Name _____ Date _____ Class _____

LAB 8.2 LABORATORY MANUAL

Formation of a Salt

Use with Section 8.2

Please pass the sodium chloride! It is amazing that food is seasoned with an ionic compound that is composed of two deadly elements—sodium and chlorine. The gain or loss of electrons can make a big difference in properties. Reacting sodium hydrogen carbonate, which is baking soda, with hydrochloric acid (HCl), the acid found in your stomach, produces salt, carbon dioxide, and water, according to the following equation:

$$NaHCO_3(cr) + HCl(aq) \rightarrow NaCl(cr) + CO_2(g) + H_2O(l)$$

If we evaporate the water, then all that should remain is the salt, NaCl.

Problem

How can we form a salt?

Objectives

- **Observe** the reaction of $NaHCO_3$ with HCl.
- **Draw** the Lewis electron-dot diagrams for Na^+ and Cl^-.
- **Give examples** of how to identify an ionic compound such as NaCl.

Materials

6*M* HCl
$NaHCO_3$
100-mL beaker
10-mL graduated cylinder
dropper
phenol red indicator
distilled water
Bunsen burner
ring stand
ring clamp
wire gauze
microscope or hand lens
balance

Safety Precautions

- **Always wear safety goggles and a lab apron.**
- **Hot objects will not appear to be hot. Be careful when handling the cooling beaker.**
- **Do not touch or taste any chemicals used or formed in the laboratory.**
- **6*M* HCl is toxic by ingestion or inhalation and corrosive to the skin and eyes.**

Pre-Lab

1. Define ionic bond.
2. Write the electron configuration for each of the following: Na, Na^+, Cl, and Cl^-.
3. Identify the noble gases that Na^+ and Cl^- resemble in their electron configurations.
4. Draw the Lewis electron-dot diagrams for Na^+ and Cl^-.

Procedure

1. Mass a clean, dry 100-mL beaker.
2. Place 0.50 g of sodium hydrogen carbonate ($NaHCO_3$) into the beaker.
3. Add about 15 mL of distilled water to the beaker and swirl the solution gently to dissolve the sodium hydrogen carbonate. Add more water if necessary to dissolve the powder completely.

4. Add 2–3 drops of phenol red indicator. The solution should be red in color. Place a piece of white paper under the beaker to view the color of the solution better.
5. While gently swirling the beaker, add the hydrochloric acid by single drops until the color of the solution changes to a definite yellow.
6. Set up the apparatus as shown in **Figure A.** Gently heat the contents of the beaker to evaporate the water. **CAUTION: Do not heat the solution too much or it will spatter out of the beaker.** When only about 5 mL of water is left in the beaker, shut off the flame and allow the heat of the beaker to evaporate the rest of the water.

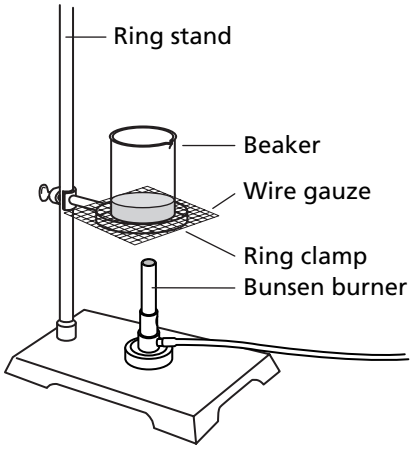

Figure A

7. Allow the beaker to cool for at least 5 minutes. **CAUTION: The beaker will appear cool before it is ready to be handled.**
8. Mass the cooled beaker with the white powder.
9. Examine the contents of the beaker. Examine the contents under a microscope or hand lens to see if the powder has the characteristic cubic shape of sodium chloride.
10. Record your data in the data table.

Cleanup and Disposal

1. Place unused chemicals in the waste can.
2. Rinse out the contents of your cooled beakers in the sink.
3. Make sure your balance is left in the same condition as you found it.
4. Be careful that your burner and clamp are cooled before putting them away.

Data and Observations

Mass of the empty beaker	g
Mass of the beaker + $NaHCO_3$	g
Mass of the $NaHCO_3$	g
Mass of the beaker + NaCl	g
Mass of the NaCl	g

1. As you added the hydrochloric acid, what did you observe?

_____

2. What gas was released during the chemical reaction?

_____

3. The sodium hydrogen carbonate underwent a chemical change. What evidence do you have of this change?

4. Describe the resulting white powder in the cooled beaker.

Analyze and Conclude

1. **Thinking Critically** How can you identify the product as being different from the reactant? **CAUTION: Remember never to taste anything in the laboratory.**

2. **Recognizing Cause and Effect** To make sure that the white powder was all sodium chloride and not mixed with sodium hydrogen carbonate, would you need to add a little less or a little more hydrochloric acid to the reaction? Explain your decision.

3. **Drawing a Conclusion** Knowing that this was a chemical reaction, explain why the mass of the product was different from the mass of the original sodium hydrogen carbonate.

4. **Error Analysis** What might have affected the accuracy of this investigation?

Real-World Chemistry

1. Sodium hydrogen carbonate is a common ingredient in antacid remedies. Using information from the equation for the reaction, explain how this chemical could relieve a stomach that contains excess acid.
2. Studies have proven conclusively that fluoride is an effective tooth decay preventative. As a result, in the late 1960s and 1970s, many communities in the United States began adding trace quantities of fluoride to their drinking water supplies. However, strong opposition arose against this "tampering" with the water supply. One of the common arguments was that fluorine was known to be a deadly gas. What would be your response to this argument?