Enthalpy Change of a reaction using Hess's Law

Objective-to determine the standard state Heat of Formation of Magnesium Oxide using Hess's Law

Prelab- Write the balanced equations for the following reactions

1. Magnesium burning

2. Magnesium reacting with 3M HCl

3. Magnesium Oxide reacting with 3m HCl

4. The standard state heat of formation reaction of liquid water

additional questions Prelab questions-

5. Look up the heat of formation of liquid water (reaction 4)

6. What are the units for specific heat capacity?

7. What are the typical units for H?

Materials

Styrofoam Cups 100mL graduated cylinder balance (massing paper)

Digital Thermometer 3M HCl MgO powder

Mg Strip stirring bar and hot plate mirror (optional)

Procedure- Reaction 1: Magnesium and HCl-

1. Mass the empty Styrofoam cup.

2. Carefully measure 100.mL of 3M HCl.

3. Mass the cup and HCl. Record the difference between 3 and 1 as the mass of HCl.

4. Slide stirring magnet into the HCl careful not to let it splash. Turn the stirrer on slow.

5. Record the initial temperature of the HCl.

6. Mass the magnesium ribbon (between 1.00g and 1.50g) and record the mass.

7. Roll the Mg into a ball, so it will sink in the HCl. Carefully drop the Mg in and record the highest temperature the reaction produces.

8. Dispose of the solution down the drain with copious amounts of water. Rinse everything and repeat.

Reaction 2: MgO and HCl

1. Mass the empty Styrofoam cup.

2. Carefully measure 100.mL of 3M HCl.

3. Mass the cup and HCl. Record the difference between 3 and 1 as the mass of HCl.

4.Slide stirring magnet into the HCl careful not to let it splash. Turn the stirrer on slow.

5. Record the initial temperature of the HCl.

6. Using massing paper, mass between 1.50g and 2.00g of MgO and record.

7. Carefully pour the MgO in and record the highest temperature the reaction produces.

8. Dispose of the solution down the drain with copious amounts of water. Rinse everything and repeat.

Data

|  |  |  |
| --- | --- | --- |
| Reaction 1 | Trial 1 | Trial 2 |
| Mass of HCl | g | g |
| Mass of Mg | g | g |
| Initial Temperature | oC | oC |
| Final Temperature | oC | oC |
| T | oC | oC |

|  |  |  |
| --- | --- | --- |
| Reaction 2 | Trial 1 | Trial 2 |
| Mass of HCl | g | g |
| Mass of MgO | g | g |
| Initial Temperature | oC | oC |
| Final Temperature | oC | oC |
| T | oC | oC |

Calculations

**Consider the Specific Heat Capacity of 3M HCl to be 4.05 Jg-1C-1‑**

1. Using your data, calculate the heat (q) produced in Reaction #1 and #2

Reaction #1 Trial #1

Trial #2

Reaction #2 Trial #1

Trial #2

2. Calculate the # of moles of Mg (24.31g mol-1) and MgO (40.31 g mol-1).

Reaction #1 Trial #1

Trial #2

Reaction #2 Trial #1

Trial #2

3. Using the heat from #1 and the moles from #2, calculate the H value(kJ/mol) for each trial of reaction #1 and #2. Determine the average for each.

Reaction #1 Trial #1

Trial #2

Reaction #2 Trial #1

Trial #2

Average Reaction #1 Average Reaction #2

4. Using the 2 reactions from this lab and the H f o for liquid water, determine the experimental heat of formation of MgO. (Show how the 3 reactions adds and their enthalpy add to attain the desired reaction and H value.)

5. Look up the actual Hof for MgO and calculate the % error.

Questions

1. For reaction #1, if 6M HCl had been used, how would the measurement and the resulting calculation of q have been different. How would the H value for #1 be affected?

2. For reaction #1, if twice the mass of Mg had been used, how would the measurement and the resulting calculation of q have been different. How would the H value for #1 be affected?

3. What is an important assumption that is made in this experiment concerning heat transfer?

4. We didn't cover the calorimeter. How would the calculation of the H f o of the MgO be affected if a large amount of heat were lost in reactions 1 and 2?

5. When performing any laboratory experiment, we try to keep errors to a minimum. State 2 errors that you could not control under our laboratory conditions.

Conclusion: