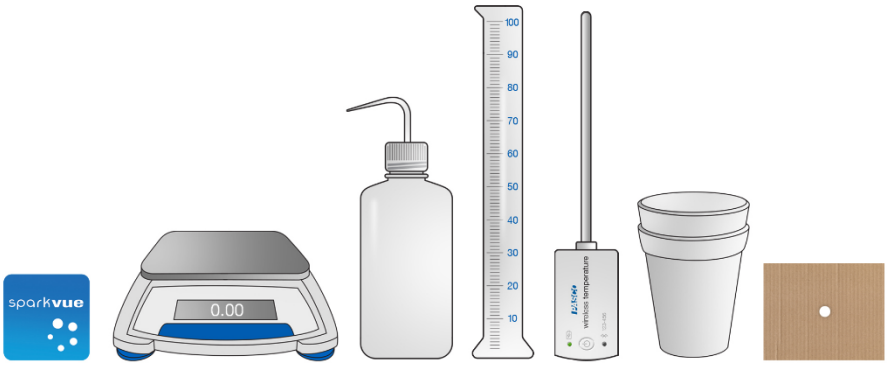
11C – HESS'S LAW

INQUIRY

How can you indirectly determine the heat of a reaction that you cannot experimentally perform?

MATERIALS

- Device with SPARKvue software
- Temperature sensor
- Graduated cylinder, 100-mL
- Balance (readability: 0.01 g)
- 1.0 M hydrochloric acid, 150 mL
- Magnesium ribbon, 0.6 g
- Magnesium oxide (MgO), 1.0 g
- Foam cup, 8-oz (2)
- Foam cup lid (or cardboard with sensor hole)
- Wash bottle with distilled water



BACKGROUND

We can use calorimetry to calculate the heat of chemical reactions. Some reactions are hard to perform experimentally, but we can still determine the heat of those reactions using Hess's Law. Hess's law allows us to determine indirectly the heat of a chemical reaction. If we can combine chemical equations into a new equation, we can also combine the enthalpy values for the known equations and add them together to get the enthalpy of the unknown equation.

In this experiment, we will determine the heat of formation of magnesium oxide (MgO) by measuring the energy associated with reactions that result in its formation. The total energy in the system that contains the MgO is conserved. The energy changes are path independent, so it does not matter how the MgO is formed. In this investigation, we will use our data to prove Hess's law.

SAFETY

Follow these important safety precautions in addition to your regular classroom procedures.

- Wear safety goggles at all times.

PROCEDURE

1. Open SPARKvue.
2. Open the 11C Hess's Law lab file in SPARKvue.
3. Use the Bluetooth icon to connect the Temperature sensor.

PROCEDURE

4. Weigh your empty double foam cup calorimeter assembly and record the mass in the space above Table 1 for Trial 1 on your answer sheet. Add 60.0 mL of 1.0 M HCl and reweigh. Record the total mass in the space above Table 1 then enter the mass of just the HCl solution inside Table 1.

5. Place the lid on the calorimeter and insert the Temperature sensor through the hole. Start collecting data. Once the temperature stabilizes, record the temperature of the HCl in Table 1.

6. Weigh approximately 0.6 g of Mg ribbon. Record the exact mass of Mg in Table 1.

7. Carefully add the Mg ribbon to your calorimeter containing the acid. Immediately place the cover over the mixture and stir gently.

8. Stop collecting data when the temperature levels off. Record the highest temperature reached and the change in temperature in Table 1.

9. When the reaction is complete, pour the mixture down the sink. Rinse the cup thoroughly (3 or 4 times) with tap water. Dry the inside and outside of the coffee cup calorimeter for the next reaction.

10. Weigh the empty double foam cups and record the mass in the space above Table 1 for Trial 2. Add 60.0 mL of 1.0 M HCl solution and reweigh. Record the total mass in the space above Table 1 then enter the mass of just the HCl solution in Table 1.

11. Place the lid on the calorimeter and insert the Temperature sensor through the hole. Start collecting data. Once the temperature stabilizes, record the initial temperature of the HCl in Table 1.

12. Weigh 1.0 g of MgO. Record the exact mass of the MgO in Table 1.

13. Add the MgO to your calorimeter containing the HCl. Cover the calorimeter and stir gently until all of the MgO has reacted.

14. Stop collecting data when the temperature levels off. Record the highest temperature reached and the change in temperature in Table 1.

15. Pour the mixture down the sink and rinse the cups thoroughly (3 or 4 times) with tap water. Dry the inside and outside of the cup.

ANALYSIS

Complete the analysis on your answer sheet.

QUESTIONS

Answer the questions on your answer sheet.