PHYS 1401
General Physics I

EXPERIMENT 4
PROJECTILE MOTION

I. OBJECTIVE

The objective of this experiment is to study projectile motion. A ball will roll down a ramp leaving the end of the ramp and becoming a projectile with a horizontal initial velocity. This velocity is measured along with the horizontal and vertical distances which the projectile travels as it goes from the end of the ramp and hits the floor of the lab.

II. APPARATUS

Ramp, photogate, steal ball, carbon paper, plumb bob, meter stick and vernier caliper.

III. EXPERIMENTAL PROCEDURE

1. Set up the ramp at the edge of the table.
2. Use the plumb bob and mark a point on the floor directly below the launch point.
3. Measure the vertical distance the ball falls through (to the nearest millimeter) as it is launched from the ramp and falls to the floor. Record in the data table.
4. Place a paper on the floor and launch the ball from a certain height and adjust the position of the paper such that the ball hits the floor landing on the paper. Place a carbon paper on top of the paper and tape them to the floor.
5. Set the photogate such that as the ball rolls out the light beam is blocked and unblocked. Plug the photogate in the LabPro Dig/Sonic1 port.
6. Open the **Logger Pro** folder and open **One Gate Timing**.
7. Use a vernier caliper and measure the diameter of the ball. Ask the instructor or the lab assistant to show you how to enter this number in the computer. This is an important quantity since the computer uses it to calculate the launch velocity of the ball.
8. Launch the ball from a certain height on the ramp. The ball will hit the carbon paper and make a mark on the white paper underneath. Measure the horizontal distance the ball traveled to the nearest millimeter.
9. Repeat the above step from a different height for a total of five runs.

IV. ANALYSIS

1. Use the kinematic equation $y = v_{0y}t - (1/2)gt^2 = -(1/2)gt^2$ (since $v_{0y} = 0.0$) and solve for the time, t in terms of y and g, to get $t = \sqrt{2|y|/g}$

2. Use the equation $x = v_x t = v_x\sqrt{2|y|/g}$ and calculate the horizontal distance which the theory predicts the projectile travels. Show your calculations in the proper section of the lab report and enter the results in the results part of the table.

3. Calculate the percent difference between the measured horizontal distance and the calculated one. Round off this percent difference to one significant figure and enter it in the results part of the table.

$$\%\,\text{difference} = \frac{|x_{\text{th}} - x_{\text{exp}}|}{\left(\frac{x_{\text{th}} + x_{\text{exp}}}{2}\right)} \times 100. \tag{1}$$

4. Write a conclusion summarizing your results. Comment on the success of this experiment. Explain any percent differences larger than 5%. What do you think are the two most important sources of error?

Experiment (4) Data Table				
Height of ramp's lower end above the floor, $\lvert y \rvert =$				
Diameter of the ball, $d =$				
Run	Initial Velocity $v_{0\mathrm{x}}$ (m/s)	Horizontal Distance x (m)	Theoretical Horizontal Distance $x = v_{0\mathrm{x}}\sqrt{\frac{2\lvert y \rvert}{g}}$	Percent Difference
1				
2				
3				
4				
5				