LESSON 91

LAB

Mole to Mole Mole Ratios

Name _____

Date _____ Period _____

Purpose

To examine how different ratios of reactants affect the amount of products.

Safety Instructions

Wear safety goggles at all times.

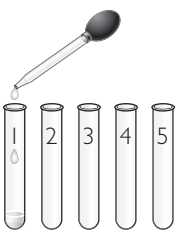
Sodium hydroxide, NaOH, is corrosive. Use extreme caution. In case of spills, rinse with large amounts of water.

Materials

- 12 × 75 mm test tubes (10)
- test tube rack
- marker to label test tubes
- set of 4 labeled dropper bottles with 25 mL each of 0.10 M solutions of $CaCl_2$, Na_2CO_3, $CuSO_4$, and NaOH

Part 1: Calcium Carbonate Formation

1. Number five small test tubes from 1 to 5. Add drops of 0.10 M $CaCl_2(aq)$, calcium chloride, and 0.10 M $Na_2CO_3(aq)$, sodium carbonate, to the test tubes as indicated in the table.
2. Swirl each test tube gently in order to mix the reactants. Allow the solids to settle for about 10 minutes while you complete the table and continue with Part 2.



Calcium Carbonate

Test tube	1	2	3	4	5
Drops of 0.10 M $CaCl_2$	4	6	12	18	20
Drops of 0.10 M Na_2CO_3	20	18	12	6	4
Ratio of $CaCl_2$ to Na_2CO_3	1:5				

Part 2: Copper (II) Hydroxide Formation

1. Number five more small test tubes from 6 to 10. Add drops of 0.10 M $CuSO_4(aq)$, copper (II) sulfate, and 0.10 M NaOH(aq), sodium hydroxide, to the test tubes as indicated in the table on the next page.
2. Swirl each test tube gently in order to mix the reactants. Allow the solids to settle while you complete the table and continue with the analysis.

Copper (II) Hydroxide

Test tube	6	7	8	9	10
Drops of 0.10 M $CuSO_4$	4	8	12	16	20
Drops of 0.10 M NaOH	20	16	12	8	4
Ratio of $CuSO_4$ to NaOH	1:5				

Analysis and Observations

1. Write the balanced chemical equation for the reaction of aqueous calcium chloride with aqueous sodium carbonate to produce calcium carbonate precipitate in an aqueous sodium chloride solution.

2. Use the balanced chemical equation to predict the ratio of moles of $CaCl_2(aq)$ and $Na_2CO_3(aq)$ that will produce the maximum amount of $CaCO_3(s)$.

3. Write the balanced chemical equation for the reaction of aqueous copper (II) sulfate with aqueous sodium hydroxide to produce copper (II) hydroxide precipitate in an aqueous sodium sulfate solution.

4. Use the balanced chemical equation to predict the ratio of moles of $CuSO_4(aq)$ to $NaOH(aq)$ that will produce the maximum amount of $Cu(OH)_2(s)$.

5. After the solids have settled (about 10 minutes), look at the test tubes at eye level on your bench to identify those with the largest quantities of $CaCO_3(s)$ and $Cu(OH)_2(s)$. Circle the ratio in the two tables that resulted in the largest volume of solid.

6. **Making Sense** How do the balanced chemical equations compare to your observations?

7. **If You Finish Early** Suppose you mix calcium chloride, $CaCl_2(aq)$, with sodium oleate, $NaC_{18}H_{33}O_2(aq)$. What products do you expect? Assuming the two solutions have the same concentration, what ratio of drops would give you the largest amount of precipitate? (*Note:* One product is calcium oleate, commonly referred to as soap scum.)