PHY 122: (Name of the experiment) **Projectile Motion**

(Prominent student's name) Andrew Cole

(lab partners' names) Robert Strow

(Group Number) 5

(Class Number): 5-digit number provided in ASU catalog

(Day and time when the experiment was performed):

(TA's name):

Objective section – (3 points)

(A statement of what physics concepts/theory/law was investigated or tested during the class. What physics quantities had to be measured? It is one or two sentences.)

The physics concept tested in the lab was the kinematics of projectile motion. Position-time and velocity –time relationships of projectile object were analyzed; the value of grav. acceleration was found.

Experimental Data (3 points)

- Report only the raw data that will be used for further calculations, do not retype all of it; attach the rest of raw data to the end of the lab report with the graphs;
- Data should be tabulated;
- Tables should have appropriate headings and contain units.

Slope of (h vs. t23cor^2) (m_1) and its uncertainty (Δm_1)	**$m_1 \pm \Delta m_1$= (4.8787+/-0.1485) m/s^2**
Mean velocity stat v vs. v graph	**1.323 m/s ; std. dev. = 0.00295 m/s**
Slope of (x vs. t23cor) (m_2) and its uncertainty (Δm_2)	**$m_2 \pm \Delta m_2$= (1.388+/-0.0485) m/s**

Data analysis section – (10 points)

- Includes equations and calculations of all quantities and their uncertainties.

Sample:

Gravitational acceleration:

$$g = 2 * m_1$$

$$g = 4.8787 \frac{m}{s^2} * 2 = 9.7574 \frac{m}{s^2}$$

Propagating error in the gravitational acceleration:

$$\Delta g = 2 * \Delta m_1$$

$$\Delta g = 2 * 0.1485 = 0.2970 \frac{m}{s^2}$$

$$\%discrepency = \frac{|(g_{exper} - g_{theor})|}{g_{theor}} * 100\%$$

$$\%discrepency = \frac{|(9.7574 - 9.81)| m/s^2}{9.81 m/s^2} * 100\% = 5.26\ \%$$

Based on the slope of the (x vs. t23cor) graph the Mean Velocity is:

$$V_{mean} = m_2 = 1.388\ m/s$$

$$\Delta V_{mean} = \Delta m_2 = 0.0485\ m/s$$

Calculating error in the Mean velocity from stat v vs. stat v graph.

$$\Delta V_{mean} = \frac{stand.dev}{\sqrt{5}} = \frac{0.00295 m/s}{\sqrt{5}} = 0.0013\ m/s$$

Results section – (3 points)

- results with their errors should be organized in clearly labeled **tables**.
- results and uncertainties have to be reported in the correct format.
- No raw experimental data should be reported in this section.

Gravitational acceleration **(h vs. t23cor^2)**	$(9.8 \pm 0.3)\mathrm{m/s^2}$
Mean velocity (statistics)	$(1.3230 \pm 0.0013) m/s$
Mean velocity (x vs. t23cor) graph	$(1.39 \pm 0.05) m/s$

Discussion and Conclusion section – (10 points)

Begin discussion with the purpose of the experiment. The purpose of this lab was to verify kinematics equations of projectile motion. Briefly explain the physics theory/concept that was tested. Projectile motion combines constant velocity motion in horizontal direction and free fall motion in vertical direction. These two types of motion exist independent of each other. Briefly explain the procedure that was used to collect the experimental data. Describe difficulties and shortcomings that were encountered during the experiment and it caused the uncertainties in the final results.

In this experiment, the ball was launched five times from 6 different heights. The elapsed time and launched velocity were measured by Data Studio software. The time of flight had to be s corrected because the ball made one additional roll around itself after the time was registered. The horizontal range and height were measured with the tape.

State only the key results (with uncertainty and units) quantitatively with numerical values; does not provide intermediate quantities. Discuss whether the results prove/disprove the concept being tested in the lab. The experimental value of gravitational acceleration found to be $(9.8 \pm 0.3)\mathrm{m/s^2}$. Since the percent discrepancy is 5.26 %, the measurement considers being accurate and consistent with the theoretical value. The linear relationship between the range the ball traveled midair and the time elapsed was proven. The slope of the position versus elapsed time graph was found to be equal to the velocity of the object in horizontal direction. Values of the horizontal velocity from the slope of the graph and measured by the software are consistent with each other. The quadratic relationship between the height and the airtime was proven.

Discuss “statistical errors” that affect your measurements, but which you can't do anything about given the time and equipment constraints of this laboratory. Suggest experimental redesigns to eliminate and overcome these troubles. Include a description of sources of “systematic errors” in your measurement that bias your result (*e.g.* friction in pulleys that are assumed frictionless in the formula). Describe the *qualitative effect* of each source of error (*e.g.* friction slowed motion, causing a smaller value of acceleration to be measured). Describe only the prominent sources of error in the experiment.

The measurements of horizontal distance had quite a large random error due to the selected method. Because the horizontal range was not an even surface and two rules had to be used to measure it, this experimental method increased the error in its measurements. No systematic errors were noticed in this lab experiment to offset the data. The improvement to the lab experiment can be done in the measurements of the horizontal range to reduce the random error.

The object was accelerating in the vertical direction, and moving with constant speed in the horizontal direction. Based upon the agreement of the value of g between theory and this experiment as well as launched velocities it can be stated that the set of kinematic equations used to describe projectile motion is valid. The objective of the experiment has been achieved.