Lab #8: Acid and Base Titration

Objectives:

To accurately determine the concentration of a solution using titration.

Pre-lab Exercise:

Write the balanced chemical equation for the neutralization of $H_2SO_{4\,(aq)}$ with $NaOH_{\,(aq)}$

Materials:

Ring Stand	10 mL Pipet	$H_2SO_{4\,(aq)}$ (0.088 mol/L)
Buret	Pipet Bulb	$NaOH_{\,(aq)}$ (unknown concentration)
Buret Funnel	1 Small Beaker	Bromothymol Blue Indicator
Buret Clamp	2 Medium Beakers	3 Small / Medium Erlenmeyer Flasks

Procedure:

1. Label the small beaker "H_2SO_4". Label one medium beaker "NaOH" and the other medium beaker "Waste".
2. Coat the 10 mL pipet with the $NaOH_{\,(aq)}$ at least twice and discard the wash fluid in a 250 mL beaker labeled as "Waste".
3. Pipet 10 mL of $NaOH_{\,(aq)}$ to each of the three Erlenmeyer flasks.
4. To each Erlenmeyer flask, add a few drops of bromothymol blue indictor.
5. Coat the buret with the 0.088 M of $H_2SO_{4\,(aq)}$ beaker 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 0.088 M of $H_2SO_{4\,(aq)}$ using the buret funnel. Be sure not to pass the 0 mL mark and no bubbles are in the buret.
8. Record the starting volume of the $H_2SO_{4\,(aq)}$. Begin titration of the unknown concentration of $NaOH_{\,(aq)}$. Swirl the Erlenmeyer flask when adding the $H_2SO_{4\,(aq)}$. The endpoint will be a green colour. Record the final volume of the $H_2SO_{4\,(aq)}$ added. Calculate the net volume of acid added. (If the solution becomes yellow, you have added too much $H_2SO_{4\,(aq)}$. Record the volume and the colour 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 $H_2SO_{4\,(aq)}$ is added one drop at a time around the endpoint.

Observations:

10.0 mL of $NaOH_{\,(aq)}$ titrated by 0.0880 mol/L of $H_2SO_{4\,(aq)}$				
	Trial 1	**Trial 2**	**Trial 3**	**Trial 4**
Initial Volume				
Final Volume				
Volume of H_2SO_4 added				
Bromothymol Blue Colour				

Analysis:

1. Calculate the average volume of $H_2SO_{4\,(aq)}$ added. Be sure not to include the trial that has a final yellow colour.
2. Using the balanced chemical equation from the pre-lab section, determine the experimental concentration of $NaOH_{\,(aq)}$.

Evaluation:

1. ***Predict*** and ***explain*** what would happen to the calculated [$NaOH_{(aq)}$] when there is/are
   a. distilled water left in the Erlenmeyer flask when $NaOH_{(aq)}$ is transferred.
   b. distilled water left in the pipet when $NaOH_{(aq)}$ is transferred to the Erlenmeyer flask.
   c. air bubbles in the pipet when $NaOH_{(aq)}$ is transferred to the Erlenmeyer flask.
   d. distilled water left in the buret when $H_2SO_{4\ (aq)}$ is added.
   e. air bubbles in the buret when $H_2SO_{4\ (aq)}$ is added.
2. The theoretical [NaOH] is 0.49 mol/L. Compare your calculated [$NaOH_{(aq)}$] with this theoretical concentration by determining the % error. What are the possible sources of error?

Conclusion:

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