Chem 1 Hour\_\_\_\_\_ Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
Dr. Wexler  
Lab: Formation of a Salt (HS-PS1-2)  
Date \_\_\_\_\_\_\_

**Brief Background:**   
A salt is an ionic compound formed by the reaction of a metal with a nonmetal . Table salt, for example, is composed of the elements sodium and chlorine. The reaction involves the gain of electron(s) by one element and the loss of electron(s) by the other.

**The balanced chemical equation is: HCl(aq) + NaHCO3(aq) → NaCl(aq) + H2O(l) + CO2(g)**This is a double replacement reaction.  
Note: H2CO3(aq) is initially produced, but this breaks down immediately into H2O(l) + CO2(g)

In this equation, 1 mole of hydrochloric acid reacts with 1 mole of sodium hydrogen carbonate to form 1 mole of sodium chloride, 1 mole of water, and 1 mole of carbon dioxide. From this, it is easy to predict that the number of moles of NaCl produced will be the same as the number of moles of NaHCO3 reacted.

However, since the molar masses of these two compounds are different, the mass of salt is expected to change during the reaction. Along with the production of gas and pH change, this is evidence that a chemical reaction has taken place.

**Objectives:**1. Observe the reaction of NaHCO3 with HCl  
2. Draw the Lewis electron-dot diagrams for Na, Cl, Na+ and Cl-   
3. Understand the dynamics of double replacement reactions  
4. Use observation to determine if a chemical reaction has occurred.

**Special Materials:**1M HCl (hydrochloric acid, muriatic acid)  
NaHCO3 (sodium bicarbonate, sodium hydrogen carbonate, baking soda)  
Phenol red pH indicator (its color exhibits a gradual transition from yellow to red over the pH range 6.8 to 8.2. Above pH   
8.2, phenol red turns a bright pink (fuchsia) color).  
Digital balance  
Bunsen burner  
 **Pre-Lab:**1. What is an ionic bond?

2. Write the electron configurations for Na, Na+, Cl, and Cl-

Na

Na+

Cl

Cl-

3. Identify the noble gases that Na+ and Cl- resemble respectively in their electron configurations:

A. Na+ has the same electron configuration as the noble gas \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

B. Cl- has the same electron configuration as the noble gas \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. Draw the Lewis electron-dot diagrams for Na and Cl. Draw the Lewis electron-dot diagrams for Na+ and Cl-. How do the ionized elements compare with the non-ionized elements in terms of the octet rule for stability?

Na

Cl

Na+

Cl-

**Procedure and Results:**  
As you follow the procedure, record the following masses (A, B, C) and then calculate D, E, F:

1. Place 1.0g of NaHCO3 into a beaker   
2. Add about 15ml of distilled water to the beaker and swirl gently to dissolve the NaHCO3.   
3. Add 5-10 drops of phenol red pH indicator (0.02%)   
 What color is the solution? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
 What is the approximate pH range for this solution based on the color of the phenol red? (see above under   
 Special Materials) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4. While gently swirling the beaker, add the HCl dropwise until the color of the solution changes to yellow and no longer fizzes when more acid is added. This should take about 10-11mLs HCl total.  
5. Cover the contents of the beaker loosely with a piece of aluminum foil and boil over a Bunsen burner until all the water is evaporated. The beaker and its contents must be completely dry. The aluminum foil will prevent splatter. Allow to cool before weighing. Record the mass **(B)**  
6. Clean and dry the beaker and re-weigh. Record the mass **(C)**

|  |  |
| --- | --- |
| Record: | |
| 1. **Mass of NaHCO3 reactant** | **1.00g** |
| 1. **Mass of the beaker + dried NaCl product** |  |
| 1. **Mass of the empty beaker** |  |
| Calculate: | |
| 1. Mass of NaCl product = B - C |  |
| 1. Moles NaHCO3 reactant = A/84.01 (note: 84.01g/mol is the molar mass of NaHCO3) |  |
| 1. Moles NaCl product = D/58.44 (note: 58.44g/mol is the molar mass of NaCl) |  |

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

2. What gas was released during the chemical reaction(based on the balanced chemical equation)?

3. The NaHCO3 underwent a chemical change. What evidence do you have that a chemical reaction occurred?

4. Compare the product (NaCl) in the cooled beaker with a sample of the reactant, NaHCO3. What differences do you observe in terms of the texture?

5. If you wanted to ensure that all of the product material in the cooled beaker was NaCl without any NaHCO3 mixed in,   
would you need to add a little less or a little more HCl to the reaction? Explain your answer.

6. Explain why the mass of the NaCl produced was different from the mass of the reactant NaHCO3?

HCl(aq) + NaHCO3(aq) → NaCl(aq) + H2O(l) + CO2(g)

7. Based on the above balanced equation for this reaction:  
A. Do you expect the number of moles of NaHCO3 and NaCl to be the same or different?

B. What did you actually observe?

C. Do you think this is reasonably within experimental error?

D. What might be some sources of experimental error in this procedure?