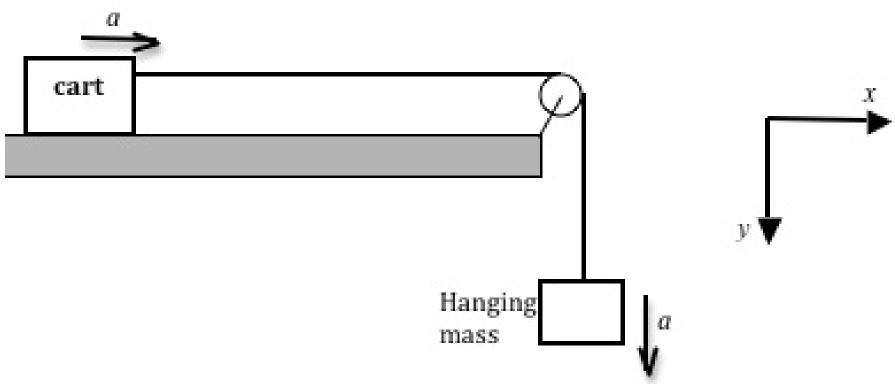
FORCES AND MOTION



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PHYS 211L 01

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THEORY

According to Newton's second law of motion, force= mass (acceleration). Force, F is the sum of all forces being exerted on the body, while m is the mass of the object. Acceleration is denoted by a. The law itself can be applied to an entire system as well as just one part of the system. Force, mass, and acceleration are proportional to each other so to find unknown value of one, the known value of the other two either multiplied or divided by each other can be used to determine the unknown's value. For example if the mass of the object is unknown, the force can be divided by the acceleration to determine that value. Newton's second law is applied to the system studied in experiment 2, using two masses, which are connected by a string; one is moving freely in the air vertically, while the other mass is a glider moving along a track horizontally on the air track. In the case of this experiment, it's assumed that the pulley is massless and frictionless, which is why the tension on both sides of the string is the same.

INTRODUCTION

The purpose of this lab was to validate Newton's second law of motion by studying the relationship between force, mass and acceleration by looking at the data based off the velocity, position, acceleration, and force graphs. To determine if force does in fact equal the mass multiplied by the acceleration, a motion sensor was used to measure the net force of a mass attached to the force sensor as it was moved towards and away from the sensor at varying velocities. Varying two masses, one of which was the vertical and the other was the horizontal, were connected to a string, which passed through a smart pulley that measured the motion of the string as the glider is released down the air track. The acceleration of gravity was measured by dropping a picket fence through the photogate sensor and using the mean of the acceleration curves for the different trials to compare it to gravity. Below illustrates a photogate set-up and the experiment set-up.

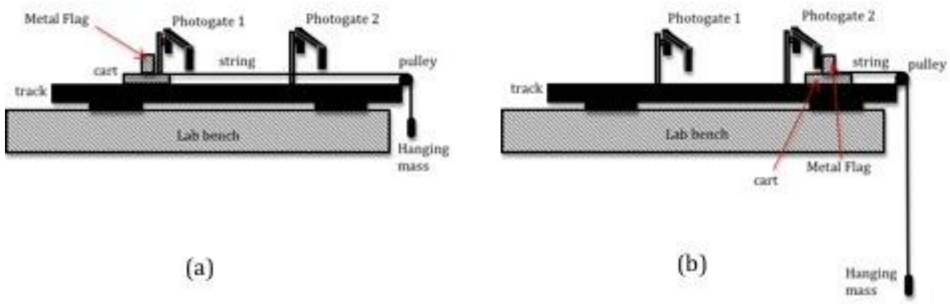

Figure 1.

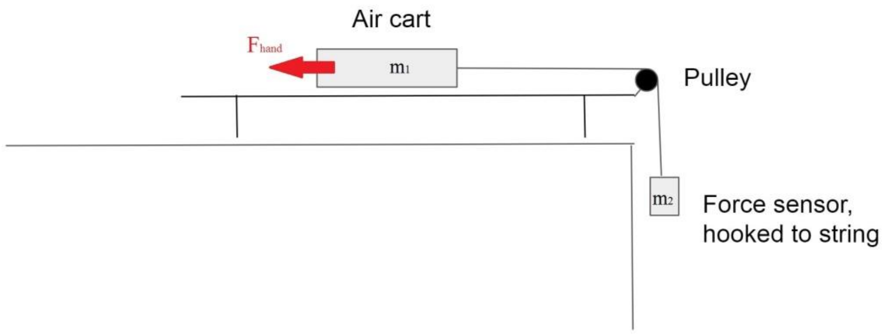

Figure 2.

