Chemistry CP

Name:

Lab: Mole Relationships in Displacement Reactions Section:

In this experiment you carry out a reaction between metallic copper ions and silver ions in solution to produce copper ions in solution and metallic silver atoms. The expression, shown without coefficients, is shown here:

$$Cu\ (s) + AgNO_3(aq) \rightarrow Cu\ (NO_3)_2\ (aq) + Ag\ (s)$$

Once the mole ratio is determined experimentally, the coefficients may be placed in front of the symbols for copper and silver. The result should be a balanced chemical equation with the atoms of the product equal in number and kind to the atoms of the reactant. Stoichiometric calculations are based on the coefficients in a correctly balanced equation.

Objectives

- To experimentally determine the mole ratio between the participants in a chemical reaction.
- To experimentally determine the coefficients in an equation for a reaction.
- To determine the percent yield in a chemical reaction.

Materials

Copper wire	0.2M silver nitrate solution
Balance	funnel
Large test tube	beaker

Hypothesis

State a hypothesis predicting the mole ratios of copper and silver nitrate in this reaction. Can you predict other mole ratios?

Safety

Silver nitrate solution will stain your hands, so avoid getting any of this solution on yourself. If you should get any on your hands, immediately wash it off.

Procedure

1. As a group, agree upon and write out a hypothesis statement.
2. Obtain a piece of heavy copper wire, about 6 inches long. Form the lower part into a coil and bend it to form a hook at the opposite end.
3. Carefully weigh the copper to the nearest 0.01 g and record your results.
4. Add about 37.5 mL of 0.2 M silver nitrate solution to a large test tube.
5. Suspend the coil of copper in the silver nitrate solution by hanging the hook over the side of the test tube.
6. Set the reaction vessel aside overnight.
7. Carefully weigh a piece of filter paper to 0.001 g. Place the filter paper into a funnel, and place the funnel in a ring above a beaker.
8. Carefully shake the silver from the copper coil into the test tube. Use a wash bottle to rinse the coil. Allow the coil to dry. Weigh and record its mass.
9. Decant the solution onto the weighed filter paper. Add 5 mL of the 0.2 M silver nitrate solution to the test tube. Break up the mass of precipitate with a stirring rod and be certain that all of the particles have come into contact with the silver nitrate solution. Allow to stand 5 minutes and then transfer all of the silver to the filter paper.
10. Wash the silver thoroughly with water at least 3 times. Allow the sample to drain.
11. Remove the filter paper from the funnel, open up on a piece of paper towel, and allow to dry overnight. Weigh and record the mass.

Data

Be sure to use significant figures properly! Show your calculations in your final lab report.

1. Mass of copper before reaction	
2. Mass of copper after reaction	
3. Mass of copper used in reaction	
4. Mass of filter paper and dry silver	
5. Mass of filter paper	
6. Mass of silver produced in reaction	
7. Moles of solid copper used	
8. Moles of solid silver produced	

Analyze and Apply

Answer these questions in complete sentences; show all your work for calculations.

1. Write a balanced equation for this reaction. What type of reaction is this?
2. Calculate the theoretical yield of silver, based on the mass of solid copper that reacted.
3. Calculate the percent yield of solid silver in your experiment.
4. If the silver in the beaker contained water during your last measurement, how would this affect your results?
5. Assume that magnesium metal would act atom-for-atom exactly the same way as copper in this reaction. How many grams of magnesium would have been used in the reaction if one gram of silver were produced? (The atomic mass of magnesium is 24.3 g/mol)
6. Account for the blue color produced in the solution.
7. Refer to an activity series of metals to predict whether or not metallic silver reacts with a solution of copper (II) nitrate and yields metallic copper and a solution of silver nitrate.

Don't forget to write an appropriate conclusion for this lab. In your conclusion, discuss whether the moles of copper and silver determined experimentally agreed with the expected mole ratios. Could you use your experimental mole values as the coefficients in the chemical equation? A good conclusion restates the key results of the lab, and discusses possible sources of error.