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09/23/2024

Lab 1 Report: Acceleration on an Inclined Plane

Analysis:

Distance (cm)	V Trial 1 (m/s)	V Trial 2 (m/s)	V Trial 3 (m/s)	Avg Velocity (m/s)	Expected A (m/s^2)	Avg V^2 (m/s^2)
0	0	0	0	0	0.398189474	0
40	0.489	0.481	0.483	0.484333333	0.398189474	0.234578778
80	0.686	0.69	0.698	0.691333333	0.398189474	0.477941778
120	0.859	0.851	0.869	0.859666667	0.398189474	0.739026778
160	1.007	0.969	0.974	0.983333333	0.398189474	0.966944444
200	1.107	1.114	1.094	1.105	0.398079919	1.221025

Incline 1	
Slope	0.6082
Expected A * 2	0.796378947
% Error	0.236293222
# Books	2
Height	7.72cm

Distance (cm)	V Trial 1 (m/s)	V Trial 2 (m/s)	V Trial 3 (m/s)	Avg Velocity (m/s)	Expected A (m/s^2)	Avg V^2 (m/s^2)
0	0	0	0	0	0.598831579	0
40	0.619	0.612	0.613	0.614666667	0.598831579	0.377815111
80	0.877	0.883	0.871	0.877	0.598831579	0.769129
120	1.071	1.083	1.068	1.074	0.598831579	1.153476
160	1.257	1.256	1.26	1.257666667	0.598831579	1.581725444
200	1.398	1.412	1.393	1.401	0.598831579	1.962801

Incline 2	
Slope	0.9781
Expected A * 2	1.197663158
% Error	0.183326302
# Books	3
Height	11.61cm

Incline 1	Distance (m)	Avg V^2 (m/s)^2)
	0	0
	0.4	0.234578778
	0.8	0.477941778
	1.2	0.739026778
	1.6	0.966944444
	2	1.221025

Incline 2	Distance (m)	Avg V^2 (m/s^2)
	0	0
	0.4	0.377815111
	0.8	0.769129
	1.2	1.153476
	1.6	1.581725444
	2	1.962801

Figure 1. Tables displaying the recorded data of both Incline 1 (2 books) and Incline 2 (3 books).

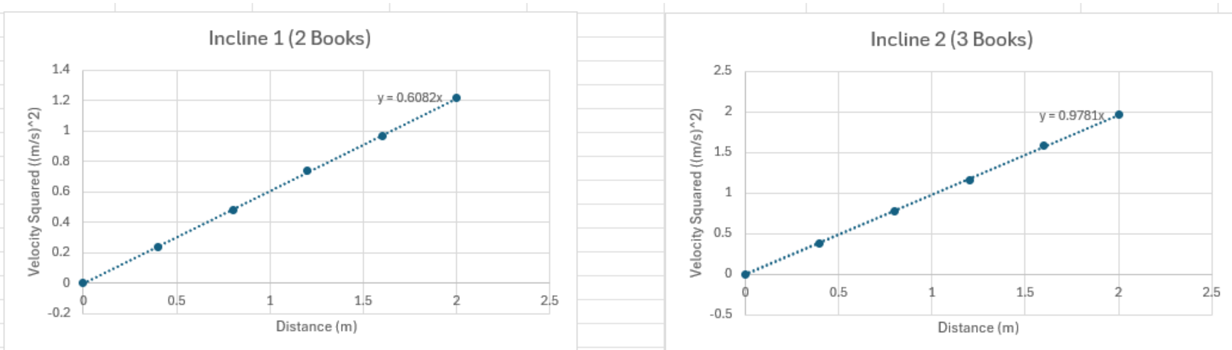

Figure 2. Two graphs displaying velocity squared ((m/s^2)^2) vs. Δx (m)

The tables for both incline 1 and incline 2 display all raw collected data, as well as some new data calculated using Excel. Notably, the average velocity and the expected acceleration (a), as well as the average velocity squared. These data points are then consolidated into a 2-column table pairing distance (Δx (m)) and velocity squared ((m/s^2)^2). Note that velocity squared includes m/s^2 as a whole and does NOT form m^2/s^2.

Expected A is solved through the equation g*sin(θ) where θ (theta) is represented by the angle at the base of the triangle created by the incline. By using the definition of sin (o/h, opposite/hypotenuse), we do not actually need to solve for the angle. For both inclines, the hypotenuse was taken at 190cm. For incline 1, the height was 7.72cm. For incline 2, the height was 11.61cm. This leads the equation for Incline 1 to be:

9.8 * (7.72 / 190) = 0.398189474, 0.3982

And for incline 2, it would be:

9.8 * (11.61 / 190) = 0.598831579, 0.5988

Therefore, we are expecting values of **0.3982** and **0.5988** for acceleration for inclines 1 and 2 respectively. The issue then in checking whether our experiment(s) are representative of these respective values is that we must determine the experimental acceleration values from our measurements.

This can be done by taking the slope of a v^2 vs Δx graph. Why? When comparing the two equations below:

v^2 = 2aΔx

y = mx (where m is the slope)

We can see that when v^2 = y (in other words, v^2 is on the y-axis), the slope of the equation (m) must be equivalent to 2 times the acceleration (2a).

When we plot the data for both inclines based on these data points, we get two linear graphs with slopes of **0.6082** and **0.9781** respectively. Remember, this value is 2a. So, the experimental accelerations are **0.3041** and **0.4891.**

The percentage error (denoted by % error) for both inclines is 23.6% and 18.3% respectively.

Conclusion

Overall, the lab, although well-designed, was not completely accurate, with both a 23.6% error for incline 1 and a 18.3% error for incline 2. As previously stated, the experimental accelerations are **0.3041** and **0.4891**, while the expected accelerations were **0.3982** and **0.5988**. Considering they are significantly lower, there must be some reason(s) for this error.

A major assumption made during this experiment is that friction is negligible, however, there will always be friction as the cart is traveling down the track. Friction would slow the cart down, and therefore would lower our experimental acceleration.

We are also assuming that wind resistance is negligible. Air resistance would slow the cart down, and therefore would also lower our experimental acceleration.

Additionally, subconscious movements could have altered the initial velocity of the cart by holding it back. Holding the cart back would have decreased the experimental acceleration.