BRAIN MAP

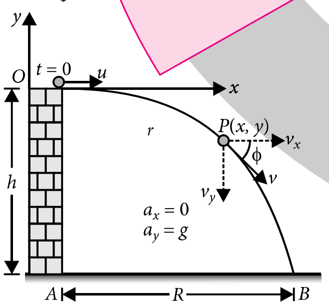
CLASS XI

PROJECTILE MOTION

PROJECTILE Motion

A body which is in flight through the atmosphere under the effect of gravity alone and is not being propelled by any fuel is called projectile and its motion is called projectile motion.

Horizontal Projectile Motion



- **Equation of Trajectory**

$$y = \frac{1}{2}\frac{gx^2}{u^2}$$

- **Time of Descent**

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

- **Horizontal Range**

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

- **Instantaneous Velocity**

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

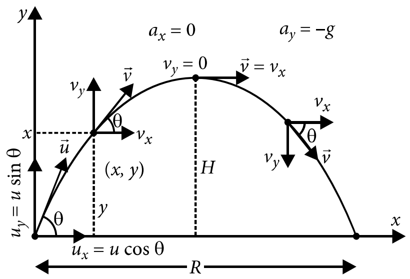
$$\tan\phi = \frac{v_y}{v_x} = \tan^{-1}\left(\frac{gt}{u}\right)$$

Oblique Projectile Motion

- **Equation of Trajectory**

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

This represents the parabolic path.



- **Maximum Height**

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

- **Time of Flight**

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

- **Horizontal Range**

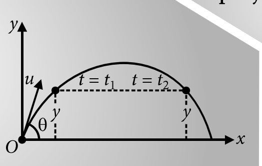
$$R = \frac{u^2\sin 2\theta}{g}$$

- Projectile passing through two different points on same height at time t_1 and t_2

$$y = \frac{gt_1t_2}{2}$$

$$t_2 = \frac{u\sin\theta}{g}\left[1 + \sqrt{1 - \left(\frac{2gy}{u\sin\theta}\right)^2}\right]$$

$$t_1 = \frac{u\sin\theta}{g}\left[1 - \sqrt{1 - \left(\frac{2gy}{u\sin\theta}\right)^2}\right]$$



- Ratio of time of ights for projectiles at complimentary angles θ and 90 – θ

$$\frac{T_\theta}{T_{90-\theta}} = \tan\theta$$

- Range R is n times the maximum height H

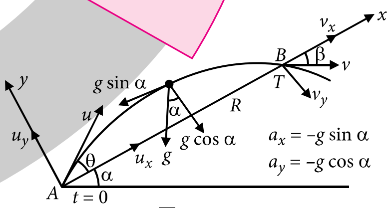
$R = nH; \theta = \tan^{-1}[4/n]$

- For complimentary angles θ and (90 – θ) range remains unchanged
- Relation between horizontal range and maximum height

$R = 4H\cot\theta$

- If $R = H$ then $\theta = \tan^{-1}(4)$ or $\theta = 76°$
- If $R = 4H$ then $\theta = \tan^{-1}(1)$ or $\theta = 45°$

Projectile Motion on an Inclined Plane



- **Time of Flight**

$$T = \frac{2u\sin\theta}{g\cos\alpha}$$

- **Maximum Height**

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

- **Horizontal Range**

$$R = \frac{2u^2}{g}\frac{\sin\theta\cos(\theta+\alpha)}{\cos^2\alpha}$$

- Maximum range occurs when

$$\theta = \frac{\pi}{4} + \frac{\alpha}{2}$$

- Maximum range along the incline when projectile is thrown upwards

$$R_{max} = \frac{u^2}{g(1+\sin\alpha)}$$

- Maximum range along incline when the projectile thrown downwards

$$R_{max} = \frac{u^2}{g(1-\sin\alpha)}$$

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