

Revised January 2013



AP LAB 9b: Indirect Enthalpy Changes



Aim To indirectly determine the enthalpy change for the combustion of magnesium

Apparatus Coffee-cup calorimeter, thermometer, weighing boat, spatula, goggles, electronic balance

Chemicals 1.00 M HCl, MgO solid, Mg ribbon

Method

Part A:

1. Mass 20.0 g of 1.00 M HCl into the coffee cup calorimeter. Record the temperature of the acid.
2. Record the mass of 1.00 m of magnesium ribbon (you will NOT be using the whole, 1.00 m, rather you are simply recording the mass of it).
3. Cut and measure 4.00 cm of magnesium ribbon and then cut the 4.00 cm piece into several, smaller pieces.
4. Add the small pieces of magnesium ribbon to the acid in the calorimeter.
5. Insert thermometer and gently stir the contents of the calorimeter and monitor the temperature. **Record the highest temperature reached.**

(N.B. This reaction gives off heat for quite a while and should be allowed to react until the temperature begins to fall.)

Part B:

1. Mass 20.0 g of 1.00 M HCl into the coffee cup calorimeter. Record the temperature of the acid.
2. Mass 0.35 g of magnesium oxide into a weighing boat.
3. Add the magnesium oxide powder to the acid in the calorimeter.
4. Insert thermometer and gently stir the contents of the calorimeter and monitor the temperature. **Record the highest temperature reached.**

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Results

Part A:

Mass of 1.00 M HCl solution used in g	
Mass of magnesium ribbon used in g	
Total mass of HCl and Mg in g	
Initial temperature of 1.00 M HCl solution before mixing in °C	
Final temperature of solution after Mg added in °C	
Change in solution temperature in °C	

Part B:

Mass of 1.00 M HCl solution used in g	
Mass of magnesium oxide used in g	
Total mass of HCl and MgO in g	
Initial temperature of 1.00 M HCl solution before mixing in °C	
Final temperature of solution after MgO added in °C	
Change in solution temperature in °C	

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Calculations/Conclusions

1. Write balanced equations for the reactions in Part A and Part B.

Part A:

Part B:

2. For the reactions in Parts A and B, calculate the heat of the reaction using, $q = m c \Delta T$
(The specific heat for the mixture = $3.97 \text{ J/g}^\circ\text{C}$ and assume that the calorimeter and surroundings do not absorb any energy).

Part A:

Part B:



- Using the values of J calculated in #2 above, convert to kJ/mol. (You need to use the moles of the limiting reactant in each case).

Part A:

Part B:

- The enthalpy of formation of water has a value of -285.5 kJ/mol. Write the equation for the formation of water from its elements.
- Combine the reaction in #4 with the reactions from Parts A and B in order to find the enthalpy change for the combustion of magnesium.

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6. Compare the experimental results with the accepted value for the enthalpy of combustion of magnesium (-603 kJ/mol) in order to calculate the percent error.

7. Was the net outcome of the reaction in this experiment endothermic or exothermic? Use your data to support your answer.

8. What could account for your percent error?

9. Could the net reaction of a three-reaction system be endothermic if two of the reactions in the system are exothermic? Explain.