Physics – 2D Motion (Projectiles) **Name:**
LAB: Shoot your Grade I (Horizontal) [20 pts] **Date:**

Background: Projectile motion (two dimensional) is most often analyzed in component form. Based on the independence of motion, and considering ideal conditions, one can examine situations, and calculate predicted values as if they were one dimensional in nature (x or y separately).

The time the object is in flight ties the two components together. The time a horizontally launched projectile spends in free-fall depends only upon the height from which it was released. Knowing the release height and the horizontal velocity is enough information to predict the range.

Objective:

predict and test the range of a marble launched horizontally

Materials:

marble, launcher, photo gate timer, meter stick, notes, text, calculator, target

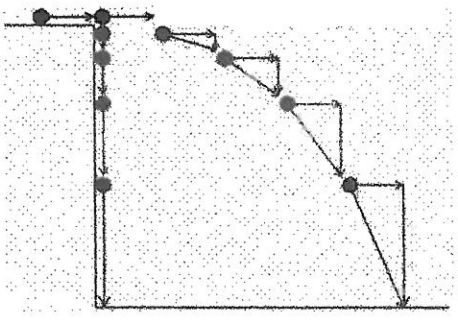
Procedure:

launch the marble into a backstop using a launch angle of zero degrees
measure speed of marble on each (1-5) setting with a photo-gate timer
take multiple measurements to obtain repeatable results
taking an average is the marble's initial velocity (v_0)

Data: (5 points)

Launcher Setting #	marble distance = diameter (m)	Average time (s)	Average initial velocity (m/s)
1	0.019m		
2	0.019m		
3	0.019m		
4	0.019m		
5	0.019m		

Label the diagram below with a coordinate system and all known variables (2 pts)



If the time it takes for the marble to reach Δx_x (range in the x direction) is the same as the amount of time it takes for a marble in free-fall from the same height (Δx_y), one can find the time the projectile will be in flight given the distance.

PreLab Predictions

A) Calculate the time it will take a marble to hit the ground *if* dropped from 1.0 meters. Consider only the vertical (y) direction where the acceleration due to gravity is 9.81 m/s^2 and the effects of air are ignored.(2pts each).

$\Delta x_y = v_{y0} t + \frac{1}{2} a_y t^2$

$t =$

B) Assuming there is no horizontal acceleration (a=0), one can use the initial velocity of an object to determine how far the object will land. Rearrange the kinematic equation and solve for range or horizontal displacement. Use the calculated horizontal velocity from the data on setting #5 on the launcher above.

$v_{x0} = \Delta x_x / \Delta t$

$\Delta x_x =$

When these are solved for – obtain one of the random heights and settings from the instructor. Use these settings to predict the range of the marble. Show calculations: (2 pts each)

Height : _____ **Launch setting #:** _____

A) time of flight =

B) range =

After calculating the range, then set up the launcher / target / carbon paper in order to test prediction. Once set up is complete, adjustments may not be made.
Launch 3 times and determine the average score.

Scores: _____ + _____ + _____ = _____ **Average =** _____

SHOOT YOUR GRADE - TARGET

THIS END FARTHEST FROM THE LAUNCH POINT

6pts

7pts

8pts

9pts

10pts

9pts

8pts

7pts

6pts

THIS END CLOSEST TO THE LAUNCH POINT