DPP-1

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1. $u\cos\theta = u_x = 20 \text{m/s}$ $\quad u_y = u\sin\theta = 30 \text{ m/s} \rightarrow$ given

(a) $T = \frac{2u_y}{g} = \frac{2\times30}{10} = 6\text{sec}$

(b) $H = \frac{4_y^2}{2g} = \frac{30\times30}{2\times10} = 45 \text{ m}$

(c) $R = \frac{2u_x u_y}{g} = \frac{2\times20\times30}{10} = 120 \text{ m}$

(d) time to reach maximum height $= \frac{\text{Time of flight}}{2} = \frac{6}{2} = 3\text{sec}$

(e) $\vec{u}_x$ = Constant during projectile motion

$\overrightarrow{u_x} = 20\hat{i}$

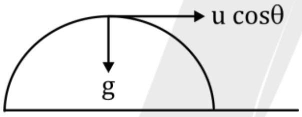
$\overrightarrow{v_y} = \overrightarrow{u_y} + \frac{1}{2}\overrightarrow{a_y}t$

$\overrightarrow{v_y} = 30i - \frac{1}{2}\times 10 \times 1 = 25 \text{ m/s}$

$\overrightarrow{v_y} = 25\hat{j}$

$\vec{v} = 20\hat{i} + 25\hat{j}$

(f)



$t = \frac{T}{2} = 3\text{sec.}$ velocity is $\perp$ to g

(g) $\vec{a} = -g\hat{j}$

$\vec{s} = 20\hat{i} + \left(30t - \frac{1}{2}gt^2\right)\hat{j}$

$\vec{a}\cdot\vec{s} = 0$

$-300t + \frac{10\times10}{2}\cdot t^2 = 0$

$50t^2 - 300t = 0$

$50t(t-6) = 0$

$t = 0 \quad \& \quad t = 6\text{sec.}$

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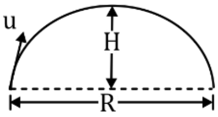
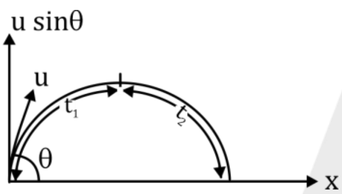
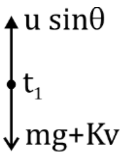
2. 

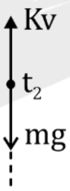
For $R_{max} \Rightarrow \theta = 45^\circ$

$$H = \frac{u^2 \sin^2 45^\circ}{2g} = \frac{u^2}{4g} = h$$

$$R = \frac{u^2 \sin 90}{g} = \frac{u^2}{g} = 4h$$

3. 



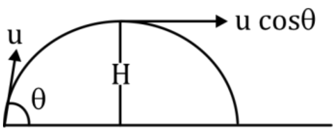


$a = g + \frac{k}{m}v$ $\qquad$ $a^1 = g - \frac{k}{m}v$

$a > g$

$t_2 > t_1$

$\frac{T_1}{t_2} < 1$

4. 

$$u\cos\theta = \frac{u}{2} = \cos\ \theta = \frac{1}{2}$$

$$\theta = 60^\circ = H = \frac{u^2 \sin^2 \theta}{2g} = \frac{u^2}{2g} \times \left(\frac{\sqrt{3}}{2}\right)^2 = H = \frac{3u^2}{8g}$$

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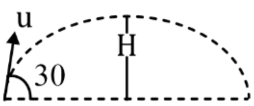
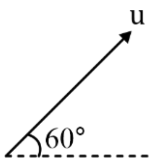
5.



Case I $H = \frac{u^2 \sin^2 30}{2g} = \frac{u^2}{8g} = 20$

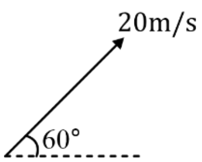
$u^2 = 160g \dots \dots (i)$



$H^1 = \frac{u^2 \sin^2 60}{2g} = \frac{3u^2}{8g}$

$H^1 = \frac{3 \times 160\, g}{8\, g} = 60\text{ m}$

6.



