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Section U

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Data Analysis:

A linear equation following the model y=mx+b had to be created in order to find the experimental acceleration, and had to be in terms of v (velocity) and delta x (displacement). In order to do this, the equation v^2=v0^2 +2a(delta x) with a being acceleration. It was found that this equation was both in terms of delta x and v, and was already is slope intercept-form. Therefore, y=v^2 (and therefore the y-axis), delta x=x (the x-axis), 2a=m (the slope), and v0=b. A graph was constructed to give the linear equation to the line of best fit, and using the slope acceleration was found. Because the slope was equivalent to 2a, therefore a=1/2m. The linear equation for the first graph is y=0.3969x-0.0121. The slope is 0.3969, and acceleration is half of the slope, so the slope is ½(0.3969)=0.19845 m/s/s. The equation for the second graph is y=1.1419x-0.0282, meaning the slope is 1.1419, and acceleration is 1/2m, so ½(1.1419)=0.57095 m/s/s. These equations are demonstrated in Figure 1.

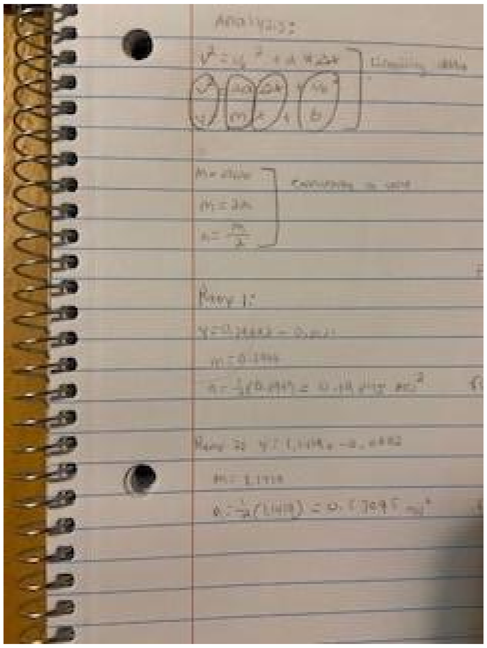


Figure 1: Calculations described above.

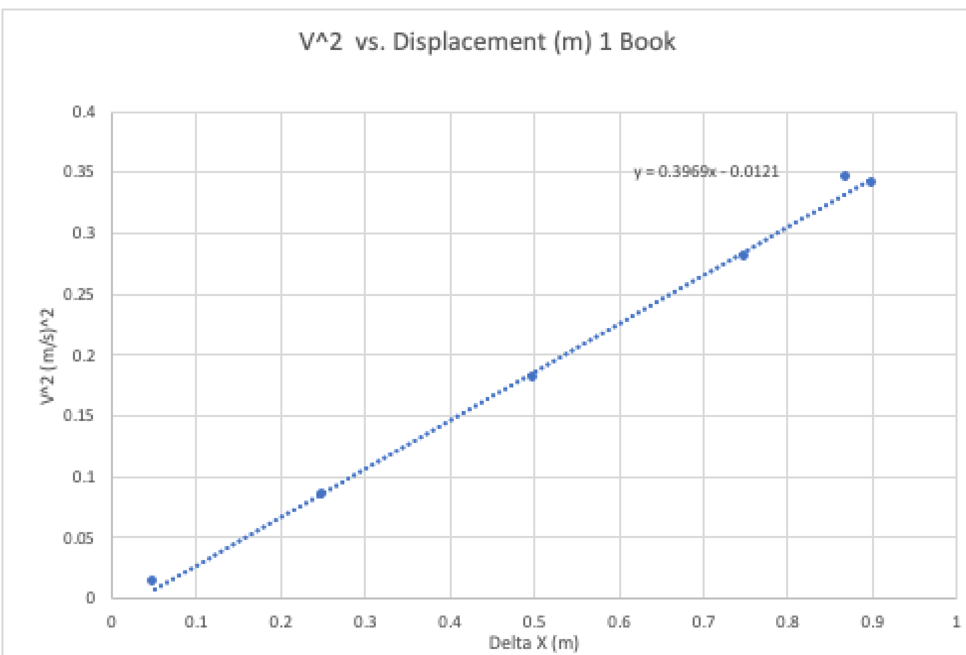


Figure 2: Graph 1-Ramp 1 (1 book)

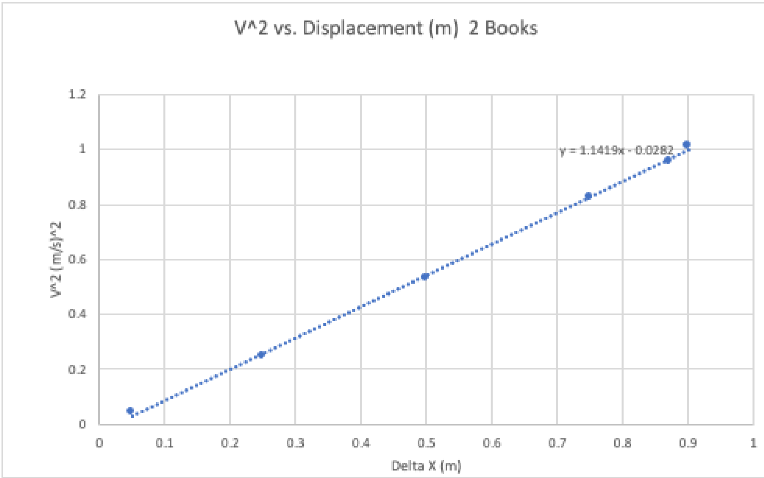


Figure 3: Graph 2-Ramp 2 (Book 2)

