Ministry of Higher Education and Scientific Research

Mustansiriyah University

College of Science / Department of Chemistry

Practical Analytical Chemistry

For First Year Students Biology Department

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Oxidation-Reduction Titrations (Redox Titration)

- **Oxidation:** Is the donation of electrons to another substances, and the oxidation number must be increases. A substances that oxidized called Reducing agents (reducers).

$$Sn^{2+} \longrightarrow Sn^{4+} + 2e^-$$

- **Reduction:** Is the acceptance of electrons from another substance, and the oxidation number must be decreases. A substances that reduced called Oxidizing agents (oxidizers).

$$Fe^{3+} + e^- \longrightarrow Fe^{2+}$$

Oxidation-reduction reactions is called redox reaction, an electron transfer reactions, electrons are transferred from the atom being oxidized to the atom being reduced. Reaction: One mole of NaCl reacts with exactly one mole of AgNO3.

Oxidation-Reduction Titrations (Redox Titration)

Tin (II) chloride reduces iron (III) chloride to iron (II) chloride in solution. In this process, the tin (II) ions are oxidized to the more stable tin (IV) ions.

$$2FeCl_3 + SnCl_2 \longrightarrow 2FeCl_2 + SnCl_4$$

$$2Fe^{3+} + Sn^{2+} \longrightarrow 2Fe^{2+} + Sn^{4+}$$

Standardization of iron ion using standard solution of Potassium Permanganate (KMnO4)

- ***Purpose:*** Determine the exact normality of iron ion.

Potassium Permanganate ($KMnO_4$): As a

1. The strong oxidant.
2. Potassium permanganate is not primary standard substance.
3. Conveniently indicated.

In this experiment, Fe^{2+} iron ion, will react quantitatively with permanganate ion, MnO^{4-}, in the presence of strong acid.

Reaction:

$$MnO_4^- + 5Fe^{2+} + 8H^+ \longrightarrow Mn^{2+} + Fe^{3+} + 4H_2O$$

Oxidation conducted of potassium permanganate in acidic, neutral and basic and it's as follows:

•Acidic medium:

$$MnO_4^- + e^- \longrightarrow MnO_4^{=}$$

$$\text{Eq.wt}_{KMnO_4} = \frac{\text{M.wt}}{1}$$

•Neutral or weak basic medium: Sodium or potassium carbonate (Na_2CO_3 or K_2CO_3).

$$MnO_4^- + 2H_2O + 3e^- \longrightarrow MnO_2 + 4OH^-$$

$$\text{Eq.wt}_{KMnO_4} = \frac{\text{M.wt}}{3}$$

•***Strong basic medium:*** Sodium or potassium hydroxide (KOH or NaOH).

$$MnO_4^- + 8H^+ + 5e^- \longrightarrow Mn^{2+} + 4H_2O$$

$$\text{Eq.wt}_{KMnO_4} = \frac{\text{M.wt}}{5}$$

Equipment	***Materials***
• Burette	o Iron(II) sulfate ($FeSO_4$)
• Beaker	o Potassium permanganate ($KMnO_4$) 0.1N
• Pipette	o Sulfuric acid (H_2SO_4)
• Pipette filler	o Distilled water
• Conical flask	
• Dropper bottle	
• Funnel	
• Stand	
• Clamp	
• Filter paper	

Procedures

1. Wash the burette, pipette and conical flask with distilled water.

2. Using a funnel, fill the burette with potassium permanganate ($KMnO_4$) 0.1N.

3. Using a pipette, transfer 5.00 mL volume of iron (II) solution to the conical flask and Add 5.00 mL volume of 1N sulfuric acid (H_2SO_4) (solution I).

4. Added potassium permanganate ($KMnO_4$) 0.1N slowly from the burette in about 1.00 mL portion to the iron (II) solution in a conical flask (solution II), swirling the conical flask after each addition. The end-point of the titration is detected by the first persisting pale-pink color. Note the burette reading.

5. Repeat the titration for a more accurate reading. Repeat the titration until two readings agree within 0.10 mL.

6. Calculate the normality of iron (Fe^{2+}).

Calculations

$$N_1 \times V_1 = N_2 \times V_2$$

$(KMnO_4)$ (Fe^{2+})

Questions:

1. Explain added sulfuric acid to the iron (II) solution prior to titration?
2. Could be used hydrochloric acid or nitric acid instead of sulfuric acid? Explain.
3. Write the balanced equation for the of Permanganate ion reaction with Iron (II) ion (FeSO4) in acid solution (H2SO4)?