CHEMISTRY EXPERIMENT THEORETICAL YIELD

In this experiment sodium hydrogen carbonate (baking soda) will be reacted with hydrochloric acid to obtain a high yield of sodium chloride. The unbalanced equation for the reaction is:

 $\underline{\qquad NaHCO_3(s) + \underline{\qquad HCI(aq) \rightarrow \underline{\qquad NaCI(aq) + \underline{\qquad CO_2(g) + \underline{\qquad H_2O(l)}}}$

You will:

- completely react an accurately measured quantity of NaHCO₃ and dilute HCI.
- isolate the NaCl from the other products and determine its mass.

The **theoretical yield** can be calculated by using the mole ratio from the balanced equation for the reaction.

After completing the lab, the **percent yield** can then be determined by comparing the experimental yield to the previously established theoretical yield.

PROCEDURE:

Day One:

1. Determine the mass of a 100mL beaker to the nearest 0.01 gram.

- 2. Weigh out, precisely, your assigned mass (______g) of sodium hydrogen carbonate into the beaker. Use a microspatula to adjust amount. Record the total mass of beaker plus contents.
- 3. Cover the beaker with a watch glass, convex side down and slightly off center so that the lip of the beaker is uncovered. Then:
 - Add dilute (3M) HCI down the lip of the beaker to the sodium hydrogen carbonate in the beaker.
 - Continue this process until no more reaction takes place when a drop of acid is added (the bubbling stops).
 - Gently swirl the beaker so that all of the solid contacts the acid. Do NOT add excess hydrochloric acid!
- 4. Carefully rinse the underside of the watch glass with a small amount of distilled water and collect the washings in the beaker. Wash the watch glass with tap water, dry, and return.
- 5. **Gently** heat the beaker and contents on a hot plate until the sodium chloride solution *just begins* <u>to boil</u>. This will drive off any excess HCl and begin the evaporation process.
- 6. Using beaker tongs, place the beaker in a drying oven to evaporate the water from the NaCl overnight.

<u>Day Two:</u>

- 1. Weigh the beaker and contents (now crystalline NaCl) to the nearest 0.01 gram. Record.
- 2. Clean, rinse, and dry the beaker. The NaCl can be washed down the drain.

THEORETICAL YIELD Lab Write-up

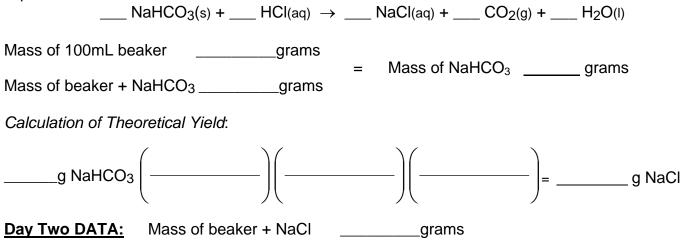
PURPOSE: The purpose of this experiment is to obtain a high yield of sodium chloride and to compare that yield to a value obtained by doing a mass-to-mass stoichiometric calculation, thus validating this type of calculation.

Day One CALCULATION:

Write the balanced equation for the reaction. Then calculate the theoretical yield of NaCl that should be obtained using your assigned mass of NaHCO_{3.} This is a gram-to-gram stoichiometry calculation.

(q of $A \rightarrow mol of A \rightarrow mol of B \rightarrow q of B$) Show factor-label method and units!!!

Equation:



ANALYSIS/CALCULATIONS:

1. Use subtraction to find the Experimental Yield of NaCl.

2. Determine the percentage yield of NaCl.

% Yield NaCl = $\frac{\text{Experimental Yield NaCl}}{\text{Theoretical Yield NaCl}} \times 100 =$

CONCLUSION/QUESTIONS:

- 1. State in a sentence what your % Yield means. This is asking you to explain the numerical result to calculation #2 above, not how you got it.
- 2. Based on your % Yield, how accurately did your stoichiometric calculation actually predict your product? Explain any discrepancies.

3. Calculate the volume, in mL, of 3.00 M HCl that would be theoretically required to react with the grams of NaHCO₃ that you used in the reaction. This is a solution stoichiometry problem. $g A \rightarrow mol A \rightarrow mol B \rightarrow mL B$

 $\underline{\qquad} g \text{ NaHCO}_3 \left(\underline{\qquad} \right) \left(\underline{\qquad} \right) \left(\underline{\qquad} \right) \left(\frac{1000 \text{ mL}}{3.0 \text{ mol HCl}} \right) = \underline{\qquad} \text{mL HCl}$