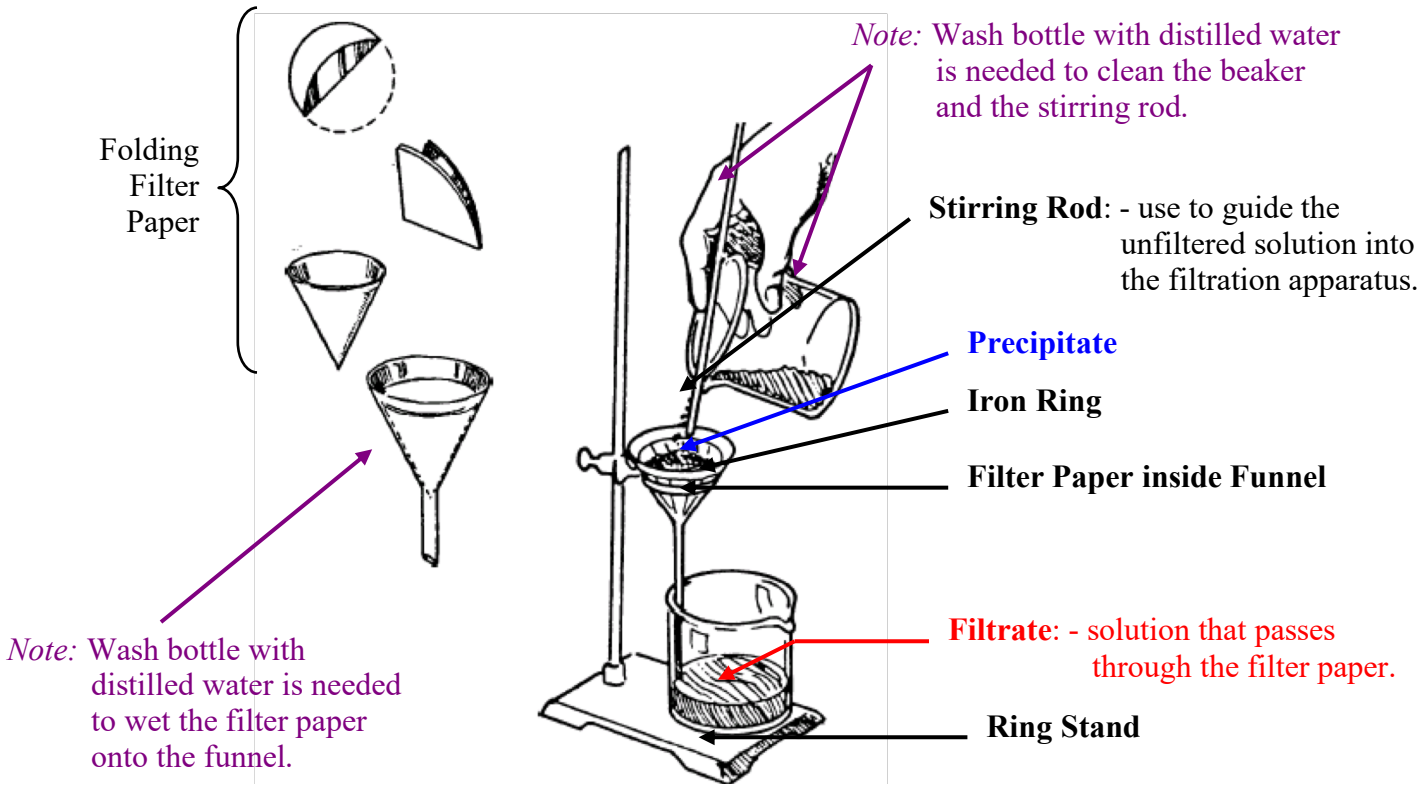
Lab #5: Gravimetric Stoichiometry

Objective:
To accurately determine the mass of the precipitate in a precipitation reaction.

Background Information:
In this experiment, an excess amount of $CuSO_4$ solution is reacted with potassium hydroxide. One of the products is a precipitate. Using proper filtration technique, it is collected and its mass is measured. The experimental mass measured will be compared to the theoretical mass calculated using stoichiometry. Because we want to collect all the precipitate form, correct washing technique must be used to ensure an accurate result.



Pre-lab Exercise:
Write the **balanced chemical equation** for the reaction between $CuSO_{4\,(aq)}$ and $KOH_{(aq)}$. Indicate the states of all the products. Identify the precipitate form for this reaction.

