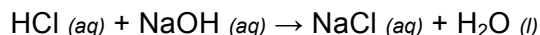


Chemistry

Acid-Base Titration Lab

Introduction

One common task that chemists must perform is to determine the concentration of a chemical using titration. There are a variety of reasons that this may be necessary, ranging from finding an unlabeled container in the stock room to applying forensic techniques in order to identify a sample at a crime scene. 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:



During the first stages of the titration, the NaOH will be completely neutralized, and an excess of acid will remain. However, at the theoretical endpoint, the acid and the base will have neutralized one another exactly, and the phenolphthalein indicator will turn 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 a very faint pink, and at this point, the number of moles of NaOH used will be equal to the number of moles of HCl in the unknown solution.

Purpose

Based on the introduction above, determine the purpose of this lab and record it in your lab notebook.

Materials

sodium hydroxide solution [NaOH], 0.1M
hydrochloric acid [HCl], unknown
phenolphthalein indicator

Equipment

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

Safety Considerations

- Hydrochloric acid and sodium hydroxide are caustic! Avoid contact with the skin and eyes.
- Safety goggles must be worn at all times; gloves are optional but highly recommended.
- Sometimes chemicals from previous labs still remain in glassware and on other lab equipment; wash all lab equipment before and after performing this lab.
- Wash your hands thoroughly after completing this lab.

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 indicator.
 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, but 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 for 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 and record the volume of NaOH used in your lab notebook.
 8. Refill the buret and repeat steps #3-7 twice more, using a clean Erlenmeyer flask.

Clean-up and Disposal

1. Drain your buret into the waste beaker and rinse it with tap water.
2. Wash any remaining solutions and materials down the sink.
3. Return all equipment to its proper place.
4. Wipe down your lab area.
5. Dispose of any weigh paper, paper towels or rubber gloves in the trash can.
6. Wash your hands before leaving the lab.

Calculations *(show all work and circle your answers!)*

1. For each trial, calculate the number of moles of NaOH used.
2. The number of moles of NaOH used is equal to the number of moles of HCl reacted. Based on your results in the previous calculation, determine the concentration of HCl for each trial.
3. Obtain the accepted concentration of HCl from your teacher. Using your average experimental concentration of HCl, determine your percent error for this lab.

Questions

1. 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?
2. Why is it a good idea to carry out titrations in triplicate?
3. Why might you use distilled water to wash a drop of solution sticking to one of the buret tips into the Erlenmeyer flask?
4. 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.

Errors

List four possible errors you may have committed in this lab that may have somehow affected your results.