Name _____ Date _____ Period _____

Conservation of Momentum

Part I: Introduction

In this simulation you will investigate the conservation of momentum inn various sorts of collisions. To begin, go to www.gigaphysics.com in your web browser, then to the **Conservation of Momentum** lab. If you are using a computer that another student has just used for this lab, be sure to click the **New Experiment** button to get your own individual data.

Part II: Measure the Carts

You will need the length and mass of each cart to perform the calculations for the rest of the lab. To find the mass of each car, click the **Green Car to Balance** and **Purple Car to Balance** buttons and read the value displayed on the balance. Convert the masses to SI units, and record these masses in the table below.

mass of green cart		mass of purple cart	
length of green cart		length of purple cart	

Similarly, find the length of each cart by using the **Green Car to Calipers** and **Purple Car to Calipers** buttons. Convert the displayed values to SI units and record those values as well.

Part III: The Carts' Velocities

Set the **Carts' Direction** to **Same direction** and the **Collision Type** to **Inelastic**. Then click the **Start Carts** button and watch what happens. You will see the carts pass through the various photogates, and when they do, each photogate displays the time it takes the cart to pass completely through that photogate. Notice the purple and green arrows to help you keep track of which cart (and in some cases which direction of travel) was being measured. The arrow that is half green and half purple means that the carts are stuck together as they pass through that photogate. If you want, you may click the **Start Carts** button a couple of times to get used to what the simulation is showing you. Use the **Reset Carts** button to reset the carts to their starting position between trials.

When you're ready, click **Start Carts** one last time and record the photogate data in the chart below. Also add the length data from part II into the chart to help organize your work. For the case in which the carts are stuck together, be sure to add the carts' lengths.

Now that you know both how carts the carts are, and how long it took that length to pass through each photogate, you can calculate the carts' velocities and add them to the table as well.

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

Part IV: Calculate the Momenta

Using the formula $\rho = mv$ (momentum = mass × velocity), calculate the momentum of each cart and record your results below. (You already found the masses and velocities of the carts in parts II and III, so you can just copy them here for convenience.) Be sure to use the total mass of the two carts when the green and purple cart are stuck together.

	Mass	Velocity	Momentum
Green cart before collision			
Purple cart before collision			
Carts (stuck) after collision			

Now calculate the total momentum of the two carts before and after the collision. Note that after the collision, there is only one set of carts stuck together, so the single measurement for the stuck carts is the total.

	Momentum (green)	Momentum (purple)	Momentum (total)
Before collision			
After collision	------	------	

You and your instructor may wish to review your results at this point, so that you can correct any errors before repeating them in the next set of calculations.

Part V: An Elastic Collsion

This time, set the **CArts' Directions** to **Opposite** and the **Collision Type** to **Elastic**. The procecdure will be the same from parts III and IV, but there is an important change to the calculations.

Cars going opposite directions have velocities with opposite signs. Most people choose to give carts moving to the right positive velocities and carts moving to the left negative velocities. If you forget to consider whether the velocites are positive or negative when you calculate momentum, you will not get the expected results.

As you work, be careful to distinguish which photogates measure pre-collision times and which measure post-collision. The arrows above the photogates help with this by showing which direction of travel is being measured. As before, you may wish to click **Start Carts** and watch a dry run or two before you take your data.

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

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

	Momentum (green)	Momentum (purple)	Momentum (total)
Before collision			
After collision			

Part VI: Your Choice of Conditions

Now repeat the experiment once more, but this time with your choice of conditions. Select any combination of **Carts' Directions** and **Collision Type** that you haven't used already.

Carts' Directions _____ Collision Type _____

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

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

	Momentum (green)	Momentum (purple)	Momentum (total)
Before collision			
After collision			

Part VII: Draw 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 phenomenon you should have noted in the previous question is called *conservation of momentum*. Based on this, what do you think it means to say that something is *conserved* in the context of physics?