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Advanced Physics

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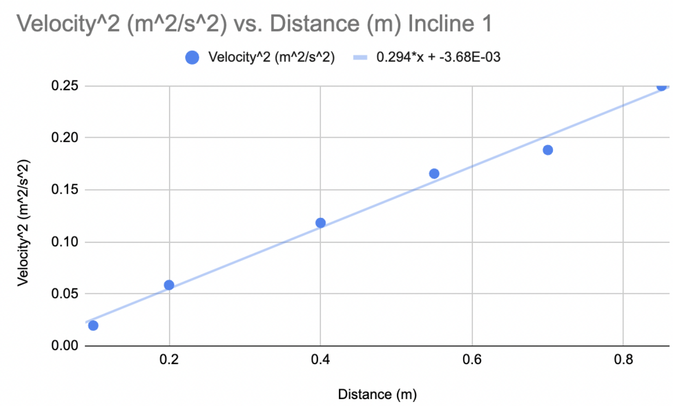
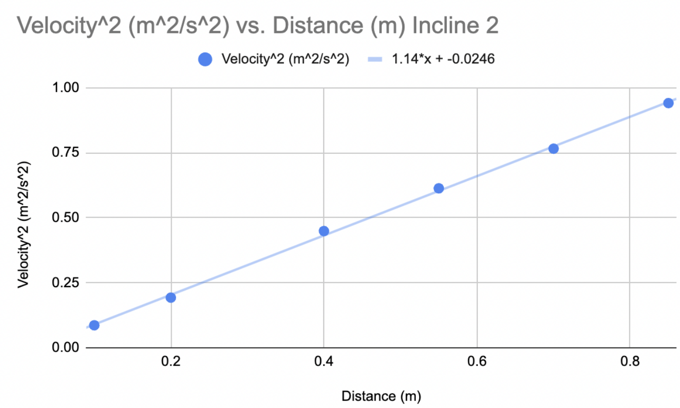
Analysis:

First, the data from each incline were added into a Google Sheet. Using the tools in Google Sheets, a graph, as well as their equation, for each table was created.

Graph for Incline 1:



Graph for Incline 2:



The equation, $V_f^2 = V_0^2 + 2a\Delta x$, can be linearized so that V_f^2 is y, Δx is x and the slope is 2a. V_0^2 is the y-intercept but can be disregarded because V_0 is always 0 m/s.

$y = mx + b \longrightarrow V_f^2 = 2a\Delta x + 0$

Using the numbers provided by the graphs, and the linearized equation, the equation for Incline 1 can be stated as, $V_f^2 = 0.294\Delta x$.

Using this, the experimental acceleration for Incline 1 can be found. Since the slope, 0.294, equals 2 times the acceleration, the acceleration can be obtained by dividing 0.294 by 2.

$2*a = 0.294\ m/s^2$

$a = 0.147\ m/s^2$

Through the same process, the experimental acceleration of Incline 2 can be found.

$V_f^2 = 1.14\Delta x$

$2*a = 1.14\ m/s^2$

$a = 0.57\ m/s^2$

Conclusion:

In this lab, the experimental acceleration values were found to be $0.147\ m/s^2$ for Incline 1 and $0.57\ m/s^2$ for Incline 2. The expected accelerations of Incline 1 and 2 can be found through the equation, $a = g*\sin(\theta)$, where a is the acceleration, g is the gravitational pull, and θ is the angle of the incline. The sine of θ is the ratio of its opposite side to its hypotenuse which, for Incline 1, is 3.9 cm divided by 118 cm. The gravitational pull of Earth is $9.8\ m/s^2$. By plugging each value in, the equation: $a = (3.9/118)*(9.8)$ is obtained, where a is the expected acceleration of Incline 1. Through this, the expected of acceleration Incline 1 is found to be $0.324\ m/s^2$. By using the same process, the expected acceleration of Incline 2 can be found:

$(7.8/118)*(9.8) = 0.648\ m/s^2$

A percent error can be used to compare the expected accelerations with the experimental accelerations.

Percent Error Incline 1:

$$\% \text{ error} = \left| \frac{\# \text{experimental} - \# \text{actual}}{\# \text{actual}} \right| \times 100$$

|(0.147 - 0.324)/(0.324)| * 100% = 54.6%

Percent Error Incline 2:

|(0.57 - 0.648)/(0.648)| * 100% = 12.0%

There are multiple possible sources of error that could have contributed to these percentages. An example would be leaving friction and air resistance unaccounted for in the expected acceleration calculations. Since friction and air resistance were present in the experiment, they would have acted as forces against the cart, making the cart travel slower, thus lowering the acceleration. This parallels the results of the experiment as both experimental accelerations were smaller than the expected acceleration. Another example of a possible source of error could be the imprecise setups. By using textbooks, which were uneven on both sides, to increase the incline, the setup forced students to sacrifice some precision when measuring the height of the ramp. A height that was measured larger than the actual height would have made the expected acceleration calculated larger than it should have been, thus increasing the percent error between the experimental and expected acceleration. In the future, standard deviation, as well as other variations in data can be looked into to identify more possible sources of error.