9th advanced W.S-3 ①

Thank

①

Given $R = H$

From $H = \frac{R}{4}\tan\theta$

$\Rightarrow H = \frac{H}{4}\tan\theta$

$\Rightarrow 1 = \frac{1}{4}\tan\theta$

$\Rightarrow \tan\theta = 4$

$\Rightarrow \theta = \tan^{-1}(4)$

②

Given $K.E = E = \frac{1}{2}mu^2$

At highest point $u = u_x$

$K.E_H = \frac{1}{2}mu_x^2$

$= \frac{1}{2}m(u\cos\theta)^2$

$= \frac{1}{2}mu^2\cos^2\theta$

$= E\cos^2 45°$

$= E\left(\frac{1}{\sqrt{2}}\right)^2 = \frac{E}{2} = 0.5E$

③

Given $x = ct^2$

$\Rightarrow u_x = \frac{dx}{dt} = \frac{d}{dt}[ct^2]$

$\Rightarrow u_x = 2ct$

$y = bt^2$

$\Rightarrow u_y = \frac{dy}{dt} = 2bt$

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

$u = \sqrt{(2ct)^2 + (2bt)^2}$

$= \sqrt{(2t)^2(c^2+b^2)}$

$= 2t\sqrt{c^2+b^2}$

④ & ⑤

From given $y = 8t - 5t^2$; ~~x~~=6

Compare with $y = u\sin\theta t - \frac{1}{2}gt^2$

$\Rightarrow u\sin\theta = u_y = 8$

Also given $x = 6t$

compare with $x = u\cos\theta\, t$

$\Rightarrow u\cos\theta = 6 = u_x$

$\therefore u = \sqrt{u_x^2 + u_y^2} = \sqrt{6^2+8^2}$

$u = 10\ m/s$

Angle made by velocity with x-axis

$\tan\theta = \frac{u_y}{u_x} = \frac{8}{6}$

$\Rightarrow \tan\theta = \frac{4}{3}$

$\Rightarrow \theta = \tan^{-1}\left(\frac{4}{3}\right)$

⑥

Given $\theta_1 = 60°$; $\theta_2 = 30°$

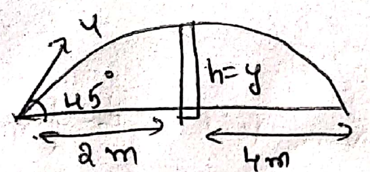
$H \propto \sin^2\theta$

$\frac{H_1}{H_2} = \left[\frac{\sin\theta_1}{\sin\theta_2}\right]^2$

$\Rightarrow \frac{H_1}{H_2} = \left[\frac{\sin 60}{\sin 30}\right]^2$

$\Rightarrow \frac{H_1}{H_2} = \frac{3}{1}$

(7)



$\leftarrow R_{max} = 6m \rightarrow$

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

$\Rightarrow 6 = \frac{u^2}{g} \Rightarrow u^2 = 6g$

From $y = \tan\theta x - \frac{g}{2u^2\cos^2\theta} x^2$

$\Rightarrow h = \tan 45° \times 2 - \frac{g}{2 \times 6g \times \cos^2 45°} \times 2^2$

$\Rightarrow h = 2 - \frac{1}{\cancel{6}^{3} \times (\frac{1}{\sqrt{2}})^2} \times \cancel{2} = 2 - \frac{2}{3}$

$\Rightarrow h = \frac{4}{3}$ m

(9)

we know that

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

This R_{max} will act as radius.

Area $= \pi r^2$

$= \pi (\frac{u^2}{g})^2$

$\Rightarrow \pi \frac{u^4}{g^2}$

(10)

Given $\theta_1 = \theta$; $\theta_2 = 90 - \theta$.

These are complimentary angles. $u_1 = u_2$

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

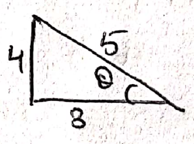
$\Rightarrow H_{max} \propto \sin^2\theta$

$\Rightarrow \frac{H_1}{H_2} = \frac{\sin^2\theta_1}{\sin^2\theta_2} =$

$\Rightarrow \frac{H_1}{H_2} = \frac{\sin^2\theta}{\sin^2(90-\theta)} = \frac{\sin^2\theta}{\cos^2\theta}$

$= \tan^2\theta$

(20)



