Investigating Question: How does the incline between similar masses affect the acceleration of the cart in a modified Atwood's machine? The setup is described below.

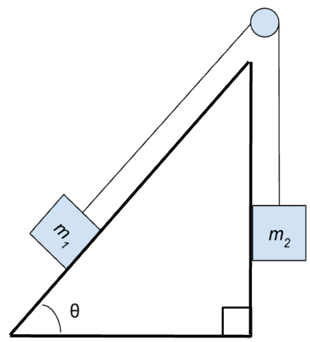


Figure 1: Modified Atwood's Machine

Hypothesis: When one mass is on an inclined plane the acceleration would be greater as the angle of θ decreases. I predict that the relationship between the average acceleration of the cart and the sin of the angle θ to be linear.

Strategy: We had the cart on one side and a counterweight hanging down, and measured their masses, which are m1 and m2 respectively. Their mass didn't affect our experiment, but we will still took these measurements for redundancy. We started them with an incline θ = 0° as a control and measured the acceleration in this scenario. Then, we changed the incline θ to 15°, measuring the acceleration at this angle. Finally, we ran two more trials with θ = 30° and θ = 45°, measuring the acceleration in both once again. We compared the acceleration between these four trials to see if the incline influenced the acceleration.

Our Data: We tested four different angles with three trials each, measuring the acceleration at each using Vernier graphing software. After, we determined the mean acceleration.

Angle	Trial 1	Trial 2	Trial 3	Mean
0	3.951	3.578	3.983	3.837333
15	2.579	2.637	2.595	2.603667
30	1.135	1.185	1.177	1.165667
45	0.06859	0.07254	0.0759	0.072343
	Cart: 286.8 g			
	Weights: 210 g			

Analysis:

The free body diagrams show the forces on the masses in the modified Atwood's machine. Here is my work deriving an equation for a and calculating our experimental g:

$F = ma \quad a = \frac{F}{m} \quad a = \frac{m2g - m1gsin\theta}{m1+m2}$

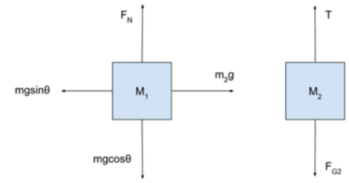
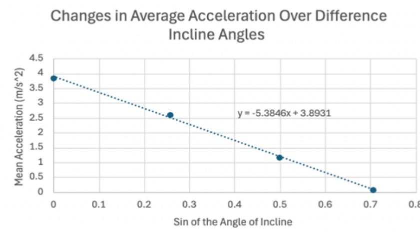


Figure 3: Free Body Diagrams

$a = \frac{m2g}{m1+m2} - \frac{m1sin\theta}{m1+m2} \quad Our\ Coeficient(-5.38) = \frac{m1g}{m1+m2}$

$-5.38 * (0.2868 + 0.21) = 0.2868g \quad g = 9.319$

To graph and analyze our lab data, we used Vernier to track the velocity and then used the slope feature to find the acceleration. Additionally, by doing this, we kept track of each incline. When creating our graph, we decided to put the sine of the angle on the x-axis and the acceleration of the cart of the y-axis as each ratio between the vertical leg and hypotenuse of an incline will have a corresponding acceleration.



The slope of the line of best fit was, as predicted, linear

Figure 2: Mean Acceleration vs. Sin of the Angle of the Incline

and came out to be –5.38. The slope's significance is that it represents the rate of change in acceleration with respect to the sine of an angle. The actual value for the slope was –5.657 which was only -0.27289 off. I solved for -5.657 using the derived equation above with the force of gravity, g, as 9.8. In doing this, the slope comes out to be -5.657. The percent error, calculated using the equation $\delta \left|\frac{(v_a - v_e)}{v_e}\right| 100\%$, was 4.83%. The hypothesis is there for supported as our data is highly accurate and extremely close to the expected result. Some possible sources of error are how we didn't account for friction, and how the graphing software we used could have been inaccurate. If we accounted for friction the acceleration would be greater which would subsequently increase the slope of our graph and yield a greater experimental value of g. Vernier also could have inaccurately represented the experiment via incorrect cart readings which would make the slope of the graph lower as well as our calculated value for g.