

Name: _____ Date: _____ Block: _____

Calorimetry FRQ



A student is to determine the enthalpy change for the reaction between solid MgO and aqueous HCl represented by the net-ionic equation above. The student is to use a coffee cup calorimeter.

a) The student only has the materials below to perform this lab. Briefly describe the steps the student should take to perform this lab. Steps should be clear and concise. The student need not use all available materials.

- Balance
- Polystyrene cups
- Thermometer
- Lid
- 100 mL graduated cylinder
- 100 mL beaker
- 250 mL Erlenmeyer flask
- Stirring rod
- Solid MgO
- 1.0 M HCl(aq)

The student uses the coffee cup calorimeter and performs four trials. Data for each trial are shown in the table below.

Trial	Volume of 1.0 M HCl (mL)	Mass of MgO(s) Added (g)	Initial Temperature of Solution (°C)	Final Temperature of Solution (°C)
1	100.0	0.25	25.5	26.5
2	100.0	0.50	25.0	29.1
3	100.0	0.25	26.0	28.1
4	100.0	0.50	24.1	28.1

- b) Which is the limiting reactant in all four trials, HCl or MgO? Justify your answer.
- c) The data in one of the trials is inconsistent with the data in the other three trials. Which trial is inconsistent? Explain how you identified the inconsistent data.

For parts (d) and (e), use the data from one of the other three trials (i.e., not from the trial you identified in part (c) above. Assume the calorimeter has a negligible heat capacity and that the specific heat of the contents of the calorimeter is $4.18 \text{ J/(g} \cdot \text{ }^\circ\text{C)}$

- d) Calculate the magnitude of q , the thermal energy change, when MgO was added to the 1.0 M HCl(aq). Include units with your answer.
- e) Determine the student's experimental value of ΔH° for the reaction between MgO and HCl in units of $\text{kJ/mol}_{\text{rxn}}$.
- f) Enthalpies of formation for substances involved in the reaction are shown in the table below. Using the information in the table, determine the accepted value of ΔH° for the reaction between MgO(s) and HCl(aq).

Substance	ΔH_f° (kJ/mol)
MgO(s)	-602
H ₂ O(l)	-286
H ⁺ (aq)	0
Mg ²⁺ (aq)	-467

- g) The accepted value and the experimental value do not agree. If the calorimeter leaked heat energy to the environment, would it help account for the discrepancy between the values? Explain.
- h) Based on your answer to part (f), indicate whether the statement in the box is true or false. Justify your answer.

The sum of the bond energies of the reactants is greater than that of the products.