

January 21, 2014

1. You throw a ball directly upwards with an initial velocity of 58 m/s . How high does the ball go, and how long does it take the ball to hit the ground?

Known:

$$V_0 = 58 \text{ m/s}$$

$$V = 0 \text{ m/s}$$

$$a = -9.8 \text{ m/s}^2$$

Unknown:

$$t = ?$$

$$x - x_0 = ?$$

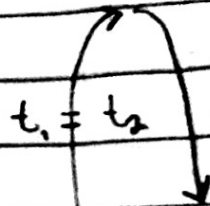


$$V = V_0 + at$$

$$x - x_0 = V_0 t + \frac{1}{2} at^2$$

$$V^2 = V_0^2 + 2a(x - x_0)$$

time



$$V_1 = V_0 + at$$

$$t = 2t_1 \leftarrow \text{Reasoning}$$

$$V_0 + at_1 = 0$$

$$V = V_0 + at$$

$$V_0 = 58 \text{ m/s}$$

$$at_1 = -V_0$$

$$t = 2t_1$$

$$V - V_0 = at$$

$$V = -58 \text{ m/s}$$

$$t_1 = \frac{-V_0}{a}$$

$$t = 11.84 \text{ s}$$

$$t = \frac{V - V_0}{a}$$

$$a = -9.8 \text{ m/s}^2$$

$$t_1 = \frac{-58 \text{ m/s}}{-9.8 \text{ m/s}^2}$$

$$t = \frac{-58 \text{ m/s} - 58 \text{ m/s}}{-9.8 \text{ m/s}^2}$$

$$x - x_0 = 0 \text{ m}$$

$$t_1 = 5.92 \text{ s}$$

$$t = 11.84 \text{ sec}$$

displacement up

$$V^2 = V_0^2 + 2a(x - x_0)$$

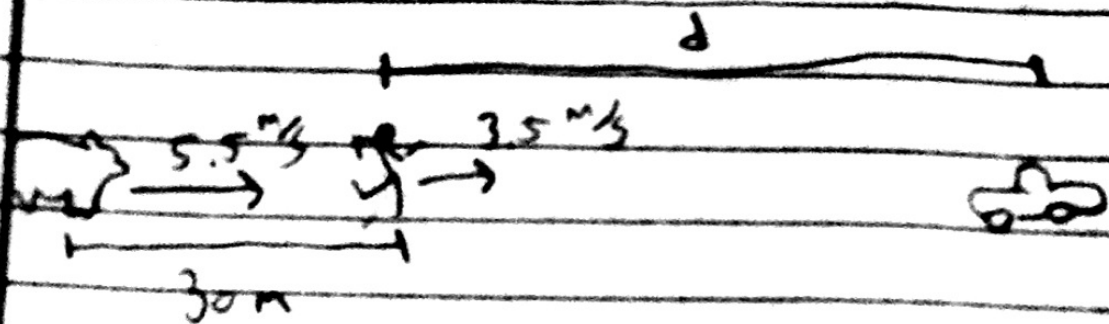
$$-V_0^2 = 2a(x - x_0)$$

$$(x - x_0) = \frac{-V_0^2}{2a}$$

$$(x - x_0) = \frac{-58^2 \text{ m/s}^2}{2(-9.8 \text{ m/s}^2)}$$

$$(x - x_0) = 171.63 \text{ m}$$

2. A tourist being chased by an angry bear is running in a straight line toward his car at a speed of 3.5 m/s . The car is distance d away. The bear is 30 m behind the tourist and running at 5.5 m/s . The tourist reaches the car safely. What is the maximum possible value of d ?



