DPP-2

SOLUTION

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1. $y = 5x - 5x^2$

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

$\tan\theta = 5$

$\frac{g}{2(u\cos\theta)^2} = 5$

$2(u\cos\theta)^2 = 2$

$u\cos\theta = 1$

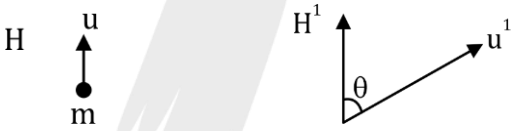
$\tan\theta = 5 \Rightarrow \frac{u\sin\theta}{u\cos\theta}$

$\frac{u\sin\theta}{u\cos\theta} = \tan\theta = 5$

$u\sin\theta = 5 \cdot u\cos\theta$

$u\sin\theta = 5$

2.



$T = \frac{2u}{g}$ $\quad T^1 = \frac{2u^1\cos\theta}{g}$

$T = T^1 \Rightarrow \quad \frac{2u}{g} = \frac{2u^1\sin\theta}{g}$

$u^1\sin\theta = u$

$H = \frac{u^2}{2g}$ $\quad H^1 = \frac{(u^1\sin\theta)^2}{2g}$

$\frac{H}{H^1} = \frac{1}{x} = 1 \quad \Rightarrow \quad x = 1$

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3. Apply equation of motion in

Y – direction

$v_y = u_y + a_y t$

$v_y = u\sin 45 - 10 \times 2$

$v_y = \frac{u}{\sqrt{2}} - 20$

$20\cos\theta = u\cos 45 \Rightarrow 20\cos\theta = \frac{u}{\sqrt{2}}$

$u = 20\sqrt{2}\cos\theta$

$\Rightarrow \sqrt{v_y^2 + v_x^2} = 20$

$\Rightarrow \sqrt{\left(\frac{u}{\sqrt{2}} - 20\right)^2 + \left(\frac{u}{\sqrt{2}}\right)^2} = 20$

$\frac{u^2}{2} + 400 - 2 \times 20 \times \frac{u}{\sqrt{2}} + \frac{u^2}{2} = 400$

$u^2 = \frac{40u}{\sqrt{2}} \Rightarrow u = 20\sqrt{2}$

$u_y = u\sin 45 = 20\sqrt{2} \times \frac{1}{\sqrt{2}} = 20$ m/s

$H_{max} = \frac{u_y^2}{2g} = \frac{400}{2\times 10} = 20$ m.

4. $R = \frac{u^2}{g}$

$\frac{u^2}{g} > 4.9 \quad \Rightarrow \quad u^2 > 49$

$u > 7$m/s & $\frac{u^2}{g} < 8.1$

$u^2 < 81 \quad \Rightarrow \quad u < 9$

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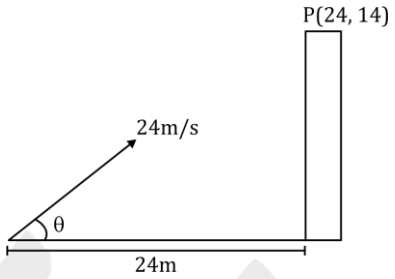
$7\ m/s < u < 9\ m/s$ (A)

5. $R = \frac{2u^2 \sin\theta\cos\theta}{g} = \frac{2\times25\times25\times\frac{3}{5}\times\frac{4}{5}}{10}$

$R = \frac{50\times12}{10} = 60\ m$ (c) 8^{th} vessel.

6. $x = 24 \quad \Rightarrow \quad y = 14$



$$y = x\tan\theta - \frac{gx^2}{2u^2}(1+\tan^2\theta)$$

$$14 = 24\tan\theta - \frac{10x^2}{2\times24\times24}(1+\tan^2\theta)$$

$$14 = 24\tan\theta - \frac{10\times24\times24}{2\times24\times24}(1+\tan^2\theta)$$

$$14 = 24\tan\theta - 5(1+\tan^2\theta)$$

$\tan\theta = m$

$14 = 24m - 5 - 5m^2$

$5m^2 - 24m + 19 = 0$

$$m = \frac{24 \pm \sqrt{(24)^2 - 4\times5\times19}}{2\times5} = \frac{24\pm14}{10}$$

