Experiment 2 Projectile Motion

Group _____

Names _____

_____

_____

Indicate which experiment your group performed:

Falling Ball Experiment   _____

Projected Ball Experiment   _____

Data:

1) For either experiment, record the angle of the tube. Make three measurements of the height of the exit point of the tube above the ground.

Angle = _____. Estimated Uncertainty in Angle = _____.

Height: =_____. Estimated Uncertainty in Height = _____.

Horizontal distance between impact point on paper and exit point:

Trial 1 _____, Trial 2 _____, Trial 3 _____,

Mean distance = _____. Estimated Error = _____.

What are the errors in these measurements? You may use as a measure of your error in the distance the average deviation of your measurements. Or, if you have a calculator with statistics capabilities, you may use a standard deviation. See *Class Notes: Error Analysis*.

2) Record the results for your three measurements for the time interval for the pulse width.

Trial 1 _____, Trial 2 _____, Trial 3 _____,

Mean Time for Pulse Width $\Delta T =$ _____.   Estimated Error = _____.

You may use as a measure of your error in ΔT the average deviation of your measurements. Or, if you have a calculator with statistics capabilities, you may use a standard deviation. See *Class Notes: Error Analysis*.

3) Let $D = 12\,\text{mm}$ is the diameter of the ball and ΔT is the time interval that the ball travels its diameter when it exits the tube. **Based on your result of part 2), calculate the average exit velocity**,

$$\overline{v}_{\text{exit}} = D/\Delta T = \underline{\hspace{5cm}}$$

Questions:

Question 1: In the above expressions for v_0 and g,

$$v_0 = \sqrt{\frac{g\, x(t)^2}{2\cos^2\theta_0\left(\tan\theta_0\, x(t) - y(t)\right)}} \quad \text{and} \quad g = \frac{v_0^{\,2}}{x(t)^2}\left(2\cos^2\theta_0\left(\tan\theta_0\, x(t) - y(t)\right)\right),$$

give unusual results if $\left(\tan\theta_0\, x(t) - y(t)\right) < 0$. Why, on physical and geometric grounds, can this possibility be excluded?

Question 2: What role does friction play in your measurements? How would your results be changed if the tube were completely frictionless?

Question 3: What error does your method for measuring the pulse width introduce into your measurement for the average velocity of the ball? What contribution does the width of the beam make? Can you estimate this effect? How does this error compare with other errors in the experiment?