Dynamics Lab Investigation

Question: Can we calculate the force of a set of fans using a Modified Atwood's machine?

Hypothesis: By creating a graph based on a Modified Atwood's machine and setting the fan force as one of the constant elements of the graph, we can calculate the force of the fans.

Strategy:

- The cart riding on the track had three fans pushing the cart (m1) in the opposite direction of the pulley and second mass (m2).
- Weight was taken from the cart and added to the hanging mass, to keep the mass of the whole system (m1 and m2) the same.
- The fans were activated, and the cart was released as to read the acceleration data coming from the cart
- Acceleration in the direction of gravity, or in the direction of the pulley was considered positive, and acceleration away from the pulley was negative.

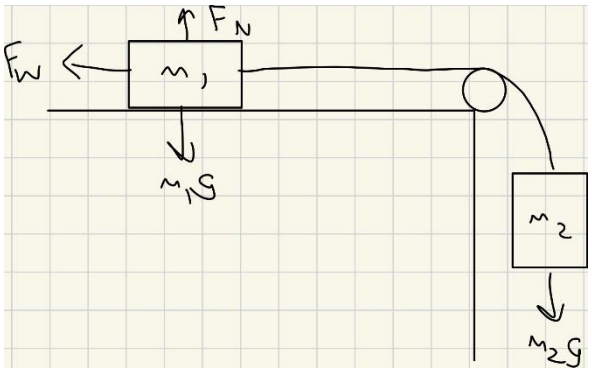

Figure 1: Freebody diagram of Modified Atwood's Machine

- We then created a graph with acceleration as the x-axis and m2G as the y-axis to get the force of the fan as the y-intercept.

Data:

Total mass of the system: 0.8124 kg

Acceleration (m/s^2) x-value	M2G (kgm/s^2) y-value
-0.1708	0.49
-0.1118	0.539
-0.0602	0.588
-0.01182	0.637
0.0114	0.686
0.0605	0.735

Analysis:

As can be seen by the Modified Atwood's machine in figure 1, The force of the fan is acting in the opposite direction of the gravitation force on the second mass. This means we can write our force equation with the force of the second mass minus the force of the fan equaling the acceleration of the system times the mass of the whole system (m1+m2).

$M2G - Fw = (m1+m2)a$

This equation can be rewritten further to

$M2G = (m1+m2)a + fw$

With this equation essentially in the form of a linear sloped line (y=mx+b) we can graph the function with M2G, a, and fw as y, x, and b respectively. This can be seen in figure 2.

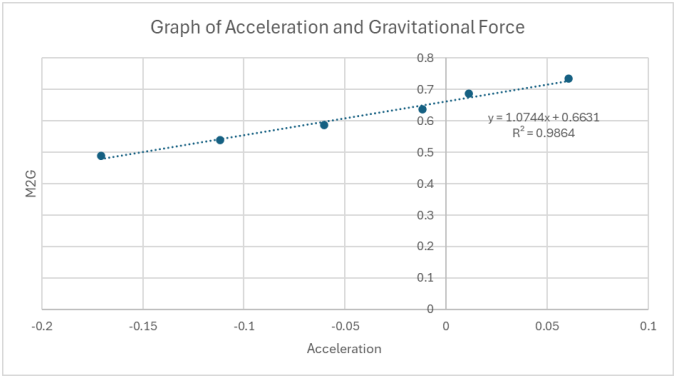

Figure 2: graph of acceleration, and gravitational force on the second mass.

With the slope of the line in the graph of figure 2 representing the total mass of the system, we can see that there was some error in our calculations. Specifically 32.25% error between the answer given by our equation and the mass we measured the system to be. This error is most likely caused by mistimed readings of the accelerations of various tests. Therefore our answer of the y-intercept, representing the force given by the fans, being 0.6631 N might not be perfectly accurate, but it can be used as a rough estimate.