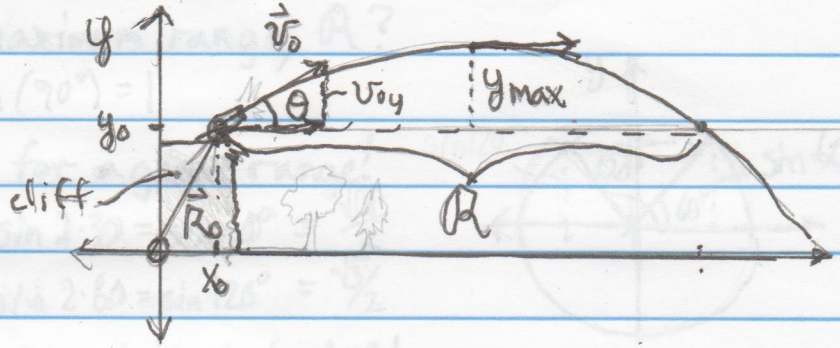
Projectile Motion

Canon ball example

Ex) $\vec{R}_0 = 5m\hat{i} + 10m\hat{j}$

$\theta = 20^\circ$

$|\vec{v}_0| = 30 m/s$



a) How long does it take for cannonball to rise to y_{max}?

Soln: $v_y(t_{max}) = v_{y0} + a_y t_{max} = 0$

$v_{y0} = v_0 \sin\theta \qquad a_y = -9.8 m/s^2 = -g$

$0 = v_0 \sin\theta - g t_{max}$

$\frac{v_0 \sin\theta}{g} = t_{max}$

$t_{max} = \frac{30 \sin 20^\circ}{9.8} = \boxed{1.047 sec}$

b) How high does the cannon ball get?

Soln: $y(t_{max}) = y_0 + y_{max}$ where $y_{max} = v_{0y} t_{max} + \frac{1}{2} a_y t_{max}^2$

$y_{max} = v_0 \sin\theta \left[\frac{v_0 \sin\theta}{g}\right] + \frac{1}{2}(-g)\left[\frac{v_0 \sin\theta}{g}\right]^2$

$= \frac{v_0^2 \sin^2\theta}{g} - \frac{v_0^2 \sin^2\theta}{2g}$

$y_{max} = \frac{v_0^2 \sin^2\theta}{2g}$

so $y(t_{max}) = 10m + \frac{30^2 \sin^2 20^\circ}{2(9.8)}$

$= \boxed{15.37 m}$