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PH – 1110 CX16

One and Two-Dimensional Motion – 111X Lab 2

Question – 1:

What happens if you do not do this step (step 2)? Try it out both ways if you are not sure. (1 - 2 sentences)

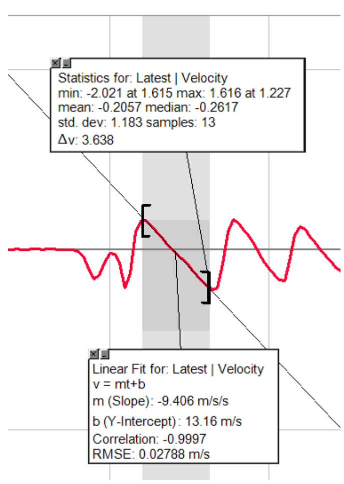
The data gathered will display the wrong direction of motion for the object being recorded if the axis for the motion sensor is not reversed. In the graph, an upward motion will seem as a downward motion and vice versa, making it challenging to examine the motion precisely.

Question – 2:

Why do we need to start the drop 15cm away from the sensor? (1-2 sentences)

Starting the drop 15 cm away from the sensor ensures that the ball will have enough space to drop and reach its maximum velocity before it encounters the sensor, enabling precise detection of the ball's motion and velocity.

Question 3 Velocity versus time questions Please include your velocity vs time graph here.



*(Figure – 1: Velocity vs Time Graph – **Only the first bounce)*

(a) What is the slope and the uncertainty for this fit?

$$Slope = -9.406\ m/s$$

$$Uncertainity = 1.183\ m/s$$

(b) What should the slope represent?

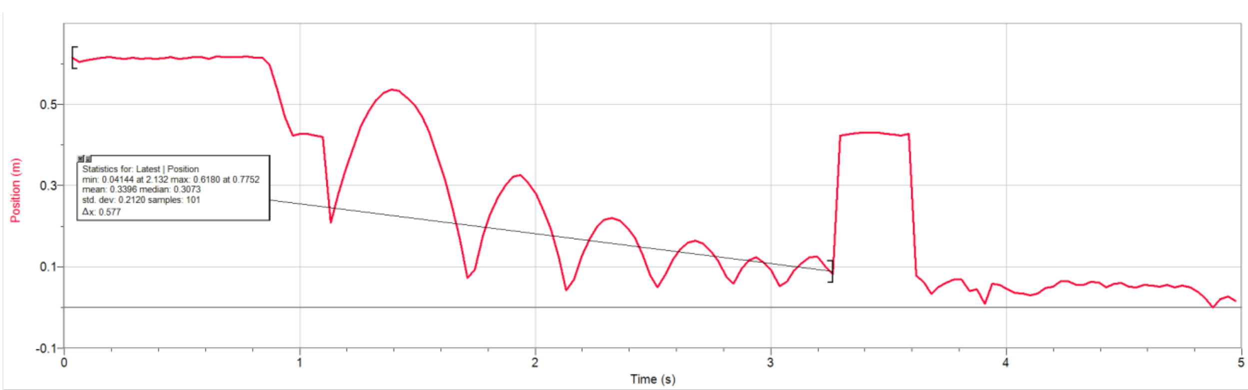
The slope should represent the velocity of the object being measured. The steeper the slope, the faster the object is moving, and the shallower the slope, the slower the object is moving.

(c) Does the result match the known value within the uncertainty of your measurement? Please compare these numbers. (1-2 sentences per question)

The slope matches the expected value within the 1.183 m/s range. Therefore the values are with the uncertainty of the measurements taken.

Question – 4: Position versus time questions

Please include your position vs time graph here. Based on your knowledge from the lecture, what form of the equation most closely describes the shape of the position graph?



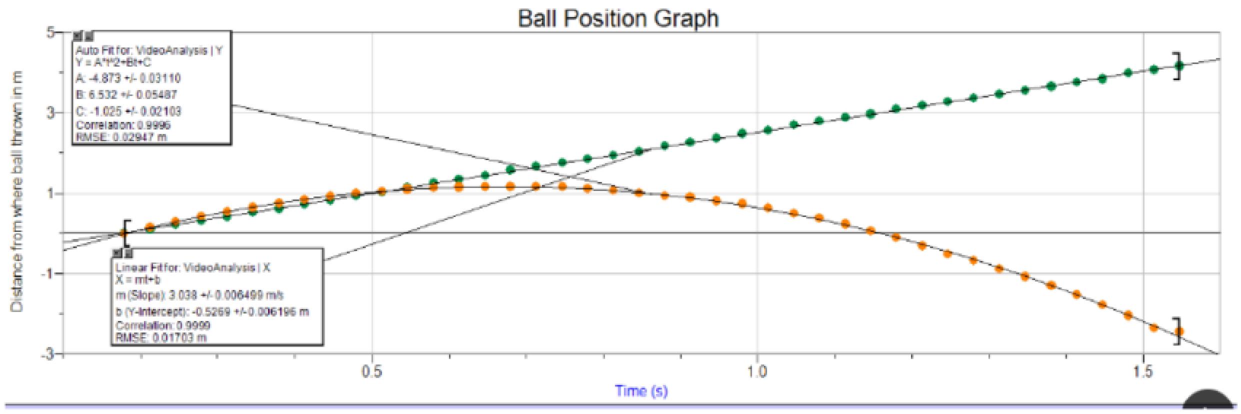
(Figure – 2: Position vs Time Graph)