$u_x = 20\cos 60 = 10\text{ m/s}$ [Constant]

$u_y = 20 \times \frac{\sqrt{3}}{2} = 10\sqrt{3}$

$v_y = u_y + a_y t$

$= 10\sqrt{3} - 10 \times 0.732$

$= 10 \times 1.732 - 7.32$

$= 17.732 - 7.32 = 10.412$

$= \tan \theta = \frac{v_y}{v_x} = 1$

$\theta \simeq 45°$

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7. $\theta = 45^\circ$

$$(\vec{v}a_v) = \frac{\vec{S}}{T} = \frac{R}{T} = \frac{2u^2\sin\theta\cdot\cos\theta}{g\times\frac{2u\sin\theta}{g}}$$

$$= u\cos\ \theta$$

$$= u\cos 45^\circ = \frac{u}{\sqrt{2}}$$

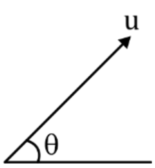
8. $R_{\theta_1} = R_{\theta_2}$ condition $\theta_1 + \theta_2 = \frac{\pi}{2}$

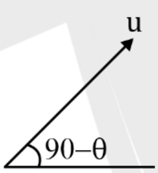
$$\theta_1 = \frac{\pi}{4} - \phi$$

$$\theta_2 = \frac{\pi}{2} - \theta_1 = \frac{\pi}{2} - \frac{\pi}{4} + \phi$$

$$\theta_2 = \frac{\pi}{4} + \phi$$

9.





$$T_1 = \frac{2u\sin\ \theta}{g}$$

$$T_2 = \frac{2u\sin\ (90-\theta)}{g}$$

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

$$T_2 = \frac{2u\ \cos\theta}{g}$$

$$T_1T_2 = \frac{4u^2\sin\theta\ \cos\theta}{g^2} = \frac{2R}{g}$$

$$T_1T_2 = \frac{2R}{g}$$

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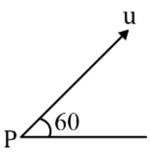
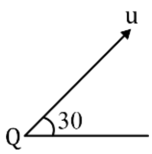
10.





$$R_p = \frac{2u^2 \sin 60 \cos 60}{g} \qquad R_Q = \frac{2u^2 \sin 30 \cos 30}{g}$$

$$= \frac{2u^2 \times \frac{\sqrt{3}}{2} \times \frac{1}{2}}{g} \qquad = \frac{2u^2 \times \frac{1}{2} \times \frac{\sqrt{3}}{2}}{g}$$

$$R_P = \frac{\sqrt{3}u^2}{2g} \qquad R_Q = \frac{\sqrt{3}u^2}{2g}$$

$$R_P = R_Q \qquad (1)$$

$$T_p = \frac{2u\sin 60}{g} \qquad T_Q = \frac{2u \sin 30}{g}$$

$$T_p = \frac{u\sqrt{3}}{g} \qquad = \frac{2u \times 1/2}{g} = \frac{u}{g}$$

$$T_p = \sqrt{3}\, T_Q \qquad (2)$$

$$H_p = \frac{u^2 \sin^2 60}{2g} \qquad H_Q = \frac{u^2 \sin^2 30}{2g}$$

$$H_p = \frac{3u^2}{8g} \qquad = \frac{u^2 \times \left(\frac{1}{2}\right)^2}{2g} = \frac{u^2}{8g}$$

$$H_Q = 3H_p \qquad (3)$$

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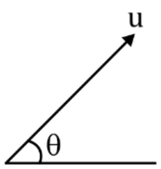
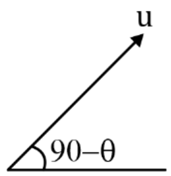
11.





$$T_1 = \frac{2u\sin\theta}{g}$$

$$T_2 = \frac{2u\sin(90-\theta)}{g}$$

$$T_2 = \frac{2u\cos\theta}{g}$$

$$R = \frac{2u_1^2\sin\theta\cdot\cos\theta}{g} = \left(\frac{2u\sin\theta\cdot 2u\cos\theta}{2g\times g}\right)g$$

$$R = \frac{T_1T_2}{2}g$$