Melanie Robertson

Physics

Mr. Lowe

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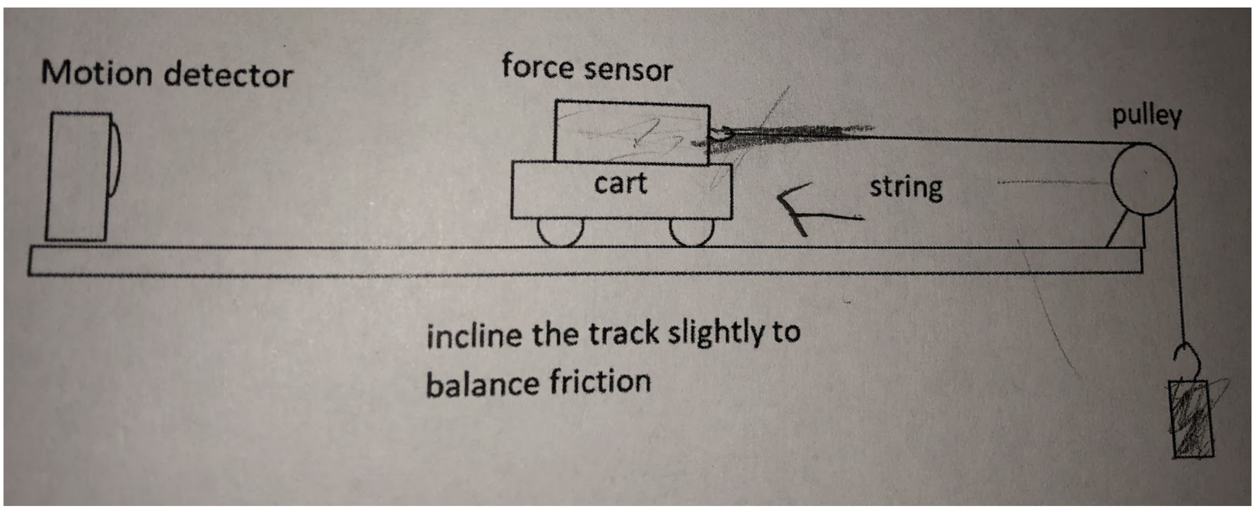
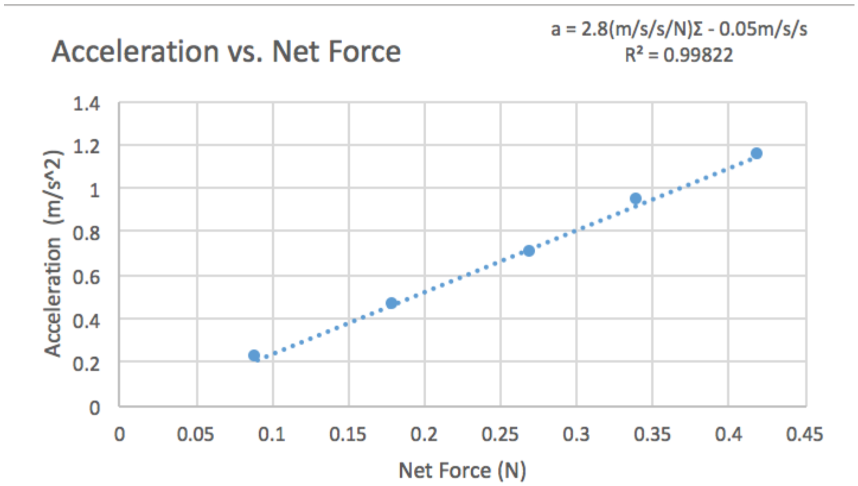
Force Cart Lab Part 1

The purpose of this lab was to graphically and mathematically determine the relationship between acceleration and net force applied of a cart rolling on a track. To determine this relationship, I will create an acceleration vs. net force graph.



For this lab we took various size masses and hung them from the end of the pulley and took data points for the acceleration and the net force applied on the car. To measure the acceleration of the car, we used a force sensor to calculate the velocity of the car over time and used the slope of that graph as our data point for acceleration in each trial To calculate the net force applied on the car, we first needed to balance out the horizontal force of kinetic friction applied on the car. We did this by tillting the track just slightly to change the direction of the normal force applied on the car. We made sure the forces applied on the car without any weight added were balanced by seeing if the car rolled at a constant velocity after it was pushed. We then assumed that the net force applied on the car was equal to the amount of force applied on the force sensor, since no other unbalanced forces would be acting on the car as the cart rolls.

Analysis



The mathematical model for this graph was a = 2.8(m/s/s/N)Σ - 0.05m/s/s. Because a newton is defined as a kg•m/s^2, the slope can be rephrased as 2.8 •1/kg. The y-intercept of this graph is zero because if the net force on the car is zero, the object would be moving at a constant velocity, or with an acceleration of zero. The slope of this graph represents the reciprocal of the mass of the cart. The reciprocal of the slope, 2.8 1/kg, simplifies to 1 over 2.8kg, or .357kg. The mass of the cart measured in the lab is .338kg and the percent difference between the two values is 5.6%.