From the knowledge we gained from class, a ball in motion creates a simple harmonic motion; the equation's shape might be a sine or cosine function. A straight line will result from the equation if the motion is uniform. A parabolic curve will represent the equation if the motion is accelerating.

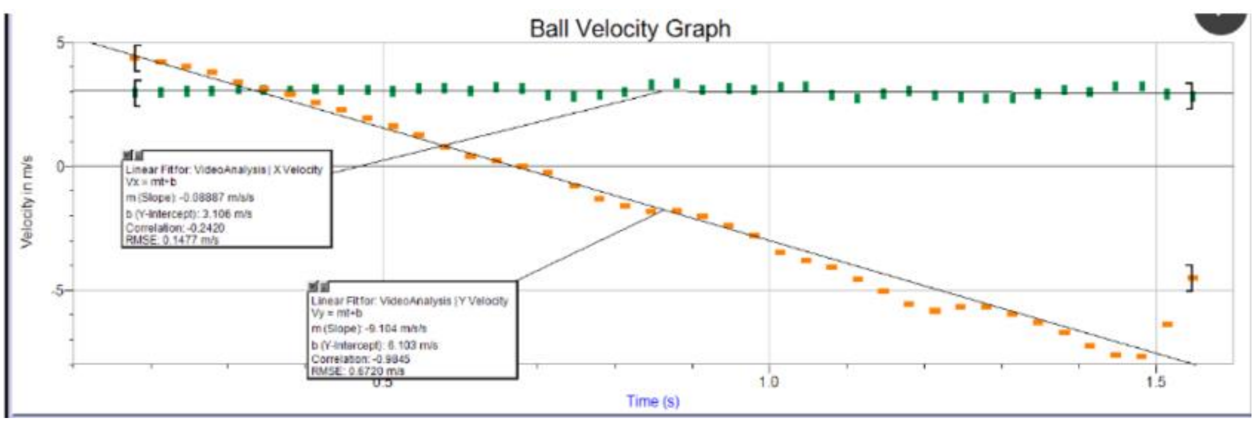
Question – 5: Qualitatively describe the goodness of the fits on the position and velocity graphs. Why or why not might this be a good fit?

The correlation coefficient (R-squared value) and residuals can be used to evaluate the fit's quality. A high correlation coefficient (around 1) and tiny residuals indicate a strong match. If the fit could be better, it can mean that the selected equation form needs to adequately describe the motion or that additional factors are at work. After determining the reason for a poor fit, a better equation form or extra data collection should be considered. In our case, out $R^2 = 0.9994$, *therefore, giving us a more correlating result with our data.*

Question – 6: 2D Basketball Graphs Attach the curve-fitted graphs along with a caption under each using the same format as presented above.



*(Figure – 3: Position vs Time Graph **Green in x and Orange in y)*



*(Figure – 4: Velocity vs Time Graph **Green in x and Orange in y)*

Question 7 Experimental Method

For just the 1D motion experiment (not the 2D basketball motion experiment), write down with bullet points the five most important steps for your data collection, including why the particular step is important. Use complete sentences (one per bullet point) not just a copy and paste of the instructions above.

- *Measuring the position of the tennis ball at regular intervals in the x-direction: This step is important because the position data will be used to calculate the ball's velocity at each interval of time and create a position vs. time graph.*
- *Measuring the initial velocity of the tennis ball in the x-direction: This step is important because the initial velocity will set the starting point for the velocity vs. time graph and affect the ball's entire motion in the x-direction.*
- *Calculating the velocity of the tennis ball at each interval of time using the position data: This step is important because the velocity data will be used to create a velocity vs. time graph, which will show the ball's motion in the x-direction.*
- *Measuring the initial velocity of the tennis ball in the y-direction: This step is important because the initial velocity will set the starting point for the velocity vs. time graph and affect the ball's entire motion in the y-direction.*
- *Measuring the position of the tennis ball at regular intervals of time in the y-direction: This step is important because the position data will be used to calculate the ball's velocity at each interval of time and create a position vs. time graph in the y-direction. This will provide a complete picture of the ball's motion, including its x-direction and y-direction components.*

Question – 8: Results

Write a sentence or two for each question asked below.

