Name_____ Date_____Period_____
Regents Chemistry
Long Beach High School Laboratory Experiment #_____

Specific Heat of a Metal

Pre-Lab: Complete on looseleaf, will be stapled into your lab notebooks

- Summarize the procedure in your own words, including materials that will be used
- List ALL safety precautions that must be taken during this lab experiment
- Create an organized data table with units that includes the 4 masses and 3 temperatures you will record (see Data section below)

Background:
Chemists identify substances on the basis of their chemical and physical properties. One intensive physical property is specific heat (c) – the amount of heat energy needed to raise the temperature of one gram of a material by one degree Celsius. In this lab, a calorimeter will be used in order to calculate a heat change. **Based on the Law of Conservation of Energy, heat released by a hot object (metal) must be equal to the absorbed by a** cool object (water in calorimeter).

Research Questions:

- How can the Law of Conservation of Energy be used to determine and calculate the specific heat capacity of a metal?
- Which metal transfers more heat and why?

Your Task:
Using a calorimeter, you will determine which substance (aluminum or copper) transfers more heat energy. The mathematical model below will be used in your calculations. Remember that heat lost by the metal is equal to heat gained by the water.

Mathematical Model: $q = mc\Delta T$

q= *heat*

m= *mass*

c = *specific heat of water*

ΔT = *the change in temperature*

Materials:
Thermometer, electronic balance, 400 mL beaker, metal cylinder, ring stand, wire gauze, calorimeter cups, Bunsen burner, tongs

Procedure:
1. Write down the identity of your metal _____
2. Use the electronic balance to determine the mass of your metal. Make sure the balance is zeroed before recording any measurement (as demonstrated by your teacher). **RECORD** it in the **data table of your own making in your lab notebook**.
3. **You must have your data tables checked before conducting your experiment. Every member of the group must have a complete notebook!!!**

4. Bring about 200mL of water to a boil in a 400mL beaker. Once the water boils, place the metal in this boiling water. Continue to heat the boiling water with the metal for 5 additional minutes. Move on to the next step as this process goes on.
5. While waiting for the water to boil, measure the mass of the calorimeter cup alone. Zero the balance first! **RECORD!!**
6. Fill the cup 2/3 of the way with cool tap water. Measure the mass of the calorimeter cup and the water together (carefully). Zero the balance first! **RECORD!!**
7. **Calculate** the mass of JUST the water. **RECORD!!**
8. Measure the temperature of the cold tap water but NOT UNTIL you are just about to place the hot metal into it. **RECORD!!**
9. After 5 minutes have elapsed (see step 4) **RECORD** the temperature of the boiling water. **Assume the temperature of the water is the temperature of the metal.**
10. Remove the metal from the boiling water and QUICKLY place it in the calorimeter using your tongs. Cover the calorimeter immediately (as demonstrated by your teacher).
11. Stir the mixture GENTLY with the thermometer until a constant temperature is reached. **RECORD** the final temperature of the mixture.

Data:
You will need 4 masses and 3 temperatures (create an organized table and include units **as part of your pre-lab assignment**)

Questions/Calculations: SHOW ALL WORK!! Complete on looseleaf paper!! All numerical answers must be labeled as to what they are.

1. Calculate the heat gained **by the tap water** in the calorimeter by doing a $q=mC\Delta T$ for **the tap water**. (q = mass tap water **x** "C"$_{\text{tap water}}$ **x** ΔT of the tap water)

2. The heat (q) from question 1 also represents the heat LOST **by the metal.** Use $q=mC\Delta T$ to solve for "C", the specific heat of the metal. Realize, you have "q" from question 1, "m" is the mass of the metal, and ΔT is the temperature change **of the metal**. (ΔT of the metal is **NOT EQUAL** to ΔT of tap water).

3. Find the accepted value for the specific heat of your metal, in joules. **Cite your source.** Calculate the percent error. SHOW ALL WORK!!

4. Find and state the accepted value for the specific heat of the OTHER metal, in joules. **Cite your source.** Remember you will need this to compare the two (copper and aluminum) as you answer one of your research questions.

5. A 25 gram mass of metal "X" at 100°C is placed in 100g of water in a calorimeter at 18°C. The temperature of the water rises to 22°C. Calculate the specific heat of the metal. **SHOW ALL WORK or get no credit!**

Lab Notebook:
Must include the Pre-Lab stapled in, Research Question, Claim, Evidence, and Data Table

Conclusion: See Lab Report Format Handout for "Reasoning" guidelines. On looseleaf!!
Your reasoning should include scientific principles related to heat transfer, including specific heat concepts in order to explain how the evidence supports EACH of your claims based on the TWO research questions. Include possible sources of **UNAVOIDABLE** errors at the end of your reasoning.