# Acid Base Titration

## Background

Before beginning this experiment, re–read the sections in your textbook concerning acid – base reactions, titrations, and molarity. Recall that an acid and a base will react to produce a salt and water. For example:

$$HNO_{3\,(aq)} + KOH_{(aq)} \longrightarrow KNO_{3\,(aq)} + H_2O_{(l)}$$

In this experiment, the molarity of one of the reactants is known and the other is not. The purpose of the titration is to determine the molarity of the latter. We say that the unknown solution has been ***standardized***. To accomplish this a known volume of the acid is added to a flask from a buret, then the base is added until the reaction is exactly complete. The volume of base required is recorded. This is called the ***end point***. The end point is detected by means of an ***indicator***. The indicator used in this experiment is ***phenolphthalein***, which is pink in basic solution and colorless in acidic solution. Only a drop or even a fraction of a drop of base at the end point will cause the solution to change abruptly from colorless to pink.

**Practice Calculation:** If 25.00 mL of 0.2160 M $HNO_3$ is required to titrate 24.20 mL of KOH with an unknown concentration, see if you can set up the relationship to show what the concentration of KOH would be.

## Equipment

From the stockroom:
- plastic 1 L bottle
- 50 mL buret
- buret clamp
- 25 mL vol. pipet and bulb

From the common drawer:
- ring stand

From your drawer:
- funnel
- 125 mL flask
- 250 mL flask
- 2 beakers (one for waste)
- wash bottle

Answer: 0.2231 M

## Procedure

### Part 1: Acid-Base Titration Lab–Standardizing NaOH

1. From the stockroom, obtain a 1 L plastic bottle, buret, buret clamp, 25.00mL volumetric pipet, and a pipet bulb.

2. Put approximately 35mL of 6M NaOH into the 1L bottle and fill it with DI water. Cap tightly and invert 10 times to mix. This is your NaOH standard.

3. Check that the stopcock on the buret is closed. Rinse the inside of the buret by filling it with 4–5 mL of your NaOH standard and repeatedly turn it while tilting the top of the buret over a waste beaker. Repeat the "tilt and turn" method 3 times with your NaOH standard and drain into a waste beaker by opening the stopcock. During these "rinses", be sure to drain the NaOH through the stopcock to rinse it as well. When draining your "rinse", check the stopcock tip for air bubbles, as these will inhibit your control of the reagent in the buret during your titration.

4. Check that the stopcock is closed. ***Below eve level*** fill the buret (using a funnel) with your NaOH standard to somewhere just below the zero mL mark. Remove the funnel and place buret in the buret clamp. Write down the initial buret volume reading to the nearest 0.01 mL.

5. Obtain about 100 mL of HC1 standard (in hood); *be sure to write down its concentration on your lab report.* Clean a 125mL Erlenmeyer flask and generously rinse with DI water; it does not have to be completely dry (think about why not). Pipet 25.00mL of the standardized HC1 into the flask. Add 3 drops of phenolphthalein indicator.

6. Titrate the HC1 with the NaOH while swirling the Erlenmeyer flask, making sure to include any splashed drops left on the walls of your flask. When one drop of NaOH turns the indicator in your solution from colorless to pink, you have reached the endpoint.

7. Write down the final buret reading to the nearest 0.01 mL. Empty the solution in the Erlenmeyer flask down the sink (think about why this is ok) with the water running.

8. Repeat Steps 4 through 7 until you have 3 volumes of NaOH that agree within 0.2 mL. Calculate the actual M of the NaOH. Safely store your standardized NaOH in your lab drawer for Part II. ***Before you leave lab,*** clean and thoroughly rinse a 250mL Erlenmeyer flask; allow it to dry in your lab drawer for use in Part II.

9. Calculate the average molarity of NaOH and record in both data tables for Part 1 and Part 2.

### Part 2 : Acid-Base Titration Lab–Unknown Acid

1. From the stockroom, obtain a buret, buret clamp, 25mL volumetric pipet, and a pipet bulb, and also bring your *clean and dry* 250mL Erlenmeyer flask from Step 8 of Part I. A stockroom worker will fill your flask with an unknown acid and affix an unknown code label; write down your unknown code on your lab report.

2. Invert your standardized NaOH bottle 10 times to remix.

3. Check that the stopcock on the buret is closed. Rinse the buret by "tilt and turn" method (see Step 3 of Part I) 3 times with your standardized NaOH and drain into a waste beaker by opening the stopcock. When draining your "rinse", check the stopcock tip for air bubbles, as these will inhibit your control of the buret reagent during your titration.

4. Check that the stopcock is closed. ***Below eye level*** fill the buret (using a funnel) with your standardized NaOH to somewhere just below the zero mL mark. Remove the funnel and place buret in the buret clamp. Write down the initial buret volume reading to the nearest 0.01 mL.

5. Clean a 125mL Erlenmeyer flask and generously rinse with DI water; it does not have to be completely dry (think about why not). Pipet 25.00mL of your unknown acid into the flask. Add 3 drops of phenolphthalein indicator.

6. Titrate your unknown acid with your standardized NaOH while swirling the Erlenmeyer flask, making sure to include any splashed drops left on the walls of your flask. When one drop of NaOH turns the indicator in your solution from colorless to pink, you have reached the endpoint.

7. Write down the final buret reading to the nearest 0.01 mL. Empty the solution in the Erlenmeyer flask down the sink (think about why this is ok) with the water running.

8. Repeat Steps 4 through 7 until you have 3 volumes of NaOH that agree within 0.2 mL.