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**Lab #41: Stoichiometry: Quantitative Precipitate**

*Materials*

* 2-250 mL flasks
* 2-stirring rods
* 1 medium funnel
* 1 piece of filter paper
* water
* Copper (II) chloride (CuCl2)
* Sodium Phosphate (Na3PO4)
* scale

**Part 1: Pre-Lab**

\*Annotate the following information\*

Stoichiometry is the method of looking at a chemical recipe and determining how much product you will create from the reactants you start with. This is similar to the idea of baking brownies. The amount of ingredients you start with will impact how many batches of brownies you can make! The experiment you run today will test your chemistry skills up to this point. A reaction will have a limiting and an excess reactant.  The limiting reactant of a reaction is the reactant that would run out first if all the reactants were to be reacted together. Once the limiting reactant is completely consumed, the reaction would cease to progress. The theoretic yield of a reaction is the amount of products produced when the limiting reactant runs out. You will be mixing two different aqueous chemicals together to form a precipitate. The amount of precipitate you create in the experiment will be your “actual yield”. We will then crunch our numbers using stoichiometry to determine how much we should have created. This is our “theoretical yield”. Using the actual and theoretical numbers allows us to see how accurate or “good” we are with our chemistry skills and math. We will do this by finding the % yield at the end of the lab. Your attention to detail and not cutting corners is key to how “good” you are!

**Pre-Lab Questions:**

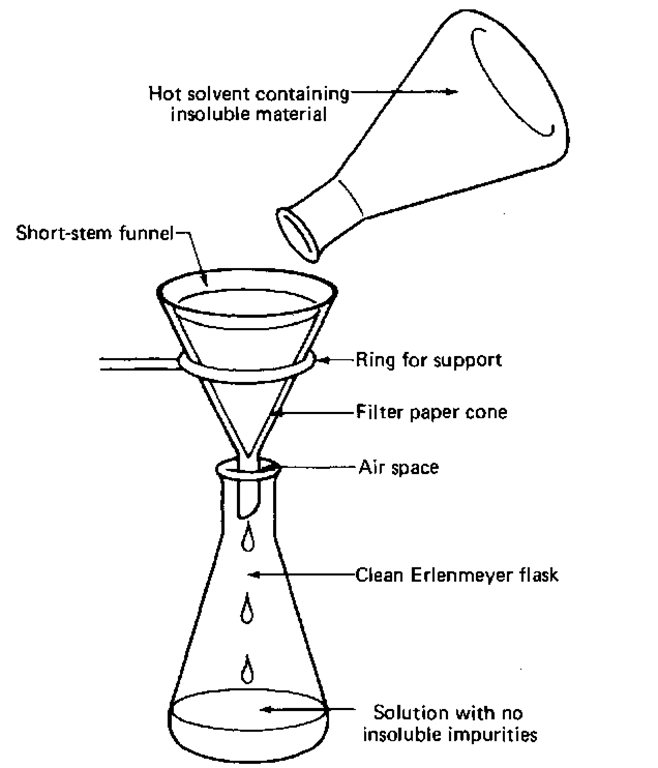
1. Describe the purpose of the lab today in 1-2 sentences?
2. What is the difference between actual yield and theoretical yield?
3. When you run the experiment today do you predict your actual yield will be less than or more than the theoretical yield and why?
4. If you have 20 girls and 25 boys at a party what is the ratio of boys to girls?
5. In the balanced chemical equation 2H2O (l) --> 2H2 (g) + O2 (g) what is the molar ratio of water to hydrogen? From water to oxygen?
6. A 0.98 grams sample of Copper (II)Chloride was put into solution and a piece of 0.56 grams of aluminum wire was placed in the solution.  The blue color due to copper(II) chloride soon faded and a red precipitate of solid copper was observed.
7. Write the balanced chemical equation of the reaction.
8. Calculate the number of moles of copper(II) chloride and of aluminum.(Convert given grams to moles)
9. What is the mole ratio of copper (II) chloride to aluminum metal?
10. What is the mole ratio of copper (II) chloride to copper?
11. What is the mole ratio of aluminum to copper?
12. Determine the theoretical yield of copper using copper (II) chloride. (calculate this!!)
13. Determine the theoretical yield of copper using aluminum.(calculate this!!)
14. What is the limiting reactant?  Why?
15. If you collect 1.2 grams of copper, what is your percent yield?

