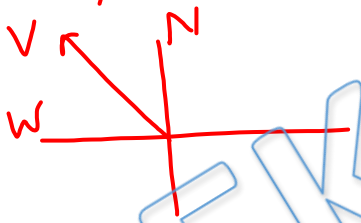
FINS-C

21)

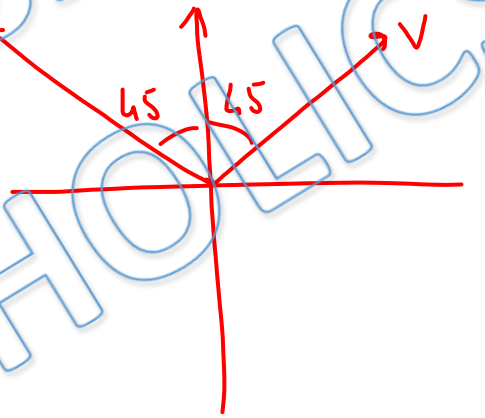
$V_{A,B}$ =



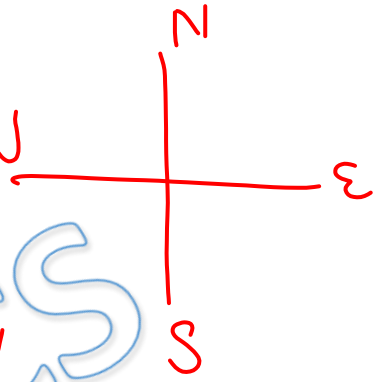
$V_{B,C}$ =



$\vec{V}_{A,C} = \vec{V}_{A,B} + \vec{V}_{B,C}$ =

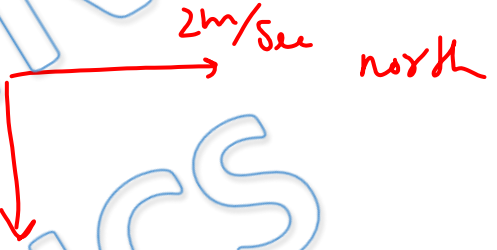


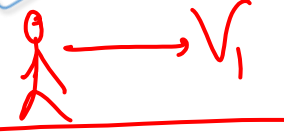
=



Ans (B)

22)

Velocity of rain w.r.t ground = 

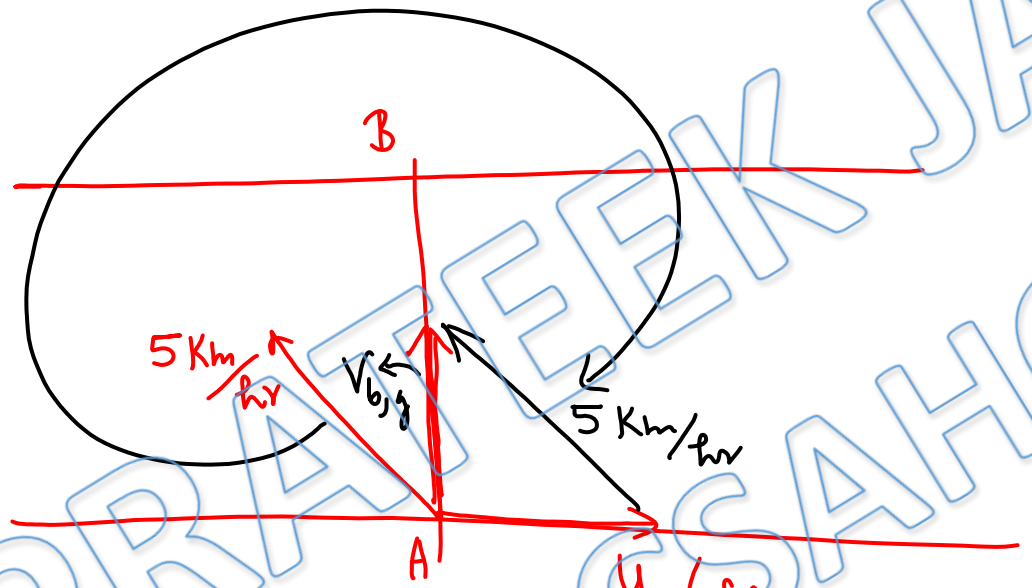
Velocity of rain w.r.t man 

$$\vec{V}_{r,g} - \vec{V}_{m,g} = \vec{2} - \vec{V_1}$$

Since this velocity is vertical $2 - V_1 = 0 \Rightarrow V_1 = 2$ due north

ANS (B)