$\sin\theta = \frac{4}{5}$

$H_{max} = 4m$; $R = 12m$

$\Rightarrow H_{max} = \frac{R}{4} \tan\theta$

$\Rightarrow H = \frac{\cancel{12}^{3}}{\cancel{4}} \tan\theta$

$\Rightarrow \tan\theta = \frac{4}{3}$

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

$\Rightarrow 4 = \frac{u^2}{2 \times 10} (\frac{4}{5})^2$

$\Rightarrow \cancel{4} = \frac{u^2}{20} \times \frac{\cancel{16}\,4}{25}$

$\Rightarrow u^2 = \frac{\cancel{20}^{5} \times 25}{\cancel{4}}$

$\Rightarrow u = 5\sqrt{5}$ m/s

(21)

Given $x = 36t$ $y = 48t - 4.9t^2$

compare with $x = u\cos\theta\, t$ compare with $y = u\sin\theta t - \frac{1}{2}gt^2$

$\Rightarrow u\cos\theta = u_x = 36$ $u\sin\theta = u_y = 48$

$\therefore u = \sqrt{u_x^2 + u_y^2} = \sqrt{(36)^2 + (48)^2} = \sqrt{3600} = 60\ m/s$

L Task

SAQ's

(1)

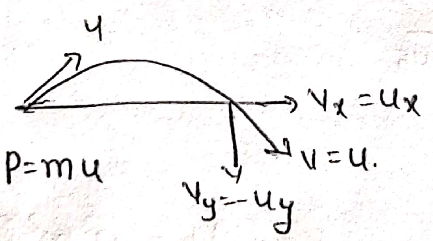
Given $R_1 = R_2 \Rightarrow$ Given the angles are complimentary angles. $\theta_1 = 60^\circ \Rightarrow \theta_2 = 30^\circ$

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

$\therefore \frac{H_1}{H_2} = \frac{\sin^2\theta_1}{\sin^2\theta_2} = \frac{\sin^2 60}{\sin^2 30} = \left[\frac{\sin 60}{\sin 30}\right]^2 = \left[\frac{\frac{\sqrt{3}}{2}}{\frac{1}{2}}\right]^2 = \frac{3}{1}$

$\Rightarrow H_2 = \frac{H_1}{3}$

(2)



$P = mu$

$\vec{u} = u_x\hat{i} + u_y\hat{j}$

$\vec{V} = V_x\hat{i} + V_y\hat{j} = u_x\hat{i} - u_y\hat{j}$

change in velocity $dv = \vec{V} - \vec{u}$

$\Rightarrow dv = \cancel{u_x\hat{i}} - u_y\hat{j} - \cancel{u_x\hat{i}} - u_y\hat{j}$

$= -2u_y\hat{j} = -2u\sin\theta\hat{j}$

$|dv| = |-2u\sin\theta\hat{j}|$

$= 2u\sin\theta$

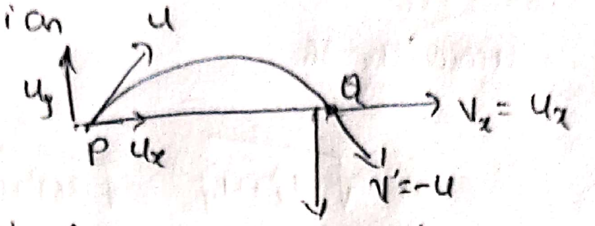
$\therefore$ change in momentum

$|dp| = m|dv| = 2mu\sin\theta$

$= 2P\sin\theta$

(3)

As the body Projected with certain velocity at P, it reaches Q with same velocity but in reverse direction



But Magnitude of velocity $V_y = -u_y$

is same

$$|\vec{u}| = \sqrt{u_x^2 + u_y^2} \quad ; \quad |\vec{V}| = \sqrt{V_x^2 + V_y^2} = \sqrt{u_x^2 + u_y^2}$$

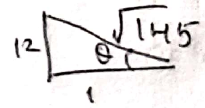
(4)

From

$$y = \tan\theta \, \cancel{x} - \frac{g}{2u^2\cos^2\theta} x^2$$

Given $y = 12x - \frac{g}{4} x^2$

$\tan\theta = 12$



$\cos\theta = \frac{1}{\sqrt{145}}$; $\sin\theta = \frac{12}{\sqrt{145}}$

Given

$u_x = u\cos\theta = 3$

$u \times \frac{1}{\sqrt{145}} = 3 \Rightarrow u = 3\sqrt{145}$

$u\sin\theta = 3 \times \frac{12}{\sqrt{145}} \sqrt{145}$

$u\sin\theta = 36$

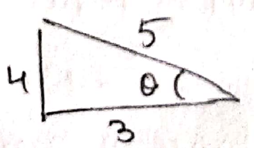
$R = \frac{2u_x \, u_y}{g}$

$R = \frac{2 \times 3\sqrt{145} \times 36}{10}$

$= 21.6\,m$

(5)

