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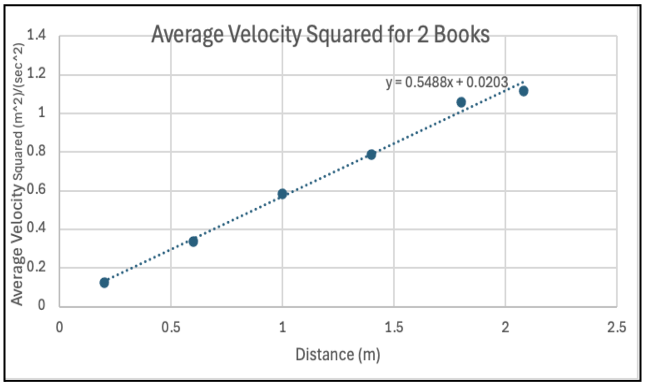
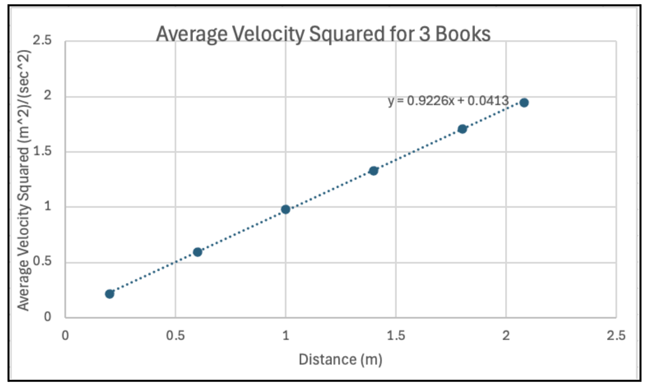
Lab 1 Report: Acceleration on an Inclined Plane

Analysis:





After looking at our data, it is important that we find a best-fit line to represent the data that we plotted onto our graph. This is important because it helps us see the correlation between the two criterias we are measuring, average velocity squared and distance, much more clearly to understand their relationship. To do this, I found the equation for the best-fit line, for each the 2 inclines we did. These can be seen on the graphs above.

After this, we have to use one of the 4 kinematic equations in order to help linearize the data. The equation that I decided to use was the $v^2 = vo^2 + 2a\Delta x$ equation. The reason I picked this equation out of the 4 options was because this equation doesn't deal with time. This is useful for us because in our experiment, we did not measure time.

We can simplify this equation, because we know that the value of vo is 0 m/s. This can cancel vo out of our equation, leaving us with $v^2 = 2a\Delta x$. Now, we can compare this new equation to the format of the equation of a line: $y=mx+b$. By comparing them, we can come to the conclusion that the y corresponds to v^2, the x corresponds to Δx, and the slope, m, corresponds to 2a. Below, we can see the equations for the best-fit lines of our 2 graphs, in terms of v^2 and Δx.

Equation of the line best fit for Average Velocity Squared for 2 Books: $v^2 = 0.5488\Delta x$

Equation of the line best fit for Average Velocity Squared for 3 Books: $v^2 = 0.9226\Delta x$

Now that we know that the slope of the lines of best-fit that we found earlier are equal to 2a, we can find the theoretical acceleration values by dividing the slope of our line by 2.

Acceleration of Average Velocity Squared for 2 Books: $2a = 0.5488$

a = 0.2744 m/s^2

Acceleration of Average Velocity Squared for 3 Books: $2a = 0.9226$

a = 0.4613 m/s^2

Now, to find the expected value of acceleration of this graph, you need to find θ. We know that the length of the ramp was 208 cm.

First incline (2 books): The height of the ramp for the first incline was 10.2 cm. To find θ, you would calculate inverse sin(10.2/208), which comes out to 2.810824°.
And to find the expected acceleration, you would use the equation $a = g * \sin(\theta)$, so in this case, you plug in the values as $a = 9.8 * \sin(2.810824)$ **a = 0.480477 m/s^2**

Now, to find the percent error, you take the ((theoretical - exact)/exact). Here, that would be ((0.2744 m/s^2 - 0.480477 m/s^2)/0.480477 m/s^2). This comes out to -0.4289, or **-42.89%**.

Second incline (3 books): For the second incline, the height was 14.1 cm. To find θ, you would calculate inverse sin(14.1/208), which comes out to 3.886973°.

Again, to find the expected acceleration, you would use the equation a = g * sin(θ), but in this case, **a = 0.664326 m/s^2**.

Once again, to find the percent error, you take the ((theoretical - exact)/exact). Here, that would be ((0.4613 m/s^2 - 0.664326 m/s^2)/0.664326 m/s^2). This comes out to -0.3056, or **-30.56%**.

Conclusion:

This experiment could definitely have had sources of error. Some of these sources of error could've been the length of the ramp and the height of the books being measured incorrectly, releasing the cart at the wrong distance, or even the photogate sensor recording the velocity inaccurately.

The source of error I think my group ran into might've been releasing the cart at the wrong distance, especially because it was hard to determine the precise location of the cart on the ramp. This might've impacted how accurate our results were.