$$m = \frac{24+14}{10}, m = \frac{10}{10} = 1$$

$m = \frac{38}{10} \quad \Rightarrow \quad m = \frac{19}{5}$

$\tan\theta = \frac{19}{5} \quad \Rightarrow \quad \theta = \tan^{-1}(19/5)$

7. $y = \sqrt{3}x - 5x^2$

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

$\tan\theta = \sqrt{3} \quad \Rightarrow \quad \theta = 60°$

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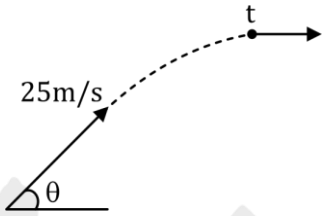
$\Rightarrow \frac{g}{2u^2\cos^2 60} = 5$

$2 = 2u^2 \times \frac{1}{4}$

$u = 2\ m/s$ (A)

8. $R = \frac{(25)^2(2\sin\theta\cos\theta)}{g}$

$R = \frac{25\times25\times2}{g} \times \sin\theta\cos\theta$



In y-dir^n

$u_y = 25\sin\theta$ $v_y = 0$

$v_y = u_y - gt$

$= 25\sin\theta - 10t$

$t = \frac{5}{2}\sin\theta$ .....(i)

$\Rightarrow R = \frac{25\times25\times2}{10} \cdot \frac{2t}{5}\cos\theta$

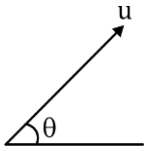
$\frac{R}{50t} = \cos\theta$ .....(ii)

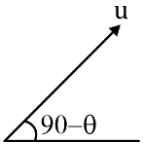
$\frac{(1)}{(1)} \frac{\sin\theta}{\cos\theta} = \frac{2t\times50t}{5\times R}$

$\tan\theta = \frac{100t^2}{5R}$ $\cot\theta = \frac{R}{20t^2}$

$\theta = \cot^{-1}\left(\frac{R}{20t^2}\right)$

9.





R_1, H_1 R_2, H_2

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$R_1 = R_2 = \frac{2u^2 \sin\theta \cos\theta}{g}$

$H_1 = \frac{u^2 \sin^2\theta}{2g}$ $\quad$ $H_2 = \frac{u^2 \sin^2(90-\theta)}{2g}$

$H_2 = \frac{u^2 \cos^2\theta}{2g}$

$H_1 \cdot H_2 = \left(\frac{u^2 \sin\theta \cos\theta}{2g}\right)^2$

$H_1 H_2 = \left(\frac{2u^2 \sin\theta \cos\theta}{4g}\right)^2$

$H_1 H_2 = \left(\frac{R}{4}\right)^2 \quad \Rightarrow \quad R = 4\sqrt{H_1 H_2}$

Reason - $H_1 H_2 = \left(\frac{u^2 \sin^2\theta}{2g}\right)\left(\frac{u^2 \cos^2\theta}{2g}\right)$ (A)

10. After 10 second

velocity in y-direction

$v_y = 20\sin\alpha - 10 \times 10$

velocity In x-dirⁿ

$v_x = 20\cos\alpha$

$\tan\beta = \frac{v_y}{v_x} = \frac{20\sin\alpha - 100}{20\cos\alpha}$

$\tan\beta = \tan\alpha - 5\sec\alpha$

11. $R = 100 = \frac{u^2}{g}$

$u^2 = 1000$

$u = 10\sqrt{10}$ m/s

$H = \frac{u^2}{2g} = \frac{1000}{2\times10} = 50$ m

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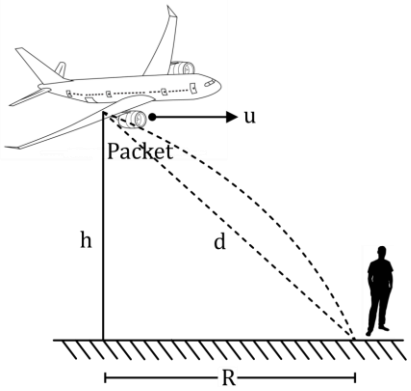
12. $u_y = 0$ $\quad H_y = -h$