23) $V_{b,w}$ = velocity of boat in still water = 5 Km/hr



$$V_{b,g}^2 + u^2 = 5^2$$

$$16 + u^2 = 25$$

$$u = 3 \text{ Km/hr}$$

$$V_{b,g} = \frac{1 \text{ Km}}{15 \text{ min}} = 4 \text{ Km/hr}$$

Ans (B)

24)

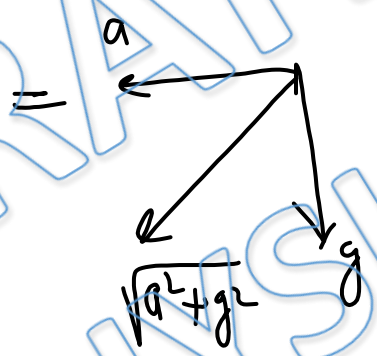
acceleration of bus w.r.t ground = $a \rightarrow$

acceleration " ball " " = $g \downarrow$

acceleration of ball w.r.t bus

$$= \vec{a}_{b,g} - \vec{a}_{bus,g}$$

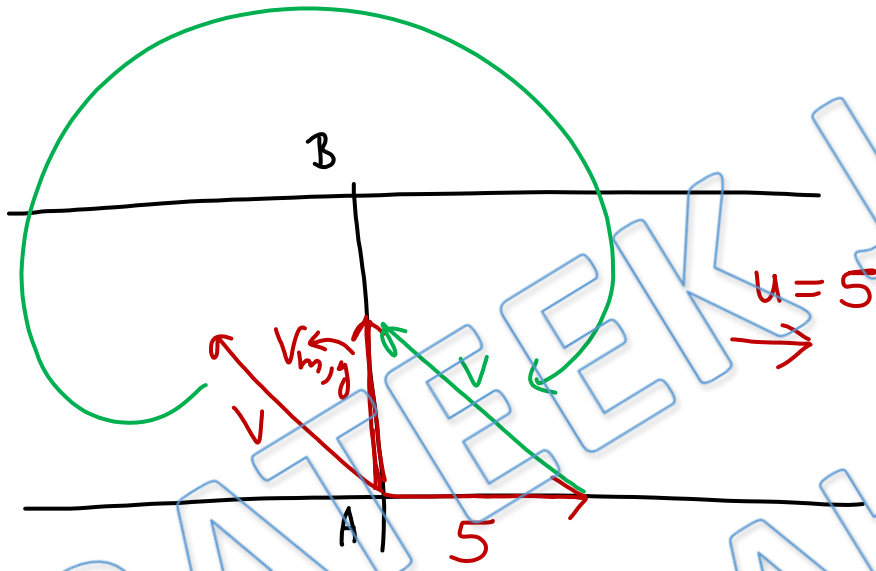
$$= \sqrt{a^2 + g^2}$$



ANS – C

25)

$v \rightarrow$ velocity of man w.r.t flow or in still water



$V_{m,g} = \frac{60}{5} = 12\ m/sec$

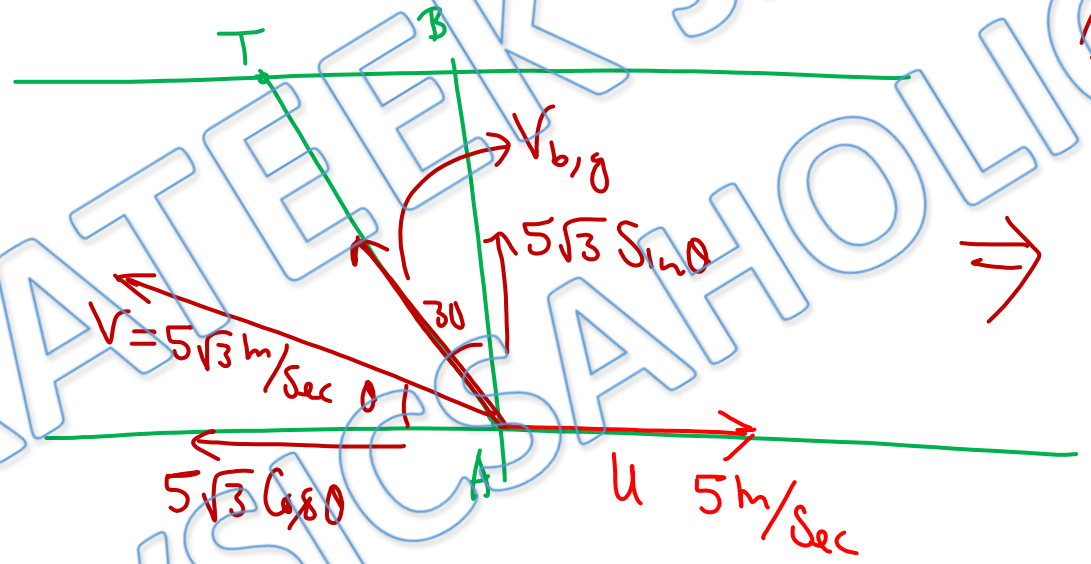
$V^2 = 12^2 + 5^2 \Rightarrow V = 13\ m/sec$

