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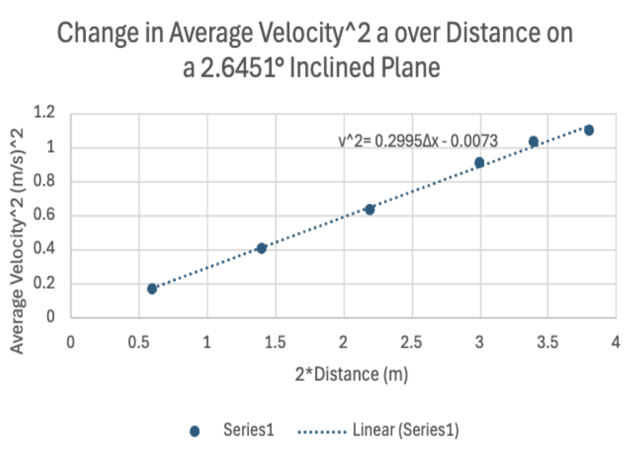
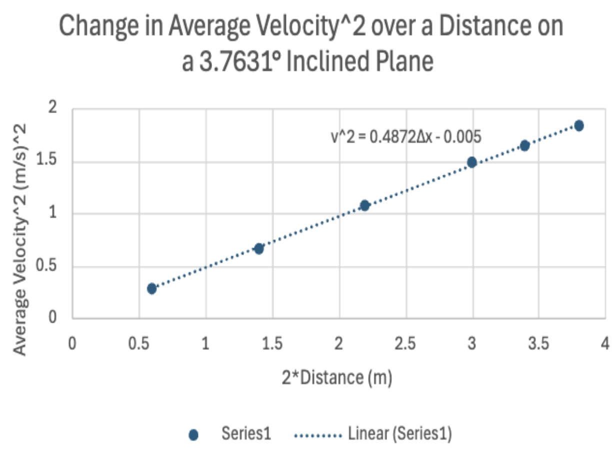
Acceleration on an Inclined Plane Lab Report

<u>Analysis:</u>
For this lab, the two variables that were used were distance and velocity squared. We placed two times distance, measured in meters, on the x-axis because that represents the independent variable as it was controlled by the experimenters. The y-axis represents velocity squared because it is a dependent variable as it changes depending on the distance (the x value). The velocity was squared because we needed to create a linear graph and this would not have been possible with the original velocity measurements used on the y-axis. By squaring the velocity and doubling the distance, we were able to make the data linear which allowed us to create lines of best fits for both inclined planes.

After linearizing the data, we need to be able to visualize the relationship between the different variables clearly. The lines of best fit for incline 1 and incline 2 are y=0.2995x-0.0073 and y=0.4872x-0.005 respectively. In terms v and Δx, the equations are v^2=0.2995Δx - 0.0073 (for incline 1) and v^2 = 0.4872Δx - 0.005 (for incline 2). Now we wanted to examine the relationship between velocity (m/s) and the displacement (m). To do this, one of the four kinematic equations, the no t equation which is v^2 = vo^2 + 2aΔx, works best for this data. This is because it consists of velocity and distance which are two variables we measured and did not include time as we did not measure it.

<u>Experimental Acceleration:</u>
Using the equation v^2 = vo^2 + 2aΔx, we substitute vo=0 in this equation since the experiment is not in motion at the beginning. By doing this, the no t equation results in the equation v^2=2aΔx. Comparing that to the equation y=mx+b, the y-value is v^2 while the x-value is Δx. This makes the slope equivalent to 2a. However since we made the x-axis 2*distance, the slope is equivalent to a.

Experimental acceleration for Incline 1 (0.1055 m): $v^2 = 0.2995\Delta x - 0.0073$

- Slope= 0.2995
- Equation: a = slope

  a = 0.2995

Experimental acceleration for Incline 2 (0.15 m): $v^2 = 0.4872\Delta x - 0.005$

- Slope= 0.4872
- Equation: a = slope

  a = 0.4872

<u>Expected Acceleration</u>

Now that the experimental acceleration was calculated, we needed to calculate the expected values of acceleration to compare the results.This can be done by using the formula $a = g \sin(\theta)$. The first step is to find theta which can be done by using the inverse tan function and the measurements of the inclines slope.

Theta for Incline 1 (0.1055 m):

$\tan(\theta) = (0.1055/2.2855)$

$\theta = 2.64$ degrees

Theta for Incline 2 (0.15 m):

$\tan(\theta) = (0.15/2.2855)$

$\theta = 3.76$ degrees

Now that we calculate theta for both inclines, we can now plug it into the equation above.

Expected acceleration for Incline 1 (0.1055 m):

$a = g \sin(\theta)$

$a = 9.81 * (\sin(2.64))$

$a = 0.4514$ m/s^2

Expected acceleration for Incline 2 (0.15 m):

$a = g \sin(\theta)$

$a = 9.81 * (\sin(3.76))$

$a = 0.6433$ m/s^2

<u>Percentage Error:</u>

To compare the experimental and expected accelerations, we can calculate the percentage of error by using the formula (expected value - experimental value)/(expected value).

Percent Error for Incline 1:

$(0.4514 - 0.2995)/(0.4514) = 33.6\%$

Percent Error for Incline 2:

(0.6433 - 0.4872)/(0.6433) = 24.3%

Conclusion:

Overall, our goal for the experiment was to find the acceleration of a cart traveling on an inclined plane and compare the measured result to the expected value. Above, we calculated the expected values of acceleration for incline 1 and 2 and got 0.4514 m/s^2 and 0.6433 m/s^2 respectively. To compare the results to the experimental accelerations, we calculated the percentage of error. For incline 1, the percentage of error was about 33.6% while for incline 2, the percentage was about 24.3%. The results for this experiment were reasonable because when we increased the incline, the acceleration increases as well. This explains why incline 2 had a greater acceleration compared to incline 1. Additionally, the percentage errors are quite reasonable as well as there are multiple factors that could have inhibited the results. One source of error is the initial velocity of the release cart. It could be possible that initial velocity was not 0 m/s as a human was releasing the cart making it prone to have had force when it dropped down the ramp. By using just our bare hands, it is extremely likely that there was initial force and to improve this, there should be a machine that can drop the cart with no initial velocity. Another source of error is that we did not account for air resistance as well as friction. It is very much possible that these variables could have inhibited the speed of the cart making the acceleration lower than what we currently calculated. Lastly, if the track was not completely smooth, there could have been bumps that affected the path of the cart overall affecting the cart’s acceleration. Bumps would have caused the cart’s experimental acceleration to be much smaller than the expected one.