

Lab #3: Gravimetric and Solution Stoichiometry

Objectives:

1. To accurately determine the mass of the precipitate in a precipitation reaction.
2. To accurately determine the concentration of a solution using titration.

Hypothesis / Pre-lab Exercise:

1. Write the balanced molecular equation, complete ionic equation, and the net-ionic equation for the reaction between $\text{CuSO}_4(aq)$ and $\text{KOH}(aq)$.
2. Write the balanced molecular equation for the neutralization of $\text{H}_2\text{SO}_4(aq)$ with $\text{NaOH}(aq)$

Materials:

Ring Stand	Two 250 mL Glass Beakers	$\text{CuSO}_4(aq)$ (0.75 M) – from Lab #2
Iron Ring	One 250 mL Plastic Beaker	$\text{KOH}(s)$ (1.44 g)
Funnel	Buret	$\text{H}_2\text{SO}_4(aq)$ (0.00720 M) – from Lab #2
Filter Paper	Watch Glass and Masking Tape	$\text{NaOH}(aq)$ (unknown concentration)
Scoopula & Stirring Rod	Buret Funnel and Buret Clamp	Bromothymol Blue Indicator
Volumetric Flasks	3 Small / Medium Erlenmeyer Flasks	Distilled Water
One 100 mL Plastic Beaker	Two 10 mL Pipets	Electronic Balance

Procedure:

A. Precipitation Reaction:

1. Measure the mass of the filter paper.
2. Set up the filtration apparatus using the ring stand, ring, funnel and a 250 mL plastic beaker.
3. Fold a correct size filter paper for the funnel.
4. Place the folded filter paper into the funnel. Wet the paper so it sticks inside the funnel.
5. Place the 100 mL plastic beaker on the electronic balance and set it to zero.
6. Measure out approximately 1.44 g of $\text{KOH}(s)$ in the plastic beaker. Record the actual mass of $\text{KOH}(s)$ used.
7. Completely dissolve the $\text{KOH}(s)$ with approximately 20 mL of water
8. Label a 250 mL glass beaker as “Waste”.
9. Coat the inside of a 10 mL pipet at least twice with the 0.75 M of $\text{CuSO}_4(aq)$ from the volumetric flask as prepared in Lab #2. Discard coating solution in the “Waste” beaker.
10. Measure out 20.0 mL of 0.75 M $\text{CuSO}_4(aq)$. Transfer it into a 100 mL plastic beaker containing the dissolved KOH . Record any qualitative observations.
11. Carefully filter the mixture from the last step using a stirring rod. Be sure to wash the beaker out thoroughly.
12. Label your name on 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’s completely dry. Measure and record the mass of the filter paper and precipitate without the watch glass.

B. Acid and Base Titration:

1. Label a clean 250 mL glass beaker as NaOH . Obtain the unknown concentration of $\text{NaOH}(aq)$ from your teacher.
2. Coat the 10 mL pipet with the $\text{NaOH}(aq)$ at least twice and discard the wash fluid in a 250 mL glass beaker labeled as “Waste”.
3. Pipet 10 mL of $\text{NaOH}(aq)$ to each of the three Erlenmeyer flasks.
4. To each Erlenmeyer flask, add a few drops of bromothymol blue indicator.
5. Coat the buret with the 0.00720 M of $\text{H}_2\text{SO}_4(aq)$ from the volumetric flask (as prepared in Lab #2) at least twice, and discard the wash fluid in the “waste” beaker.
6. Set up the titration apparatus with the ring stand, buret clamp, buret and buret funnel.
7. Fill the buret with the 0.00720 M of $\text{H}_2\text{SO}_4(aq)$ using the buret funnel. Be sure not to pass the 0 mL mark.
8. Record the starting volume of the $\text{H}_2\text{SO}_4(aq)$. Begin titration of the unknown concentration of $\text{NaOH}(aq)$. Swirl the Erlenmeyer flask when adding the $\text{H}_2\text{SO}_4(aq)$. The endpoint will be a green color. Record the final volume of the $\text{H}_2\text{SO}_4(aq)$ added. Calculate the net volume of acid added. (If the solution becomes yellow, you have added too much $\text{H}_2\text{SO}_4(aq)$. Record the volume and the color anyway).

9. Repeat Step 8 twice with the other two Erlenmeyer flasks. Be sure to record the initial and final volume of the buret each time. Try to adjust the buret valve in such a way so $\text{H}_2\text{SO}_4(aq)$ is added one drop at a time around the endpoint.

Observations:

Part A: Precipitation Reaction:

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

Part B: Acid and Base Titration:

10.0 mL of $\text{NaOH}(aq)$ titrated by 0.00720 mol/L of $\text{H}_2\text{SO}_4(aq)$			
	Trial 1	Trial 2	Trial 3
Initial Volume			
Final Volume			
Volume of H_2SO_4 added			
Bromothymol Blue Colour			

Analysis:

Part A: Precipitation Reaction:

- Determine the experimental mass of the precipitate.
- Calculate the theoretical mass of precipitate formed when 20.0 mL of 0.75 mol/L of $\text{CuSO}_4(aq)$ is reacted with the mass of $\text{KOH}(s)$ used.

Part B: Acid and Base Titration:

- Determine the experimental concentration of $\text{NaOH}(aq)$.

Evaluation:

Part A: Precipitation Reaction:

- Calculate the % error of the precipitate and comment on the possible reasons for the errors.
- Predict and explain what would happen to the experimental mass of the precipitate if the plastic beaker containing both the $\text{KOH}(aq)$ and the $\text{CuSO}_4(aq)$ did not get washed out with distilled water.
- Why is it unnecessary to calculate the concentration of $\text{KOH}(aq)$ used to find the theoretical mass of the precipitate form?

Part B: Acid and Base Titration:

- Predict and explain** specifically what would happen to the calculated $[\text{NaOH}(aq)]$ when there is/are
 - distilled water left in the Erlenmeyer flask when $\text{NaOH}(aq)$ is transferred.
 - distilled water left in the pipet when $\text{NaOH}(aq)$ is transferred to the Erlenmeyer flask.
 - air bubbles in the pipet when $\text{NaOH}(aq)$ is transferred to the Erlenmeyer flask.
 - distilled water left in the buret when $\text{H}_2\text{SO}_4(aq)$ is added.
 - air bubbles in the buret that got dislodged when $\text{H}_2\text{SO}_4(aq)$ is added.
- The approximate theoretical concentration of $\text{NaOH}(aq)$ is 0.0540 M. Compare your calculated $[\text{NaOH}(aq)]$ with this theoretical concentration by determining the % error. What are the possible sources of error?

Conclusion:

- Accounting for the % errors, what would you do to improve the procedures of this lab?
- Summarize what you have learned from this lab.