WS-4 9th advanced

Thanks

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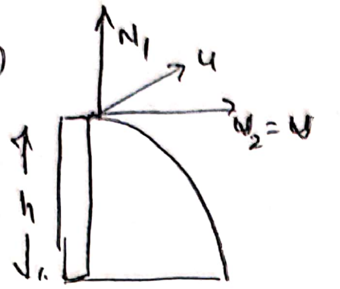

$u = \sqrt{u_1^2 + u_2^2 + 2u_1u_2\cos\theta}$

$u = \sqrt{v^2 + v^2 + 2vv\cos 90}$

$u = \sqrt{2}\, v.$

Range $= u \times T_d$

$= \sqrt{2}\, v \sqrt{\frac{2h}{g}}$

$= \sqrt{\frac{4hv^2}{g}}$

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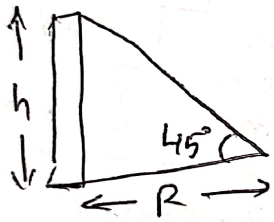

$\tan 45° = \frac{h}{R}$

$\Rightarrow h = R$

$\Rightarrow h = u\sqrt{\frac{2h}{g}}$

$\Rightarrow (\sqrt{h})^2 = u\sqrt{\frac{2h}{g}}$

$\Rightarrow u = \sqrt{\frac{gh}{2}}$

Velocity after 't' sec

$v = \sqrt{u^2 + g^2t^2}$

$= \sqrt{u^2 + g^2\left(\sqrt{\frac{2h}{g}}\right)^2}$

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

$= \sqrt{\frac{5gh}{2}}$

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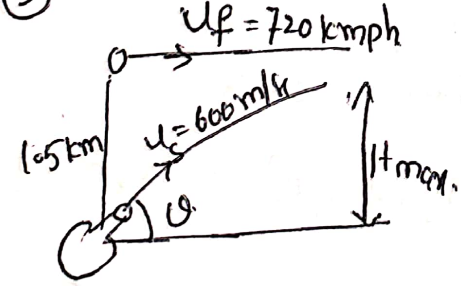
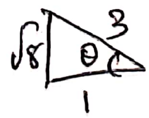


From fig $\sin\theta = \frac{u_f}{u_s}$

$\sin\theta = \frac{720 \times \frac{5}{18}}{600}$

$\sin\theta = \frac{1}{3}$

θ, with vertical $\sin(90-\theta) = \cos\theta = \frac{1}{3}$



$\sin\theta = \frac{\sqrt{8}}{3}.$

From $H = \frac{u^2\sin^2\theta}{2g} = \frac{(600)^2\left(\frac{\sqrt{8}}{3}\right)^2}{2 \times 10}$

$= \frac{600 \times 600 \times \frac{8}{9}}{20} = 16$ km

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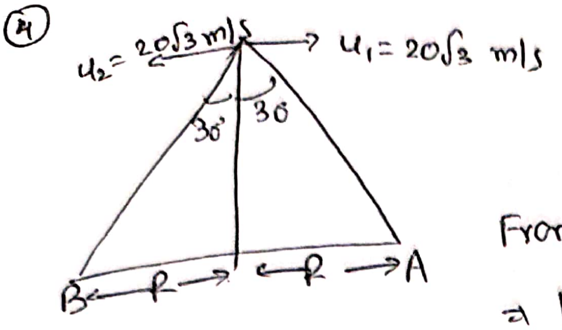

$R = u \times t$

$= 20\sqrt{3} \times 12$

$= 240\sqrt{3}$

$S_1 = u_1 t$

$= 20\sqrt{3}\, t$

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

$\Rightarrow h = \frac{1}{2} g t^2$

$\Rightarrow h = \frac{1}{\cancel{2}} \times \cancel{10}^{5}\, t^2$

$\Rightarrow h = 5(12)^2$

$= 720$ m

$\tan 30° = \frac{R}{h}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{R}{h}$

$\Rightarrow \frac{1}{\sqrt{3}} = \frac{20\sqrt{3}\, t}{5t^2}$

$\Rightarrow t = 12$ sec

$AB = 2R = 2 \times 240\sqrt{3}$

$= 480\sqrt{3}$ m.