Materials:

Ring Stand and Iron Ring	Hot Plate	Anhydrous $CuSO_{4\,(s)}$ (2.3 g to 2.4 g)
100 mL Graduate Cylinder	Scoopula	$KOH_{(s)}$ (1.2 g to 1.3 g)
Funnel and Filter Paper	2 Stirring Rods	Distilled Water
3 beakers (2 × 250 mL and 100 or 150 mL)	Watch Glass	Electronic Balance
	Masking Tape	

Procedure:
1. Measure the mass of the filter paper and record the result.
2. Place a 250 mL beaker on the electronic balance and set it to zero.
3. Measure out 2.3 g to 2.4 g of anhydrous $CuSO_{4\,(s)}$ into the beaker. Record the actual mass of anhydrous $CuSO_{4\,(s)}$ used.
4. Using a graduated cylinder, measure out approximately 100.0 mL of distilled water. Transfer it into the beaker containing the $CuSO_{4\,(s)}$. Dissolve it completely using a stirring rod. Leave the stirring rod in the beaker when dissolving is completed. (If it becomes difficult to completely dissolve the $CuSO_4$, you may set

up the hot plate to increase the temperature of the solution so to aide the dissolving process. Be careful not to let the solution boil – set your dial to 6 or 7 max.)
5. Set the small beaker (100 or 150 mL) on the electronic balance and set it to zero.
6. Measure out approximately 1.2 g to 1.3 g of $KOH_{(s)}$. Record the actual mass of $KOH_{(s)}$ used.
7. Completely dissolve the $KOH_{(s)}$ with approximately 20 mL of distilled water from the graduated cylinder. Dissolve it completely using another stirring rod. Use the distilled water bottle, rinse that stirring rod thoroughly (with the washed liquid back into the beaker) after dissolving is completed. Place that stirring rod on the bench.
8. Transfer the KOH solution into the 250 mL beaker containing the $CuSO_4$ solution. Using the distilled water bottle, wash the KOH solution beaker thoroughly and transfer all washed solution into the $CuSO_4$ beaker. Record any qualitative observations.
9. Set up the filtration apparatus using the ring stand, ring, funnel and a clean 250 mL beaker.
10. Fold the filter paper for the funnel. Place it into the funnel. Using the distilled water bottle, wet the paper so it sticks to the funnel.
11. Carefully filter the mixture from step 8 using the stirring rod that was in the $CuSO_4$ beaker. Be sure to wash the beaker and the stirring rod thoroughly. All washed fluid should go into the funnel. Slow down when pouring. Do not overfill the funnel.
12. Label your name on the bottle of a watch glass using a masking tape.
13. Carefully take out the filter paper from the funnel. Open it up and place it on the watch glass to dry. Wait at least a whole day until it is completely dry. Measure and record the mass of the filter paper and precipitate without the watch glass.

Observations:

Mass of Dry Filter Paper	
Mass of Dry Filter Paper and Precipitate	
Actual Mass of $CuSO_4$ used	
Actual Mass of KOH used	
Observation(s) of the Precipitate formed	

Analysis:
1. Determine the experimental mass of the precipitate.
2. Calculate the theoretical mass of precipitate formed when the measured mass of $CuSO_4$ is reacted with the mass of KOH used in this experiment. Show all your steps and label all units and chemicals. Identify the limiting reactant.

Evaluation:
1. Calculate the % yield and % error of the precipitate and comment on the possible reasons for the error.
2. Predict and explain what would happen to the experimental mass of the precipitate if the beaker containing $CuSO_{4\,(aq)}$ did not get washed out with distilled water.
3. **(BONUS)** You may find that the experimental mass of the precipitate is a lot bigger than the theoretical mass calculated in the Analysis section. This is because Cu^{2+} can form a complex structure with a variety of anions available. The actual unbalanced equation of the precipitation is below.

$$CuSO_{4\,(aq)} + KOH_{(aq)} \rightarrow Cu_2(OH)_2SO_{4\,(s)} + K_2SO_{4\,(aq)}$$

   a. Balance the above equation.
   b. Recalculate the mass of the precipitate form.
   c. Re-evaluate your % error. Comment on the validity of the above equation.

Conclusion:
1. In light of the % error, what would you do to improve the procedure of this lab?
2. Summarize what you have learned from this lab.