Impulse-Momentum lab
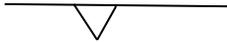
Purpose: The purpose of this two part lab is to investigate the 1) relationship between the impulse applied to an object and the resulting change in momentum, and 2) how conservation of momentum shows how objects react after a collision. In this lab you will again use Excel (Sheets) to display your collected data and calculate your momentum relationships. You will also add a short concluding paragraph expressing your finding about the principles of momentum for each part.

Procedure for Part One: "**Impulse-Momentum Theorem**" We will use the *plunger cart* as the object and the plunger to supply the force (impulse).

1. Set up the cart, track, and force probe as shown below. Set a small ring stand on the end of the track against the track stop and secure the force probe to it (be sure the switch on the force probe is at the *10 N* setting). With the plunder extended place the photogate about 2 ½ centimeters behind (beyond) the picket fence (so it doesn't make reading until after the plunger is fully extended).

2. Plug the photogate into the *Dig/Sonic* 1 port (left side) and the *Force* Probe into the *Ch 1* port (right side – you'll have to use the grey DIN adapter for the force probe). Open *Logger Pro* and Click the Lab Pro icon (left hand ribbon) to get to the Sensor menu and then drag the photogate icon to the *Dig/Sonic* 1 box. Set the photogate to *Gate Timing*, and then go to *Set distance or length* and choose *User Defined* and set the distance to 0.025 – that's the length of the single opaque area on the top of the picket fence. Now, drag the Dual-range Force Probe icon from the analog sensor menu to the "*CH 1*" box and drop it in. Calibrate the force probe with a 100 g mass and a 500 g mass. Click on force probe icon and "Zero" the probe, make sure the probe is set to the 10 N range.

3. Compress the plunger and roll the cart so the plunger is touching the force probe. You're set. When you're ready click *Collect* and activate the plunger. You will see three graphs (probably) on you Logger Pro screen. The top one is the Force vs Time graph. If you have a good trial the graph would look like this: Highlight the triangle and use the *Integral* button to find the area- this is your impulse in Ns. You may want to use your *auto* scale function to enlarge your graph! Now highlight the vel. vs time graph (probably the bottom one) and use your *Stats* function to find the cart's velocity after the impulse. You can also read the velocity from the data table on the left side of the screen.

4. Mass the cart and determine your observed and accepted values for impulse and change in momentum. Determine what the value for the impulse should have been using the mass and velocity (this is your "A" value for the impulse) and then determine what the velocity should have been using the experimental impulse (This is your "A" value for your momentum) and cart mass. Perform at least 3 trials with the same set up before you change the mass of the cart.

Procedure for Part Two: "**Law of Conservation of Momentum**" … We will use the plunger cart and regular cart for this part.

1. Set up the carts, track, and photogates as shown below. With the plunder extended place the photogate about 2 ½ centimeters behind the picket fences on each side so they are read after the plunger is extended. Again, set up the photogate for *Gate Timing* as above.

2. Compress the plunger and roll the cart so the plunger is touching the non-plunger cart. Double check your photogates so they are in the correct position. Hit *Collect* and then activate the plunger. Determine the velocity (from the graph) and mass of each cart and record their values. Calculate the momentum of each cart. Using the data from the plunger cart determine what the velocity of the non-plunger cart should have been.
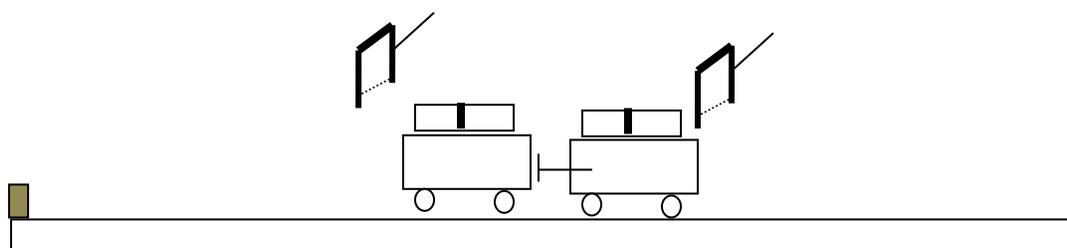
3. Do at least three trials before you change the mass of one of the carts.

Your Excel document is inserted into a Word document that's hosting your Conclusion. Remember to list all the information (name, section ……) necessary for your lab document. Your Excel should contain all observed data listed in the units it is collected in. It should be easily followed with all calculations (no calculator values) made in Excel. This time each measuring device should contain the Uncertainty of the Measurement.