

Chemistry II - Laboratory #4
Standardization of a Solution Using a Primary Standard

Goal

The goal of this lab is to determine the molarity of a sodium hydroxide solution.

Topics to Include in Research

titration, molarity, types of volumetric glassware [especially burets], standard solution, acid-base indicator, phenolphthalein, potassium hydrogen phthalate (KHP), equivalent mass

Example Problem to Work and Explain in Research

- Calculate the molarity of a solution of sodium hydroxide, NaOH, if 23.64 mL of the solution is needed to neutralize 0.5632 g of potassium hydrogen phthalate.

Background

Titration is a method of volumetric analysis—the use of volume measurements to analyze an unknown. In acid-base chemistry, titration is most often used to analyze the amount of acid or base in a sample or solution. Consider a solution containing an unknown amount of hydrochloric acid. In a titration experiment, a known volume of the hydrochloric acid solution would be “titrated” by slowly adding dropwise a standard solution of a strong base such as sodium hydroxide. The titrant reacts with and consumes the acid via a neutralization reaction. The exact volume of base needed to react completely with the acid is measured. Knowing the exact concentration and volume added of the titrant gives the number of moles of sodium hydroxide. The latter, in turn, is related by stoichiometry to the number of moles of hydrochloric acid initially present in the solution.

The concentration of the NaOH solution must be accurately known. To “standardize” the NaOH, the NaOH is titrated against a solid acid, potassium hydrogen phthalate (KHP). The KHP is chosen because it is easily dried and massed and has a relatively high equivalent mass. KHP has one ionizable hydrogen, so one mole of KHP will neutralize one mole of NaOH.

Guidelines

1. Use 0.40 to 0.60 grams of potassium hydrogen phthalate (KHP) per trial.
2. Perform at least three trials.
3. Add the KHP to a 125 mL Erlenmeyer flask, rinsing all of the KHP in with distilled water, and adding about 40 mL of distilled water to the solid.
4. After cleaning the buret with distilled water, rinse it with three small portions (about 7 mL) of the NaOH solution.
5. Use three drops of phenolphthalein per trial.
6. Add NaOH solution SLOWLY to the Erlenmeyer flask while continuously swirling until the pink color starts to persist. Be sure to rinse down the sides of the Erlenmeyer flask with distilled water. Reduce the rate of NaOH to drop-by-drop until the pink color persists for 15 seconds.

Lab handout based on the experiment “Acid-Base Titrations” in Laboratory Experiments for Advanced Placement Chemistry (Second Edition) by S.A. Vonderbrink (Flinn Scientific, 2006)