Newton’s Second Law

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Objective of the experiment:

The purpose of this activity is to study the relationship among force, mass, and acceleration using Atwood’s Machine apparatus.

Theory:

The acceleration of an object depends on the net applied force and the object’s mass. In an Atwood’s Machine, the difference in weight between two hanging masses determines the net force acting on the system of both masses. This net force accelerates both in the hanging masses; the heavier mass is accelerated downward, and the lighter mass is accelerated upward.

Procedure:

First, we got the computer and device ready to use. We then got the masses weighed out properly with one having 100g and the other having 105g. Then, we started testing the data by having one person on the computer and another person operating the device. To operate the device we had to make sure that the red LED light was off before we started to record our data then we worked together to start at the same time to get a proper measured acceleration. We repeated this several times for all the data that we needed but we took one of the weights off of one of the hangers and moving it to the other one for constant total mass.

Next, we put the masses back to how they were originally and then we added weight to both hangers evenly and did that several times to fill out our table to get the constant net force.  
After we got all the measured results we started to do some calculations to get the accepted acceleration and also the percent difference between the measured and accepted acceleration values.

Data:  
Constant Total Mass

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Run | M1(kg) | M2(kg) | Aexp(m/s^2) | Fnet(N) | M1+M2(kg) | Atheo(m/s^2) | % diff |
| 1 | .100 | .105 | .248 | .049 | .205 | .239 | 3.77% |
| 2 | .110 | .095 | .674 | .147 | .205 | .717 | 6.00% |
| 3 | .120 | .085 | 1.61 | .343 | .205 | 1.67 | 3.59% |
| 4 | .125 | .080 | 2.08 | .441 | .205 | 2.15 | 3.26% |
| 5 | .130 | .875 | 2.54 | .539 | .205 | 2.63 | 3.42% |

Constant Net Force

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Run | M1(kg) | M2(kg) | Aexp(m/s^2) | Fnet(N) | M1+M2(kg) | Atheo(m/s^2) | % diff |
| 1 | .100 | .105 | .244 | .049 | .205 | .239 | 2.09% |
| 2 | .105 | .110 | .231 | .049 | .215 | .228 | 1.32% |
| 3 | .115 | .120 | .214 | .049 | .235 | .209 | 2.39% |
| 4 | .120 | .125 | .210 | .049 | .245 | .200 | 5.00% |
| 5 | .125 | .130 | .198 | .049 | .255 | .192 | 3.13% |

Formulas:

Atheo = Fnet/M1+M2 Fnet = (M2-M1)g

% diff = (|accepted-measured|/accepted)\*100 Aexp= (M2-M1)g/M1+M2

Results:

Our results were pretty close to what the accepted was for both constant total mass and constant net force. Also found out that the mass does make a big difference on the net force on an object.

Questions:

1. What are some reasons that would account for this percent difference?  
   See error analysis
2. For the Constant total mass data, plat a graph of Fnet vs. Aexp  
   See attached grid on back
3. Draw the best fit line on your plot. What does the slope of this line represent?  
   Mass
4. How does the Force vs. Acceleration plot relate to Newton’s Second Law?  
   Second law says that F=ma

Error Analysis:

Some errors we thought of were; resistance in the spindle bearing, integrity of the string over time, vibration in the apparatus, and motion of the mass when released.

Conclusion:

I learned that mass does affect the net force greatly and if it is the same mass no matter what the weight of the object is the net force will remain the same. I also learned the experiment did accomplish the objective because both of the tables we filled out in the constant mass experiment the mass stayed the same and in the net force experiment the net force stayed the same for the experiment.

References:

We only used each other for refernces.