Given $R = 24\,m$, $H = 8\,m$



From $H = \frac{R}{4}\tan\theta$

$\Rightarrow 8 = \frac{24}{4}\tan\theta$

$\Rightarrow \tan\theta = \frac{4}{3}$

$\Rightarrow \sin\theta = \frac{4}{5}$

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

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

$\Rightarrow u = \frac{\sqrt{2gH}}{\sin\theta} = \frac{5}{4}\sqrt{2\times10\times8}$

$= \frac{5}{4} \times 4\sqrt{10} = 5\sqrt{10}$

$\Rightarrow u = 5\sqrt{g}\ m/s$

(6)

Given $\theta_1 = 30^\circ$; $\theta_2 = 45^\circ$

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

$$\Rightarrow H \propto \sin^2\theta$$

$$\Rightarrow \frac{H_1}{H_2} = \frac{\sin^2\theta_1}{\sin^2\theta_2} = \left[\frac{\sin\theta_1}{\sin\theta_2}\right]^2$$

$$\Rightarrow \frac{H_1}{H_2} = \left(\frac{\sin 30}{\sin 45}\right)^2$$

$$= \left[\frac{\frac{1}{2}}{\frac{1}{\sqrt{2}}}\right]^2 = \left[\frac{1}{\sqrt{2}}\right]^2$$

$$\Rightarrow \frac{H_1}{H_2} = \frac{1}{2}$$

(7)

Given $\theta_A = 10^\circ$; $\theta_B = 30^\circ$; $\theta_C = 45^\circ$; $\theta_F = 80^\circ$.

$$\text{Range} = \frac{u^2 \sin 2\theta}{g} \quad ; \; R \propto \sin 2\theta.$$

Range is maximum when $\sin 2\theta = 1$

$$\Rightarrow 2\theta = 90^\circ$$

$$\Rightarrow \theta = 45^\circ$$

so third ball 'C' strike the ground farthest Point

(8)

Given $2y = 96t - 9.8t^2$

$$\Rightarrow y = 48t - 4.9t^2$$

compare with

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

$$\Rightarrow u\sin\theta = u_y = 48$$

and also given $x = 36t$

compare with $x = u\cos\theta\, t$

$$u\cos\theta = u_x = 36$$

$$H_{max} = \frac{u_y^2}{2g} = \frac{(48)^2}{2g} = 115.2\,m$$

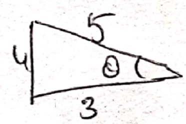
(9)

Given $R = 3H_{max}$

$$\Rightarrow H = \frac{R}{4}\tan\theta$$

$$\Rightarrow H = \frac{3H}{4}\tan\theta$$

$$\Rightarrow \tan\theta = \frac{4}{3}$$



$$\Rightarrow \sin\theta = \frac{4}{5}$$

$$\Rightarrow \theta = \sin^{-1}\left(\frac{4}{5}\right)$$

(20)

Given $\theta_1 = 60^\circ$ since Ranges are same θ_2 so $\theta_2 = 30^\circ$

$H_1 = 102\text{ m}$; $H_2 = ?$

we know $H = \frac{u^2 \sin^2\theta}{2g} \Rightarrow H \propto \sin^2\theta$

$\Rightarrow \frac{H_1}{H_2} = \frac{\sin^2\theta_1}{\sin^2\theta_2} \Rightarrow \frac{102}{H_2} = \left(\frac{\sin 60}{\sin 30}\right)^2$

$\Rightarrow \frac{102}{H_2} = \left[\frac{\frac{\sqrt{3}}{2}}{\frac{1}{2}}\right]^2 = [\sqrt{3}]^2 \Rightarrow 3$

$\Rightarrow H_2 = \frac{102}{3} = 34\text{ m}$

(21)

Given $R = 4\sqrt{3}\,H$

$\Rightarrow H = \frac{R}{4} \tan\theta$

$\Rightarrow H = \frac{\cancel{4}\sqrt{3}\cancel{H}}{\cancel{4}} \tan\theta$

$\Rightarrow 1 = \sqrt{3}\tan\theta$

$\Rightarrow \tan\theta = \frac{1}{\sqrt{3}} \Rightarrow \theta = 30^\circ.$