Dynamics Friction Lab

Question: Does the coefficient of friction between two surfaces vary with normal force?

Hypothesis: The relationship between the mass of an object and the force of friction will be linear as increasing the weight of an object will increase the amount of friction it will require to move.

Strategy:

- Vernier cart (126.3 grams) was dragged across a flat surface by a string that was attached to it.
- 3 weights are added incrementally on top of the cart and the mass was recorded in the data table below. There were three trials conducted for each weight and an average static friction value was taken.
- The force of static friction is measured with the spring scale and the Vernier motion detector by looking at the highest value of static friction on the electronic graph before it drops to kinetic friction when the cart moves.

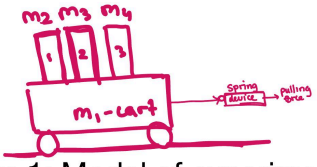


Diagram 1: Model of experiment

Data:

Weight added	Trial 1 (N)	Trial 2 (N)	Trial 3 (N)	Mass (g)	Mass (kg)	Avg Friction (N)
Cart (0)	0.382	0.425	0.431	126.3	0.1263	0.412666667
1	1.591	1.563	1.582	625.4	0.6254	1.578666667
2	2.832	3.158	3.01	1124.2	1.1242	3
3	4.223	4.185	4.961	1623.4	1.6234	4.456333333

Table 1. Contains mass in kg, measures all three trials and takes average of Frictional force for the control and when weights are added.

Analysis:

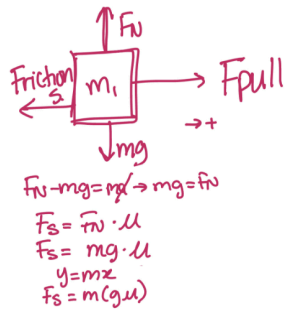
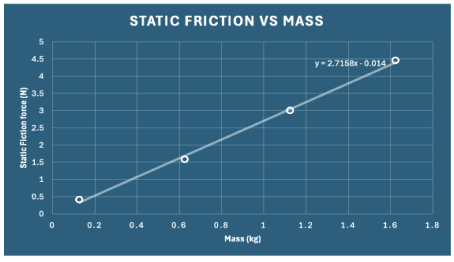


Figure 1: Linear equation derivation and free body diagram of cart

In Figure 1, the free body diagram shows how there was a pulling force acting on the cart when it was being pulled by the string at constant velocity. The equation for static friction is already linearized because $Fs = Fn * \mu$. The normal force is clearly mg due to zero acceleration in the vertical direction.



Graph 1: The relationship between static friction and mass.

This investigation was to determine how much static friction is required for an object to move. The linear line displayed on the graph proves our hypothesis that the force of static friction will increase as the mass of an object increases; they have a direct relationship. The axes were chosen by using the linear equation for static friction – the mass is the independent variable while static friction measured is the dependent variable. The slope of 2.7168 indicates μ*g – meaning that μ would have an approximate value of 2.7168/9.8 which is 0.28.

Possible sources of error would include holding the string and pulling on the cart at an angle instead of directly horizontal. This could alter our values for forces because there would be sin and cosine components added if the string was held at a slight angle. In addition, another source of error would occur when pulling on the string with various tensions during the many trials conducted. To conclude, there is no way to calculate the percent error in this lab because we are not provided with the mu value and cannot compare values to find the percent error.