OBJECTIVE:

To prepared and determine the concentration of solution

LEARNING OUTCOMES

After conducting this experiment, you should be able to:
1. How to prepare the standard solution and dilute the solution
2. Determine the concentration of solution in various units

INTRODUCTION:

In chemistry, concentration is the measure of how much of a given substance there is mixed with another substance. This can apply to any sort of chemical mixture, but most frequently the concept is limited to homogeneous solutions, where it refers to the amount of solute in a substance

A solution generally consists of a solute dissolved in a solvent. To work quantitatively with a solution we must have ways to express their concentrations. The most useful expressions are molarity (M) density (g/L or g/mL) and percent weight (%w/w). A solution is prepared in a volumetric flask to ensure that a precise final volume is obtained.

Molarity = moles of solute per liters of solution
Density = weight of solute per volume of solution
Percent weight = (weight of solute per weight of solution) x 100%

A **standard solution** is prepared from pure (≥ 99%) substance and the exact concentration of the solution is known. Some solutions need to be standardized because their concentrations vary over time due to chemical reactions such as oxidation.

To lower the concentration of solution, we use the process of **dilution**, or adding more solvent to a solution. In this process, the relative numbers of solute and solvent particles change. Adding more solvent increase the number of solvent particles and increases the volume. For a given amount of the original solution, the number of solute stays the same, but they are spread out through a greater volume, so their concentration is less.

If we dilute a solution of known molarity, we can calculate the molarity of diluted solution using the formula given by.

$$M_1V_1 = M_2V_2 \qquad \text{(eq. 3.1)}$$

where M_1 and V_1 the molarity and volume of the solution before dilution, M_2 and V_2 are the molarity volume of the solution after dilution

Titration is a common laboratory method of quantitative/chemical analysis which can be used to determine the concentration of a known reactant. Because volume measurements play a key role in titration, it is also known as *volumetric analysis*. It was process of determining the concentration of one substance in solution by reacting it with a solution of another substance that has a known concentration. In a typical acid-base titration, a pipette is used to precisely measure a volume of a

solution of unknown concentration into a conical flask, followed by the addition of an indicator solution.

An indicator solution is a dye that has one color in an acidic solution and another in a basic solution. A standard solution is that added from the burette until some visual effect, such as color change, signals that the reaction is complete. The solution in the burette is referred to as the titrant.

In this experiment, you will be required to prepare a standard solution of oxalic acid. The oxalic acid will be used to standardize a solution of sodium hydroxide of unknown concentration. The chemical reaction between oxalic acid and sodium hydroxide occurs as follows:

$$H_2C_2O_4 \bullet 2H_2O + 2NaOH \rightarrow Na_2C_2O_4 + 2H_2O \qquad \text{(eq. 3.2)}$$

The molar equivalence of the reactants can be calculated using the formula given by

$$\frac{M_a V_a}{a} = \frac{M_b V_b}{b} \qquad \text{(eq. 3.3)}$$

Where M_a and V_a the molarity and volume of the acid, M_b and V_b are the molarity and the volume of the base; a and b are the stoichiometric constants respectively.

LAB EQUIPMENT

Small and large beakers
100 mL volumetric flask
50 mL burette
Retort stands and clamps
250 mL conical flask
20 mL pipette
Filter funnel
Dropper
Glass rod

CHEMICALS AND MATERIALS

Oxalic acid crystal ($H_2C_2O_4 \bullet 2H_2O$)
NaOH solution (already prepared in the lab)
Thymol blue indicator solution
Distilled water

EXPERIMENTAL PROCEDURE

Part A: Preparation of solution

1. Weigh approximately 0.35 – 0.40 g of oxalic acid in a small beaker. Record the exact weight of the acid.
2. Dissolved the acid in some distilled water and stirred by using glass rod.
3. Use funnel transfer all acid solution from beaker into a 100 mL volumetric flask
4. Add distilled water into volumetric flask until the diluted solution fills the flask to the marked level.
5. Placed the stopper in the flask and inverted the flask for several times to thoroughly mix the solution.
6. Calculate the concentration of solution in g/mL, g/L and molarity

Part B: Dilution of NaOH solution

1. Use a beaker to obtain approximately 30 mL of NaOH solution (already prepared for you in the lab)
2. Pipet 20 mL of NaOH from beaker into a 100 mL volumetric flask
3. Add distilled water into volumetric flask until the diluted solution fills the flask to the marked level.
4. Placed the stopper in the flask and inverted the flask for several times to thoroughly mix the solution.

Part C: Titration

1. Set up the equipment for titration. Use a beaker to obtain approximately 80 mL of NaOH solution (that have prepared from **Part B**)
2. Fill the burette with the oxalic acid that you have prepared from **Part A** (use a funnel). Record the initial reading on the burette.
3. Pipet 20 mL of NaOH into a conical flask and add 2 - 5 drops of Thymol Blue. Titrate the NaOH solution until the color of the solution changes from blue to a permanent light yellow. Record the final reading.
4. Repeat step 2 and 3 two more times. Determine the average amount of oxalic acid used.
5. Calculate the concentration of diluted NaOH and standard NaOH (already prepared for you in lab)

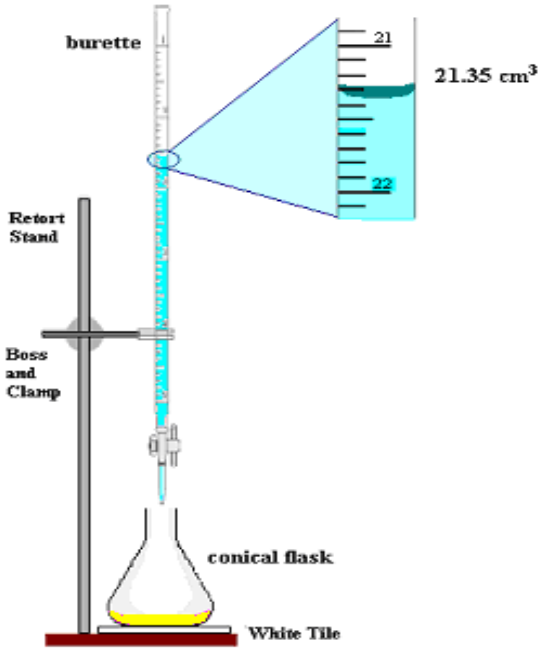

Figure 3.1: Experimental setup for titration process