DIGITAL EDUCATION
MARTCOST

# INTERMEDIATE

# Projectile Motion

*Hand Notes For JEE Mains, Advance, NEET UG, Class 11 & 12 etc…*

## Hand Notes

**Page Length : 8**

***Note :*** *We also providing IIT JEE, Advance, NEEt, JEE UG, GATE, IES, PSUs & Competitive Exam Materials [Handnotes, Shortnotes & Books], All Reports [Seminar Reports & PPT]*

***Goto : www.martcost.com***

# 'PROJECTILE MOTION'

If velocity of particle in one direction is const & Acceleration which is in ⊥ direction Remain same w.r.t Motion of particle is called projectile & It path is always parabolic.

## Ground – Ground projection

$T = \frac{2u\sin\theta}{g} = \frac{2u_y}{g}$ ← Time of flight.

$h_{max} = \frac{u^2\sin^2\theta}{2g} = \frac{z^2_y}{2g}$ → max Height.

$R = (u\cos\theta)T = \frac{2u_x u_y}{g} = \frac{u^2\sin\theta}{g}$

$\vec{v} = (u\cos\theta)\hat{i} + (u\sin\theta - gt)\hat{j}$

$\alpha = (u\cos\theta t)\hat{i} + (u\sin\theta t - \frac{1}{2}gt^2)\hat{j}$

$y = x\tan\theta - \frac{gx^2}{2u^2\cos^2\theta} = x\tan\theta\left[1 - \frac{x}{R}\right]$

* From bottom to top $\alpha$ ↓
* At top position $\alpha = 0$
* From top to bottom $\alpha$ ↑

* Horizontal Range.
$R = \frac{u^2\sin 2\theta}{g}$

* K.E at lowest point.
$KE = \frac{1}{2}mu^2$

* velocity at time 't'

Horizontal
$V_x = u\cos\theta \propto t^0$

Vertical
$V_y = (u\sin\theta) - gt$

* Angle of velo. from ✱-axis
$\alpha = \tan^{-1}\left(\frac{v_y}{v_x}\right) = \tan^{-1}\left(\frac{u\sin\theta - gt}{u\cos\theta}\right)$

* Disp. at time 't'
$|\vec{r}| = \sqrt{x^2+y^2}$

NOTE → * Horizontal component of velocity Remain same all points of Its path
* At top point path of particle is circular & Resultant velo. Remain same.

## Special case for Ground to Ground protection

### case-I → Max Range condition

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

$\theta = 45^\circ / \pi/4$

* $u = c, g = c \Rightarrow R = f(\theta)$ (max)
$(\sin 2\theta) = 1$
$\Downarrow$
$2\theta = 90^\circ, \pi/2$

# $R_{max} = \frac{u^2}{g} = R_{45^\circ}$

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

# $\theta = 90^\circ$ (vertical protection)

$R_{90^\circ} = 0$

$h_{90^\circ} = \frac{u^2}{2g} = \frac{R_{45^\circ}}{2} \Rightarrow R_{45^\circ} = 2h_{90^\circ}$

$T_{max} = \frac{2u}{g} = T_{90^\circ}$

$h_{45^\circ} = \frac{R_{45}}{4} = \frac{h_{90}}{2}$

$R_{max} \Rightarrow \theta \Rightarrow 45^\circ$
$H_{max}, T_{max} \Rightarrow \theta = 90^\circ$

|a| → $0 \le \theta \le 45$
$\theta$ ↑, T ↑, $h_{max}$ ↑, R ↑

|b| → $45^\circ < \theta \le 90^\circ$
$\theta$ ↑, T ↑, $h_{max}$ ↑, R ↓