**Newton’s 2nd Law**

Newton’s second law relates the net force an object experiences, its mass, and its acceleration:



In part one of today’s lab, you will be:

* comparing position vs. time and velocity vs. time graphs for objects experiencing a constant force with different masses
* determining how the acceleration of an object changes under a constant force when its mass changes
* determining if the force applied by the cart fan is constant

Pre-Lab Activity: Draw the free body diagram and write the summation equation for the cart

Lab Steps:

* Find the mass of the cart and fan, and the additional masses that you will use later
* Set up the track and attach the fan to the cart with no extra mass added to the cart
* Put the cart into motion and use the motion sensor to create position vs. time and velocity vs. time graphs, and sketch these in your notebook
* Use the graph tools with the velocity vs. time graph to determine the acceleration of the cart
* Repeat the steps for one, then two, masses added to the cart

Questions to Consider:

1. What shape does the position vs. time graph have? What does this indicate about the motion of the cart?
2. How does the position vs. time graph change as more mass is added to the cart?
3. What shape does the velocity vs. time graph have? Does this support or refute your answer to question 1?
4. How does the slope of the velocity vs. time graph change as more mass is added to the cart?
5. Does the fan apply a constant force to the cart in each case? ***Support your answer with calculations***.

For part two, you will be changing the force applied to the cart and keep the mass constant.

In order to change the force applied, you should replace one battery at a time with the metal cylinders next to the fan. Use the motion sensors to create and sketch the position vs. time and velocity vs. time graphs, and estimate the acceleration of the cart for three different forces applied to the same mass.

Questions to Consider:

1. How does the position vs. time graph change as less force is applied to the cart?
2. How does the slope of the velocity vs. time graph change as less force is applied to the cart?
3. What is the force applied by four, three, and two batteries to the cart?

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