Newton’s second law – practical report essay sample

Aim:

a:, To observe changes in motion due to changes in force and measure force, mass and acceleration, and examine their influence on motion.

b: To investigate the relationship between the variables; mass, force and acceleration and determine an inertial mass through the use of a trolley, ticker-timer and set of slotted masses.

Introduction:

Newton’s second law states “ The acceleration of an object as produced by a net force is directly proportional to the magnitude of the net force, in the same direction as the net force, and inversely proportional to the mass of the object..” Unlike Newton’s first law, the second law deals with objects and forces that are not balanced. The law simply states that the acceleration of an object depends on the net force acting upon the object and the mass of the object.

This means that a is proportional to F, and 1/m.

Basically, Newton’s second law of motion can be summarized as:

F= ma

Or, Force is equal to Mass x Acceleration.

Hypothesis:

As the slotted masses are added to the mass carrier, the acceleration of the system will increase proportionally. Therefore when acceleration is plotted against force for each run, a straight line trend should be formed.

Diagram:

(included in word document)

Procedure:

The apparatus was set up as in the diagram. A mass carrier was suspended to a long piece of string, over the edge of a table, and then passed through a pulley on the corner of the table and attached at the other end of the string to a trolley. The trolley was attached to a length of ticker-timer tape, which passed through a ticker-timer, connected to an AC power supply. The ticker-timer tape, trolley and string were all lined up horizontally, to reduce errors due to friction in the final results.

A slotted mass of 50g was placed on the mass carrier, and 250g on the trolley. The trolley was then pulled back so that it was a distance from the edge of the table, at this point the trolley was released and the ticker-timer turned on to record the motion of the trolley. This was repeated, each time shifting a 50g mass from the trolley to the mass carrier, the results were recorded on ticker-timer tape each time.

NB: The cart has a mass of 850g

Results: (Table and graphs included in word document)

Analysing the results:

The line of best fit for the Force Vs Acceleration graph has a gradient of approx 0. 550 and a Y intercept of 0. 049. As with Newton’s second law, Acceleration is proportional to Force. Therefore the gradient of the line of best fit represents a constant.

ΔAccell /ΔForce = K = 1/m

Which in this case according to Newton’s second law, is the inverse of the mass of the trolley (1/m). In an environment with no friction due to these elements and no error, the line of best-fit would intercept the Y axis at the origin, instead of slightly above. To reduce the error associated with the measurements and calculations involved, more than one test could have been conducted for each mass to limit the chances of error.

As mentioned earlier, the three variables associated with the experiment (mass, acceleration and force) can be associated with an equation.

F= ma

This equation can be proven using the results of the experiment and results calculated using Newton’s Second Law.

(graph included in word document)

A set of results can be calculated using Newton’s second law, as if the experiment were performed under ideal conditions with no friction and very low error. The best fit line for this graph had a gradient of 0. 426 and a Y-intercept at the origin.

(graph included in word document)

The tested results come within a reasonable range of the calculated results, taking into consideration the fact that the calculated results do not account for errors in measurement or friction.

The inertial mass of the system can be inversely derived from the gradient of the line of best-fit (change in acceleration / change in force) as 1/m. Using a few simple calculations based on the graphs (calculated and tested results), the inertial mass of the calculated and tested results can be obtained as 1. 15Kg and 0. 962Kg respectively. The gravitational mass of the system was 1. 150Kg, the cart used had a mass of 850g and there was consistently 300g of additional mass either on mass carrier or the cart throughout each test. These results seem to support Newton’s second law, if we allow for error and friction in the calculations.

The graphed results for the experiment suggest that frictional forces were consistent throughout the experiment, but due to the limited accuracy of the results as each test was only conducted once, more comprehensive results may suggest otherwise. Every effort was taken to ensure that the test environment was kept consistent was taken.

Conclusion:

As 50g masses we transferred from the trolley to the mass carrier, the force pulling the system forward was increased, but the mass of the entire system remained constant. It was then possible to manipulate the results to derive and prove a relationship between the three vector quantities measured, force, mass and acceleration.