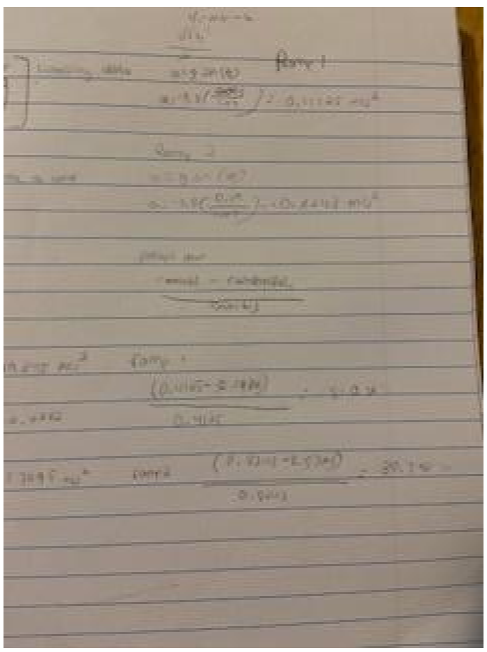


Figure 4: Theoretical acceleration and percent error calculations.

Conclusion:

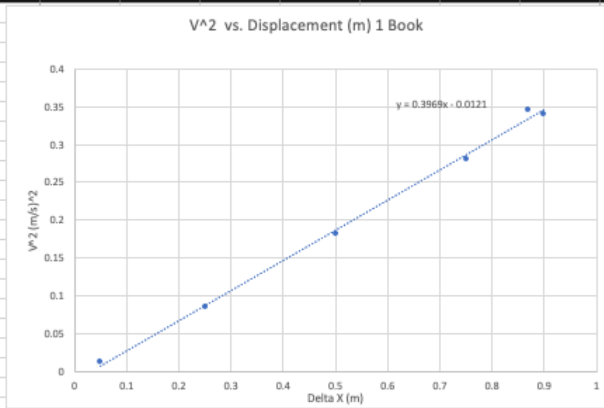
As previously found, the acceleration on Ramp 1 was 0.19845 m/s/s, and the acceleration on Ramp 2 was 0.57095 m/s/s. The expected value is found using the equation g(sin(theta)). Sin (theta) is equal to the opposite length of the ramp (height) over the hypotenuse length. For Ramp 1, it was 9.8(0.045/1.07)=0.4125 m/s/s. For Ramp 2, it was 9.8(0.09/1.07=0.8243 m/s/s. Both of these numbers are larger than the actual accelerations due to different sources of error. Percent error is calculated by taking the difference between the expected and experimental results, and dividing by the expected result. For Ramp 1, it was (0.4125-0.19845)/0.4125=51.9 %. For Ramp 2, it was (0.8243-0.57095)/0.8203=30.7%.

There were multiple different sources of error. Common error shared among both ramps was friction. Friction was ignored in the theoretical value, causing the experimental acceleration to be smaller than the theoretical value. Friction includes both drag, and the friction between the object and the ramp itself. The measurements made for the ramps were also slightly off, causing small sources of error. The ramps weren't exactly 4.5 and 9 inches tall, but these numbers were rounded introducing very small amounts of error. These discrepancies among measurements caused the experimental value to decrease as well. The last source of prominent error was during the release of the object. Because it was released by a person, the initial velocity was both increased and decreased at times. This error introduced caused the experimental acceleration to be greater than it should have been, as the initial velocity wasn't 0. The error is greater for the first ramp due to the velocity from a distance of 0.9 m being lower than from a distance of 0.87 m. This was likely caused by the initial lag due to the release of the object being released at 0.9 m, slowing it down, and therefore making the experimental acceleration lower. Calculations for the theoretical acceleration and percent error are shown in Figure 4.

Overall, the experimental acceleration rates were calculated by linearizing the data, and using the slope to solve for acceleration. However, because of the large amount of error caused by friction and discrepancies in measuring and releasing the object, this data isn't precise. If this experiment were to be replicated, more attention to mitigating error would be required.

Excel Sheet With Data:

Ramp 1	Distance (m	Velocity (m/s)	V^2	Distance (m	V^2 (m/s)
	0.05	0.112	0.012544	0.05	0.012544
	0.25	0.291	0.084681	0.25	0.084681
	0.5	0.426	0.181476	0.5	0.181476
	0.75	0.529	0.279841	0.75	0.279841
	0.87	0.588	0.345744	0.87	0.345744
	0.9	0.584	0.341056	0.9	0.341056



Ramp 2	Distance (m	Velocity (m/s)		Distance (m	V^2
	0.05	0.206		0.05	0.042436
	0.25	0.496		0.25	0.246016
	0.5	0.73		0.5	0.5329
	0.75	0.91		0.75	0.8281
	0.87	0.979		0.87	0.958441
	0.9	1.007		0.9	1.014049