Given $h = 5$m

$R = 10$m

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Give

$R_{earth} = R_{planet}$

$\Rightarrow \frac{u_e^2 \sin 2\theta}{g_e} = \frac{u_p^2 \sin 2\theta}{g_p}$

$\Rightarrow \frac{5^2}{10} = \frac{3^2}{g_p}$

$\Rightarrow g_p = \frac{3^2 \times 10}{5^2} = 3.6\ m/s^2$

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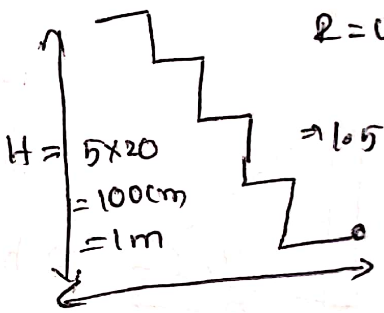

$R = 5 \times 30$cm

$= 1.5$m

$R = u\sqrt{\frac{2h}{g}}$

$\Rightarrow 1.5 = u\sqrt{\frac{2 \times 1}{10}}$

$\Rightarrow u = 1.5\sqrt{5}$ m/s

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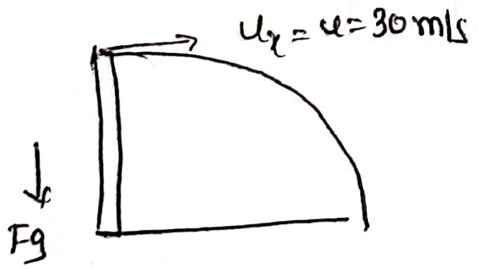


After t_1 = ~~$\frac{u}{g} = \frac{30}{10} = 3$~~

$u_y = u_x$

$\Rightarrow u_y + a_y t_1 = u$

$\Rightarrow g t_1 = u \Rightarrow t_1 = \frac{u}{g} = \frac{30}{10} = 3$

Given $y = x$

$\Rightarrow u_y t_2 + \frac{1}{2} a_y t_2^2 = u_x t_2 + \frac{1}{2} a_x t_2^2$

$\Rightarrow 0 \times t_2 + \frac{1}{2} g t_2^2 = u t_2 + \frac{1}{2}(0) t_2^2$

$\Rightarrow \frac{1}{2} g t_2^2 = u t_2$

$\Rightarrow t_2 = \frac{2u}{g} = \frac{2 \times 30}{10} = 6$ sec

$t_2 - t_1 = 6 - 3 = 3$ sec.

(8)

Given $h = 5m$

$R = 10m$

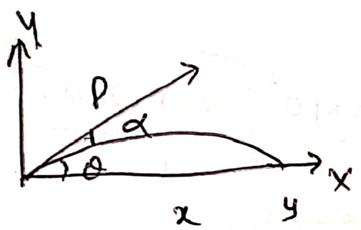
We know $R = u\sqrt{\frac{2h}{g}}$

$\therefore u\sqrt{\frac{2h}{g}} = 10$

$\Rightarrow u\sqrt{\frac{2\times5}{10}} = 10$

$\Rightarrow u = 10m/s$

(10)



$P = \left(\frac{3R}{4}, \frac{R}{4} \right)$

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

$y = x\tan\theta\left[1 - \frac{x}{R}\right]$

$\Rightarrow \frac{R}{4} = \frac{3R}{4}\tan\theta\left[1 - \frac{3R}{4R}\right]$

$\Rightarrow 1 = 3\tan\theta\left[1 - \frac{3}{4}\right]$

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

$\Rightarrow \theta = 53^\circ$

(2)

(9)

$u_1 = u\cos30\,\hat{i} + u\sin30\,\hat{j}$

$= u\frac{\sqrt{3}}{2}\hat{i} + u\frac{1}{2}\hat{j}$

$v_2 = -u\cos60\,\hat{i} + u\sin60\,\hat{j}$

$= -\frac{u}{2}\hat{i} + u\frac{\sqrt{3}}{2}\hat{j}$

$u_1 - u_2 = \frac{\sqrt{3}u}{2}\hat{i} + \frac{u}{2}\hat{j} + \frac{u}{2}\hat{i} - \frac{\sqrt{3}}{2}u\hat{j}$

$= \frac{u}{2}\hat{i}(\sqrt{3}+1) + \frac{v}{2}(1-\sqrt{3})\hat{j}$

$|u_1 - u_2| = \sqrt{\left[\frac{v}{2}(\sqrt{3}+1)\right]^2 + \left[\frac{v}{2}(1-\sqrt{3})\right]^2}$

$= \frac{v}{2}\sqrt{(\sqrt{3}+1)^2 + (\sqrt{3}-1)^2}$

$= \frac{v}{2}\sqrt{2(3+1)} = u\sqrt{2}$

(14)

Initial velocity $= u$

$V = 4u$

From $v^2 - u^2 = 2as$

$\Rightarrow (4u)^2 - u^2 = 2gH$

$\Rightarrow 15u^2 = 2gH$

$\Rightarrow H = \frac{15}{2g}u^2$

$R = u\sqrt{\frac{2H}{g}} = u\sqrt{\frac{2\times15u^2}{2g\,g}}$

$R = \frac{u^2}{g}\sqrt{15}$

(18)

