STOICHIOMETRY OF THE REACTION OF CARBONATES OF SODIUM AND HYDROCHLORIC ACID

unknown # ____

Sodium hydrogen carbonate (a.k.a. baking soda) and sodium carbonate (a.k.a. washing soda) both react with hydrochloric acid in a double replacement reaction. One of the products formed is salt, which can be dried and weighed, and the other products are water and carbon dioxide gas. From the mass of the unknown starting material (either $NaHCO_3$ or Na_2CO_3), one can calculate the mass of the NaCl that should be produced theoretically and then compare this to the actual mass of NaCl obtained in the lab. Based on the theoretical yields and your actual yield, you should be able to identify your sample.

Problem : What is the identity of the unknown compound, $NaHCO_3$ or Na_2CO_3?

Materials :

- unknown carbonate
- 6M hydrochloric acid
- ring stand and ring
- burner
- sodium carbonate
- evaporating dish
- wire gauze
- watch glass

Procedure :

1. Clean and dry an evaporating dish and a watch glass.

2. Determine the mass of the evaporating dish and watch glass together.

3. Place 1.5 grams of the unknown into the evaporating dish.

4. Place the evaporating dish and its contents onto a wire gauze and ring on a ring stand.

5. Using a dropper, slowly add 6M hydrochloric acid to the unknown soda, a few drops at a time. Use the watch glass to prevent loss of products. Continue adding acid until the reaction stops. Carefully tilt the evaporating dish back and forth to ensure there is no unreacted powder clinging to the sides of the evaporating dish.

6. Holding a Bunsen burner in your hand, gently heat the evaporating dish. Move the burner back and forth to avoid spattering. When almost all the liquid is gone, remove the burner and place the watch glass on the evaporating dish but leave a small opening so that water vapor can still escape. Heat the dish again until the solid in the dish is <u>completely</u> dry. Allow the dish to cool.

7. Determine the mass of the dish, the glass, and the solid material together and then calculate the mass of the solid product alone.

Data and Calculations :

mass of evaporating dish and watch glass _____

mass of unknown powder (either $NaHCO_3$ or Na_2CO_3) _____

mass of evaporating dish and watch glass and solid product _____

mass of solid product (NaCl) _____

Name: _____ **Period:** _____ **Date:** _____

Lab Questions :

1. Write a balanced equation for the reaction between $NaHCO_3$ and HCl. (Look at introduction for hints.)

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2. Write the balanced equation for the reaction between Na_2CO_3 and HCl. (Look at introduction for hints.)

_____

3. What gas is produced in these reactions? _____

4. What liquid is produced in these reactions? _____

5. What is the solid residue produced in these reactions? _____

6. Using stoichiometry, show your work to solve for the mass of NaCl that should be produced in the reaction using 1.5 g $NaHCO_3$.

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7. Using stoichiometry, show your work to solve for the mass of NaCl that should be produced in the reaction using 1.5 g Na_2CO_3.

_____

8. What is the actual mass of NaCl you obtained in your experiment? (look at your data table)

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9. Based on the two theoretical yields and the actual yield in this lab, which compound did you start with, $NaHCO_3$ or Na_2CO_3 ?

unknown #_____ unknown ID: _____

10. What is the percent yield in this reaction? $\left(\frac{\text{actual}}{\text{theoretical}} \times 100\right)$

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