**Name:**

**Lab Partners:**

**Course: AP Physics**

**Period:**

**Date:**

**AP Lab #3- Projectile Motion**

**Purpose/Problem:** To analyze the motion of a projectile under the influence of only gravity and therefore determine its acceleration due to gravity.

**Hypothesis:** You know what to do here. (Refer to Lab #2)

**Materials:** marble launcher, photogate timers, plastic marble, meter stick or tape measure, (RESTRICTION: no stopwatches! – don’t include this restriction in your materials list when you publish)

**Experimental Design & Procedure:**

1. (Set up the photogate timer and marble launcher as demonstrated by Mr Fallon. Your write-up needs to explain more of the details of your set-up and will not include this parenthetical).

Launch the ball horizontally only. Adjust the initial velocity to obtain changing range values along the floor. (You may want to average many values to get an idea of where it is landing.) Use these two measurements along with the drop height to determine the acceleration of gravity. Hint: you will have to linearize this again, but it will be helpful to determine the theoretical relation between the two variables beforehand this time to guide what you should place on each axis in order to do so.

**Observations & Data:**

|  |  |  |  |
| --- | --- | --- | --- |
| Trial | Horizontal Distance Covered  (m) | Time from Photogate Timer  (s) | Initial Velocity of Launch (m/s) |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |
| 4 |  |  |  |
| 5 |  |  |  |

**Analysis:**

1. Calculate the initial velocities for each launch and fill them into the table *above*. Show a sample calculation here. Remember to include initial equation using familiar variables, plug-in values, and units.
2. Show all your work to determine the algebraic relationship between your measured values and the acceleration due to gravity. This needs to start from somewhere we all recognize, i.e. familiar kinematic equations – they’re well-established! (I'll give you a hint: the time from the photogate timer is **not** the time of flight and therefore can’t be plugged into a kinematic equation that uses the time of flight as “the time”). When you’re finished, aside from any constants, you should be left with only initial velocity, vertical displacement, horizontal displacement, and the acceleration due to gravity.
3. Graph your function from step 2.
4. What, when plotted on x and y axes, will linearize the function? (In other words: A graph of \_\_\_\_\_\_\_ (y-axis) versus \_\_\_\_\_\_(x-axis) will produce a linear function.)
5. Perform the calculations necessary to linearize the function you determined in step 2 (you do not need to show your calculations for these values unless they require more than one mathematical operation). Use these values to fill in the table *below*. (Label the columns specifically: not just “y-values…”, but say what they actually are.)

|  |  |  |
| --- | --- | --- |
| Trial | y-axis values necessary for linearization (appropriate units) | x-axis values necessary for linearization (appropriate units) |
| 1 |  |  |
| 2 |  |  |
| 3 |  |  |
| 4 |  |  |
| 5 |  |  |
|  |  |  |

1. Plot your linearized graph from step 5. As usual, you will use this to find the best-fit line and determine the slope of the line (which, in physics, always includes units unless the units cancel) with which you will determine the equation of the best-fit line. Show all your calculations and final equations in the analysis section here.
2. “Unpack” the acceleration from your slope. Show your work here to really make a clear statement of the acceleration determined from your data set.
3. Compare the acceleration you found to the theoretical value of the acceleration due to gravity. In our labs, the word “compare” means to calculate a "percent difference." Again, this is calculated in the following way (note the absolute value symbols—in physics, percent difference is typically reported as a positive value):

% Difference = ׀ Most Trusted Value – Least Trusted Value׀ 100% X

Most Trusted Value

**Conclusion:**

1. Make sure that this is at least a six to seven sentence paragraph.
2. Relate the conclusion to the problem and hypothesis.
3. Do NOT repeat procedure, observations, or data unless you’re going somewhere with it
4. Error Analysis Tips:
   1. work backwards (How did you get the final value? What did you need to plug in to get there? How did you get those original values to plug in? [usually measurements] What did you use to measure them? Could they be uniformly too big? Too small?)
   2. *quantify*: estimate amounts! (how closely did you round your measurements? How much will the sources of “error” [which in science means “uncertainties caused by things having to do with the measurement procedures” – not “mistakes”] effect the final calculation?)
   3. use the equation you used to calculate the experimental value to determine how much effect your sources of “error” have on the final result (For Example: if you’re calculating with a *time2* in the denominator of your calculation and your time measurements are all about twice as large as the actual values are, you’ll be getting *four* times the denominator you need, so the overall calculation will be *one fourth* as big – at least that’s the contribution from this measurement. Provide an analysis like this)