ANALYSIS

The figures below verify Newton's law of motion by showing the sum of forces, friction and applied forces.

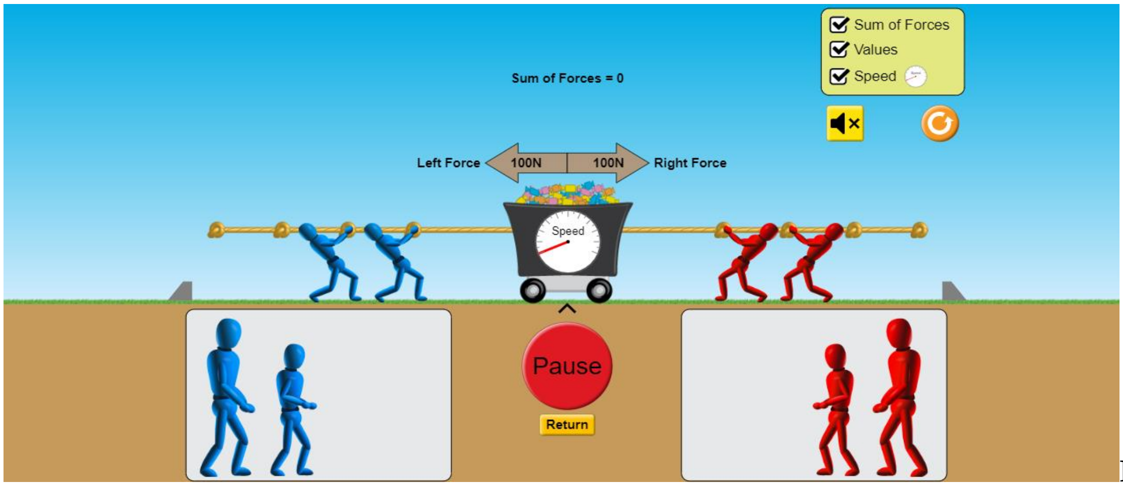

Figure 3.
Demonstrates Newton's law of motion, when the sum is zero the force will remain the same.

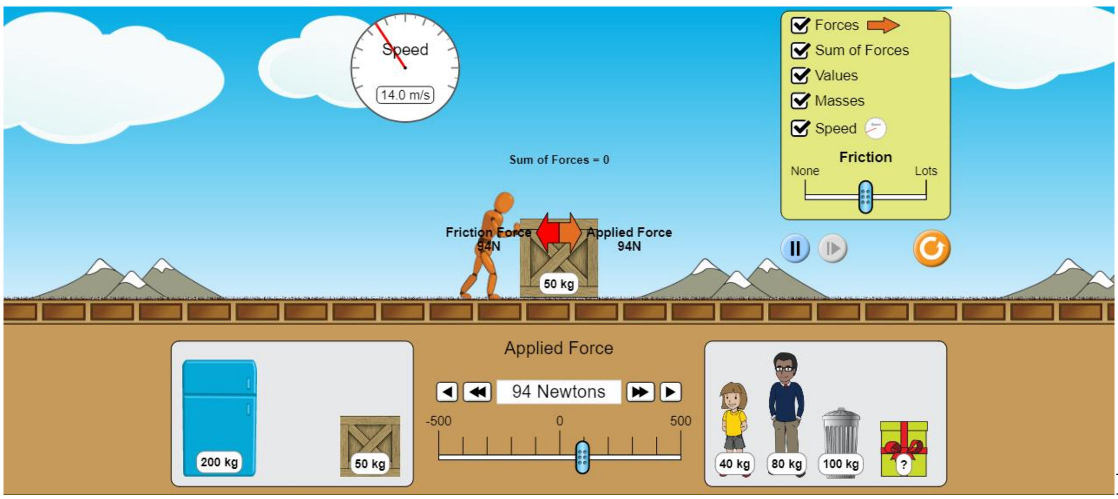

Figure 4.
N=50*9.8=490N, $Fs(max) = \mu sN$ $\mu sN = \frac{94}{N} = \frac{94}{490} = 0.19$, static friction= 0.19

