

# ACID-BASE TITRATION USING A PRIMARY STANDARD

Ref: Working with Chemistry, Gilason S. F., Kuehn J. E., Wink D. J., pg97  
Experiments in General Chemistry, Greco T. G., Rickard L. H. Weiss G. S., pg65.

## LAB PH.2

### STANDARDS ADDRESSED

- 3.2.10A Apply knowledge and understanding about the nature of scientific and technological knowledge
- 3.2.10D Identify and apply the technological design process to solve problems.
- 3.2.12B Evaluate experimental information for appropriateness and adherence to relevant science processes.
- 3.4.12A Apply concepts about the structure and properties of matter.

### INTRODUCTION

This experiment gives us a chance to improve and perfect our experimental technique, especially for degree of accuracy and precision required.

In this experiment you will titrate with a primary standard and a secondary standard. The primary standard will be used to determine the concentration, Molarity, of the secondary standard. The second standard will be used to determine the Molarity of an unknown acid solution.

### SAFETY

Both sodium hydroxide and Hydrochloric acid are harmful to skin and eyes. Wear eye protection! If any of either gets on skin or eyes rinse immediately and thoroughly with water.  
Never add water to acid. Always add acid to water.

### MATERIALS

Magnetic stirrer with stir bar	DI Water
Potassium Hydrogen Phthalate 4g	Buret 50 ml or Vernier Drop Counter
Sodium hydroxide solution	Hydrochloride Acid Solution
Erlenmeyer flasks 125 ml (4)	Pipet, volumetric 1- 5 ml
Phenolphthalein indicator	Beaker 250 ml
Laptop computer with Logger Pro 3 or higher	

## **PROCEDURE**

### Part I Standardization of the secondary standard

Clean and rinse well with DI water four 125 ml Erlenmeyer flasks,

Place between 0.20 and 0.25 g of Potassium Hydrogen Phthalate (KHP) into each Erlenmeyer flask. These do not have to be completely dry. Record the exact mass added to each flask. Add about 25 ml of DI water to each flask. Set each flask aside.

Rinse the buret twice with water and at least once with the sodium hydroxide solution. Next fill the buret with this solution to the 0.00 ml mark. Make sure the tip of the buret is filled and contains no air.

Swirl each of the flasks containing the KHP until they are completely dissolved. Add two drops of indicator to each flask. The solution should be colorless.

Titrate each of the KHP solutions with the sodium hydroxide solution. The approach to the end point is suggested by the temporary appearance of a pink color that fades when the flask is swirled. A pink color that persists for at least 30 seconds signals the actual end point.

### Part II Determination of the concentration of the hydrochloric acid

Using a clean, dry beaker, obtain an unknown acid sample. This acid is monoprotic. Rinse the pipet that was filled with HCl with two 5 ml portions of DI water and then with the unknown acid solution.

Transfer 25.0 ml portion to into four clean Erlenmeyer flasks. Add 2 drops of indicator to each flask. Titrate with the standardized sodium hydroxide from Part I until a faint pink color persists.

Use the molarity of sodium hydroxide determined in Part I to determine the molarity of the acid.

Record your data using the appropriate number of significant figures.

## **DATA ANALYSIS**

Record your results in a table. Give concentrations for sodium hydroxide and hydrochloric acid. Indicate the amount of primary standard used in each of the four trials. Show sample calculations to determine the concentration of the standard and the acid. Account for any differences in the calculated molarity for each solution.

## QUESTIONS

1. As the acid solution is titrated, the pink color forms where drops first enter solution but disappears as the solution is swirled. Explain why this happens.
2. A solution of HCl is titrated but an air bubble had been in the tip of the buret during the initial volume reading. The bubble was dislodged during titration. Will the calculated molarity be affected and if so how?
3. During this experiment the pipet used to measure the acid was not clean and some acid remained above that left in the tip. How will this affect the molarity of the acid?

## EXTENSIONS

Use the same procedure and primary standard to determine the molarity of a solution of sulfuric acid.

Household vinegar may be analyzed for acetic acid by the same procedure and its concentration expressed as percent mass (w/w). Most commercial products acetic acid in the range of 4% to 5.5% .