IMPULSE

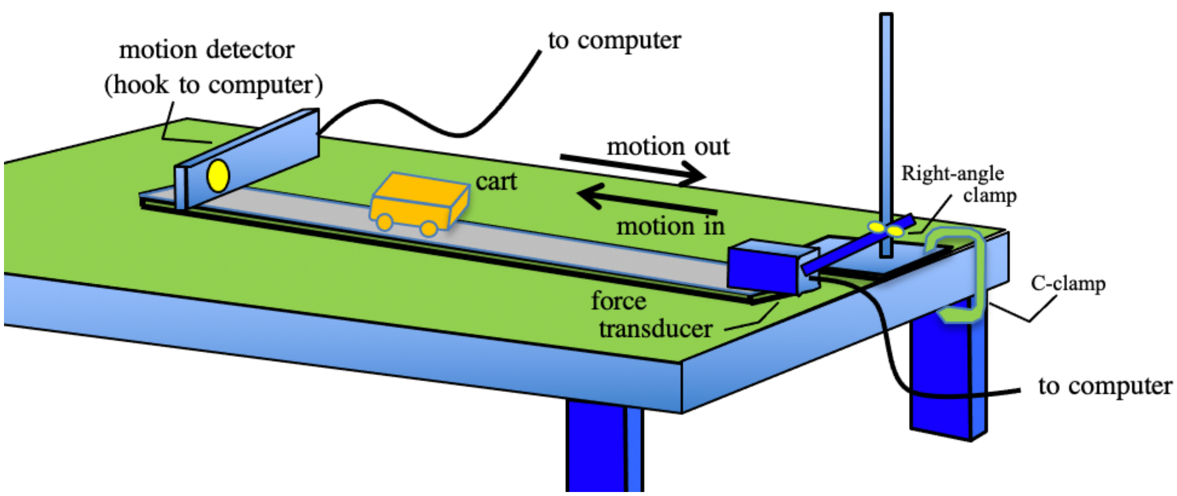
(L-12a)

Does the *impulse* really equal the mass's *change of momentum*? This lab will give you the opportunity to find out.

PROCEDURE--DATA

Part A: (comparing the *impulse* **F**Δt to a body's *change of momentum* Δ**p**)

Set up the track, cart and Motion Detector as shown in the sketch (you will be connecting the Motion Detector to the computer). Connect a Force Transducer to the computer, but do not yet set it up as shown in the sketch (you'll have to calibrate the Transducer before using). Note that the track needs to be level AT THE END. Use the cart to check this (if the cart is placed stationary on the track, then begins to move, the track isn't perfectly horizontal). Do whatever is necessary to make the track horizontal.



a.) Open up the Logger Pro program on the computer. You should see a force vs time graph, a velocity vs time graph and a position vs time graph. Delete the velocity vs time graph. Make each remaining graph half a screen tall. Click on both graphs and add "extra lines."

b.) Calibrate the Force Transducer. If you don't remember the procedure, it is as follows:

i.) In the EXPERIMENT tab along the top ribbon, click on CALIBRATE.

ii.) A dialogue box will appear asking if you want to calibrate "now." Click "yes."

iii.) The program will highlight a box at the bottom of the dialogue box asking for a value of the force being applied to to the hook of the Transducer. With the Transducer hanging over the side of the table so the hook is in the vertical, and with *nothing* hanging from the hook, put ZERO in that box and click on KEEP.

iv.) Put 500 grams (0.5 kg) on the hook. The program will have highlighted the second box (to the right of the first) asking how much force is now being applied. Write "4.9" (that's the number of newtons a 0.5 kg mass will apply due to gravity). Click on KEEP, then click on DONE.

v.) If you done this correctly, the large box in the bottom left-hand corner of the screen should read the force being applied to the Transducer. With the 500 gram mass on the hook, that number should be 4.9. When you remove that mass, that number should be ZERO.

c.) With the Force Transducer calibrated, *remove the hook at its end* (put this somewhere where you can replace it at the end of the lab—if you lose the hook, the Transducer will be useless for other labs) and place it into the track set-up as shown in the sketch.

d.) With the Transducer positioned in the system, go to EXPERIMENT on the computer and click on ZERO (this will zero the Transducer in its new orientation).

e.) To acquire a little more accurate data, go to EXPERIMENT, then DATA COLLECTION, and where it says DATA RATE, put "200." (This will instruct the computer to take 200 data points per second instead of the default, which is 50.)

Part B: (taking data to compare the *impulse* $\mathbf{F}\Delta t$ to a body's *change of momentum* $\Delta\mathbf{p}$)

f.) On the computer, click on the START button at the top of the window. You should get a WAITING FOR DATA message. Push the cart down the track toward the Force Transducers. The computer should begin to take data. Let the cart bounce off the Transducer.

g.) Upon completing the run, the *force vs time* graph should show a bump identifying the force applied to the Transducer by the cart due to the collision. You can magnify that curve if you'd like, but in any case you need to highlight the curve, then use the INTEGRATION tool to determine the *area under the curve*. Record that value.

h.) The *position vs time* graph should also show track's the cart's position through the run. Magnify the section associated with *before*, *at* and *after* the collision. Use the REGRESSION LINE tool to determine the slope of the line *just before* the collision (that will be the incoming velocity). Record that value. Do similarly to the section *just after* collision line. Record that value.

i.) After clicking on your screen to get rid of any grayed out areas, PRINT your graphs.

j.) Mass of the cart.

CALCULATIONS

Part A: (relationship between *impulse* and a body's *change of momentum*)

1.) What was collision's impulse as determined by the area under the *force versus time* graph (your computer gave you this number—just state it with appropriate BLURB)?

2.) We'd like to see if the impulse determined by the area under the *force versus time* graph curve is the same as the cart's *change of momentum*. That is, is $\mathbf{F}\Delta t = \Delta \mathbf{p}$? To find out: We need to determine the cart's *change of momentum*. To do so:

a.) Determine the incoming and outgoing momenta (label well).

b.) Determine the *net change of momentum* (including units) of the mass during the collision. BE VERY CAREFUL WITH YOUR SIGNS!

3.) As was stated above, the computer was kind enough to provide you with a numerical value for the area under the *force versus time* graph. Generated as a consequence of the glider's momentum-changing collision with the Transducer's ARM in our set-up, this area was $\mathbf{F}\Delta t$.

If our theory is correct, the glider's *change of momentum* determined in *Calculations 2* should equal to a real good approximation that $\mathbf{F}\Delta t$ value.

Check this by doing a % comparison between the two. Comment.