Name:_______________________________ Date:_____________________

Lab # ____ Specific Heat

Minutes: ___

Aim: Determine the specific heat of an unknown metal and use this physical property to identify the metal.

Vocabulary (Define) (10 points):

1. Law of conservation of energy: ____
   ____
2. Heat: ____
3. Temperature:____
4. Specific Heat: ____

Background: Calorimetry is a laboratory technique in which we can measure the quantity of heat transferred from a substance with a known heat capacity (specific heat) (water) to one with an unknown specific heat (our unknown metal). Using the Law of Conservation of Energy, we can then solve for the specific heat of the unknown and use that physical property to help identify the unknown.

Materials:

Unknown Metal Sample (about 50g)
Scale
Weighing boat
Large Test Tube
400mL Beaker
Ring Stand
Hot Plate
Pinch Clamp (2)
Thermometer (2)
Calorimeter
Water
Hot Mitt
Goggles

Method:

1. Preparation and mass of sample: Measure and record the mass of approximately 50g of the unknown metal on the scale (use a weighing boat as a tare).

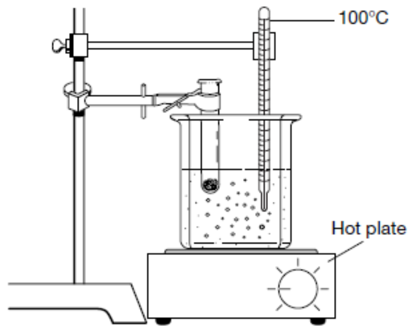
2. Transfer the metal into a clean, empty large test tube.

3. Heating the sample:

   a. Set up a ring stand with two clamps – one to hold the test tube with the metal and one to hold a thermometer.

b. Fill a 400mL beaker halfway with water. Place the beaker on a hot plate next to the ring stand so that thermometer and test tube are sitting in water. The entire bulb of the thermometer and the full mass of the metal should be immersed within the water (see diagram).

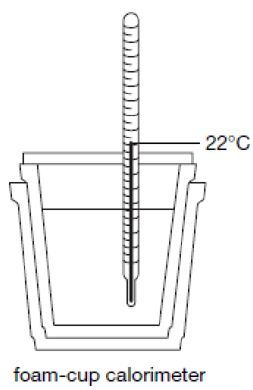
c. Turn on the hot plate and heat water bath to 100°C. Heat test tube for at least 3 minutes after water reaches 100°C (or a constant temperature). Record this as the initial temperature of the unknown metal.



4. Mass of water: Measure and record the volume of approximately 100mL of water. Compute the mass of the water (remember density of water = 1g/mL).

5. Transfer the water to the calorimeter.

6. Place second thermometer into the calorimeter so that the bulb is immersed in the water. Measure and record the initial temperature of the water in the calorimeter.



7. Using a hot mitt, carefully and quickly transfer the metal from the test tube into the calorimeter. Students may wish to rehearse this transfer in order to minimize the amount of time the metal is outside the closed system.

8. Monitor the temperature in the calorimeter and record the highest temperature (this will be the final temperature of both the metal and the water).

Data Table (15 points): ***5 points deducted for lack of precision in recording measurements!***

Steps	Quantity	Metal	Water
1, 4	**Mass**		
3c, 6	**Initial temperature**		
8	**Final temperature**		

Questions (15 points):

1. What caused the temperature of the water in the calorimeter to increase?
   ____
   ____

2. Which had the larger temperature change, the metal or the water?_______
   Why?:____
   ____
   ____

3. Why was the final temperature of the water the same as the metal? (Explain in terms of heat flow)?
   ____
   ____
   ____

Calculations (25 points):

1. Calculate the heat gained by the water? (use $q=mc\Delta T$, c is the specific heat of the water and $\Delta T = T_{final} - T_{initial}$ for the water): (10 points)

2. How much heat was given off by the metal? (Remember the Law of Conservation of Energy)(5 pts)

3. What is the specific heat of the metal? (10 points)
   (again use $q=mc\Delta T$, only this time c is the unknown and $\Delta T = T_{initial} - T_{final}$ for the metal)

Percent Error (5 points): Given the following values for specific heat capacities of some metals, which metal was likely the unknown?______________________

Metal	**Specific heat (J/gK)**
Magnesium	1.05
Aluminum	0.91
Nickel	0.44
Copper	0.39
Tin	0.21
Gold	0.13

Based on your selection above, what is the percent error in your measurement of specific heat (c) for your metal? (show formula, numerical setup, and solution):

CLAIM, EVIDENCE, REASONING (30 points):

CLAIM: ____

____

EVIDENCE: ____

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REASONING: ____

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