Laboratory Investigation Name _____

Chemistry: Form L9.5A Date _____ Period _____

The Product of an Acid-Base Neutralization

PROBLEM

How is the mass of the product of an acid-base neutralization measured?

INTRODUCTION

Acids and bases react to form water and a salt. It is not possible to judge the acidity of a solution just by looking at it, but acidity can be monitored with an indicator such as phenolphthalein. A neutralization reaction can be carried out by adding phenolphthalein to a base and adding acid one drop at a time until the color changes. At the point where the color changes, neutralization is complete and the salt can be recovered by evaporating the water. In this laboratory exercise you will carry out a neutralization reaction using the base sodium hydroxide and the acid hydrochloric acid. Then you will evaporate the water and determine the mass of the salt that formed.

MATERIALS (*per group*)

Acid (0.5 M HCl); balance; base (0.3 M NaOH); 50 mL beaker; Bunsen burner; 250 mL flask; graduated cylinder; medicine dropper; phenolphthalein; ring stand and ring; safety goggles; tongs; wire gauze

PROCEDURE

1. Set up a ring stand and a ring with a wire gauze and a Bunsen burner. Put on safety goggles and light your Bunsen burner. *CAUTION: Always wear safety goggles while working with heat or strong acids and bases.*

2. Heat a clean flask to dryness (for about 2 minutes, or until there is no sign of moisture or condensation anywhere in the flask). Then, using tongs, set the flask aside to cool.

3. After the flask has cooled, measure the mass of the empty flask with a balance and record the result in the data table on the next page.

4. With a small graduated cylinder, measure 20 mL of 0.3 M sodium hydroxide into the flask. Add two drops of phenolphthalein. Note the color.

5. Fill a 50 mL beaker halfway with 0.5 M hydrochloric acid. Using a medicine dropper add one drop of acid to the base in the flask as shown in the diagram to the right. Then swirl the flask by the neck. Continue adding acid to the base one drop at a time and swirling the flask after each addition until the color changes.

6. Evaporate the liquid in the flask by heating to dryness with a Bunsen burner. When there are no more signs of moisture in the flask, remove the flask from the flame with tongs and set it aside to cool.

7. After the flask cools, measure the mass of the flask and the product with a balance. Record the mass in the data table on the next page (First heating).

8. Reheat the flask for three minutes, cool, and remeasure the mass. Record the result below. Repeat this procedure until the mass remains constant. Then calculate the mass of the product.

9. Do an error analysis by comparing your result to the theoretical result.

(a) Calculate the theoretical mass of the product by setting up a mass-mass problem. The mass of the sodium hydroxide used (GIVEN) is calculated as follows: **g = M × L × GFM** . Using the given mass of sodium hydroxide and the balanced equation for the reaction determine the number of moles of reactant and product. Then calculate the mass of the product.

(b) Find the absolute error by determining the difference between the theoretical and observed mass of the product. Find the percentage error by dividing the absolute error times 100 by the theoretical mass.

OBSERVATIONS

(1) Mass of empty flask . . . . . _____

(2) Mass of flask and product after:

(a) first heating . . . . . _____

(b) second heating . . . . . _____

(c) third heating . . . . . _____

(3) Mass of product **[2-1]** . . . . . _____

(4) Mass of sodium hydroxide **[g = M × L × GFM]** . . . . . _____

(5) Theoretical mass of product . . . . . _____

EQUATION:

Mole Ratio				
GFM				
Grams				
Moles				

(6) Absolute error **[5-3]** . . . . . _____

(7) Percentage error **[(6×100)/5]** . . . . . _____

CONCLUSIONS

1. What is the function of phenolphthalein in this laboratory exercise? _____

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2. What are some possible sources of error in this laboratory exercise? _____

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3. What is the aim of this laboratory exercise? Was it accomplished? _____

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4. How do you know there is only one product in the flask and no unreacted reactant? _____

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