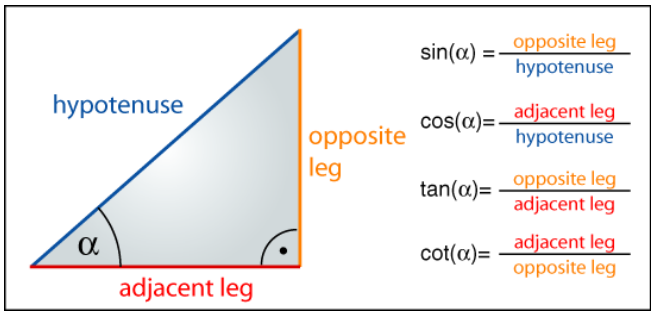
Projectile Motion Notes

When objects move in two dimensions they often move at an _____angle_____.

Example: For a triangle with a 90° angle, two 45° angles, and each of the legs measuring 1 meter, what is the length of the hypotenuse?

(1 meter) * sin or cos(45°)

Answer: $\sqrt{2}$



In order to understand projectile motion you need to understand motion in the X direction (left and right) and the Y direction (up and down).

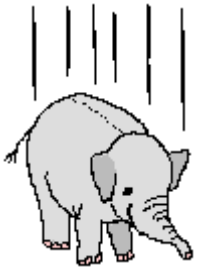
Vertical

Horizontal

1) Free fall from rest

$V_{iy} = 0$

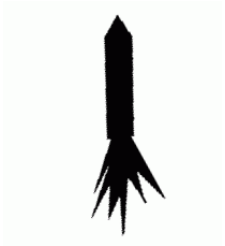
$a_y = +9.8 m/s^2$



2) Launching an object straight up

$V_{iy} > 0$

$a_y = -9.8\ m/s^2$



3) Launching an object straight down

$V_{iy} > 0$

$a_y = +9.8\ m/s^2$

4) Horizontal Motion

$Vix = Vfx$

$ax = 0\ m/s^2$

Then there are the equations. Don't let them overwhelm you, which equation you use depends on the information you are given.

Vertical Y-direction	Horizontal X-direction
$a_y = 9.8\ {}^{m}/_{s^2}$	$V_{xi} = V_{xf}$
$a_y = \frac{V_{yf} - V_{yi}}{t}$	$d_x = v_x t$
$d_y = v_{iy}t + \frac{1}{2}\,at^2$	
$V_{yf}^2 = V_{yi}^2 + 2a_y d_y$	
$V_y = V_{y0} + a_y t$	

When solving a projectile motion problem you should draw a picture, include angles, distances, velocities, and any other information possible.

Example: Find the max height and range a cannonball reaches if shot at an angle of 35° with an initial velocity of 120 m/s.

Step 1: Sketch with information:

Y Direction	X Direction
Viy =	Vix =
Vfx =	ax =
ay =	dx =
dy =	t =
t =	

Step 2: Circle what you are trying to solve for.

Step 3: Fill in what you already know or can easily find.

In Y Direction:

V_{iy} = 120 sin 35 = 68.83 m/s Vfy=0

a_y = - 9.81 m/S2

In X Direction:

$V_{ix} = 120 \cos 35 = 98.3$ m/s ax = 0

Step 3: Use formulas to solve for unknown. **Cancel out units!!!**

Part I:

$V_f^2 = V_i^2 + 2\,(a_y)\,(d_y)$

$0 = 4737.5 - 19.62\,(d_y)$

$d_y =$ **241.5 m**

$$a_y = \frac{V_{fy} - V_{iy}}{t}$$

$$-9.81 = \frac{0 - 68.83}{t}$$

t=7.01s

Part II (Use t = 7.01 found from Part I)

$d_x = (V_{ix})(t)$

$d_x = (98.3)\,(7.01)$

$d_x =$ **689.4 m**