$5.5 \text{ m/s} - 3.5 \text{ m/s} = 2.0 \text{ m/s}$ bear is gaining with respect to the 30 m .

$$2.0 \text{ m/s} (t_{\text{time}}) = 30 \text{ m}$$

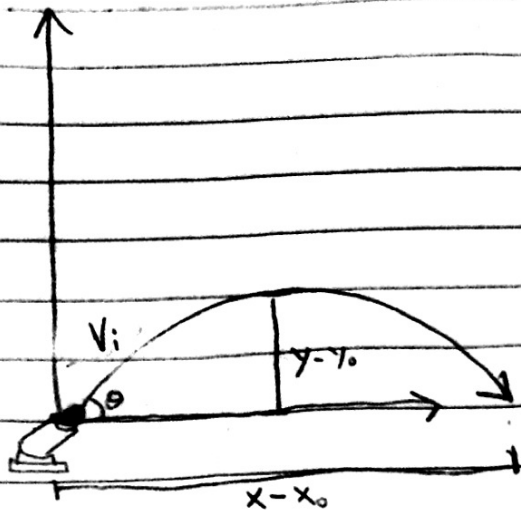
$$t = \frac{30 \text{ m}}{2.0 \text{ m/s}}$$

$$t = 15 \text{ s}$$

$$(3.5 \text{ m/s})(15 \text{ s}) = \boxed{52.5 \text{ m}} = d$$

3. A cannonball leaves a cannon at 250 m/s . The cannon is pointed 28° East to north. How far does the cannonball travel horizontally, and what is the maximum height achieved by the cannonball?

Known	Unknown
$V_0 = 250 \text{ m/s}$	$x - x_0$
$\theta = 28^\circ$	$y - y_0$
$a_y = -9.8 \text{ m/s}^2$	t
$a_x = 0 \text{ m/s}^2$	

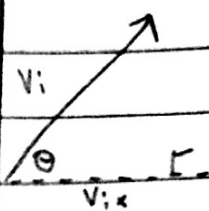


$$V = V_0 + at$$

$$x - x_0 = V_0 t + \frac{1}{2} a t^2$$

$$V^2 = V_0^2 + 2a(x - x_0)$$

horizontal
need V_{ix}



SOHCAHTOA

$$\cos(\theta) = \frac{V_{ix}}{V_i}$$

$$V_i \cos(\theta) = V_{ix}$$

$$250 \text{ m/s} \cos(28^\circ) = V_{ix}$$

$$V_{ix} = 220.74 \text{ m/s}$$

$$V_x = V_{0x}$$

$$V_x^2 = V_{0x}^2 + 2a_x(x - x_0)$$

$$V_x^2 - V_x^2 = 2a_x(x - x_0)$$

$$x - x_0 = \frac{0}{2a_x}$$

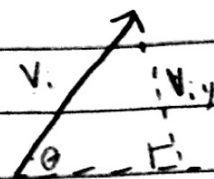
$$x - x_0 = \frac{0}{0}$$

Stuck, 0 can't be in denom.

go to y

Vertical

Need V_{iy}



$$\sin(\theta) = \frac{V_{iy}}{V_i}$$

$$V_i \sin(\theta) = V_{iy}$$

$$250 \text{ m/s} \sin(28^\circ) = V_{iy}$$

$$V_{iy} = 117.37 \text{ m/s}$$

$$V_{fy} = 0 \text{ m/s}$$

$$V_{iy} = V_{0y} + a_y t$$

$$a_y t = -V_{0y}$$

$$t = \frac{-V_{0y}}{a_y}$$

$$t = \frac{-117.37 \text{ m/s}}{-9.8 \text{ m/s}^2}$$

$$t = 11.98 \text{ s}$$

$$y - y_0 = V_{0y} t + \frac{1}{2} a_y t^2$$

$$y - y_0 = 1.1737 \text{ m/s} \cdot 23.96 \text{ s} - 703.25 \text{ m}$$

$$y - y_0 = 702.85 \text{ m}$$

back to horizontal

$$t = 2t$$

$$t = 23.96 \text{ s}$$

$$x - x_0 = V_{0x} t + \frac{1}{2} a_x t^2$$

$$x - x_0 = 5.288.9 \text{ m}$$

$$5.29 \text{ km}$$