$$-h = \frac{1}{2}(-g)t^2$$

$$t = \sqrt{\frac{2h}{g}} \quad \Rightarrow R = vt = v\sqrt{\frac{2h}{g}}$$

$$d = \sqrt{R^2 + h^2} \quad \Rightarrow d = \sqrt{\frac{2v^2h}{g} + h^2}$$



13. motion in y-direction

$s_y = -80$ m

$a_y = -10$ m/s^2

$u_y = 0$

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

$$-80 = \frac{1}{2}(-10)t^2 \quad \Rightarrow \quad 16 = t^2$$

$t = 4$sec

time of flight = 4sec

Horizontal Range $= 15 \times 4 \Rightarrow$ 60 m.

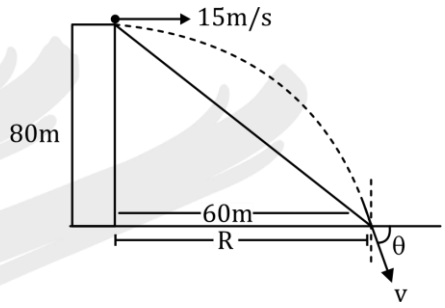
$$v_y = u_y + a_y t$$

$$v_y = -10 \times 4 = -40 \text{ m/s}$$

$u_x = 15$ m/s

$$\tan\theta = \frac{40}{15} = \frac{8}{3} \quad \theta = \tan^{-1}(8/3)$$

$$d = \sqrt{(80)^2 + (60)^2} = 100 \text{ m}$$



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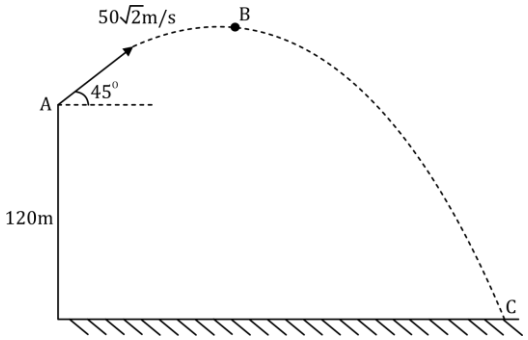
14. For A to B [motion in vertical direction]



$v_y = u_y + a_y t$

$0 = 50 - 10t$

$t = 5\text{sec}$

motion b/ω A to C

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

$-120 = 50t + \frac{1}{2}(-10)t^2$

$5t^2 - 50t - 120 = 0$

$t^2 - 10t - 24 = 0$

$t^2 - 12t + 2t - 24 = 0$

$t(t-12)2(t-12) = 0$

$t = -2 \;\&\; t = 12\text{sec}$

time of flight $= 12\text{sec}$

Horizontal Range $= 50 \times 12 = 600$ m

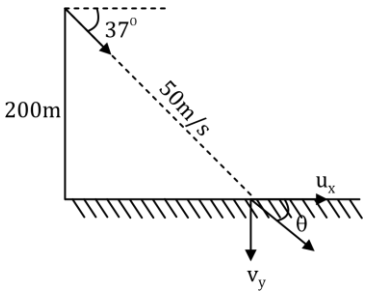
15. $u_y = -50\sin 37 = -50 \times \frac{3}{5} = -30$ m/s

$u_x = 50 \times \frac{4}{5} = 40$ m/s $\Rightarrow$ $a_y = -10$ m/s^2

$sy = -200$ m $\Rightarrow$ $sy = u_y t + \frac{1}{2} a_y t^2$

$-200 = -30t - 5t^2$

$t^2 + 6t - 40 = 0$ $\Rightarrow$ $t^2 + 10t - 4t - 40 = 0$



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$t(t+10)-4(t+10)=0 \quad \Rightarrow \quad t=4\text{sec}$

Time of flight $=4\text{sec}$

$\Rightarrow$ Range $=40\times 4=160$ m.

$\Rightarrow v_y=-30-10\times 4=-70$ m/s

$u_x=40$ m/5

$\tan\theta=\frac{70}{30}$ $\theta=\tan^{-1}\left(\frac{7}{3}\right)$

option,(A) (B) (C) & (D)