**Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Date\_\_\_\_\_\_\_\_\_\_Hour\_\_\_\_\_\_\_**

**Specific Heats of Metals (40 pts)**

**Purpose:** Identify the unknown metal by calculating the specific heat using a calorimeter.

**Materials:** Hot Plate, two beakers 400 mL or larger, one sample of unknown metal, two Styrofoam cups, thermometer, graduated cylinder, hot mitt

**Procedure:**

1. Place a beaker ¾ full of water on a hot plate to boil. While you’re waiting for it to boil, you can go on to the next step.
2. Find the mass of enough metal to fill up your test tube about half way. Record this mass in your data table.
3. Record the mass of a pair of Styrofoam cups—this is your calorimeter. (stack one inside the other).
4. With a graduated cylinder, measure approximately 75.0 mL of water to the cups. Record the mass of the calorimeter and water.
5. Place the stacked cups inside a larger beaker for stability during the experiment.
6. Once the water on the hot plate starts to boil, while wearing heat protection, slowly lower the test tube filled with metal into the boiling water. Let the metal sit in the boiling water for at least 10 minutes—you want to ensure that the metal reaches the same temperature as the boiling water.
7. Take the temperature of the boiling water. **\*Be sure not to touch the bottom of the beaker with your thermometer.\*Be sure you let the thermometer cool to room temperature before beginning the next step**. This will be the initial temperature of your metal (realize that the metal will be sitting in the boiling water and should now be the same temperature as the water) and record it in your data table. Dry off your thermometer.
8. Take the temperature of the water in your calorimeter and record it in your data table.
9. While wearing heat protection, quickly remove the test tube from the boiling water and pour the metal directly into your calorimeter. Immediately begin to stir the water (without touching the metal) and closely watch your thermometer. The temperature of the water should rise after adding the hot metal. **Once the temperature stops increasing, or begins to decline, record the highest temperature you saw.**
10. Repeat the process for a second trial (and a third if there’s time). (Hint—the mass of the metal and the Styrofoam cups should be the same for all three trials. Make sure you dry off your metal and calorimeter in between trials.)

**Data Table: Mass and Temperature Data (6 pts)**

|  |  |  |
| --- | --- | --- |
| Trial 1 | Trial 2 | Trial 3  (optional) |
| Mass of Metal(g) |  |  |  |
| Mass of Calorimeter (g) |  |  |  |
| Mass of Calorimeter and water (g) |  |  |  |
| Temp of the Boiling water after 10 min. (⁰C) **\*\*Initial Temp of metal\*\*** |  |  |  |
| Temp of cool water in calorimeter (⁰C)  **\*\*Initial Temp of water\*\*** |  |  |  |
| Temp of water-metal mix (highest temp) (⁰C) \*\***final temp of water and metal\*\*** |  |  |  |

**Calculations: 20 pts total**

1. Mass of the water in the calorimeter (3 pts- eqn/number subs, ans/unit, s.f.).
2. Specific Heat of the Metal (7 points-eqn, work – 3pt , ans, unit, s.f.)

(Note: heat gained by water = -heat lost by the metal OR mcΔTwater = - m**c**ΔTmetal)

↑

You are solving for this!

**Trial 1 Calculations (10 pts):**



**Trial 2 Calculations (10 pts):**



**Sample #\_\_\_\_\_\_\_Identity of unknown metal sample: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (correct 2 pts)**

Choose from the list:

Lead 0.16 J/g °C Zinc 0.39 J/g °C Magnesium 1.05 J/g°C

Nickel 0.44 J/g °C Aluminum 0.89 J/g°C Tin 0.21 J/g °C

Silver 0.24 J/g °C Brass 0.09 J/g °C

**Conclusion (12 points):**

**Please include**

* Restatement of the purpose of the lab. (1 pt)
* Define and discuss the concept of specific heat. (2pts)
* Explain how a calorimeter works. (2 pts)
* What claim do you make as to the identity of the unknown metal? (1 pts)
* What evidence do you have to justify the findings? (2 pts)
* List at least **two possible reasons for error** in this lab and **explain how your error affected the results.** Massing wrong or doing your math wrong is NOT a source of error! (2 pts)
  + Possible error to examine:

-Try to think about what assumptions were made in this experiment?

-Was there anything that occurred that may have caused your results to be less accurate?

* Explain in terms of specific heat capacity why the temperature decrease of the metal was so much greater than the temperature rise of the water? (2 pts)

Conclusion:

|  |  |  |
| --- | --- | --- |
| Lab report requirements  Points | | |
| Title |  | 1 |
| Purpose |  | 1 |
| Background information | Concept of specific heat is defined and discussed.  Explain how a calorimeter works.  All equations that will be used in the lab are listed. | 3 |
| Materials |  | 1 |
| Procedure | Numbered steps, clear, correct, logical, complete  Should be easily replicable | 10 |
| Data Table | Correct sig figs, units, complete | 3 |
| Calculations | Sample calculation shown, correct sig figs, units, correct answer | 12 |
| Identify Unknown | Unknown is correctly identified based on specific heat capacity. | 2 |
| Conclusion | Includes all of the bullet points listed in the conclusion section above. | 7 |