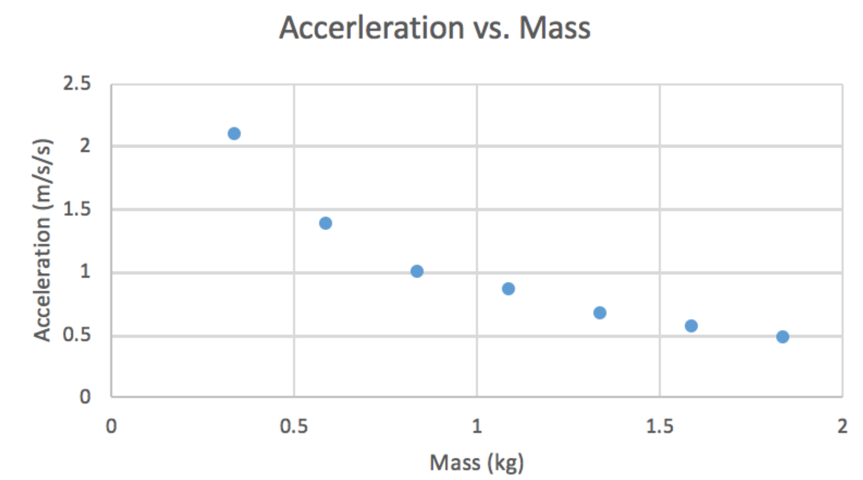
Conclusion

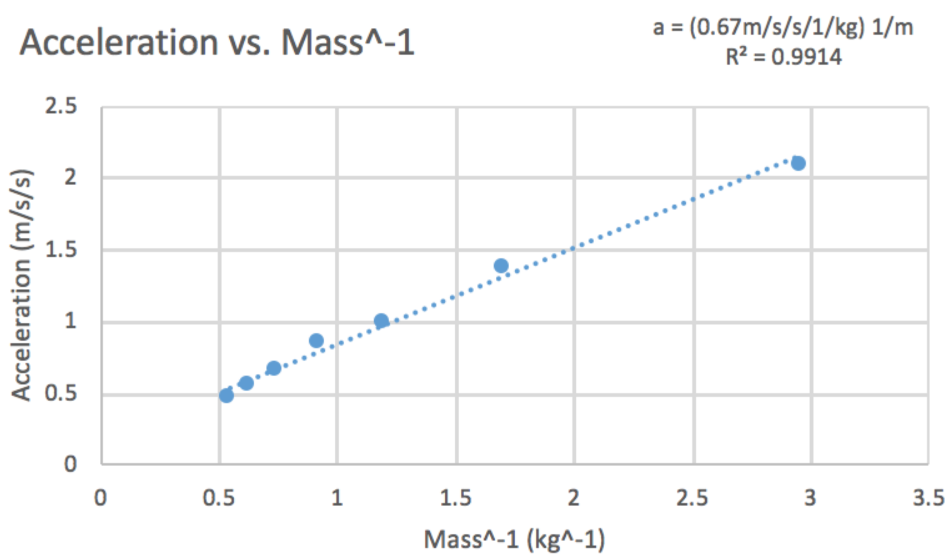
The purpose of this lab was to graphically and mathematically determine the relationship between acceleration and net force applied on a cart rolling across a track. It has been shown that acceleration and net force have a linear relationship and are directly related. The graph had a correlation coefficient of .998, showing that the data clearly fits a linear trendline. The slope value of the graph is 1/kg, so by finding the reciprocal of the slope value, you will find the mass of the car. The reciprocal of the slope value is .357 kg which is close to the measured mass of the cart, .338 kg and the percent difference between the two values is 5.6%. Because the inverses of the slope was f/a, and that value was almost identical to the mass, we can assume that the inverse of the slope is equal to the mass. Therefore the relationship between acceleration and net force is linear and acceleration is equal to the net force over the mass of an object, or $a = F\Sigma/m$.

Force Cart Lab Part 2

The purpose of this lab was to graphically and mathematically determine the relationship between acceleration and mass of a cart rolling on a track. To determine this relationship, I collected data and create an acceleration vs. mass graph. This lab had the same set up as part one but we kept the hanging mass/pulling force at the end of the pulley at a constant 100g and manipulated the mass of the cart instead. We took one trial of the cart with no additional masses added, measuring the acceleration and the mass of the car. We then did an addition 6 trials with different amounts of mass added to the car, continuing to measure the acceleration and mass of the car.

Analysis





When I graphed the acceleration of the car vs. the mass of the data was non-linear. To linearize the data, I took all of the mass values and raised them to the negative 1 power or 1/mass. The linearized graph had a correlation coefficient of .991. The mathematical model for the acceleration vs. 1/mass graph is a = (.67m/s/s/1/kg) 1/m. This can be simplified to a = (.67m/s/s•kg) 1/m or a = (.67N) 1/m because N = m/s/s•kg. The y-intercept of this graph is zero because if the mass of the car is zero, it would have no acceleration. The slope must signify a force because the unit, newtons, is a measure of force but .67N is not similar to the constant pulling force on the car of about 1N.

Conclusion

The purpose of this lab was to graphically and mathematically determine the relationship between acceleration and mass of a cart rolling on a track. To determine this relationship, I created create an acceleration vs. mass graph. It has been shown that acceleration and mass have a nonlinear relationship and are inversely related. To make the relationship linear, I took all of the mass values and raised them to the negative 1 power. The linearized graph had a correlation coefficient of .991, showing that the data clearly fits a linear trendline.