Name _____ Date _____ Period _____

The Conservation of Momentum

Find the Lab

- In your web browser, go to **www.gigaphysics.com**, then go to **Virtual Labs**, and then click **Conservation of Momentum**.
- If someone else used the computer for this lab before you, click **New Experiment**. This will ensure that you have your own unique cart data when you do the experiment.

Part I: Measure the Carts

- To find the length of the purple cart, use your mouse to drag the cart over the caliper in the upper left corner of the lab. Convert the length to the SI unit of meters, then record your result in the table below. Repeat for the green cart.
- Find the masses of the carts by dragging each one in turn over the electronic balance in the upper right corner. The balance reads in grams, so convert each mass to the SI unit of kilograms, then record your data.

Mass of purple cart	Length of purple cart	Mass of green cart	Length of green cart

- *These measurements will stay the same as long as you don't refresh the screen or click the button to start a new experiment. If you don't complete the lab if one sitting and have to load the lab page again, the lengths and masses will change. If this happens, you will need to measure them again and use the new values for the remainder of the lab.*

Part II: Determine the Carts' Velocities

- Select "same direction" from the **Carts' Direction** menu and "inelastic" from the **Collision Behavior** menu.
- Click **Start Carts** to put the carts in motion. The red numbers you will soon see tell you how many seconds it took each cart to pass through that photogate. If you lose track of which photogate is measuring which cart, notice the purple and green arrows labelling each; a half purple/half green arrow is used when both carts were stuck together as they passed through. You can also click **Start Carts** if you want to watch the collision again.
- Record your times in the data table at the top of the next page. Also copy the lengths from part I. Be sure to add the lengths of the two carts when the carts are stuck together.
- Calculate each cart's velocity and enter it in the table as well.

	Elapsed time	Length	Velocity
Purple cart before collision			
Green cart before collision			
Carts stuck together after collision			

Part III: Calculating Momentum

- Use the fact that momentum equals mass times velocity to calculate the momentum of each cart. Remember to add the masses when the carts are stuck together.

	Mass	Velocity (from part II)	Momentum
Purple cart before collision			
Green cart before collision			
Carts stuck together after collision			

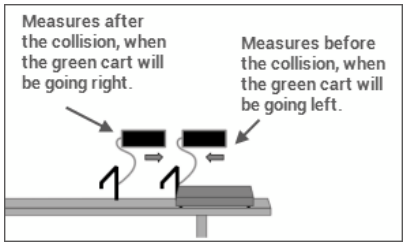
- Calculate the total momentum of the two carts before and after the collision.

	Purple cart's momentum	Green cart's momentum	Total momentum
Before collision			
After collision	----------	----------	

- You should find that the total momentum before and after the collision is identical (at least to within rounding errors.) If you don't, you should find out what went wrong and correct it before you complete the next part.

Part IV: The Elastic Collision

- This time, set the **Carts' Direction** to opposite and the **Collision Behavior** to elastic. Repeat the same steps as in part II and III. (The data table is at the top of the next page.)
- When you calculate the velocities and momenta, signs matter. Make sure that carts that are moving to the left have negative velocities. If you lose track of which direction the carts were going for each photogate, you have the arrows to help you, and you can click **Start Carts** to watch the collision again.



	Elapsed time	Length	Velocity (with sign!)
Purple cart before collision			
Green cart before collision			
Purple cart after collision			
Green cart after collision			

	Mass	Velocity	Momentum
Purple cart before collision			
Green cart before collision			
Purple cart after collision			
Green cart After collision			

	Purple cart's momentum	Green cart's momentum	Total momentum
Before collision			
After collision			

Part V: One More Case

- Repeat the experiment once more, this time with any combination of **Carts' Direction** and **Collision Behavior** you have not used already. Record which settings you use, then complete the calculations as before.

Carts' Direction _____ Collision Behavior _____

	Elapsed time	Length	Velocity (with sign!)
Purple cart before collision			
Green cart before collision			
Purple cart after collision			
Purple cart before collision			

	Mass	Velocity	Momentum
Purple cart before collision			
Green cart before collision			
Purple cart after collision			
Purple cart before collision			

	Purple cart's momentum	Green cart's momentum	Total momentum
Before collision			
After collision			

Part VI: Conclusions

What did you notice about the total momentum before the collision and the total momentum after the collision in each of the above cases?

The principle you should have noted in the previous question is called *conservation of momentum*. What do you think it means to say something is *conserved* in the context of physics?

Do you think there is any combination of conditions in this lab under which momentum would not have been conserved? Explain your answer.