Given $u = 600$ kmph

$= 600 \times \frac{5}{18}$

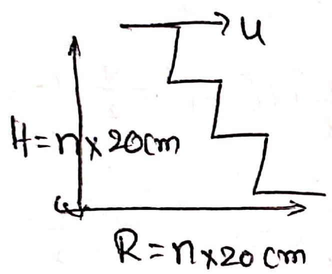
$= \frac{500}{3}$ m/s

$\text{Range} = u\sqrt{\frac{2h}{g}} = \frac{500}{3}\sqrt{\frac{2}{9.8} \times 1960}$

$= \frac{500}{3}\sqrt{\frac{2 \times 19600}{98}}$

$= \frac{500}{3} \times 20 = 3.3$ km

(19)



let 'n' be the No. of steps

$u = 150$ cm/sec $= 150 \times 10^{-2}$ m/sec

$H = 20n \times 10^{-2}$ m ; $R = 20n \times 10^{-2}$ m.

We know $R = u\sqrt{\frac{2H}{g}}$

$\Rightarrow 20n \times 10^{-2} = 150 \times 10^{-2}\sqrt{\frac{2 \times n \times 20 \times 10^{-2}}{10}}$

$\Rightarrow 15 \times 10^{-1}\sqrt{n} = n \Rightarrow n \simeq 3$

L Task

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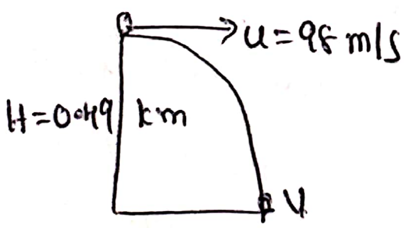


$V = \sqrt{u^2 + 2gH}$

$= \sqrt{(98)^2 + 2(9.8)(490)}$

$V = 98\sqrt{2}$ m/s.

(2)

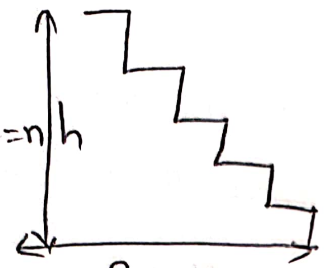
$u_A = 10$ m/s ; $u_B = 20$ m/s

$t_A = t_B$

Because time of descent independent on velocity

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

(3)



let 'n' be the No. of steps
'h' be the height of each step
'x' be the width of each step

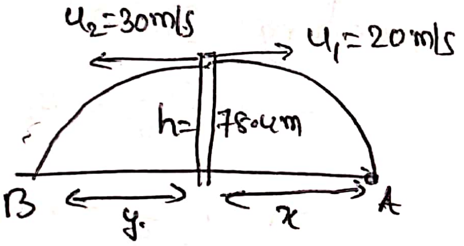
$$\text{Range} = u\sqrt{\frac{2h}{g}}$$

$$\Rightarrow nx = u\sqrt{\frac{2H}{g}}$$

$$\Rightarrow nx = u\sqrt{\frac{2nh}{g}} \Rightarrow u = x \times n\sqrt{\frac{g}{2nh}}$$

$$\Rightarrow u = x\sqrt{\frac{ng}{2h}}$$

(4)



$$x = u_1\sqrt{\frac{2h}{g}} = 20\sqrt{\frac{2\times 78.4}{9.8}}$$

$$\Rightarrow x = 20\times 4 = 80$$

and $y = u_2\sqrt{\frac{2h}{g}}$

$$= 30\sqrt{\frac{2\times 78.4}{9.8}}$$

$$= 30\times 4$$

$$= 120\,m$$

Seperation After reaching ground

$$= x+y = 80+120 = 200\,m.$$

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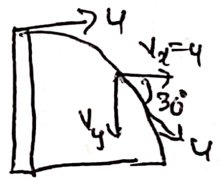


$t = 2$ sec.

$$\tan\theta = \frac{V_y}{V_x} = \frac{gt}{u}$$

$$\Rightarrow \tan 30 = \frac{2g}{u}$$

$$\Rightarrow \frac{1}{\sqrt{3}} = \frac{2g}{u} \Rightarrow u = 2\sqrt{3}\,g.$$

(7)

Initial velocity $= u$
Final velocity $= V = 2u$

From $v = \sqrt{u^2+2gh}$

$$v^2 = u^2+2gh$$

$$\Rightarrow 4u^2 = u^2+2gh$$

$$\Rightarrow h = \frac{3u^2}{2g}.$$

(6)

