Name _____ Section_____

Problem Statement: How is heat transferred between substances?

I. Data Collection
A. Go to https://media.pearsoncmg.com/bc/bc_0media_chem/chem_sim/calorimetry/Calor.php. The simulation will open to an image of the calorimeter setup, which is quickly replaced with a new screen with an Overview page. You are welcome to read the Overview Page, and by clicking on the Learning Outcomes tab near the top of the display, you may read the Learning Outcomes Page. After reviewing these two pages click on the Experiment tab. When the screen changes the page will show two buttons: Run Demonstration button and Run Experiment button. You are welcome to click on the Run Demonstration button, but the instructions below are for the Run Experiment button. After clicking on the Run Experimental button the screen will look like Figure I.
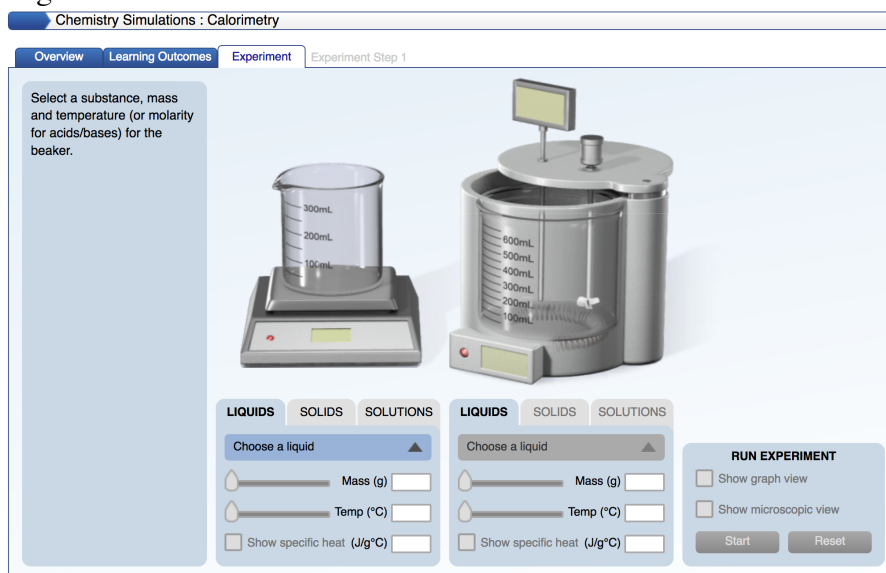

Figure I. Experimental Setup for the Calorimetry Simulation

The Experimental setup shows a beaker on a hot plate to the left, and a calorimeter on the right. Below the beaker and hot plate are three tabs (Liquids, Solids and Solutions). In this activity you will be using the Solids tab beneath the beaker and hotplate, and the Liquids tab beneath the calorimeter.

B. Beneath the beaker and hot plate click on the Solids tab and select Ag. Adjust mass to 20.0 g and adjust the temperature to 200. °C. Click the Next button in the left frame near the bottom of the screen. Now click on the Liquids tab beneath the calorimeter and add 30.00 g of water and adjust the water temperature to 20.00 °C. Record the beginning conditions in the Table I below.

Table I.

	Ag	water
Mass		
Initial Temp		
Final Temp		
Change in Temp		
Heat Content		

C. In the Run Experiment section click on the Start button. What do you observe happening? Record the final conditions of Ag and the water in the table above.

II. Data Analysis and Interpretation

A. Which substance, Ag or water, loses heat when they are combined? Which substance, Ag or water, gains heat when they are combined? Which process is endothermic and which is exothermic?

B. Calculate the heat (q) transferred to or from Ag. Use the equation $q = m \, C_S \, \Delta t$ (q is heat in Joules, m is mass, C_S is the heat content, and Δt is the change in temperature).

C. Calculate the heat (q) transferred to or from water.

D. Compare the heats associated with the Ag and water. Make a generalization concerning these heats.

E. How would your results have been different if you had used different amounts of Ag and water starting at different temperatures? Try this out by doing new experiments with Ag and water and report your results below.

III. Particulate Level View

    A. Repeat the experiment you set up in I.B. above. This time be sure to check the box to show the microscopic view. You may want to repeat the experiment with the box selected to see all of the different behaviors. In the space below draw a picture depicting a microscopic view of a piece of solid silver metal in liquid water.
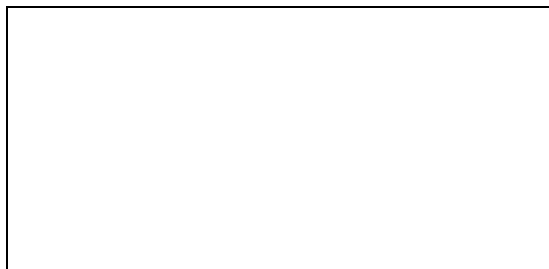
    B. In II. A. you indicated which substance lost heat and which substance gained heat when a hot piece of silver metal is added to water at room temperature. Using words, and if you like, pictures describe <u>how</u> heat was transferred between the two substances. Be sure to include what you observed happening to the atoms of silver and molecules of water, during the period just after they were added to each other and until the final temperature was reached, that would help explain how heat is transferred.

IV. Data Collection
Repeat the experiment for Au, Cu, and Fe. Record the data you collect in the following table.

	Au	water	Cu	water	Fe	water
m						
t_i						
t_f						
Dt						
C_s						
q						
molar heat capacity						

V. Data Analysis and Interpretation

A. Calculate the heat lost or gained by each metal. Show your work for one of the calculations below.

B. Compare the results for all four metals. How are these metals different from each other?

C. Which of these metals would make the best cookware? Explain your answer.

D. Calculate the molar heat capacity for Au, Cu, and Fe in units of $\dfrac{J}{mol\ °C}$. Record the value in the table on the previous page. Compare the molar heat capacity for each of the metals.

VI. Conclusions

A. Repeat the experiment for the unknown metals. Record the data you collect in the following table.

	Unknown I	water	Unknown II	water
m				
t_i				
t_f				
Dt				
C_s				
q				

B. Calculate values for the heat contents for the two unknown metals.

C. Based on the comparison you made in IV.D., estimate the molar heat capacity for each unknown metal.

D. Calculate the molar mass of each unknown metal.

E. Assuming the unknown metals are pure substances, identify them. Show how you arrived at your answers below.