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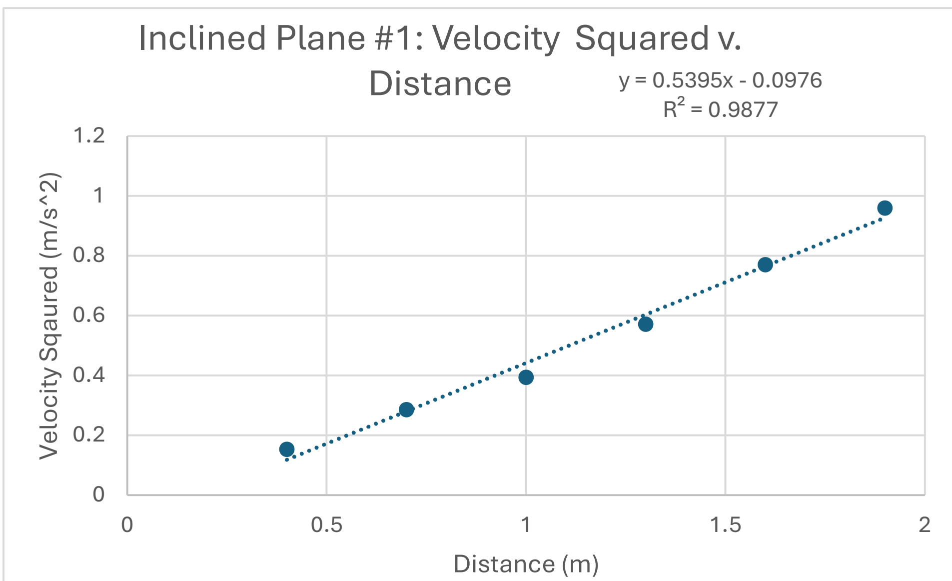
Physics Lab #1: Acceleration on an Inclined Plane – Analysis

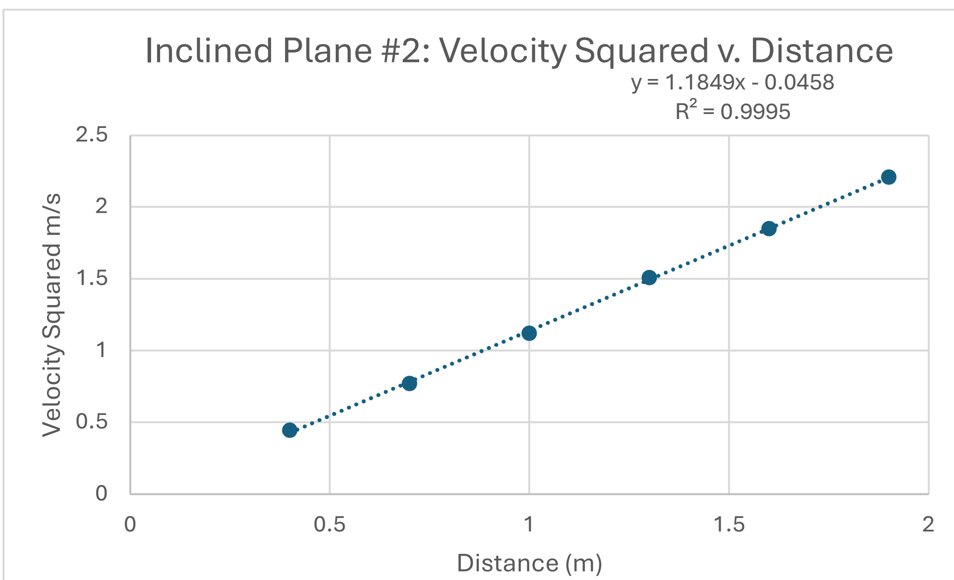
After the data was collected, the information was put into google sheets and graphs were created. This is graph #1, where the inclined plane = 2 books, or .071 m.



The axis for the graphs were chosen based off of the equation $v^2=v_0^2 + 2a\Delta x$. Since this experiment only deals with falling objects, $v_0 = 0$. Therefore, the equation used to label the axes was $v^2= 2a\Delta x$. If one were to look at this equation in the format of y=mx+b, they would notice that Δx is in the x position of the equation, and v^2 is in the y position. This implies that Δx should be put on the x-axis, v^2 should be put on the y-axis, and 2a is the slope of the line. By inputting the data to Microsoft excel, the regression equation is found to be $v^2 = .5395\ \Delta x$.

The formula for finding the expected acceleration is $a = g\sin\theta$. The length of the ramp in this situation was 2m, and the height was .071m. This means $\sin\theta = (.071/2)$. Plug this back into the $g\sin\theta$ to get the expected value of a, which comes out to be .3479 m/s^2. To find the experimental value of a, use the slope of the regression line, which is 2a. Since the slope of the regression is 2 times the value of a, divide the slope by 2. This comes out to be .2675 m/s^2.

This is graph #2, where the height of the inclined plane equals 4 books, or .14m.



The axes for these data were chosen in a similar manner to the other data. Using the equation $v^2 = v_0^2 + 2a\Delta x$ and knowing $v_0 = 0$, Δx can be assumed to correspond with the x-axis, and v^2 corresponds to the y axis. By inputting the data for this inclined plane into Microsoft excel, a liner regression of $v^2 = 1.1849\Delta x - .0458$ is found.

The length of the ramp was also 2m in this situation, and the formula to find the expected acceleration is a=gsinθ. Sinθ = (.14/2), so put this back into the gsinθ equation to get a. After doing this calculation, a=.686. To get the experimental value of a, divide the slope by 2. After doing this, the experimental value of a=.592m/s^2.

Conclusion

Due to the fact that the r^2 values for both graphs were extremely close to 1, the experimental acceleration values of .2675m/s^2 (1st inclined plane) and .592 m/s^2 (2nd inclined plane) seem to be pretty reasonable. The expected values of the accelerations for both inclines seem reasonable too. Using the percent error formula, the degree to which the expected error is wrong can be found

Percent error of 1st inclined plane:

(.2675-.3479)/.3479 = 22.5% error

Percent error of 2nd inclined plane:

(.592-.686)/.686 = 13.6% error

While these errors seem to be slightly high, they still aren't super unreasonable. The cart could've been pushed slightly while being released, which could've lead to a faster experimental acceleration than expected. Friction was also unaccounted for in the expected values, which could've also led to this discrepancy. The data was also collected about 10 centimeters ahead of the end of the ramp, so the car may not have been able to speed up as much as it could've, had it reached the end of the ramp. However, these percent errors aren't extremely high, so it is reasonable to assume that the actual acceleration values fall between the experimental and theoretical value for acceleration.