Dynamics Lab Report

Investigation Question: How will acceleration vary when the mass (M_2) changes along an inclined plane?

Hypothesis: The larger the M_2 is, the higher the value of the acceleration will be.

Strategy:

Diagram of Set-up:

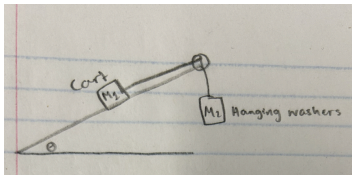

Fig 1. Set up of experiment

A modified Atwood's machine was set up in order to create a right triangle with the ramp incline. Pulleys were attached to a cart and a weight that would be on the other end of the ramp, weighing down the cart depending on the masses. The triangle was found to be 45 inches by 12.5 inches, and the angle formed by the ramp and the surface (θ) was 13 degrees. From there, the masses were altered through adding or subtracting different washers, which would then help us determine the effects of M2 on acceleration.

Process:

Using the given information, we were able to employ two different equations to find the expression for acceleration. These equations represent the equation F = ma, and were customized for situations by taking the tensions and different masses into account. These were:

$T - M1g(\sin\theta) = M1a$ **AND** $M2g - T = M2a$

After this, we began to derive an expression for a. We started by making both equations equal to T. After this, we moved both terms with acceleration to one side of the equation. Finally, we isolated a, which allowed for us to derive this equation for acceleration:

$a = (M_2g\,(1 + \sin 13) / M_{Total})) - g\sin 13$

Furthermore, we rearranged the equation above to create a direct, linear relationship between the different variables in our experiment. This was:

$M_2 = ((M_1a + \sin(13)M_1g)) / g - a$

Measured Data:

We tested different masses on the cart and the weight that was off the side of the ramp. We did this by starting with all of the weight on the hook off the ramp, and then we transferred the weight to the cart to see the effects M2 would have on acceleration. The table with our collected data is below:

a	m2	m1	m1+m2	Expected slope (g(1+sinθ)/(m1+m2)
-3.225	0.25	0.3	0.55	21.8264006
-2.376	0.21	0.34	0.55	
-1.457	0.17	0.38	0.55	
-0.5994	0.13	0.42	0.55	
0.1816	0.09	0.46	0.55	
1.067	0.05	0.5	0.55	

Fig 2. Table with collected data

Analysis:

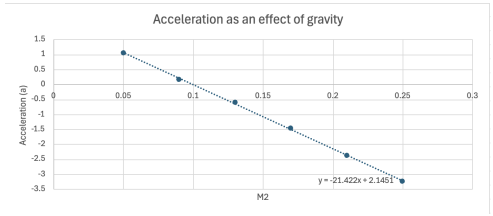

Fig 3. Graph of acceleration as an effect of gravity

As mentioned earlier, we were able to find a linear relationship between M2 and the acceleration. We found that the slope, which is represented by the equation (g(1+sinθ)/(m1+m2), was 21.826.. Furthermore, we found that the expected y-intercept is represented by g sinθ, which was 2.205. We also found a percent error of 1.85%, which is important in the context of this experiment. However, there were some sources of error that could have affected the results of our experiment. For instance, we could have accidentally applied some force. This would then affect the acceleration for our data. Another source of error could be friction, as we didn't really take this into account in our experiment. Overall, we were able to find the relationship between acceleration and M_2 on an inclined plane.