1D experiment

1. Using mathematical and physics terms, describe the motion of the tennis ball on the table.

Due to the effect of gravity, the tennis ball moves at a constant velocity in a straight line along one axis and a constant acceleration along the other axis.

2. What was the velocity and acceleration of the tennis ball, if either value was changing, what were the limits of the values, and what mathematical shape was the graph of those values?

The elements, such as the initial velocity, height, and projection angle, affect the velocity and acceleration of the tennis ball. In general, as it goes along the y-axis, the velocity will change over time, beginning at its initial velocity, rising as it falls due to gravity, and finally reaching its maximum velocity shortly before it touches the table. The graph of acceleration versus time would be a straight line, but the graph of velocity versus time would have a parabolic shape. Acceleration was -9.741 throughout the experiment, and velocity was changing positive to negative and constantly decreased its value.

2D experiment

1. Using mathematical and physics terms, describe the basketball's motion in the movie.

2. For the X-direction motion, what were the velocity and acceleration, if either value was changing, what were the limits of the values, and what mathematical shape was the graph of those values?

The x-direction motion had a constant velocity of 3.106m/s and no acceleration. Therefore the graph resulted in a way that the y-axis has a linear decreasing function from positive to negative.

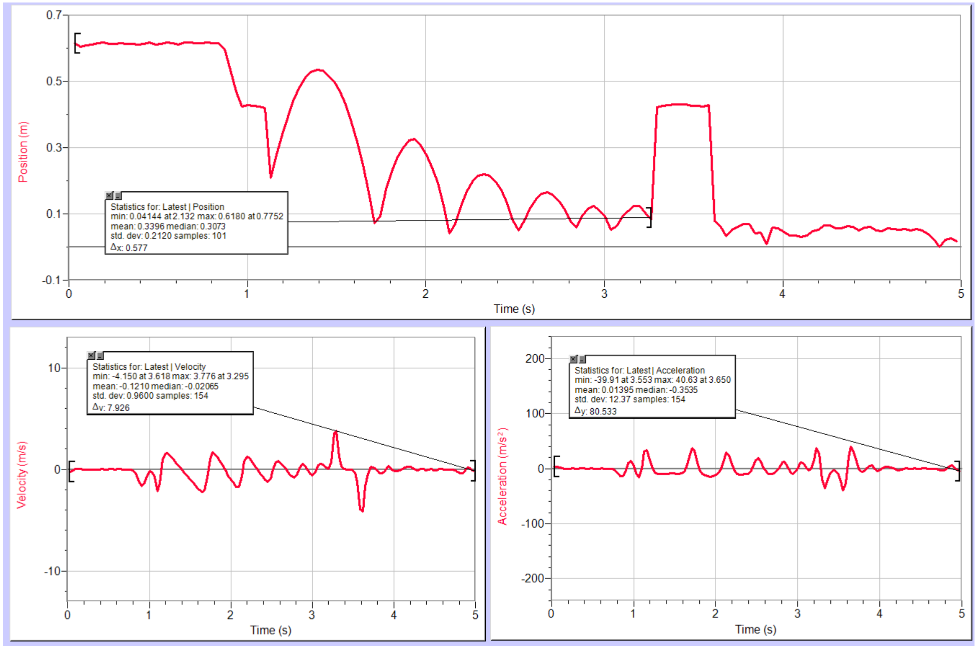
3. For the Y-direction motion, what were the velocity and acceleration, if either value was changing, what were the limits of the values, and what mathematical shape was the graph of those values?

The tennis ball's y-direction velocity would have started out at a certain speed and gradually decreased due to gravity. It follows that the acceleration in the y-direction would be -9.8 m/s, the same as the acceleration brought on by gravity. When the ball's velocity was 0 m/s, the greatest value for the y-position would have been 1.162 m. While the graph of acceleration vs time in the y-direction would be a straight line with a constant value of -9.8 m/s, the graph of velocity vs time in the y-direction would have a parabolic shape starting from the initial velocity and reaching 0 m/s at the maximum height.

Question – 9: Conclusion Based on your results listed above, what motion similarities are there in the experiments you performed? What are the differences?

The 1D and the 2D motion have shown similar situations because they both had the same acceleration, "g". But however, in the 2D motion, we have one more graph which discusses the x-direction motion, which the 1D motion does not incorporate.

Additional Graphs:



Meme Extra Credit: