Physics II Name: ______________________________________
Unit I: Projectiles

Unit Introduction:

In this unit, we will be working with projectiles and their launchers. We will examine the flight paths of the projectiles themselves: distance, velocity, height, flight path, etc. We will also examine the efficiencies of launchers by comparing potential energy to the kinetic energies of their projectiles. We will be using pre-made launchers, and we will be creating our own. Launchers will range from small to large. At times we will ignore air resistance, and at times we will account for it.

This Activity:

Part I: Projectile motion review. Determine the muzzle velocity of a launcher. Then predict the landing point of a projectile fired at an angle, relative to horizontal

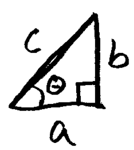
Part II: Using Microsoft Excel, create a graph showing your projectile's flight path for any muzzle velocity and angle of release.

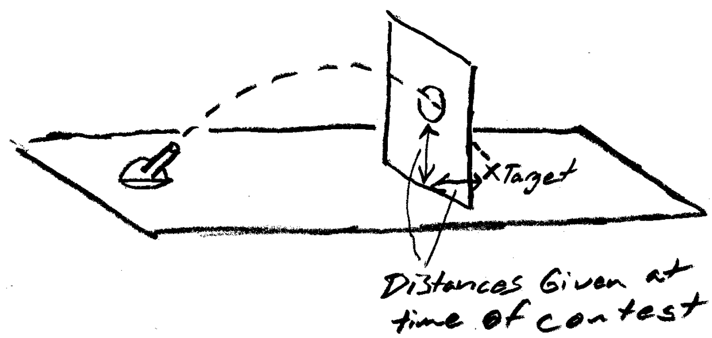
Part III: Siege Contest – Loft a projectile through a hole in a wall, and hit an object on the other side (at starting elevation). The winners will be the group that gets the projectile through the wall and closest to the target, in three shots.

Helpful Formulas:

$d = v_0t + \frac{1}{2} gt^2$ [d = displacement; v_0 = initial velocity]
$\sin \theta = b/c$
$\cos \theta = a/c$

Assume that $g = -9.8 m/s^2$





Practice Questions:

A. A projectile launcher fires a projectile directly upward. The projectile reaches its apogee at 2m above its launch point. What is the launcher's muzzle velocity?
B. Suppose a projectile is fired at an 80° angle from a horizontal surface. Its muzzle velocity is the velocity from part A. What are the horizontal and vertical components of the projectile's initial velocity? [Resolve the initial velocity into these two vectors.]
C. How far, horizontally, will the projectile of part B travel before returning to the surface?

Part I: Use the following steps to determine your launcher's "long range" muzzle velocity (velocity as it leaves the launcher). This is not the only way to do it.

1. Aim your launcher directly upward and measure the maximum height reached by your shot. Do this several times to arrive at a best answer. Measure as accurately and precisely as you can.

_______ = max height

2. Use that max height to calculate the amount of time that it must have taken for your shot to reach its highest point (or, equivalently, the time for your shot to drop from its highest point).
_______ = time projectile spent traveling upward

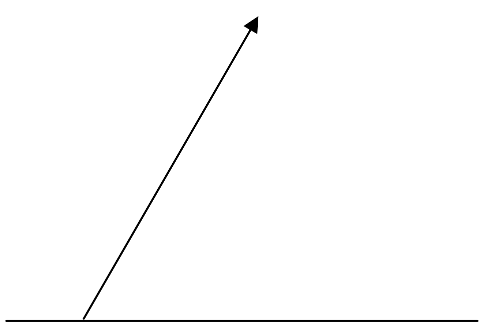
3. Use your previous answer to calculate your launcher's muzzle velocity.

_______ = muzzle velocity (at long range setting).

Part II: Determining Trajectory

4. The diagram below shows a vector representing the launcher's muzzle velocity. Assume that the vector is inclined at 60˚, and that the ground is level.
a. Label the vector with your launcher's muzzle velocity.
b. Resolve the muzzle velocity vector into separate horizontal and vertical components
c. Label these component vectors with their magnitudes.
d. Use the vertical component of velocity to determine how long the shot will stay in the air.
e. Calculate the total distance traveled by the projectile before it hits the ground.
f. Set your launcher at a 60° angle. Aim it so that the projectile will land on your table. Place a piece of paper where you expect the projectile to land. Shoot your projectile compare its landing point to your expected landing point.

Calculated Time aloft = _______ Calculated Horizontal Travel Distance = _______



5. Predict the time aloft and horizontal distance traveled if you launch your projectile at a 30˚ angle. Place a target at your expected landing point and shoot your projectile at the target. Record the distance of your miss.

Calculated Time aloft = _______ Calculated Horizontal Travel Distance = _______