

Name:

Period:

Seat#:

Required Sections: (Refer to R-5 for guidelines and requirements. Make note of any specific changes given by your teacher in class)

Prelab: Prelab Questions, Materials, Procedures, and set up Data Table before you get to class.

During Lab: Data section – Fill out your data table that is already set up from the prelab.

Post-lab: Calculation section, Post Lab Discussion Questions section, Post-Lab Two Pager done on separate worksheet.

Pre-Lab Questions

1. Define thermochemistry
2. Define specific heat
3. Write the equation used to determine heat transferred.
 - o What does each variable stand for?
 - o What are their units?
4. Explain what the algebraic sign represents when calculating heat transferred.
5. Describe the process of calorimetry.
 - o How is it used?
 - o What key Law allows us to do the math in calorimetry?

Concepts:

1st Law of Thermodynamics

Specific Heat

Calorimetry

Materials

Hot plate

400-600 ml Beaker

Thermometer

Metal Cubes

Graduated Cylinder

Styrofoam cup with lid

Water

Balance

Tongs

Procedure:

- 1) Measure the mass of your metal cube.
- 2) Place the metal cube into the 250ml beaker and submerge with water. Start a hot water bath in a beaker. Crank the hot plate to 450°C. Be sure the water level will cover the metal cube when submerged
- 3) Measure 75 ml of tap water and record the mass on your data table. Pour the 75 ml of water into the Styrofoam calorimeter
- 4) Measure and record the temperature of the water in the calorimeter on your data table as T_{initial} for the water
- 5) When the water is boiling, start the time for 4 minutes. Assume the temperature of boiling water is the temperature of the metal and record as T_{initial} for the metal cube. Do NOT assume the water is boiling at 100°C exactly – it may not be pure water, and your thermometer may not be calibrated. You need to actually take the temperature to help insure good calculations!
- 6) Using tongs remove the metal cube from the boiling water and quickly transfer it to the Styrofoam calorimeter containing the 75 ml of water. Quickly place a lid on the cup and insert the thermometer.
- 7) Record the highest temperature of the water and record as T_{final} for the water and the metal
- 8) Perform a second trial on the same metal block so you can average your results.
- 9) Perform the lab again (steps 1-8) with a second metal block. If your instructor has enough calorimeters you may be able to do the second metal cube at the same time by running two calorimeters at once.

Safety Precautions

Remember that hot and cold glass, and hot and cold metal cubes will look the same! Do not burn yourself! Assume things are hot if you do not know otherwise!

Dougherty Valley HS Chemistry

Thermochem – Identifying an Unknown Metal with Specific Heat

Data Table

Remember, you need to make sure your data table has all required elements!
This is just to get you started on the right track.

Descriptive Title for Data Table				
	Trial One		Trial Two	
	75 ml H ₂ O	Metal Cube #1	75 ml H ₂ O	Metal Cube #1
Mass (g)				
T _{initial} (Celsius)				
T _{final} (Celsius)				
ΔT (Celsius)				
Q (energy in J)				
	Trial One		Trial Two	
	75 ml H ₂ O	Metal Cube #2	75 ml H ₂ O	Metal Cube #2
Mass (g)				
T _{initial} (Celsius)				
T _{final} (Celsius)				
ΔT (Celsius)				
Q (energy in J)				

Calculations PLEASE BOX FINAL ANSWERS!

- Calculate (Q) for water using $Q = (m)(C)(\Delta T)$
- Calculate the specific heat (C) for the metal using the same equation in #1. Remember that $q_{\text{water}} = -q_{\text{metal}}$.
- Using the chart below, identify the metal(s) that you tested. Support with evidence (your calculations/results).
- Calculate your % error based on which metal(s) you believe you had.

Metal	Specific Heat (J/g°C)
Steel	0.46
Lead	0.130
Aluminum	0.903
Brass	0.376
Gold	0.129
Niobium	0.265
Krypton	0.248
Copper	0.385

$$\% \text{ error} = \frac{|\text{Accepted value} - \text{Experimental Value}|}{\text{Accepted value}} \times 100\%$$

Post Lab Discussion Questions

- If a student did a similar lab but instead of unknown metal cubes, they used a small brass pipe fitting (fitting #1) and a large brass pipe fitting (fitting #2) that they found at Home Depot. Identify which variables should be the same, which will be different, which will be bigger and which will be smaller. Be sure to include the following variables: m, C, T_{initial}, T_{final}, Q.
- A 50.6 g sample of iron metal is heated and put into 104 g of water at 19.7°C in a calorimeter. If the final temperature of the iron sample and the water is 24.3°C, what is the temperature of the iron sample when it was placed in the water? Show all work to receive full credit. *Put a box around your final answer.*
- If 40.0 g of water at 70.0°C is mixed with 40.0 g of ethanol at 10.0°C, what is the final temperature of the mixture? (*Hint: the heat lost by the water equals the heat gained by the ethanol. Assume no heat loss to the surroundings*). Show all work to receive full credit. *Put a box around your final answer.*