Analysis:

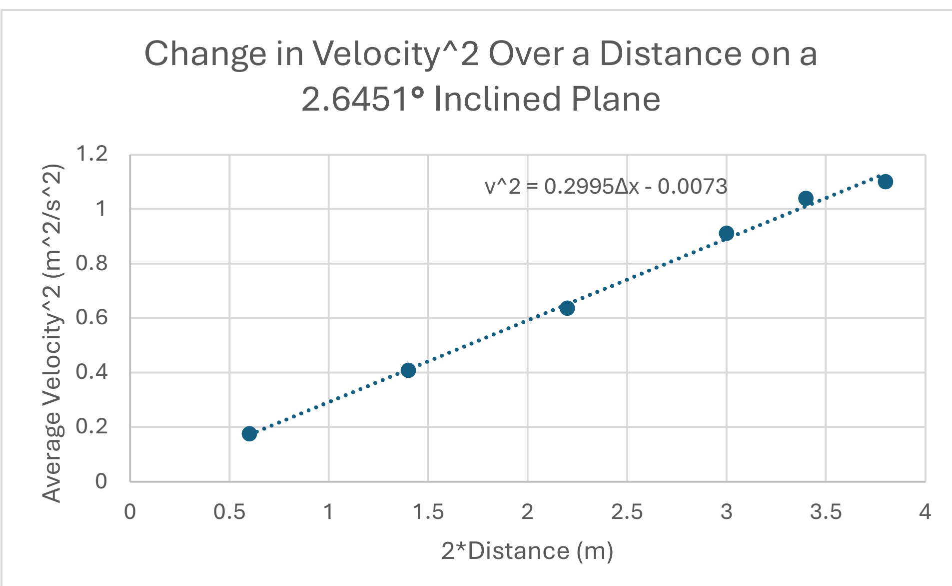
The goal of this lab was to find the acceleration of a cart sent down an inclined plane. The data we collected in this lab were the distances that the carts were released from (Δx) and their final velocity (v), measured by a sensor. To find the acceleration (a) from rest, the best kinematic equation to represent this data would be $v^2 = {v_o}^2 + 2a\Delta x$. However, this equation needs to model the data linearly, modeling the form $y = mx + b$. To do this, it should take the form $v^2 = a2\Delta x$. There is no initial velocity when accelerating from rest, so the ${v_o}^2$ does not need to be included. The y-axis would have v^2, because that is the dependent variable. The x-axis should have $2\Delta x$, because that is the independent variable, controlled by us. This means that the slope is strictly the acceleration.

To graph this equation, our data needed to be modified. The measured velocity (v) became v^2 to match the linear equation, and the distances the carts were released from, *Δx*, became *2Δx*. Once the points were graphed, a line of best fit was made.

For the first incline level of 2.6451°, the equation was $v^2 = 0.2995\Delta x - 0.0073$. The slope of $0.2995\ m/s^2$ was the acceleration. To calculate the angle of the inclined plane, the inverse sin function was used.

$$\sin\theta = \frac{Ramp\ height}{Ramp\ length}$$

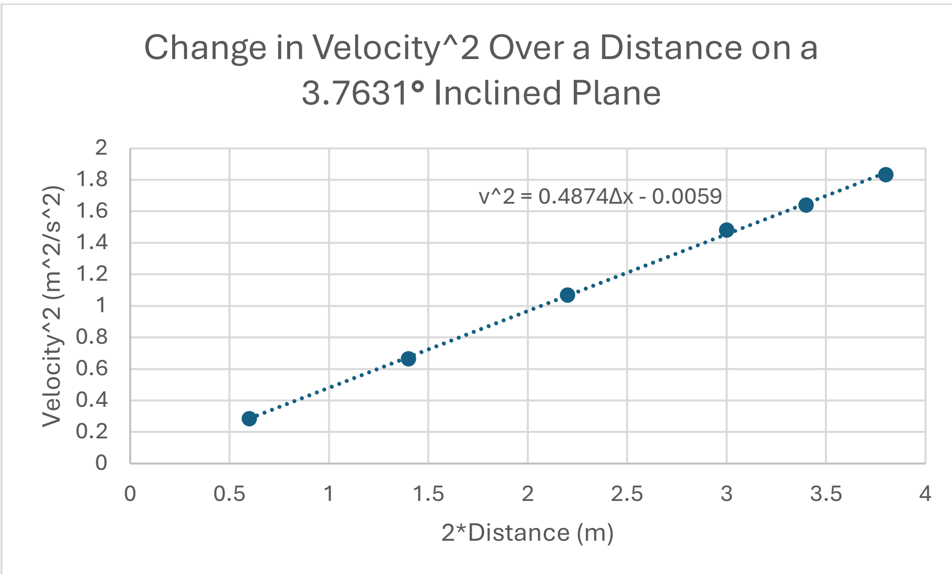
$$\sin^{-1}\left(\frac{0.1055\mathrm{m}}{2.2855\mathrm{m}}\right) = 2.6451^{o}$$



For the second incline level of 3.7631°, the equation was $v^2 = 0.4874\Delta\mathrm{x} - 0.0059$. The slope of $0.4874\frac{m}{s^2}$ is the acceleration. The steps to calculate the new ramp angle were repeated from the first incline.

$$\sin\theta = \frac{Ramp\ height}{Ramp\ length}$$

$$\sin^{-1}\left(\frac{0.1500\text{m}}{2.2855\text{m}}\right) = 3.7631^{o}$$



Conclusion:

The results of this lab showed that the acceleration for the first incline was 0.2995 m/s^2. The expected value was $a = g\sin\theta$. To solve for this expected value, $\sin\theta$ would be equivalent to the height of the inclined plane over the total length of the inclined plane, and g is 9.8 m/s^2. The height and length of the inclined plane were measured at the beginning of the experiment.

$$\sin\theta = \frac{0.1055m}{2.2855m}$$

$$\sin\theta = 0.04616$$

$$a\ = 9.8m/s^2(0.04616)$$

$$a\ = 0.452368\ m/s^2$$

Based on the above calculated expected value and the experimental value of 0.2995 m/s^2, the percent error is 33.80%.

For the second incline, the experimental acceleration was 0.4874 m/s^2.

$$\sin\theta = \frac{0.1500m}{2.2855m}$$

$$\sin\theta = 0.06563$$

$$a = 9.8m/s^2(0.06563)$$

$$a = 0.6432\ m/s^2$$

Based on the above calculated expected value and the experimental value of $0.4874\ m/s^2$, the percent error is 24.22%.

Based on the data we collected, the results of this experiment make logical sense. As the inclined plane became steeper, a 2.6451° plane versus a 3.7631° plane, the acceleration increased. However, the percent errors are significant, likely due to multiple factors in the experiment. First, we did not account for the friction or air resistance of the cart along the track. Although these values would likely be extremely small, they have the potential to affect the overall result by making the experimental acceleration less than the expected value, which was the case here. Additionally, anything on the track or bumps that the cart may have faced while traveling down the ramp would affect the measured velocity. They would likely slow the cart and final velocity down, therefore lessening the experimental acceleration.

Another possible source of error is with the manner in which the cart was released. It is extremely difficult for humans to perfectly release the cart without pushing it slightly forward or pulling it slightly back, both of which would affect the overall acceleration. Changing the lab procedure to use a mechanical stop that can be released immediately without affecting the cart would yield more accurate results.