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 $_{(aq)}$ (unknown concentration)
Buret	Pipet Bulb	NaOH $_{(aq)}$ (0.100 mol/L)
Buret Funnel	1 Medium Beaker	Bromothymol Blue Indicator
Buret Clamp	2 Large Beakers	3 Small / Medium Erlenmeyer Flasks

Procedure:

1. Label one large beaker "NaOH". Label another large beaker as "Waste".
2. Label the medium beaker "H_2SO_4".
3. Coat the 10 mL pipet with the H_2SO_4 $_{(aq)}$ at least twice and discard the wash fluid in the "Waste" beaker.
4. Pipet 10 mL of H_2SO_4 $_{(aq)}$ to each of the three Erlenmeyer flasks.
5. To each Erlenmeyer flask, add a few drops of bromothymol blue indictor.
6. Coat the buret with the 0.100 M of NaOH $_{(aq)}$ at least twice, and discard the wash fluid in the "waste" beaker.
7. Set up the titration apparatus with the ring stand, buret clamp, buret and buret funnel.
8. Fill the buret with the 0.100 M of NaOH $_{(aq)}$ using the buret funnel. Be sure not to pass the 0 mL mark and be sure there are no bubbles in the buret.
9. Record the starting volume of the NaOH $_{(aq)}$. Begin titration of the unknown concentration of H_2SO_4 $_{(aq)}$. Swirl the Erlenmeyer flask when adding the NaOH $_{(aq)}$. The endpoint will be a green colour. Record the final volume of the NaOH $_{(aq)}$ added. Calculate the net volume of base added. (If the solution becomes blue, you have added too much NaOH $_{(aq)}$. Record the volume and the colour anyway.)
10. Repeat Step 9 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 NaOH $_{(aq)}$ is added one drop at a time around the endpoint.

Observations:

10.0 mL of H_2SO_4 $_{(aq)}$ titrated by 0.100 mol/L of NaOH $_{(aq)}$				
	Trial 1	**Trial 2**	**Trial 3**	**Trial 4**
Initial Volume				
Final Volume				
Volume of NaOH added				
Bromothymol Blue Colour				

Analysis:

1. Calculate the average volume of NaOH $_{(aq)}$ added. Be sure not to include the trial that has a final blue colour.
2. Using the balanced chemical equation from the pre-lab section, determine the experimental concentration of H_2SO_4 $_{(aq)}$.

Evaluation:

1. ***Predict*** and ***explain*** what would happen to the calculated $[H_2SO_4$ $_{(aq)}]$ when there is/are
   a. distilled water left in the Erlenmeyer flask when H_2SO_4 $_{(aq)}$ is transferred.
   b. distilled water left in the pipet when H_2SO_4 $_{(aq)}$ is transferred to the Erlenmeyer flask.
   c. air bubbles in the pipet when H_2SO_4 $_{(aq)}$ is transferred to the Erlenmeyer flask.
   d. distilled water left in the buret when $NaOH$ $_{(aq)}$ is added.
   e. air bubbles in the buret when $NaOH$ $_{(aq)}$ is added.
2. The theoretical $[H_2SO_4]$ is 0.088 mol/L. Compare your calculated $[H_2SO_4]$ 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.