ANS → (B)

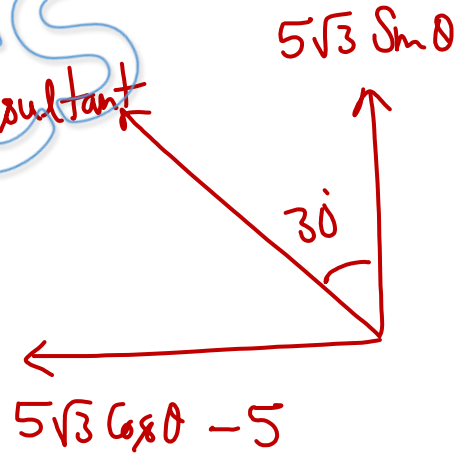
2c)

$V = V_{b,f} = 5\sqrt{3}$

$V_{b,g}$ is resultant of V & u



$\Rightarrow$

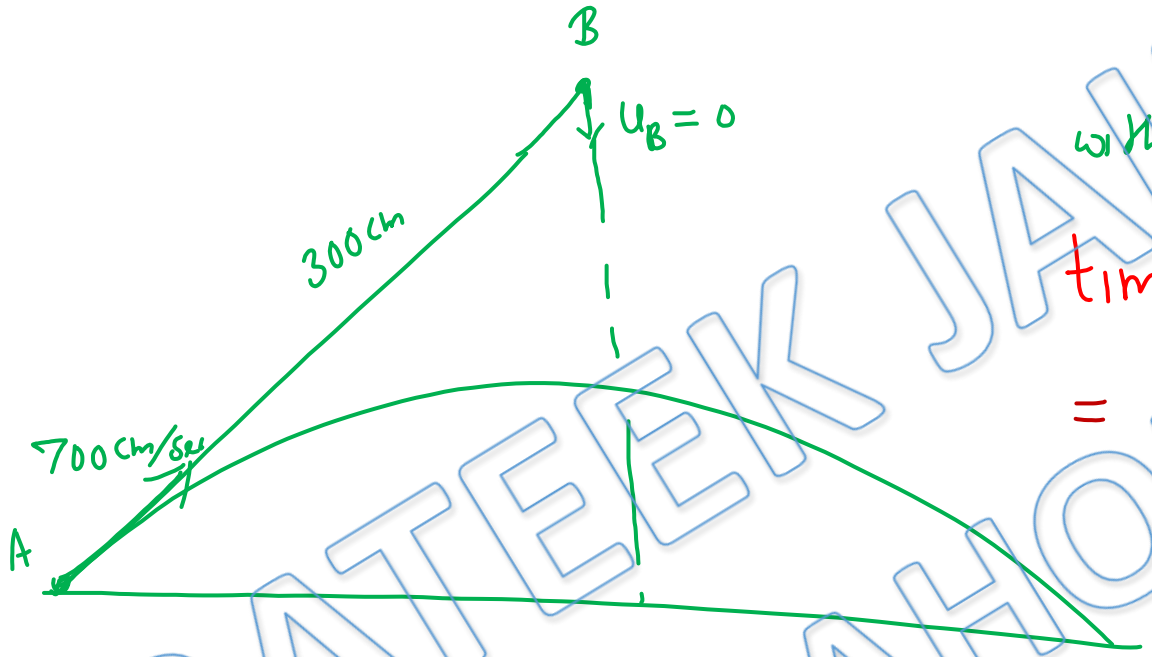


$$\tan 30 = \frac{5\sqrt{3}\cos\theta - 5}{5\sqrt{3}\sin\theta} = \frac{1}{\sqrt{3}} \Rightarrow \sqrt{3}\cos\theta - 1 = \sin\theta \Rightarrow \frac{\sqrt{3}}{2}\cos\theta - \frac{1}{2}\sin\theta = \frac{1}{2}$$

$\Rightarrow \cos(\theta + 30) = \cos 60 \Rightarrow \theta = 30^\circ \Rightarrow$ 30 wrt. line of destination

ANS-(c)

