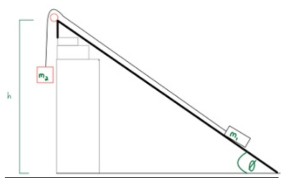
Research Question: Does increasing theta affect the acceleration using a modified Atwood's machine?

Hypothesis. We hypothesized that as the theta increased, our acceleration would decrease. We expect our slope to be negative as the increased theta will require more energy. Our Y intercept will be the $\frac{m2}{m1}$.

Strategy: Our group used a modified Atwood's machine at the end of a frictionless track. Attached to the modified Atwood's machine was a string with 210.5 grams attached to a cart that could measure its acceleration over time. We would release the cart from the end of the track and observe the acceleration. Then, we would find a best-fit line for our acceleration vs theta. As we increased our height, we would measure the acceleration and observe how our acceleration is changing with the change in theta. We would increase the height closer to the end of the machine to increase our theta. We did this by stacking textbooks.

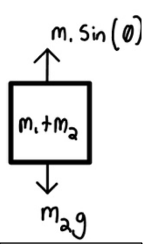


Represents the set-up of the experiment where m1 represents the cart and m2 represents the mass pulling it down

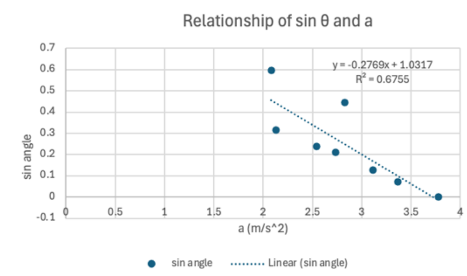
hypotenuse (cm)	height (cm)	sin angle (deg)	a (m/s^2)
	0	0	3.778
210	15	0.071497444	3.368
176	22.2	0.126198969	3.114
149	31.2	0.209396706	2.735
147	35	0.238092746	2.541
139	44	0.316543191	2.133
131	58.3	0.445041594	2.826
126	75	0.595243604	2.082

Data Gather. The "a" stands for the acceleration gathered using a Vernier cart that could measure the acceleration that the cart.

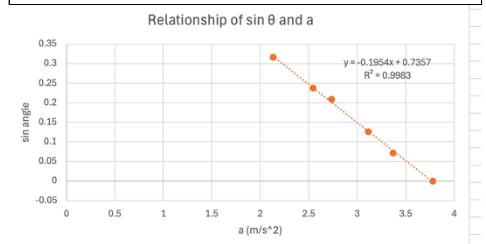
Analysis: As our height increased, our acceleration lowered, which confirmed our hypothesis that the cart's acceleration would decrease as the height increased. The slope of our line, which is represented as the equation $\left(\frac{m2g}{m1g}\right) - \left(\frac{m1+m2}{m1g}\right) a = \sin(\theta)$. The first term represents the y-intercept, which should be a constant. However, due to slight issues in our experience, such as potentially pushing the project slightly or our hands getting caught on it upon release, it could change the ratio or the y-intercept. The second aspect represents the slope. Our original data resulted in two strong outliers with an r^2 value of 0.6755. We did remove these data points as it is possible that there were sources of error on these tests that varied the data because, after their removal, we can achieve an r^2 value of 0.9983, which indicates to us that this data is much more accurate. Within this lab, there are a few potentials for error, such as all of it being done by humans. When we release the weights, there is a potential that our hands get caught in the weight, altering the acceleration. We also assumed friction was negligible but could have had a slight effect. Using the earlier equation, we can calculate a slope error of -12.566% and an intercept error of -4.845%. Other potential causes of this could include a slight miscalculation of the angle, calculated using right triangle trigonometry, and the extension of the hypothesis to find where it would contact the table. Then, using the height, we were able to calculate the angle. We confirmed it through the iPhone-level app to confirm that our angle made relative sense. There also could have been some error with the release point of the cart; while we attempted to keep the release point constant, there could have been slight variations in the fact, causing acceleration variation.



Free Body Diagram for work done



Graph before the data points were removed for normalization



Graph with data points removed to normalize the data.