Lab 3-5: **Projectile Motion off a Table**

Purpose:
1. To analyze the motion of a toy ball rolled off a table through video analysis.
2. To produce position and velocity graphs of a projectile's motion for horizontal and vertical components.

Procedure:
1. 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.
2. Enable video analysis by clicking on the box on the bottom right of the movie that looks like the button to the left.
3. 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 horizontal black line, which is 0.5 meters long.
4. Set the origin by clicking on the "Set Origin" button (upper right corner), and then clicking on the first position of the ball.
5. 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 the next frame. Do this for each frame of the movie. The ball will get smeared the faster it is moving - just click on the midpoint of the smear.
6. To clean up the window, under **Page**, choose **Auto Arrange**. You should now see the position vs. time graphs on the main screen.
7. To add the velocity vs. time graphs, under **Insert**, choose **Graph**. A floating window will appear with a new graph in it. Again, under **Page**, choose **Auto Arrange**.
8. To add the second velocity graph, click on the axis label (probably "Y Velocity" or "X Velocity") and then choose **More...** in the pop-up window that appears. Make sure both "X Velocity" and "Y Velocity" are checked off and then click **OK**.
9. You now have four graphs - one is a straight line with a positive slope and part of one is a straight line with a negative slope. Determine those slopes.
10. You will have to sketch the graphs and record the slopes in the questions below.

Questions:
First, let's go through the graphs for the horizontal motion, which are easier to interpret, but perhaps more surprising.

1. Sketch and interpret the horizontal position (x) verses time graph.

2. Sketch the graph of horizontal velocity(v_x) verses time. How do you interpret this graph, taking into account the graph of horizontal position verses time? Was there any acceleration in the x-direction?

3. Big Idea: Looking <u>only</u> at the graphs of x vs t or v_x vs t, could you tell whether the ball was rolling horizontally on the track or if it was falling?

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The graphs of the vertical motion are harder to interpret, because they show two different things going on. Let's go through this:

4. Sketch the graph of vertical position (y) vs time here. Mark on the graph where the ball was rolling horizontally and where it was falling. Interpret what each part of the graph shows.

5. Sketch the graph of vertical velocity(v_y) vs time here. Mark on the graph where the ball was rolling horizontally and where it was falling. Interpret what each part of the graph shows.

Let's summarize these results:

6. While the ball was <u>on the track</u>:
   a. What was its horizontal velocity (v_x)?

   b. What was its vertical velocity (v_y)?

   c. What was its horizontal acceleration?

   d. What was its vertical acceleration?

7. While the ball was <u>in the air</u>:
   a. What was the horizontal velocity (v_x)? Did this change from when it was on the track?

   b. What was the initial vertical velocity (just as it left the table)? What happened to the vertical velocity (v_y) as it fell?

   c. What was its horizontal acceleration?

   d. What was its vertical acceleration?