

Standardization of NaOH and Determination of Equivalent Weight of an Unknown Acid

Commercially available NaOH is quite impure. (Solid NaOH is very hygroscopic and reacts with CO_2 in the air). Therefore, solutions of NaOH to be used quantitatively must be standardized against a primary standard. Primary standards are compounds which react quantitatively, completely, and with known stoichiometry with the substance to be standardized. One such primary standard for NaOH is potassium acid phthalate (KHP formula $\text{C}_8\text{H}_5\text{O}_4\text{K}$). KHP is available in high purity, is crystalline and easily handled, and reacts in a 1:1 molar ratio with OH^- .

Standardization of NaOH: Obtain ca 200 mL of the ~0.1 M NaOH and rinse and fill a 50 mL buret. Weigh three samples of KHP (calculate the mass required to use about 25–40 mL of the NaOH solution) and quantitatively transfer to 250 mL Erlenmeyer flasks. Add about 50 mL distilled water to the flasks and 3–5 drops of the phenolphthalein indicator solution. Titrate each sample to the first faint persistent appearance of pink. Remembering that one mole KHP reacts with one mole OH^- , calculate the molarity of the NaOH solution. Also calculate your average and standard deviation. Put your results on the board and compare to the rest of the class results and calculate an average and standard deviation for all the data.

Equivalent Weight of Unknown Acid: Weigh triplicate samples of an unknown acid (instructor will provide approximate masses to require 25–50 mL of titrant) into 250 mL flasks. Add 50 mL water and titrate with the now accurately standardized NaOH solution. Assuming that the acid is monoprotic, you can calculate the MW of the acid by knowing that each mole of OH^- added in the titration reacts with one mole of the acid.

$$\text{MW} = (\text{grams unknown acid}) / (\text{volume titrant} * \text{conc. titrant})$$

Using your three titrations, calculate your average value and the standard deviation for the MW of the unknown.

Acetic Acid Content of Vinegar: Assuming that the only titratable acid in vinegar is acetic acid (probably a reasonable assumption for plain white distilled vinegar) determine the acetic acid content of two different vinegars by titrating with your standardized NaOH solution with phenolphthalein as the indicator. The supplied vinegar is a 1:10 dilution and you should titrate accurately pipetted 25 mL aliquots. Do at least three replicates of each of the vinegars. Calculate the amount of acetic acid in the original vinegars expressed both as %w/v and as molarity. Do the different vinegars appear to have the same acetic acid content?