Name _____ Date _____ Period _____

Elastic and Inelastic Collisions

Part I: Open the Lab

In your web browser (mobile phones not recommended), navigate to www.gigaphysics.com, then click **Virtual Labs** in the heading bar and **Conservation of Momentum** from the list of labs. If you're using a computer that someone else just used for this lab, you should also click the **New Experiment** button to obtain your own random cart data.

Part II: Measure the Carts

You will need the length and mass of each cart to perform the calculations in the rest of the lab. To find the mass, use the mouse to drag the cart over the electronic balance and release the cart on top of the balance. The balance reads in grams. Do this for both carts and record your data in the table below. (To return the carts to the track, you can drag the carts anywhere off the balance or click the **Reset Carts** button.)

To find the carts' lengths, drag the ruler to the carts. Though the ruler contains tick marks only every centimeter, try to estimate the tenths digit. Also convert your values to meters and kilograms if you want to use SI units.

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

Warning: If you do not complete this lab all in one sitting, or if you click the **New Experiment** button, this data will change, and you will have to take new measurements to use for the remainder of the lab!

Part III: Determine the Carts' Velocities (Inelastic case)

Set the **Carts' Direction** to same direction and the **Collision Behavior** to inelastic. Click the **Start Carts** button and watch what happens. You will see the carts pass through the various photogates, and when they do, the time it takes the cart to pass through the photogate will appear on the display. Notice the purple and green arrows to help you keep track of which cart was being measured. The arrow that is half green and half purple indicates that the carts are stuck together as they pass that point. If you want, you can hit the Start Carts button a couple of times to get used to what the simulation is showing you.

When you're ready, hit **Start Carts** one last time and record the photogate data in the chart below. (The photogate timers read in seconds.) Also add the length data from above into the chart to help organize your work. For the case in which the carts are stuck together, be sure to add the lengths of the carts. Then use the lengths of the carts and the times it took to pass through the photogate to calculate the carts' velocities.

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

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Part IV: Calculate the Carts' Momenta and Kinetic Energies

Using the masses from part II and the velocity from part III, calculate the momentum and kinetic energy for each cart and enter your results in the table below. Remember to use the total mass of the two carts when the two are stuck together.

	Mass	Velocity	Momentum	Kinetic energy
Purple cart before collision				
Green cart before collision				
Carts stuck together after collision				

Now add the results for each cart to find the total momenta and kinetic energies of the two carts before and after the collision.

	Total momentum	Total kinetic energy
Before collision		
After collision		

Assuming your instructor wants you to, it may be wise to show your results to your instructor before proceeding. That way you can correct any errors before repeating them in the next set of calculations.

Part V: Compare the Elastic Case

Now repeat the procedure with the **Carts' Direction** menu set to same direction and the **Collision Behavior** to elastic.

	Elapsed time	Length	Velocity
Purple cart before collision			
Green cart before collision			
Purple cart after collision			
Green cart after collision			

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

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	Total momentum	Total kinetic energy
Before collision		
After collision		

Part VI: The Partially Elastic Case

Repeat the procedure one more time, this time with the **Carts' Direction** menu set to same direction and the **Collision Behavior** to partially elastic.

	Elapsed time	Length	Velocity
Purple cart before collision			
Green cart before collision			
Purple cart after collision			
Green cart after collision			

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

	Total momentum	Total kinetic energy
Before collision		
After collision		

Part VII: Draw Conclusions

Remember that when physicists say that something is conserved, they mean that it can never be created or destroyed. In other words, if something is conserved, then the amount of the quantity at the beginning of a process and the end of the process must be the same.

Using this definition and your calculations from this lab, fill in each cell of the chart below.

	Is momentum conserved?	Is kinetic energy conserved?
Inelastic collision		
Elastic collision		

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Summarize your conclusions by filling in the blanks in the sentence below.

_____ is conserved in all kinds of collisions, whether elastic or inelastic, but _____ is conserved only in elastic collisions.

Based on your results in part VI, does a partially elastic collision act like an elastic collision or an inelastic collision with respect to the basic principle above? Explain.

Suppose that you wanted to use either conservation of momentum or conservation of kinetic energy to predict the outcome when a large car collides with a smaller car in a demolition derby. Which of the two would be more appropriate for your calculation? Explain.