The republic of iraq

Ministry of Higher Education and Scientific Research

Al-Mustaqbal University

College of Engineering

Experiment No.3

Oxidation-Reduction Titration

Prepared by:

Shahd Ammar Hatem

1. General Background

In this lab experiment, you will perform titrations for an oxidation-reduction reaction (often called "redox" reaction) and will find that the stoichiometry is not 1:1 and that the reaction is selfindicating; that is, there is no indicator needed.

Potassium permanganate ($KMnO_4$) is a common chemical found in most laboratories. It can be used for a variety of purposes and although hazardous in concentrated solutions it is relatively safe in small concentrations. It is best known for its deep purple color that can be seen with the naked eye at low concentrations.

Potassium permanganate, as an oxidant, can be reduced in acidic solutions to produce Mn^{+2} as well as in Alkaline solution to produce MnO_2. In the alkaline environment, the end point of the reaction is not completely controlled and is not clear during the process. For this reason, permanganates are oxidized in acidic environments and are often used in volumetric analysis methods.

2. Objectives of the Experiment

- Develop skills in the reliable measurement of mass and volume
- Learn proper use of buret for volume determination
- Learn and reinforce the concepts of titration as an analytical method
- Develop skills with substances that may be hazardous
- Gain experience with stoichiometry in balanced reactions
- Observe a reduction oxidation process
- Understand quantitative analysis

3. Procedure

Part One

Prepare approximately 0.02 M solution of potassium permanganate

- Dissolve 3.2 g of chemically pure potassium permanganate in a liter of distilled water.
- Heat the solution for 30-60 minutes to the boiling point, then cool the solution.
- Filter the solution through pure asbestos (free of organic materials) or through glass wool or porous glass.
- Transfer the solution to a regular colored (opaque) bottle with a glass stopper. Keep the solution away from steam and light to prevent it from decomposing.

Part Two

Prepare a solution (0.02 M) of oxalic acid supplemented with iron cations

- Take 1.6 g of oxalic acid and then dissolve it in a small amount of distilled water in a 100 ml beaker.
- Dilute the resulted solution with 150 ml of distilled water.

Part Three

Titration of potassium permanganate solution with (0.02 M) oxalic acid

- Fill the buret with potassium permanganate solution to the mark
- Pipette 10 ml of the oxalic acid solution into a conical flask containing 100 ml of distilled water.
- Trim the solution against the permanganate solution present in the burette by adding the permanganate solution to it drop by drop until the color of the solution disappears, drops are added very slowly until reach the end point of the reaction (the solution turns from purple to a colorless liquid).

Figure 1 illustrates the titration process.

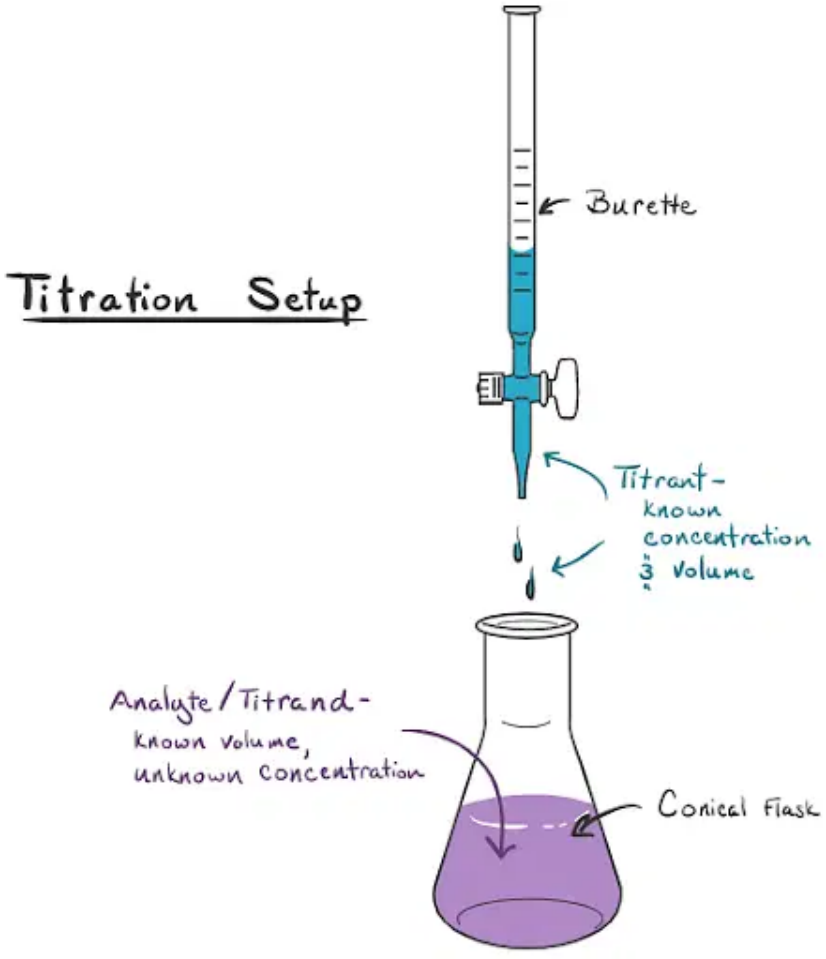

Fig. 1: Titration process.

4. Calculations

Potassium permanganate solution reacts with the acid as follows:

$$MnO^-_4 + 8H^+ + 5Fe^{+2} \longrightarrow Mn^{+2} + 5Fe^{+3} + 4H_2O_4$$

- Calculate Fe^+ moles by the following relation:

$$\frac{\text{y MnO4}}{\text{y Fe}} = \frac{\text{n MnO4}}{\text{n Fe}}$$

- Calculate Fe^+ concentration by the following relation:
- $M = \frac{n}{V}$

Where: y = number of molecules/atoms/ions in the chemical reaction; n = moles number; M = Molar concentration; V = volume.

*Hint:

- Use the above chemical reaction equation to find y.
- Use the molar concentration relation (referred to above) to calculate the moles number of MnO_4

5. Discussion

a) Why is it preferable to oxidize potassium permanganate in acidic rather than basic media?

b) prove that oxidation and reduction processes occur when a solution of potassium permanganate reacts with oxalic acid supplemented with iron cations, support your answer with the scientific equation.

c) What are the disadvantages of using potassium permanganate solution in the experiment?

d) Leave your special comment that you think is necessary to be deal in this experiment discussion.