04

Monday, February 29, 2016 8:32 AM

Who Wants to Launch Stuff off of Stuff?

In kinematics we dropped stuff off of stuff, or launched stuff straight up off of stuff.

This time we are actually going to have an initial velocity. We can shoot a gun off of a cliff and predict the location of the bullet hitting the ground.

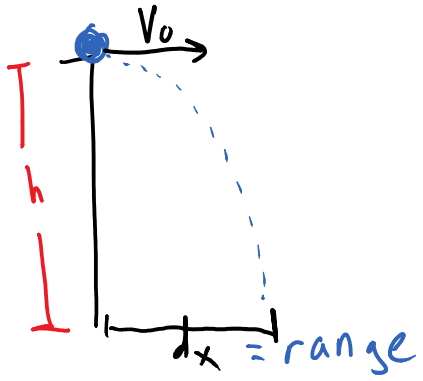
Projectiles refers to any object which is launched into the air and only affected by the acceleration due to gravity after launching. ie: they are considered to be in freefall -- even though we are launching them horizontally.

2 parts to any projectile situation v_{0x} and v_{0y} (we need to be comfortable decomposing vectors into x and y components) $V_y = 0$

1. Use the vertical part to find time*
2. All projectiles assume no air resistance
3. All projectiles' motion obeys the kinematic formulae

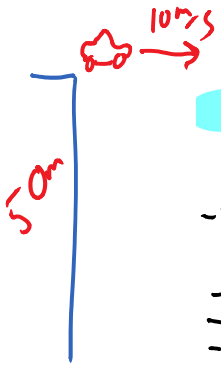
$d = v_{avg}t$	$\Delta v = at$	$d = v_0 t + \frac{at^2}{2}$	$v_f^2 = v_i^2 + 2ad$

We will be focussing on type I projectiles. We will do a little bit of type II tomorrow.



Sydney throws a car horizontally at 10 m/s off a 50 m high bridge, what will be its range?

1. Draw the picture
2. Forget about the horizontal velocity. It hits the ground at the same time regardless of its initial horizontal component.
3. Use the vertical component to see how long it takes to hit the ground.
4. Use this time to find how long the object travels horizontally. We claim that t=t, and so we solve with d=vt.



$d = v_0 t + \frac{1}{2}at^2$

$-50 = \cancel{0t} - \frac{9.8}{2}t^2$

$\frac{-50}{-4.9} = t^2$

$t = 3.19\text{ s}$

$v_f^2 = v_i^2 + 2ad$

$v_f^2 = 0 + 2(-9.8)(-50)$

$v_f = \pm\sqrt{2(-9.8)(-50)}$

$= -31.3\text{ m/s}$

$x^2 = 4$

$x = \pm 2$

$v_f - v_i = at$

$-31.3 - 0 = -9.8t$

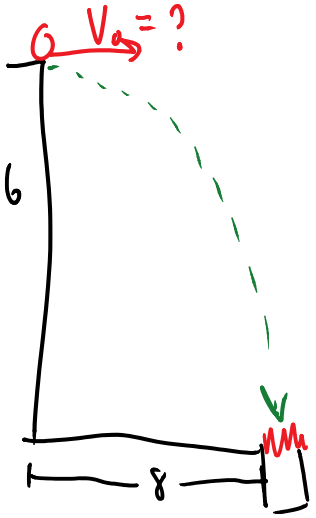
$\frac{-31.3}{-9.8} = t = 3.19\text{ s}$

$d = vt$

$-50 = \frac{-31.3 + 0}{2}t$

$\frac{-50(2)}{-31.3} = t = 3.19\text{ s}$

A flaming barrel of oil lies exactly 8.0 m from the base of a 6.0 m high KSS. With what horizontal velocity must Chris throw a zombie to splash directly into the barrel?



$v_{fy}^2 = v_{iy}^2 + 2ad$

$v_{fy}^2 = 0 + 2(-9.8)(-6)$

$v_{fy} = -10.8\text{ m/s}$

$v_f - v_i = at$

$-10.8 - 0 = -9.8t$

$\frac{-10.8}{-9.8} = t = 1.1\text{ s}$

$d_x = v_x t$

$8 = v_x(1.1)$

$\frac{8}{1.1} = v_x$

$v_x = 7.27\text{ m/s}$

$d = vt$

$= 10(3.19)$

$= 31.9\text{ m}$

What is the final velocity?

$v_f =$ 7.27 (→), 10.8 (↓)

$v_f = \sqrt{7.27^2 + 10.8^2}$

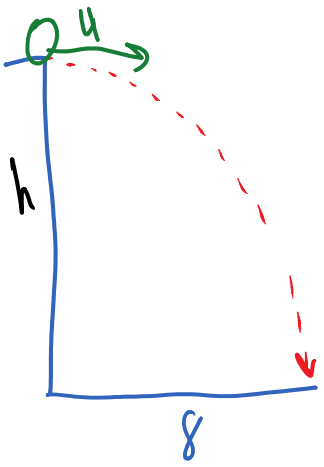
$= 13.0\text{ m/s}$

$@\ \theta = \tan^{-1}\left[\frac{10.8}{7.27}\right]$

$= 56^\circ$ S. of E.

Determine the velocity of the ~~goblin~~ zombie when it lands in the barrel.

Dale throws a watermelon off a bridge with a velocity of 4.0 m/s (horizontally), it strikes the rail tracks a distance of 8.0 m from the base of the bridge, determine the height of the bridge.



$d = vt$

$d_x = v_x t$

$8 = 4t$

$\frac{8}{4} = t = 2s.$

$d = v_0 t + \frac{at^2}{2}$

$d = 0 - 4.9(2)^2$

$= -4.9(4)$

$= -19.6\,m.$

Projectile Practice - Do it. Get good.

1. A watermelon is thrown horizontally at a velocity of 18.0m/s from the top of a cliff. If the object hit the ground 100.0m from the base of the cliff, how high is the cliff? (151m)

2. A pumpkin is thrown horizontally at a velocity of 20.0m/s from the top of a cliff. If the object hit the ground 48.0m from the base of the cliff, how high is the cliff? (28.3m)

3. A large dense 15kg spider is thrown horizontally from the top of a building at a velocity of 15.0m/s. If the object takes 5.50s to reach the ground, how high is the building? (148m)

4. An _____ is thrown horizontally from the top of a cliff at a velocity of 20.0m/s. If the object takes 4.20s to reach the ground, how far from the base of the cliff did the object hit the ground? (84.0m)