Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***Smart Cart Lab: Newton’s 2nd Law, Part I* (Distance Learning Version)**

(In this distance-learning version of this activity, all needed data can obtained from screenshots that have been provided on the last page.)

In this lab, we’ll use PASCO Smart Carts and SPARKvue software to confirm Newton’s 2nd Law of Motion.

Procedure:

1. Obtain a 1-m long track. Adjust the feet and use a bubble level to make sure the track is level.
2. Obtain a single Smart Cart. Turn it on, and make sure you see a blinking red light. This means it is blue tooth ready. Remove the magnetic “bumper” from the front of your Smart Cart and attach the hook to where the bumper had been screwed in. This hook now will be attached to the Smart Cart’s force sensor. Use a scale to determine the mass of your Smart Cart:

mCart = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Obtain a PC laptop, insert a Bluetooth adapter into a USB port, begin running SPARKvue, and connect your Smart Cart to SPARKvue.
2. Build an experiment with 3 pages. On the first page, have a data table with columns for time, force, and acceleration. (You can add columns to your data table by clicking on the icon at the bottom of the page.) On the 2nd page have a graph of both force and acceleration vs. time. (You’ll have to click on the option of adding a Y-axis.) On the 3rd page have a graph of force vs. acceleration.
3. Add four 250-g masses to the top of your cart.
4. Before you can take data, you need to zero-out your force sensor. Click the “Show Hardware Setup” icon, and then “Configure Sensor” (it looks like a gear) next to “Smart Cart Force Sensor”. Then click “Zero Sensor Now”.
5. Place your cart on one end of the track. Click to start taking data. Grab the hook and pull and push the cart back and forth across the track for a few seconds. Try to vary the strength with which you’re pulling and pushing the cart. After a few seconds stop taking data.
6. On your Force and Acceleration v. time graph, click the “Lock” button in the graph tools, then click “Scale to fit”.
7. Describe what you notice when you examine your Force v. Time and Acceleration v. Time graphs.
8. Save a snapshot of your Force and Acceleration v. Time graph to your Journal.
9. Now examine your Force v. Acceleration graph. Most of your data should be clustered into a relatively clearly linear trend. Highlight these points, but not the any outliers if there are any, and fit a linear curve. What is the slope of this line?

Slope = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. What is the physical meaning of this slope?
2. Calculate your %-error between your slope from #11 and what you would expect it to be, given your answer to #12.
3. How do you account for your experimental error?
4. Save a snapshot of your Force v. Acceleration graph including your best-fit line to your Journal.
5. Explain why this activity constitutes confirming Newton’s 2nd Law.
6. Export your journal, print out both graphs, and then attached them to this lab sheet before turning it in.



