Ans: to : que: no: 1

a] $\vec{R_1} = 2\hat{i} + 3\hat{j} - 6\hat{k}$

$\vec{R_2} = 2\hat{i} - m\hat{j} - 8\hat{k}$

As y component of R_2 is Unknown. so if we compare the x, z components of R_1 and R_2 we get the following,

Comparing x components:

$$A_x = \frac{R_1 x}{R_2 y} = \frac{2}{2} = 1$$

Comparing z components:

$$A_z = \frac{R_1 z}{R_2 z} = \frac{-6}{-8} = \frac{3}{4}$$

$\therefore A_x \neq A_z$, so, differences between components of x and z are not same.

As their differences are not same we can say that $\vec{R_1}$ and $\vec{R_2}$ ~~are not Parallel~~

(Ans 1)

b) As, $\vec{R_1} \parallel \vec{R_3}$ means they are parallel,

So, we can say that, $\vec{R_1} \times \vec{R_3} = 0$

$$\therefore \vec{R_1} \times \vec{R_3} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 3 & -6 \\ n & 4.5 & -9 \end{vmatrix}$$

$$= \hat{i}(-27+27) - \hat{j}(-18+6n) + \hat{k}(9-3n)$$

$$= \hat{j}(6n-18) + \hat{k}(9-3n)$$

$$|\vec{R_1} \times \vec{R_3}| = \sqrt{(6n-18)^2 + (9-3n)^2}$$

$$= \sqrt{324 - 216n + 36n^2 + 81 - 54n + 9n^2}$$

$$= \sqrt{45n^2 - 210n + 405}$$

So, $|\vec{R_1} \times \vec{R_3}| = 0$ ← As they are parallel

$\therefore 45n^2 - 210n + 405 = 0$

$\therefore n = 3$

Now,

$$\vec{R_2} \times \vec{R_3} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & -m & -8 \\ 3 & 4.5 & -9 \end{vmatrix}$$

$$= \hat{i}\,(9m+36) - 6\hat{j} + (9+3m)\hat{k}$$

$$\therefore \vec{R_1} \cdot (\vec{R_2} \times \vec{R_3}) = 2(9m+36) - 6 \times 3 + (-6)(9+3m)$$

$$= 18m + 72 - 18 - 64 - 18m$$

$$= 0$$

$$|\vec{R_2} \times \vec{R_3}| = \sqrt{(9m+36)^2 + 6^2 + (9+3m)^2}$$

$$= \sqrt{81m^2 + 1296 + 648m + 36 + 81 + 54m + 9m^2}$$

$$= \sqrt{90m^2 + 702m + 1413}$$

The condition given in the question,

$$2\,|R_2 \times R_3| = R_1(R_2 \times R_3) + \sqrt{58.8 \times 3}$$

$$\Rightarrow 2\sqrt{90m^2 + 702m + 1413} = 0 + \sqrt{58.8 \times 3}$$

$$\Rightarrow 4(90m^2 + 702m + 1413) = 176.4$$

$$\Rightarrow 360m^2 + 2808m + 5652 - 176.4 = 0$$

$$\therefore m = -3.9 \quad \text{(Ans-2)}$$

c) We get from que (b) that $m = -3.9$ and $n = 3$.

Now, we can say that,

$\vec{R_2} = 2\hat{i} + 3.9\hat{j} - 8\hat{k}$

$\vec{R_3} = 3\hat{i} + 4.5\hat{j} - 9\hat{k}$

$\therefore \vec{R_3} - \vec{R_2} = \hat{i} + 0.6\hat{j} - \hat{k}$

$|\vec{R_3} - \vec{R_2}| = \sqrt{(1)^2 + (0.6)^2 + 1^2}$

$= 1.536$

$\therefore (\vec{R_3} - \vec{R_2})$ makes angle with $\hat{i}$ axis,

$\theta_x = \cos^{-1}\left(\frac{1}{1.536}\right)$

$= \cancel{49.38}\ 49.38°$

$\therefore (\vec{R_3} - \vec{R_2})$ makes angle with $\hat{j}$ axis,

$\theta_y = \cos^{-1}\left(\frac{0.6}{1.536}\right)$

$= 67.006°$

$\therefore (\vec{R_3} - \vec{R_2})$ makes angle with $\hat{k}$ axis

$$\theta_z = \cos^{-1}\left(\frac{-1}{1.536}\right)$$

$$= 130.62^\circ$$

$\therefore$ We can say $(\vec{R_3} - \vec{R_2})$ makes angle with $\hat{i}, \hat{j}, \hat{k}$ axis are 49.38°, 67.006°, 130.62°,

(Ans-3)

Ans: to: que: no: 2

a) We get from question that,

$x = 66t$ and $y = 86t - 4.9t^2$

For x condinate,

Defferentiating x we get velocity.

$$\frac{\partial}{\partial t}(x) = 66$$

$$\therefore V_x = 66$$

Defferentiating v we get acceleration,

$$\frac{\partial}{\partial t}(V_x) = 0$$

$$\therefore a_x = 0$$

For y condinate,

Defferentiating y we get velocity.

