Laboratory Investigation Name ______________________

Chemistry: Form L8.6A Date ______________ Period ___

Measuring the Mass of Solute in a Solution of Known Concentration

PROBLEM

How much solute is dissolved in a sample of solution of known volume and concentration?

INTRODUCTION

Laboratory reagents are frequently water solutions. This is, in part, because many reactions occur more readily in water. It is also because a known volume of a solution of known concentration delivers a predictable amount of reagent. Unit analysis shows us that

$$\frac{mol}{L} \times L \times \frac{g}{mol} = g$$

because moles and liters cancel. Since molarity is the number of moles per liter and the gram formula mass is the number of grams per mole, the following calculational equation is derived.

$$\mathbf{g = M \times L \times GFM}$$

Scientists often find it more convenient to measure a small volume of solution when they need a small mass of solute than to use a balance. In this laboratory investigation, you will measure the volume of a sample of a solution of known concentration and evaporate the water. Then you will compare the mass of the solute recovered to the expected mass of the solute.

MATERIALS *(per group)*

Balance; Bunsen burner; copper II sulfate solution (0.5 M); flask (125 mL); graduated cylinder (25 mL); ring stand and iron ring; safety goggles; tongs; wire gauze

PROCEDURE

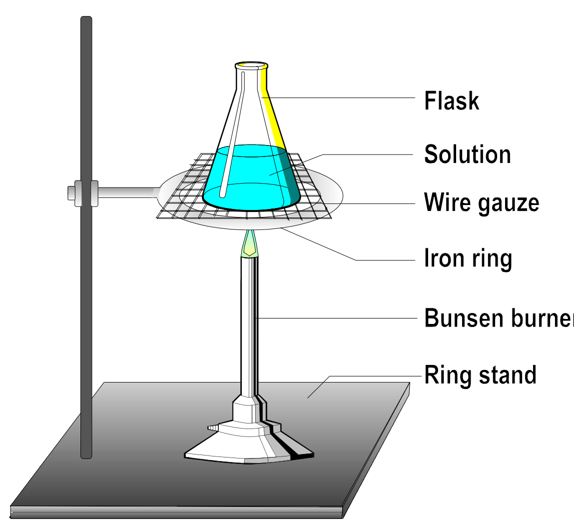
1. Put on safety goggles. Set up a Bunsen burner, a ring stand and iron ring, and a wire gauze. Heat a clean flask to dryness. After it cools, measure its mass with a balance. Record the mass of the empty flask in the data table on the next page.

2. Using a graduated cylinder, measure exactly 25 mL of 0.5 M copper II sulfate solution. Transfer the copper II sulfate solution to the flask.

3. Heat the flask to dryness. Using tongs, set the flask aside to cool. When the flask is cool, measure the mass of the flask and the and the anhydrous copper II sulfate. Record the mass after the first heating in the data table on the next page.

4. Heat to a constant mass as follows: Heat the flask for three to five minutes. Then set it aside to cool. When the flask is cool, measure the mass of the flask and the and the anhydrous copper II sulfate. Record the mass in the data table on the next page. If the mass is not the same as in the previous heating, heat the flask again until the mass remains constant. Then record the final mass.

5. Calculate the mass of the copper II sulfate. Record the result in the data table on the next page.



6. Calculate the theoretical mass of the copper II sulfate using the relationship $g = M \times L \times GFM$. Record the result in the data table below.

7. Do an error analysis by calculating the absolute error and the percentage error. Record the results in the data table below.

OBSERVATIONS

1. Mass of empty flask . . . . ________

2. Mass of empty flask and anhydrous salt after

   [a] first heating . . . . ________

   [b] second heating . . . . ________

   [c] third heating . . . . ________

   [d] final heating . . . . ________

3. Mass of anhydrous salt . . . . ________

4. Theoretical mass of anhydrous salt ($g = M \times L \times GFM$) . . . . ________

5. Error analysis

   [a] Absolute error . . . . ________

   [b] Percentage error . . . . ________

CONCLUSIONS

1. What are the likely sources of error in this laboratory investigation? ________

2. How could you accurately measure out 0.0016 g of anhydrous copper sulfate using a balance accurate to 0.1 g? ________

3. How many grams of ammonium nitrate are contained in 20.0 mL of a 3.0 M solution? ________

4. What volume of 2.0 M calcium chloride is needed to obtain 6.6 g of anhydrous salt? ________

5. How can you determine how much solute is dissolved in a sample of solution of known volume and concentration ...

   [a] without measuring it? ________

   [b] by measuring it? ________