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|  | **Table 1: Reactant Data** | |
| Item | Mass (g) | Observations |
| Filter Paper |  | \_\_\_\_\_\_ |
| CuCl2 (s) |  |  |
| Na3PO4 (s) |  |  |

**Part 2: Preparing aqueous solutions**

1. You will need two **clean** 150 mL beakers or Erlenmeyer flasks.
2. Measure out between 0.9-1.1g of the CuCl2 and Na3PO4 solids.
3. Record the ***exact*** amount used in data table 1.
4. Place each solid in a ***separate*** beaker, and add 25-30 mL of water. Gently stir the mixture to dissolve the salts. Be sure to use a ***different*** stirring rod, or clean the stirring rod after use so that you do not cross contaminate your solutions.
5. Record the color of your solutions in data table 1.
6. **Part 3: The precipitate reaction**
7. Add a little of the CuCl2 solution slowly to the Na3PO4. Swirl to mix and record your observations in data table 2 below.
8. Continue to slowly add the CuCl2 and Na3PO4 and swirl to mix. The slow addition of CuCl2 along with the continuous swirling allows for the greatest amount of product to be formed, because more ions are able to contact each other.

**Part 4: Isolating the product to get actual yield**

1. Obtain a piece of filter paper and fold it according to your teacher’s demonstration. (Fold it in half and then in half again, so that it looks like a snow cone.) Write your name in pencil near the top outside edge of the filter paper.
2. Weigh the dry filter paper and write in table 2.
3. Open one of the “mouths” of the filter paper and wet the filter paper with a little distilled water so that 3 folds of paper are on one side and one paper thickness is on the other, this sticks it to the funnel and keeps it in place.
4. Place the filter paper in the funnel and place the funnel inside the neck of an empty Erlenmeyer flask. (See the picture.)
5. Swirl your mixture to suspend the solid in solution, slowly pour the mixture into the filter paper. As you pour the mixture be sure that the solution does not come above the filter paper. Check to see that the “filtrate” (the solution draining into the flask below the funnel) is clear. If it is not clear you may have a tear in your filter paper or some mixture escaped over the top. You will need to refilter this to ensure you have all of the solid.
6. When all of the solution is added, rinse the empty flask with a squirt bottle of water and add this to the mixture. This removes any remaining precipitate.
7. Remove your filter paper containing the precipitate and place it in the area designated by your instructor. It will dry overnight. Try and get the solid as spread out as possible.
8. Clean and rinse all equipment. You may need to use a test tube brush to remove solid particles that are stuck on.
9. The next class period weigh your filter paper and solid. Record the color and mass of the precipitate in data table 2.

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|  | **Data Table 2: Product Data** | |
| Item | Mass (g) | Observations |
| Filter Paper |  | --------- |
| Actual yield of Precipitate (day 2) |  |  |

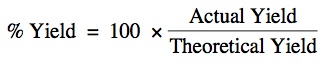


**Part 5: Determining the theoretical yield of your reaction.**

1. Write out the balanced equation for this double replacement reaction.
2. Which product is your precipitate?(HINT USE SOLUBLITY CHART)
3. Looking at the data collected, determine the limiting reactant in this reaction (CuCl2 or Na3PO4) and show your work for how you determined this. This is the cap for the number of grams you can get of your product.

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| --- | --- |
| Results | Mass (g) |
| Theoretical yield Precipitate |  |

1. Calculate your percent yield of the precipitatein this reaction.



1. Was your percent yield 100%? If not, why do you think this is the case?
2. List two sources of error that could have caused your actual yield to be low. “We didn’t measure correctly” is not a complete response. Explain this “human error.”
3. List one source of error that could have caused your actual yield to be falsely high. Explain