Chemistry
Acid-Base Titration Lab

Introduction:
In this experiment you will titrate a measured volume of HCl with a solution of NaOH of known concentration. The acid and the base react with one another according to the equation:

$$HCl\ (aq) + NaOH\ (aq) \rightarrow NaCl\ (aq) + H_2O\ (l)$$

The HCl is placed in an Erlenmeyer flask, and phenolphthalein indicator is added. The NaOH solution is then added from a buret into the flask containing the acid. During the first stages of the titration, the NaOH will be completely neutralized, and an excess of acid will remain. However, eventually there will be a point, the theoretical endpoint, at which the acid and the base have neutralized one another exactly, and no more base should be added to the flask.

The phenolphthalein indicator is used to experimentally determine the endpoint, or the point at which the base has neutralized the acid. Phenolphthalein is colorless in acid solution. It turns pink when the acid is completely neutralized and a slight excess of base is present. In this titration, a successful endpoint is achieved if one drop of base turns the solution in the flask from colorless to pink.

If you should overshoot the endpoint by adding too much base, you will have to dispose of the solution in the Erlenmeyer flask and start over.

Since you know both the molar concentration in moles per liter and the volume of the NaOH, you can calculate the number of moles of base used. At the endpoint, the number of moles of HCl used equals the number of moles of NaOH used. Therefore, you know the number of moles of HCl in a measured volume of acid, and you can calculate the concentration of the HCl by dividing the number of moles by the volume.

Purpose:
To determine the concentration of a solution of hydrochloric acid by acid-base titration.

Materials:
standardized solution of NaOH
unknown solution of HCl
phenolphthalein indicator

Equipment:
beakers, 250 mL
buret, 25 or 50 mL
buret clamp
Erlenmeyer flask, 250 mL
ring stand

Procedure:

1. Obtain approximately 120 mL of NaOH in a 250 mL beaker.

2. Rinse the buret with approximately 10 mL of the NaOH solution, and let the liquid drain through the buret tip into an empty 250 mL "waste" beaker. Repeat this procedure twice more, using new 10 mL samples of NaOH solution each time.

3. Refill the buret so that the meniscus of the solution is above the 0 mL mark. Position the buret in a double buret clamp on a ring stand. Let some of the solution run rapidly from the buret to expel all air bubbles from the tip and to bring the level of the solution down to the calibrated region of the buret. If there is a drop of solution hanging on the tip of the buret, remove it by touching the drop to the inside wall of the 250 mL beaker.

4. Read the initial volume of the NaOH solution at the bottom of the meniscus. Your eye must be at the same level as the meniscus.

5. Pour 20.0 mL of HCl into a clean 250 mL Erlenmeyer flask. Add two drops of phenolphthalein.

6. Place the Erlenmeyer flask under the tip of the base buret. A piece of white paper placed under the flask will make it easier to see the color changes. While continuously swirling the flask to ensure thorough mixing, run in the NaOH solution from the buret. Initially, a pink color will appear at the point where the NaOH comes in contact with the solution in the flask; however, this color disappears quickly. As the endpoint nears, the color will disappear more slowly. Eventually, the NaOH should be added drop by drop until one drop turns the entire solution in the flask pink. This pink color should remain at least 15 seconds while the solution is being swirled.

7. If you overshoot the endpoint, you will have to discard the solution and begin again. When you have reached a satisfactory endpoint, read the final volume of the buret.

8. Refill the buret and repeat steps #3-7 twice more, using a clean Erlenmeyer flask.

Name: _____

Date: _____

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Data:

Measurements	Trial #1	Trial #2	Trial #3
Concentration of NaOH (M)			
Initial reading of buret (mL)			
Final reading of buret (mL)			
Volume of NaOH used (mL)			
Volume of HCl reacted (mL)			

Calculations:

Calculation	Trial #1	Trial #2	Trial #3
Moles of NaOH used			
Moles of HCl used			
Concentration of HCl			

Average concentration of HCl: _____

Questions:

1. If 27.31 mL of 0.2115 M NaOH is able to neutralize 37.45 mL of HCl, what is the concentration of the acid?

2. What volume of 0.117 M HCl is needed to neutralize 28.67 mL of 0.137 M KOH?

3. Why does the pink color, which forms at the point where the NaOH comes into contact with the solution in the flask, disappear more slowly near the endpoint?

4. Why is it a good idea to carry out titrations in triplicate?

5. Why might you use distilled water to wash a drop of solution sticking to one of the buret tips into the Erlenmeyer flask?

6. Would the addition of several milliliters of distilled water to the Erlenmeyer flask during the titration affect the results of the titration? Explain your answer.

7. If 35.93 mL of 0.1590 M NaOH neutralizes 27.48 mL of sulfuric acid, what is the concentration of the sulfuric acid? *(Hint: remember that sulfuric acid produces twice as many hydrogen ions in solution per mole!)*

Wondering:
Write one question this lab makes you wonder about.

Errors:
List four lab errors that could have affected your results.

1.

2.

3.

4.