

Equations for Projectile Motion

In the X-direction

$$a_x = 0$$

$$v_{0x} = v_0 \cos \theta_0 = v_x$$

$$\Delta x = v_{0x} t$$

$$R = \frac{v_0^2 \sin(2\theta_0)}{g}$$

$$T = \frac{R}{v_{0x}}$$

In the Y direction

$$a_y = -g = -9.8 \frac{m}{s^2} = -32 \frac{ft}{s^2}$$

$$v_{0y} = v_0 \sin \theta_0$$

$$v_y = v_{0y} - gt$$

$$\Delta y = v_{avg} t = \frac{1}{2}(v_y + v_{0y})t$$

$$\Delta y = v_{0y} t - \frac{1}{2} g t^2$$

$$\Delta y = \frac{v_y^2 - v_{0y}^2}{-2g}$$

$$t_{1/2} = \frac{v_{0y}}{g}$$

$$T = 2t_{1/2} = \frac{2v_{0y}}{g} = \frac{R}{v_{0x}}$$

$$H = y_{\max} = \frac{v_{0y}^2}{2g}$$

$$\Delta y = \Delta x (\tan \theta_0) - \frac{g}{2} \left(\frac{\Delta x}{v_{0x}} \right)^2$$

$$\Delta y = \Delta x (\tan \theta_0) - \frac{g}{2v_0^2} (1 + \tan^2 \theta_0) (\Delta x)^2$$