$$\frac{\partial}{\partial t}(y) = 86 - 9.82t$$

$\therefore V_y = 86 - 9.82t$

Deffenentiating v we get acceleration

$$\frac{\partial}{\partial t}(V_y) = -9.82$$

$\therefore a_y = -9.82$

~~$\therefore$ we can~~

$\therefore$ We can say acceleration vector throughout the flight $a = a_x\hat{i} + a_y\hat{j}$

$$= 0 + (-9.82)\hat{j}$$

$$= -9.82\hat{j} \quad \text{(Ans-1)}$$

b) From (a) we get,

$V_x = 66$

$V_y = 86 - 9.82t$

At, O point $t = 0$,

On $t = 0$, V_x and V_y will be,

$V_x = 60$

$V_y = 86 - 9.82(0)$

$= 86$

$\therefore$ The velocity is $V = V_x \hat{i} + V_y \hat{j}$

$= 66\hat{i} + 86\hat{j}$

(Ans-2)

c) From qua (a) we get $V_y = 86 - 9.82t$

$y = 86t - 4.91t^2$

We know at the highest point the projectile

$V_y = 0$

So, we can write that,

$86 - 9.82t = 0$

$\Rightarrow 9.82t = 86$

$\Rightarrow t = 8.75$ sec

As now we have the time it takes to reach the highest point, now we can find the highe

Point.

∴ The highest point from the ground

$y = 86(8.75) - 4.9(8.75)^2$

$= 377.34$ m

∴ Maximum height $h = 377.34$ m

Now,

As the projectile falls 120 m in the negative y axis, while falling it also goes forward to x-axis.

So, we can write that,

$86t - 4.9t^2 = -120$

$\Rightarrow 86t - 4.9t^2 + 120 = 0$

∴ $t = 18.85, -1.299$

∴ The distance the projectile travel is

$x = 66(18.85) = 1244.1$

$\therefore$ The Range $L = 1244.1$ m

After all we can say,

$h = 377.34$ m

$L = 1244.1$ m

(Ans-3)

Ans: to: que: no: 3

(A)

a) In the given figure-2 we can see that, On P point the angle of V_x and V_y are the same and the angle is $90°$;

$\therefore V_x = V_y$

We can say that,

$V_y^2 = V_0^2 + 2gh$

$\Rightarrow V_y^2 = 2gh$

$\therefore V_y = \sqrt{2gh}$

$\therefore$ ~~As V~~

$\therefore V_n = V_y = \sqrt{2gh}$

$\therefore$ The speed at P_1 is $\sqrt{2gh}$ (Ans-1)

b) From (a) we get $V_n = \sqrt{2gh}$

The ball bouncing from P_1 to P_2,

At ~~the~~ P_2 point,

$x = V_n t$

$\therefore y = V_y t + \frac{1}{2} g t^2$

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As their angle between them is 45°

we know, $\tan\theta = \frac{y}{x}$

$\Rightarrow \tan 45^\circ = \frac{y}{x}$

$\therefore \cancel{1}\; y = x$

So, we can say that the value of y and x are the same while bouncing P_1 to P_2.

$\therefore \cancel{V_x t = V_y t + \frac{1}{2}}$

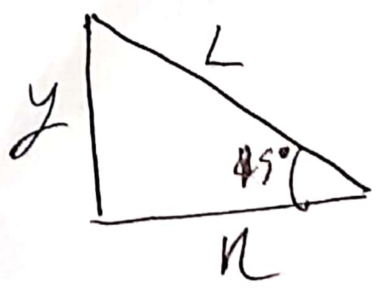
$\therefore V_x t = V_0 t + \frac{1}{2} g t^2$

$\Rightarrow \sqrt{2gh} = 0 + \frac{1}{2} g t^2$

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

we know,

$\cos 45^\circ = \frac{x}{L}$



we know,

$$x = vt$$

$$= \sqrt{2gh} \times \frac{2\sqrt{2h}}{\sqrt{g}}$$

$$= 4h$$

$$\therefore \cos 45^\circ = \frac{1}{\sqrt{2}} = \frac{4h}{L}$$

$$\therefore L = 4\sqrt{2}\,h \quad \text{(Ans-2)}$$

c) During the flight from P_1 to P_2 they maintain a horizontal speed and that is,

$$V_x = \sqrt{2gh}$$

A from (b) we get $t = \frac{2\sqrt{2h}}{\sqrt{g}}$

$$\therefore V_y = V_0 + gt$$

$$= 0 + g \times \frac{2\sqrt{2h}}{\sqrt{g}}$$

$$= 2\sqrt{2gh}$$

$$\therefore V = V_x \hat{i} + V_y \hat{j}$$

$$\therefore |V| = \sqrt{(V_x)^2 + (V_y)^2}$$

$$= \sqrt{(\sqrt{2gh})^2 + (2\sqrt{2gh})^2}$$

$$= \sqrt{10gh}$$ (Ans-3)