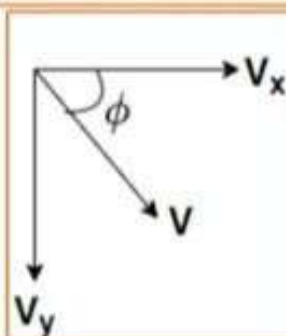




<b>Projectile motion –</b> ➤ Initial velocity $u_x = u \cos \theta$ , $u_y = u \sin \theta$ ➤ Acceleration $a_x = 0$ , $a_y = -g$		<b>Equation of trajectory:</b> It describes the path of particle $y = x \tan \theta - \frac{1}{2} \frac{gx^2}{u^2 \cos^2 \theta}$													
<b>Displacement of particle:</b> $\vec{r} = (u \cos \theta)t\hat{i} + \left((u \sin \theta)t - \frac{1}{2}gt^2\right)\hat{j}$		<b>Instantaneous velocity:</b> $\vec{V} = V_x\hat{i} + V_y\hat{j}, \quad  \vec{V}  = \sqrt{u^2 + g^2t^2 - 2u \sin \theta gt}$													
<b>Time of flight:</b> The time taken to complete the motion $T = \frac{2u \sin \theta}{g}$	<b>Ascent time: (<math>t_a</math>)</b> the time required to reach max height $t_a = \frac{T}{2} = (t_d) \text{ Descent time}$	<b>Maximum Height:</b> $H_{\max} = \frac{u_y^2}{2g} = \frac{u^2 \sin^2 \theta}{2g}$													
<b>Range:</b> The maximum horizontal distance covered $R = \frac{u^2 \sin 2\theta}{g} = \frac{u \cos \theta \cdot 2 \cdot u \sin \theta}{g} = \frac{2 \cdot U_x \cdot U_y}{g}$		<b>Maximum Range:</b> For range to be max, $\theta = 45^\circ$ $R_{\max} = \frac{u^2 \cdot \sin (2 \times 45^\circ)}{g} = \frac{u^2}{g}$													
<b>NOTE:</b> Range will be same for complementary angles, $\theta$ and $90 - \theta$															
<b>Relation between range and height:</b> $\tan \theta = \frac{4H}{R}$		<b>NOTE:</b> For complementary angles of projection $\theta$ and $90^\circ - \theta$ Ratio of maximum height $\frac{H_1}{H_2} = \tan^2 \theta$													
<b>Change in velocity:</b> $\Delta V = V_f - V_i$ $\vec{V}_i = \vec{u}_i = u \cos \theta \hat{i} + u \sin \theta \hat{j}$ $\Delta \vec{V} = -gt \hat{j}$		<b>Change in velocity in complete projectile:</b> $\Delta \vec{V} = \vec{v}_f - \vec{u}_i = -2u \sin \theta \hat{j}$													
		<b>Equation of trajectory:</b> $y = x \tan \theta - \frac{1}{2} \frac{gx^2}{u^2 \cos^2 \theta} = x \tan \theta \left[1 - \frac{x}{R}\right]$													
<b>HORIZONTAL PROJECTILE MOTION</b>															
<table border="1"> <tr> <th>Horizontal</th> <th>Vertical</th> </tr> <tr> <td><math>u_x = u</math></td> <td><math>u_y = 0</math></td> </tr> <tr> <td><math>V_x = ?</math></td> <td><math>V_y = ?</math></td> </tr> <tr> <td><math>S_x = x</math></td> <td><math>S_y = -y</math></td> </tr> <tr> <td><math>a_x = 0</math></td> <td><math>a_y = -g</math></td> </tr> <tr> <td><math>t_x = t</math></td> <td><math>t_y = t</math></td> </tr> </table>	Horizontal	Vertical	$u_x = u$	$u_y = 0$	$V_x = ?$	$V_y = ?$	$S_x = x$	$S_y = -y$	$a_x = 0$	$a_y = -g$	$t_x = t$	$t_y = t$	<b>Equation of trajectory:</b> $y = \frac{gx^2}{2u^2}$		<b>Displacement of particle –</b> $ \vec{r}  = \sqrt{(ut)^2 + \left(\frac{1}{2}gt^2\right)^2}$ $\alpha = \tan^{-1} \left(\frac{gt}{2u}\right)$
Horizontal	Vertical														
$u_x = u$	$u_y = 0$														
$V_x = ?$	$V_y = ?$														
$S_x = x$	$S_y = -y$														
$a_x = 0$	$a_y = -g$														
$t_x = t$	$t_y = t$														
	<b>Instantaneous velocity:</b> $\vec{V} = u\hat{i} - gt\hat{j}$		$\phi = \tan^{-1} \left[\frac{V_y}{V_x}\right]$ $\phi = \tan^{-1} \left[\frac{gt}{u}\right]$ 												
	<b>Range –</b> $R = u \cdot \sqrt{\frac{2H}{g}}$														
<b>Time of flight –</b> $T = \sqrt{\frac{2H}{g}}$		<b>Speed –</b> $ \vec{V}  = \sqrt{u^2 + (gt)^2}$													