27)



w.r.t B, A is moving with constant velocity 700cm/sec

time elapsed before hitting

$= \frac{300}{700} = \frac{3}{7}$ Sec

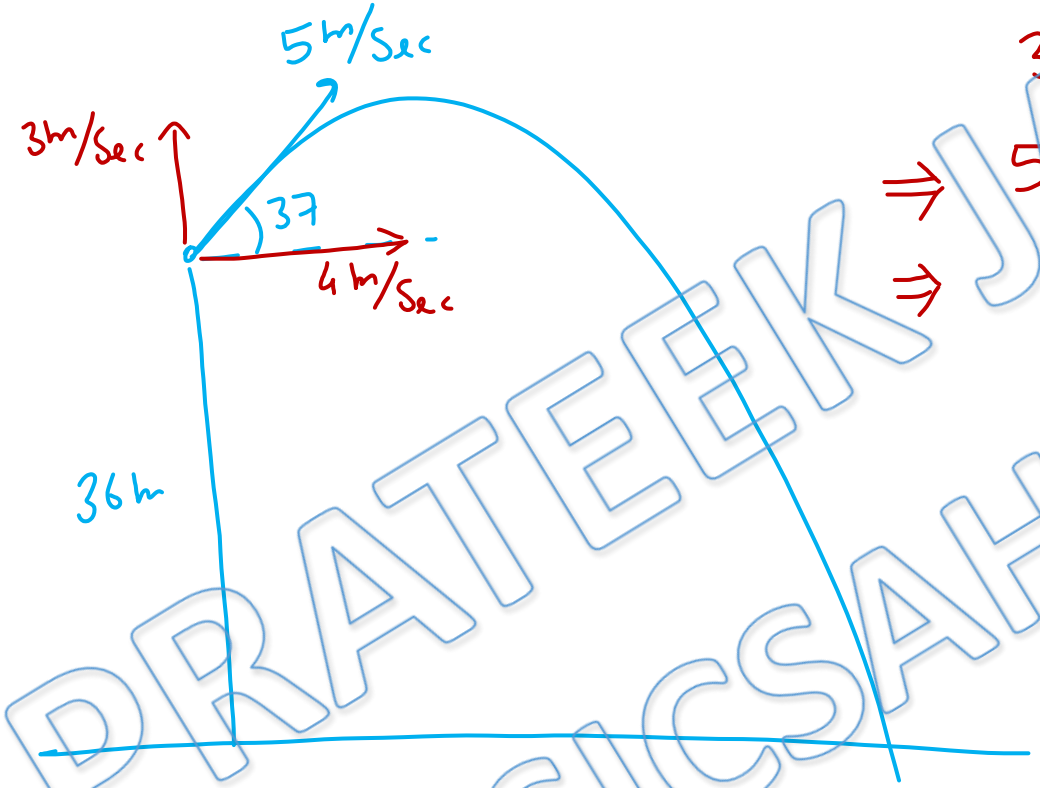
Displacement of B in $\frac{3}{7}$ Sec

$= \frac{1}{2} g t^2 = \frac{1}{2} \times \cancel{9.8} \times \frac{9}{\cancel{49}}$

$= .9$ meter $= 90$ cm

ANS – A

28)



Using $x = ut + \frac{1}{2}at^2$ for vertical motion

$$36 = -3t + \frac{1}{2} \times 10 \times t^2$$

$$\Rightarrow 5t^2 - 3t - 36 = 0$$

$$\Rightarrow t = 3 \text{ Sec}$$

$$R = u_x t$$

$$= 4 \times 3$$

$$= 12 \text{ m}$$

Ans (A)

29) $\vec{V} = 3\hat{i} + 4\hat{j}$, $\vec{a} = -\hat{i} - .5\hat{j}$

$\Rightarrow u_x = 3$, $a_x = -1$, $u_y = 4$, $a_y = -.5$

at max x-Co-ordinate $V_x = 0 = u_x + a_x t$

$\Rightarrow 0 = 3 - t \Rightarrow t = 3$ Sec

at $t = 3$

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

$$= 4 \times 3 + \frac{1}{2}\left(-\frac{1}{2}\right) 9$$

$$= 12 - \frac{9}{4}$$

$$= \frac{39}{4}$$

ANS-(D)

30) $\vec{r} = 3t^2\hat{i} + 4t^2\hat{j} + 7\hat{k}$

$\vec{v} = \frac{d\vec{r}}{dt} = 6t\hat{i} + 8t\hat{j}$

$\Rightarrow v = \sqrt{36t^2 + 64t^2} = 10t$

$\Rightarrow \int_0^s ds = \int_0^{10} 10t\, dt$

$\Rightarrow s = \left[5t^2\right]_0^{10}$

$= 500\,m$

ANS-(c)

Chalo Niklo