Question
In what manner does the acceleration of the washer on the incline increase as the mass of the hanging washer increases on an Atwood's machine?

Hypothesis
I hypothesize that the acceleration of the washer on the incline will increase linearly as the mass of the hanging washer increases.

Strategy
- To set up this experiment, we used an Atwood's machine and had one of the weights on an incline, and the other hanging.
- The weight on an incline, labeled as A, was kept at a constant mass of 123.9g.The hanging mass, labeled as B, began at 100g, then weight was added with each trial.
- In each trial, we measured the position, velocity and acceleration for each mass for 2-3 seconds.
- Since we had to do the trial over the course of a few days, we made sure to keep the measurements such as the angle of the incline, the length of the incline, and the height of the incline constant

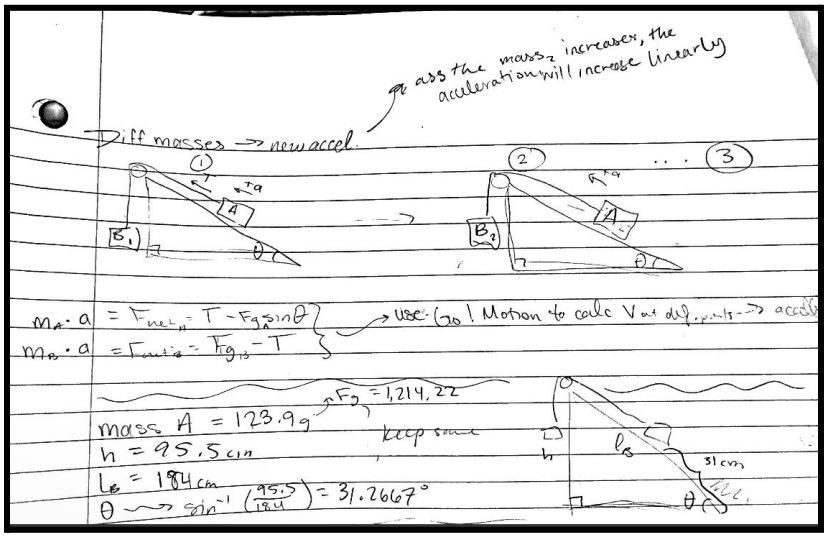


Figure 1: Atwood's machine layout

Data

Hanging Mass (g)	Average Acceleration (m/s^2)
100	0
120	0.6236002712
140	1.730871673
150	1.84632444
170	2.903572879
190	3.050600376
200	3.178768722

Figure 2: average acceleration for different masses of hanging mass B.

Analysis

The equation equating the net force and the force of gravity along with tension for mass B, found on figure 1, can be manipulated to see the relationship between different elements. Here, that equation is restated, then rewritten in two additional ways, along with a free body diagram for more clarity:

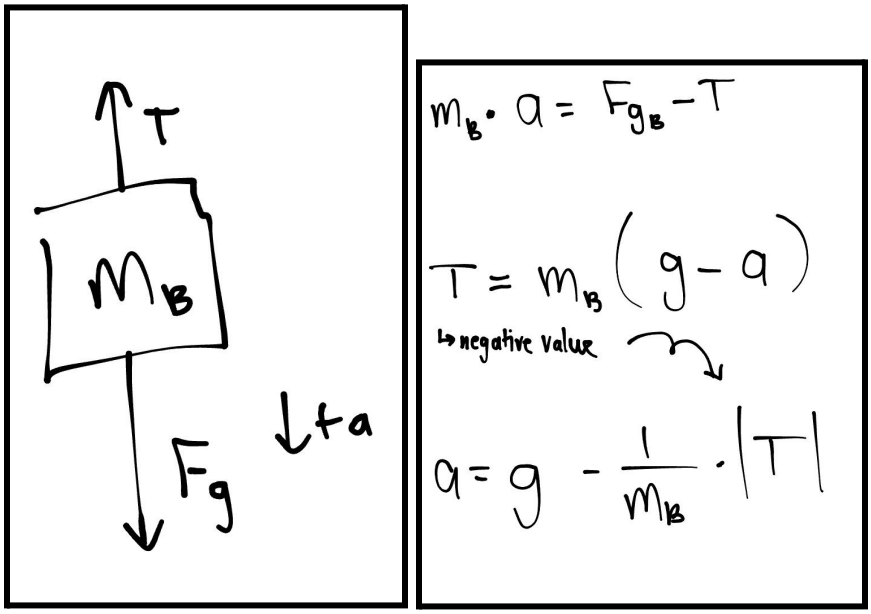
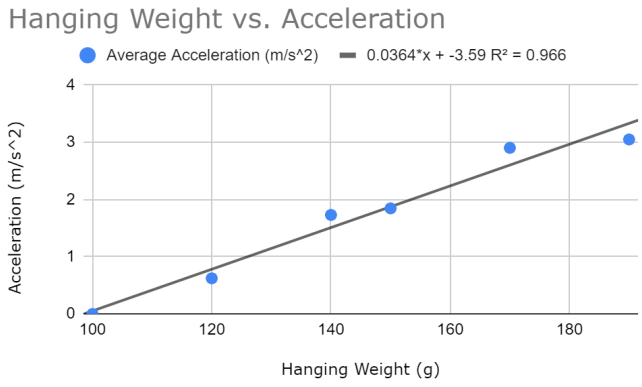


Figure 3a: net force equation for hanging mass B
Figure 3b: free body diagram of mass B

According to the first equation derived, the magnitude of tension of the system has a direct relationship with the magnitude of mass B (fig. 3b). Knowing this, as mass B increases, the tension will directly increase in magnitude (its actual value will increase negatively since tension is going against the acceleration of mass B). According to the second equation derived, and keeping in mind that the mass and tension increase at the same time in relation to each other, the acceleration will also increase as mass B increases (fig. 3b).

Using features on google sheets, we created a line best fit for the data points from figure 2:



Simply looking at these data points, one can see that they follow a linear pattern. The graphed line provided by google sheets further proves the linear relationship that the acceleration of the system and mass B have, following the hypothesis made. Some of the theoretical acceleration values did not match the observed acceleration, with an average percent error of 9.53%. This disparity could be due to inaccuracy in measuring the acceleration data, or failing to maintain the exact measurements during the multiple days of collecting data.

Figure 4: graph of data points from fig. 2