A cannon ball is fired from the mouth of a cannon which is six feet off the ground. If the vertical velocity is $50 ft/sec$ and the horizontal velocity is $70 ft/sec$ how far does it fly before it hits the ground?

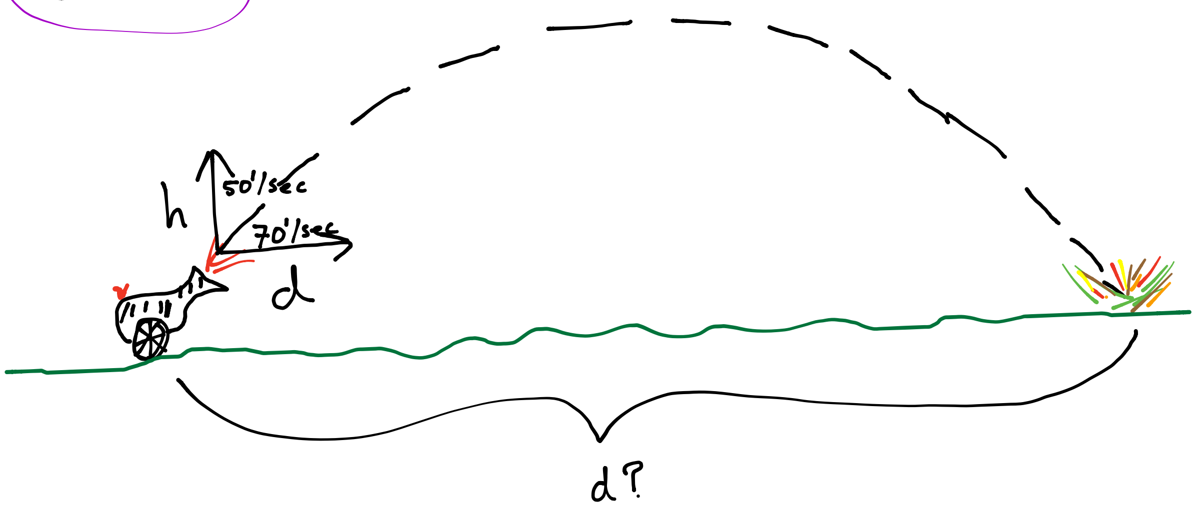
$h = -\frac{1}{2} a t^2 + V_0 t + s_0 = -16 t^2 + 50 t + 6 = 0$, then

$d = V_1 t = 70 t$

if $t = 3.24$,

$d = 70(3.24)$
$= 226.8$ ✓

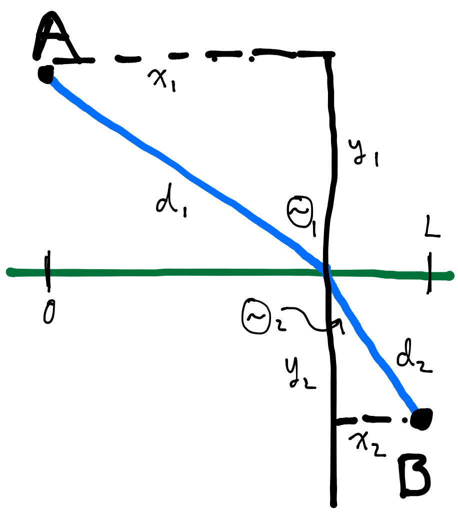
$$t = \frac{-50 \pm \sqrt{50^2 - 4(-16)(6)}}{-32} = 3.24$$



Snell's Law states that as light passes from one medium to another

$$\frac{\sin(\theta_1)}{c_1} = \frac{\sin(\theta_2)}{c_2}$$

where θ_1 and c_1 are the angle of incidence and speed of light in the first medium and θ_2 and c_2 are the angle of refraction and speed of light in the second. Prove that Snell's Law holds by minimizing the travel time of light from a point in the first medium to a point in the second.



$$T = \sqrt{x_1^2+y_1^2} + \sqrt{x_2^2+y_2^2}$$

$$y_1 = y_2 = 1$$

$$x_2 = \underbrace{L - x_1}_{\rightarrow\, x}$$

$$\Rightarrow T = \sqrt{x^2+1} + \sqrt{(L-x)^2+1}$$

$$d = vt \;=\; t = d/v$$

$$t = \frac{d_1}{c_1} + \frac{d_2}{c_2} = \frac{\sqrt{x^2+1}}{c_1} + \frac{\sqrt{(L-x)^2+1}}{c_2} \Rightarrow \frac{dt}{dx} = \frac{1}{c_1}\cdot\frac{\cancel{2}\overset{x_1}{x}}{\cancel{2}\underbrace{\sqrt{x^2+1}}_{d_1}} - \frac{1}{c_2}\,\frac{\cancel{2}\overset{x_2}{(L-x)}\cdot -1}{\cancel{2}\underbrace{\sqrt{(L-x)^2+1}}_{d_2}}$$

$$\text{SOH CAHTOA} \rightarrow \sin(\Theta_1) = \frac{x_1}{d_1}$$

$$\sin(\theta_2) = \frac{x_2}{d_2}$$

$$\frac{dt}{dx} = \frac{1}{c_1}\cdot\sin(\theta_1) - \frac{1}{c_2}\sin(\theta_2) = 0$$

$$\Rightarrow \frac{\sin(\theta_1)}{c_1} = \frac{\sin(\theta_2)}{c_2} \checkmark$$