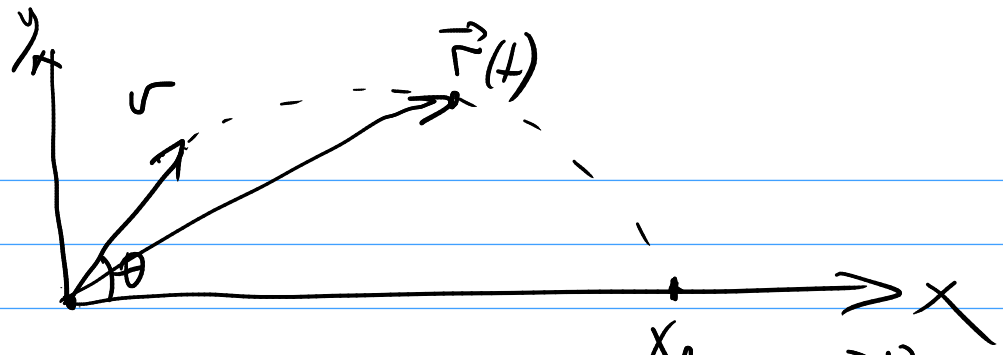
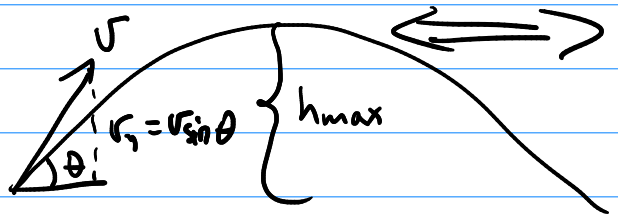


$$\vec{r}(t) = \vec{r}_i + \vec{v}_i t + \frac{\vec{a}t^2}{2} \qquad \vec{a} = \vec{g} \downarrow \{0, -g\}$$

$$x_f = x(t) = x_i + v_{x_i} t + \frac{a_x t^2}{2} \quad (a_x = 0)$$

$$y_f = y(t) = y_i + v_{y_i} t + \frac{a_y t^2}{2} = y_i + v_{y_i} t - \frac{gt^2}{2} = 0$$

$$y_f = 0 \Rightarrow t = 0, \frac{2v_{y_i}}{g} \Rightarrow x_f = \frac{v^2}{g}\sin(2\theta)$$



$\Longleftrightarrow$ $v_y = 0$

$$v_y(t) = v_{y_i} - gt = 0$$

$$t_{h_{max}} = \frac{v_{y_i}}{g}$$

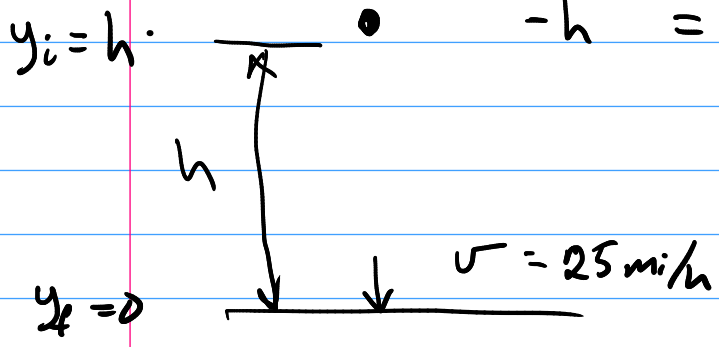
$$y_f(t_{h_{max}}) = h_{max} = 0 + v_{y_i} t + \frac{-gt^2}{2} = 0 + \frac{v_{y_i} v_{y_i}}{g} - \frac{g\left(\frac{v_{y_i}}{g}\right)^2}{2}$$

$$h_{max} = \frac{v_{y_i}^2}{2g} = \frac{(v \cdot \sin\theta)^2}{2g} \qquad v_{human} = 10\ m/s$$

$$g = 9.84\ m/s^2 \approx 10$$

$$h_{max} = \frac{(10 \cdot (\sin 90°))^2}{2 \cdot 10} = \frac{10^2}{2 \cdot 10} \simeq 5\ m$$

