Lab 3-3: **Projectile Motion**

Purpose:
1. To examine the motion of a projectile through the use of a camcorder.
2. To produce position and velocity graphs of a projectile's motion for horizontal and vertical components.
3. To analyze the motion of the projectile.

Procedure:
1. Two students will be video-taped tossing a tennis ball back and forth. This video will be converted into a small computer file, which will be analyzed using Logger Pro.
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.  Enable video analysis by clicking on the box on the bottom right of the movie that looks like the button to the left.
4.  Set the scale of the movie by clicking on the "Set Scale" button (upper right corner), then clicking and dragging across the length of the meter stick on the wall.
5.  Set the origin by clicking on the "Set Origin" button (upper right corner), and then clicking on the first position of the tennis ball.
6.  Now to record the actual position of the tennis ball for each frame of the movie, click on the "Add Point" button (upper right corner.) Carefully center the mouse on the tennis ball, and click. Logger Pro will record the x and y coordinates of the mouse click, and the movie will automatically go the next frame. Do this for each frame of the movie.
7. To clean up the window, under **Page**, choose **Auto Arrange**. You should now see the position vs. time graph on the main screen.
8. To add the velocity vs. time graphs, under **Insert**, choose **Graph**. A floating window will appear with a new graph in it. Grab it and drag it to the bottom right part of the window and then Auto Arrange again to make it look nice with the other graph.
9. Print out two pages. The first page should have the position vs time and velocity vs time for the horizontal components, and the second page should have the same for the vertical components. Make sure that the graphs are titled, and that any straight lines have the regression lines drawn through them. (Hint: To print both graphs on one page, click on the data table, and then under **File** choose **Print Graphs**. If one of the graphs is clicked on and active with a black box around it, then only that graph will print.)
10. Answer the questions on the other side.

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Questions:

1. The graph of horizontal position verses time is a straight line. Interpret this graph, including the equation that describes this motion.

2. The graph of horizontal velocity verses time is scattered. How do you interpret this graph, taking into account the graph of horizontal position verses time?

3. The graph of vertical position verses time is a curve that is concave down. What can you conclude from this? (Be careful!)

4. The graph of vertical velocity verses time is a straight line. Interpret this graph, including the equation that describes this motion.

5. What was the initial velocity of the tennis ball in component form?

6. What was the initial velocity of the tennis ball in magnitude and direction?

7. In general, how would you summarize projectile motion.

8. 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?

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

   d. what is true about the initial and final speeds and initial and final directions?

   e. what is its velocity at its maximum height?

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