Thermochemistry Lab #3: Enthalpy Reaction of Magnesium; SC5 a,b,c

Introduction: The Heat of Reaction (also known and Enthalpy of Reaction) is the change in the enthalpy of a chemical reaction that occurs at a constant pressure. It is a thermodynamic unit of measurement useful for calculating the amount of energy per mole either released or produced in a reaction. Since enthalpy is derived from pressure, volume, and internal energy, all of which are state functions. In this lab, the mass of a measured length of polished magnesium ribbon is determined. A small length of ribbon is cut and its length measured. From the length of the small piece, its mass is calculated. A known volume of acid is placed in a calorimeter. The temperature is measured. The magnesium is added to the calorimeter, and a reaction takes place. The temperature is measured once reaction ceases. From the mass of ribbon reacted, the temperature increase, and the volume of acid used, the heat of formation of Mg^{2+}(aq) is determined. The purpose of this lab is to calculate the enthalpy of reaction for magnesium using a calorimeter and to compare this experimental value with the accepted (known) value. Please note that magnesium burns in a very exothermic reaction. Never look directly at burning magnesium. Cuts when polishing the magnesium metal are possible. The dilute acid is corrosive. Keep magnesium away from ignition sources such as open flames. Wear gloves when polishing the magnesium metal ribbon. Wear eye protection; wash acid spills immediately.

Demonstration: Place 100 mL of 3 M hydrochloric acid in a 250-mL beaker. Fold a 10-cm length of magnesium ribbon, place in the solution, and note evidence for reaction. This will be done as a demonstration.

Experiment:

1. Carefully measure and record the length of one of the cut pieces of polished magnesium ribbon. Obtain the mass of a 1.00 meter length of polished magnesium ribbon from your instructor.

2. Crumple the piece of magnesium into a small ball.

3. Pour 50-60 mL of 3 M hydrochloric acid into a 100-mL cylinder. Measure and record the exact volume to the nearest 0.2 mL.

4. Assemble a calorimeter as shown in the diagram to the right.

5. Pour the measured volume of acid into the inner calorimeter cup. Cover. Insert the thermometer. Read and record the temperature to the nearest 0.1 °C at regular intervals until it becomes constant.

6. Add the crumpled magnesium to the acid solution. Swirl gently. Note the temperature.

7. Record the maximum temperature reached by the hydrochloric acid solution.
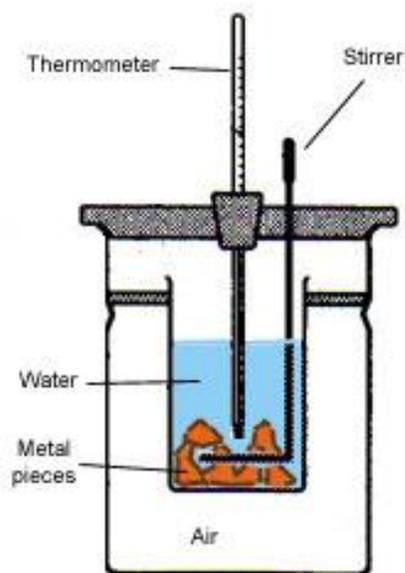
Data Table: (transcribe the data table below)

length magnesium ribbon (cm)	
mass Mg/ m (provided by instructor)	
mass Mg used	
mol Mg used	
volume HCl (mL)	
initial temperature, °C	
maximum temperature, °C	
temperature rise, °C	
energy released (J)	
energy released/ mol Mg (kJ/mol)	
Percent Error	

Accepted value = -462.0 kJ/mol at 25 °C for 1 M H^+

Post Lab Questions:

1. Write an equation for the reaction of magnesium metal with hydrochloric acid. Include the heat of reaction calculated above.

2. State the relationship between the heat of reaction for this reaction and the heat of formation of aqueous magnesium ion.

3. The accepted heat of formation of Mg^{2+}(aq) is -462.0 kJ/mol (25 °C, 1 M). Find the percent error for the experiment