$u_1 = 20\ m/s$

$u_2 = 0$

Given $m_1 = m_2$

According to Law of conservation of Linear momentum

$$P_A = P_B$$

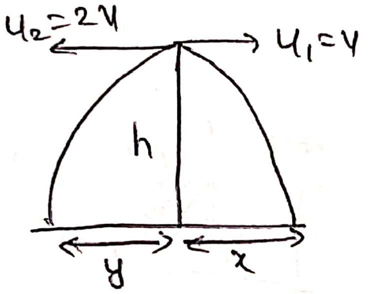
$$\Rightarrow m_1 u_1 + m_2 u_2 = 0$$

$$\Rightarrow m_1 u_1 = -\cancel{m_1} u_2$$

$$\Rightarrow u_1 = -u_2$$

$$\therefore\ t = \frac{2\sqrt{u_1 u_2}}{g} = \frac{2\sqrt{20\times 20}}{10} = \frac{2\times 20}{10} = 4\ sec.$$

(8)



x, y are ranges

$$x = v\sqrt{\frac{2h}{g}}$$

seperation between two bodies After reaching ground $= x + y$

$$\Rightarrow u_1\sqrt{\frac{2h}{g}} + u_2\sqrt{\frac{2h}{g}}$$

$$\Rightarrow v\sqrt{\frac{2h}{g}} + 2v\sqrt{\frac{2h}{g}}$$

$$\Rightarrow x + 2x = 3x.$$

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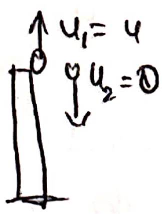

Given $\frac{m_1}{m_2} = \frac{1}{4}$

$$\Rightarrow \frac{V_2}{V_1} = \frac{1}{4}.$$

$$\Rightarrow V_2 = \frac{V_1}{4}$$

According to law of conservation of momentum

$$P_A = -P_B$$

$$\Rightarrow m_1 V_1 = -m_2 V_2.$$

$$\Rightarrow \frac{V_2}{V_1} = \frac{m_1}{m_2}$$

$$\therefore\ x = (V_1 + V_2)^2 2\sqrt{\frac{V_1 V_2}{g}}$$

$$= [V_1 + \frac{V_1}{4}]^2 2\sqrt{\frac{V_1 \frac{V_1}{4}}{g}}$$

$$\Rightarrow \frac{5V}{4} \times \frac{2 \times \frac{V}{2}}{g} = \frac{V^2 \times 5}{4\times 10}$$

$$= \frac{V^2}{8}.$$

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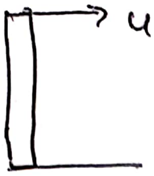
mentum

④

⑩



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

$= u\hat{i} + 0\hat{j}$

$\vec{u} = u\hat{i}$

$u_x = u\cos\theta = u$

$u_y = u\sin\theta = 0$

$\vec{v} = v_x \hat{i} + v_y \hat{j}$

$= u\hat{i} + gt\hat{j}$

$[\, v_y = u_y + a_y t$

$= 0 + g t$

$v_y = gt \,]$

$|\vec{v} - \vec{u}| = u\hat{i} + gt\hat{j} - u\hat{i} = gt\hat{j}$

$= |gt\hat{j}| = gt = g\sqrt{\frac{2h}{g}} = \sqrt{2gh}$

⑮

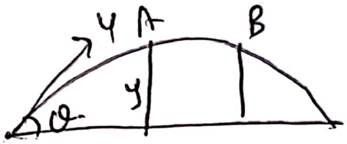
Given $a = 5\ m/s^2$

$\tan\theta = \frac{a}{g}$

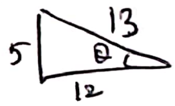
$\Rightarrow \tan\theta = \frac{5}{10} = \frac{1}{2}$

$\Rightarrow \theta = \tan^{-1}(\frac{1}{2})$

⑳



Given $u = 52\ m/s$



$\tan\theta = \frac{5}{12}$

$\sin\theta = \frac{5}{13}$

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

$\Rightarrow 15 = \cancel{52}^{4} \times \frac{5}{\cancel{13}} t - \frac{1}{2} \times 10 t^2$

$\Rightarrow \cancel{15}^{3} = 4 \times \cancel{5} t - \cancel{5} t^2$

$\Rightarrow 3 = 4t - t^2$

$\Rightarrow t^2 - 4t + 3 = 0$

$\Rightarrow (t-3)(t-1) = 0$

$t = 3$ sec or 1 sec.

$\therefore$ To reach A 1 sec taken and to reach B 3 sec taken

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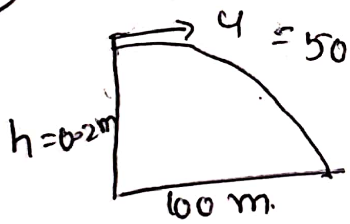

Range = 100m

$\Rightarrow u\sqrt{\frac{2h}{g}} = 100$

$\Rightarrow 500\sqrt{\frac{2h}{10}} = 100$

$\Rightarrow \sqrt{\frac{h}{5}} = \frac{100}{500} = \frac{1}{5}$

$\Rightarrow \frac{h}{5} = \frac{1}{25}$

$\Rightarrow h = 0.2m$

$= 20cm$