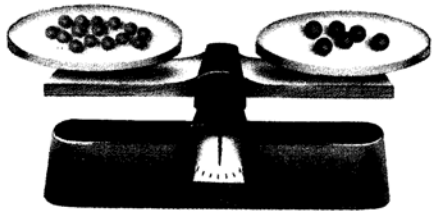
Stoichiometry

In a Single Replacement reaction



Objective:

To determine the quantitative relationship between aluminum and copper when aluminum foil is reacted with copper sulfate solution. This laboratory exercise will provide an opportunity develop the skills of recording data carefully and neatly while furnishing a chance to increase proficiency in measuring and calculating with the correct number or significant figures.

Safety: Copper(II) sulfate is a skin and respiratory irritant. Boiling water can cause severe burns.

Procedure:

- Put on your goggles and apron. Read through the entire laboratory procedure.
- Create a data table that will accommodate all of your measured values. Use your own paper. Neatness counts a lot. Using a spreadsheet program like MS Excel and printing it out is STRONGLY recommended. If not, you will want to use a ruler. Keep in mind such things as units and significant figures.
- Obtain a clean and dry 400 mL beaker, label it with your name, determine and record its mass.
- Obtain about 20 grams of copper (II) sulfate, determine and record its mass.
- Obtain between 1.00 and 1.25 grams of aluminum foil. Thoroughly rough-up the surface on both sides of the sheet with steel wool. Determine and record its mass AFTER you have rubbed it with the steel wool.
- Using the 400 mL beaker, dissolve the copper (II) sulfate in about 150 mL of distilled water. Also add about 5 grams of sodium chloride to the solution – this functions as a catalyst and does not need to be included in your calculations.
- To speed up the dissolving as well as the reaction that follows, heat the solution until it is boiling. When the solution has reached boiling you should reduce the amount of heat before proceeding. You want to continue heating just enough to keep the solution boiling. See figure 1.
- Tear the piece of aluminum foil into small pieces and drop them a few at a time into the hot copper sulfate solution and observe the reaction.
- Continue heating the solution until no more aluminum is visible.
- Carefully decant the solution into another beaker. Remember that <u>it is the solid material</u> you are attempting to recover. See figure 2. Dispose of decanted solution down the drain.
- Wash the solid several times with distilled water. Dispose of wash water down the drain.
- Place the beaker into the oven. The solid will need to dry completely before the final massing.
- Determine the mass of the dried solid in your beaker.
- Perform the calculations and answer the questions on the report sheet.

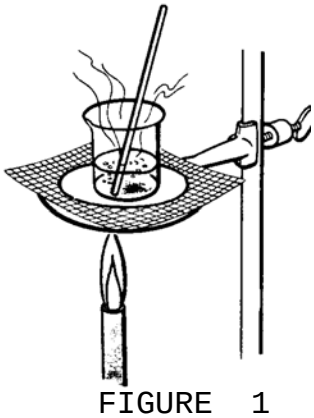
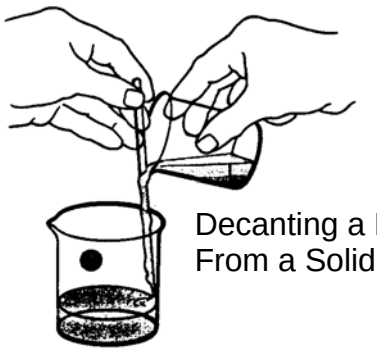


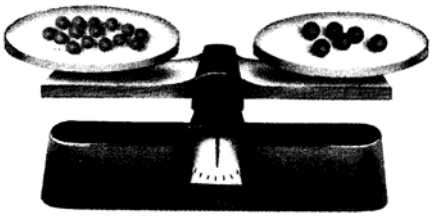
FIGURE 1



Decanting a Liquid From a Solid

FIGURE 2

Report Sheet
Stoichiometry
In a Single Replacement reaction



Name_____Date_____Class Period_____

All calculations must be shown in the proper format.

1. Calculate the moles of aluminum reacted.

2. Calculate the moles of copper reacted.

3. Show the ratio of moles of copper to moles of aluminum using your actual mole amounts determined above.

$$\frac{mol\ Cu}{mol\ Al}$$

4. Write a balanced equation for this reaction.

5. What is the mole ratio in the balanced equation? $\frac{mol\ Cu}{mol\ Al}$

6. Convert both ratios to a decimal value and compare your calculated ratio and the balanced equation ratio.

7. Explain the similarities or differences.

8. Describe the appearance of the copper (II) sulfate crystals, the copper (II) sulfate solution, and the aluminum foil at the start of the experiment.

9. Describe the appearance of the solution after reacting.

10. Describe the appearance of the solid remaining at the end of the lab.

11. What **IS** the solid at the end of the lab?

12. Was all of the copper (II) sulfate reacted in this lab? Explain how you know this.

13. How does this lab support the organization of the activity series of metals?

14. Identify the excess and limiting reactants.

15. Identify the **two** dissolved substances that were washed away from the final solid.

16. If the washing of the solid at the end was not done, how would this change the calculated ratio of $\frac{mol\ Cu}{mol\ Al}$?

ATTACH YOUR DATA TABLE TO THIS PAGE BEFORE TURNING IN YOUR LAB REPORT.