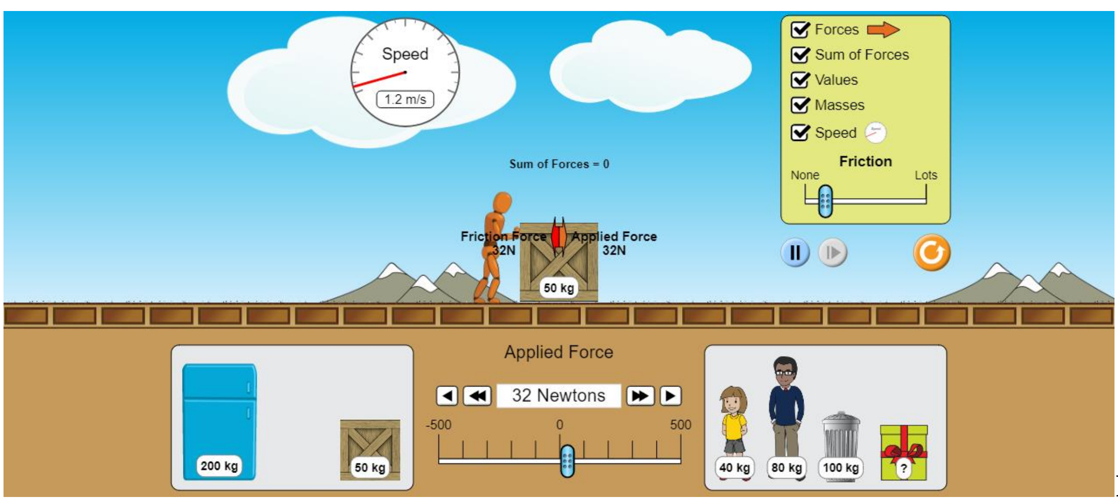

Figure 5.
N=50*9.8=490N, $Fs(max) = \mu sN$ $\mu sN = \frac{32}{490} = 0.07$, static friction= 0.07

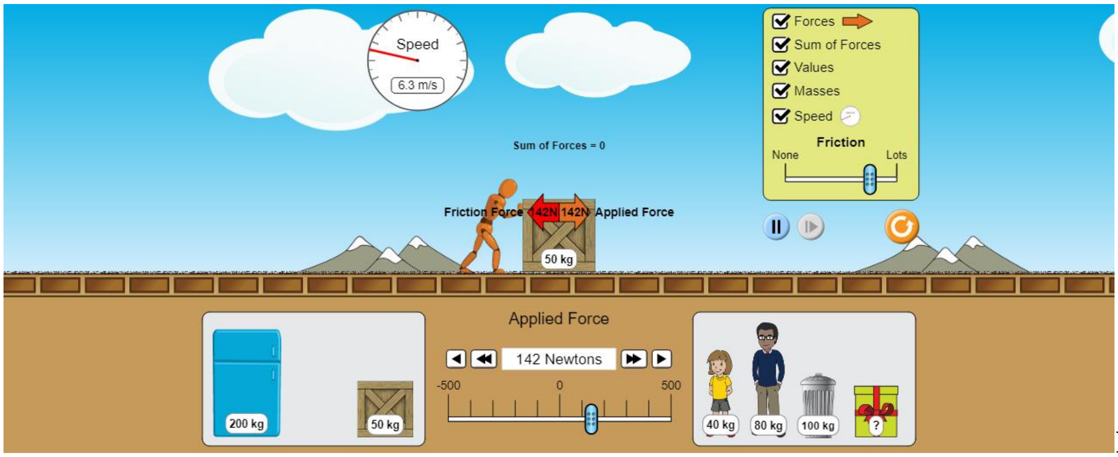

Figure 6.

N=50*9.8=490N, $Fs(max) = \mu sN$ $\mu sN = \frac{142}{490} = 0.29$, static friction= 0.29

DISCUSSION

Newton's 2nd law of motion was proved in this lab based on the data obtained. Based on the figures from this experiment, it can be determined that force is proportional to acceleration. The experiment proved that the force of tension and the mass of an object could be used to determine its relationship, and if the pulley was massless and frictionless then the tension can be assumed to be the same for both masses so the acceleration of the system depends on the acceleration of M1. The data from experiment revealed that when an object is dropped from the same height, would not affect the acceleration of the object because acceleration cannot change based on the height of the object, only the speed could change. In conclusion, whenever forces act on an object in opposite directions the net force is equal to the difference between the two forces. In other words, one force is subtracted from the other to calculate the net force. A force can cause a resting object, or it can accelerate a moving object by changing the object's speed or direction. When the forces on an object are balanced, the net force is zero and there is no change in the object's motion. When an unbalanced force acts on an object, the object accelerates. If the forces on an object are balanced, the net force is zero. If the forces are unbalanced forces, the effects don't cancel each other. Any time the forces acting on an object are unbalanced, the net force is not zero, and the motion of the object changes. For example, the game of tug of war is a good example of each of Newton's laws. When the game starts, both the sides are pulling the rope and neither side is moving. Once one side pulling on the rope exerts more force and therefore more pull, the other side has to increase their pull to try and get the rope back. The error in this lab could be a result of human error. During the experiment, the glider’s acceleration was determined by capstone based on the glider’s position and velocity just prior to hitting the end of the track.