Lab 3-6: **Projectile Motion**

Names:

Purpose:
1. To examine the motion of a projectile through the use of video analysis.
2. To produce position and velocity graphs of a projectile's motion for horizontal and vertical components.
3. To determine what happens to the velocity of a projectile while in the air.

Procedure:

1. Download a copy of the movie to analyze from Google Classroom to your computer – remember where you saved it.

2. Make sure that the LabPro is NOT plugged into the computer. Open up Logger Pro. Under **Insert**, choose **Movie...**. Choose the correct movie. It will open up in the middle of the screen of Logger Pro.

3. Under **Options**, choose **Movie...**. Change the following two numbers in the window that pops up:
   a. "Override frame rate" to **240**
   b. "Advance the movie __**5**__ frame(s) after adding a new point."

4.  Enable video analysis by clicking on the box on the bottom right of the movie that looks like the button to the left.

5.  Set the scale of the movie by clicking on the "Set Scale" button (upper right corner), then clicking and dragging across the vertical meter stick.

6.  Set the origin by clicking on the "Set Origin" button (upper right corner), and then clicking on the first position of the ball. Now that the scale and origin is entered, you don't need to see it (and in fact they both get in the way) so click on the buttons labeled "Show Origin" and "Show Scale" to turn them off.

7.  Now to record the actual position of the toy ball for each frame of the movie, click on the "Add Point" button (upper right corner.) Carefully center the mouse on the toy ball, and click. Logger Pro will record the x and y coordinates of the mouse click, and the movie will automatically go to the next frame. Do this for the entire movie.

8. To clean up the window, under **Page**, choose **Auto Arrange**. You should now see the position vs. time graphs on the main screen. Save your LoggerPro file (in case something blows up) and remember where you saved it.

9. As you answer the questions, you will need to make a total of 4 graphs and then cut and paste them into this Google Doc. To change what the graph shows, on the vertical axis of the graph, click and choose **More...** in the pop up window that appears. Then choose **X**. (Later on choose **Y**, then **X Velocity** and lastly **Y Velocity**.) Some of the graphs will need a best fit line, so pay attention.

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Graphs and Questions:

Horizontal Position vs Time (X vs T) **include the slope of the line**

Paste X vs T graph here.

1. This graph should be a straight line. What was the slope of your line, and what does that slope represent?

2. Describe the motion shown by the Horizontal Position vs time graph.

3. Can you tell if the ball was going up or down from this graph? Explain.

Vertical Position vs Time (Y vs T)

Paste Y vs T graph here.

4. The graph of vertical position verses time is a curve. How do you interpret this graph?

5. Can you tell if the ball was going up or down from this graph? Explain.

Horizontal Velocity vs Time (V_x vs T)
Fix the vertical scale by double-clicking in the middle of the graph, click on "Axes Options" tab, and then choosing "Manual" for the scaling, and setting the top value to 3 and the bottom value to 0.

Paste V_x vs T graph here.

6. The graph of horizontal velocity verses time should be basically horizontal. How do you interpret this graph?

7. Was there any acceleration in the horizontal direction?

8. Can you tell if the ball was going up or down from this graph? Explain.

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Vertical Velocity vs Time (V_y vs T) **include the slope of the linear part**
Fix the vertical scale by double-clicking in the middle of the graph, clicking on the "Axes Options" tab and choosing "Autoscale from 0".

Paste V_y vs T graph here.

9. The graph of vertical velocity verses time is a straight line. What is the slope of the line, and what does the slope represent? (*Hint: if you did everything correctly, the slope should be close to –9.8 m/s^2.)*

10. Can you tell if the ball was going up or down from this graph? Explain.

11. Look at the graph of Y vs t and this graph – what was the vertical velocity when the ball was at its maximum height?

12. This is one of the few graphs all year in which we care about the vertical intercept from the Logger Pro linear fit. What was the intercept, and what does it represent?

Questions:
13. What were the components of the initial velocity of the ball?

14. What was the initial speed of the ball?

15. For an object that is caught at the same height from which it was thrown and ignoring air resistance
    a. what is true about the time needed to go up compared to the time needed to go down?

    b. what is true about the initial horizontal velocity compared to the final horizontal velocity?

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c. what is true about the initial vertical velocity compared to the final vertical velocity?

d. what is its velocity at its maximum height? Be careful!

e. what is its acceleration initially, at its maximum height and finally?