$$x_f = D_{max} \simeq 2 \cdot h_{max} \simeq 10\ m$$

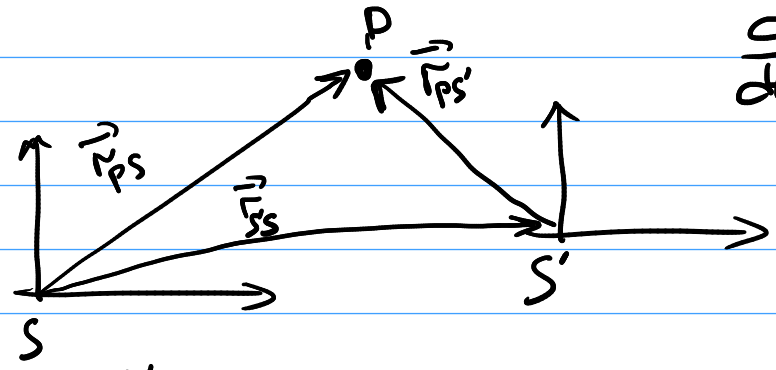


$$-h = (y_f - y_i) = \frac{v_{fy}^2 - v_{iy}^2}{2a_y} \qquad a_y = -g$$

$$\frac{v_{fy}^2}{+2g} = +h$$

$$25\ \frac{mi}{h} = \frac{25 \cdot 1600\ m}{h}\ \frac{1h}{3600s} \approx 11\ m/s \Rightarrow \frac{v_s^2}{2g} = \frac{11^2}{2 \cdot 10} = \frac{121}{20} = 6m$$

relative coordinate systems

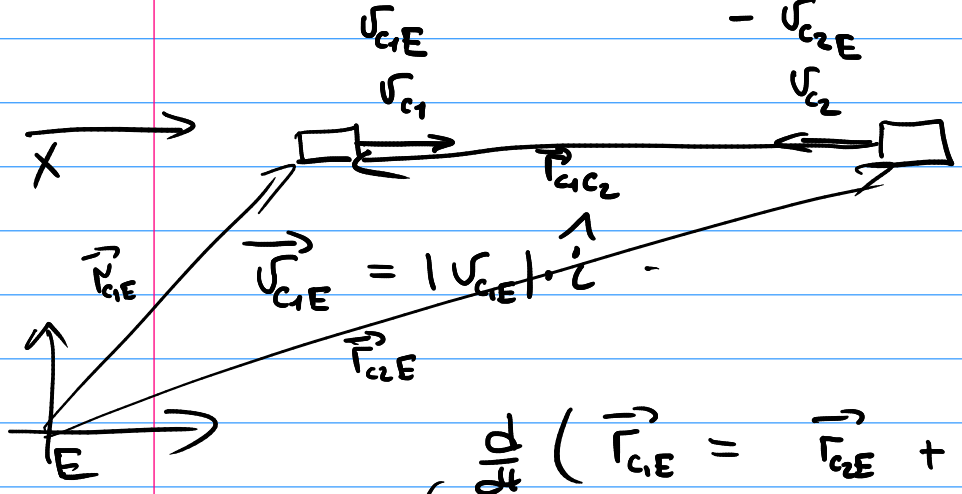


$$\frac{d}{dt}\left(\vec{r}_{PS} = \vec{r}_{PS'} + \vec{r}_{S'S}\right)$$

$$\frac{d}{dt}\vec{r}_{PS} = \vec{v}_{PS} = \vec{v}_{PS'} + \vec{v}_{S'S}$$

$\vec{r}_{PS}$

What is relative to what



$$\vec{v}_{c_1E} = |v_{c_1E}| \cdot \hat{i}$$

$$v_{c_2E} = -|v_{c_2E}| \cdot \hat{i}$$

$$\frac{d}{dt}\left(\vec{r}_{c_1E} = \vec{r}_{c_2E} + \vec{r}_{c_1c_2}\right)$$

$$\vec{v}_{c_1E} = \vec{v}_{c_2E} + \vec{v}_{c_1c_2} \Rightarrow |v_{c_1E}|\hat{i} = -|v_{c_2E}|\hat{i} + v_{c_1c_2}\hat{i}$$