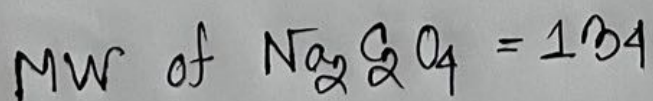
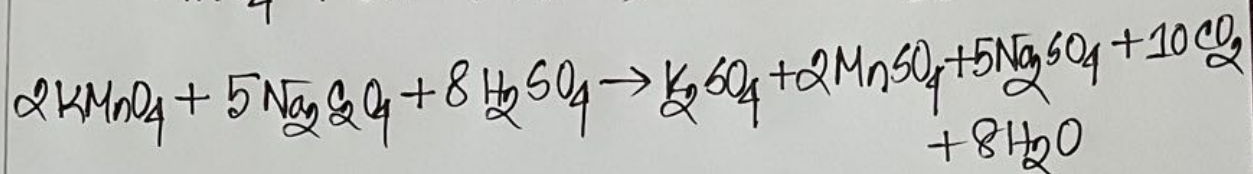
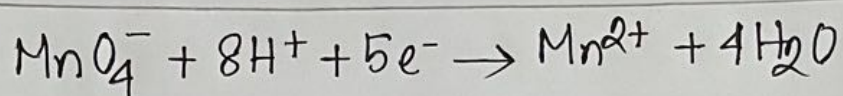


Experiment Name: Standardization of Potassium Permanganate solution with Standard Sodium Oxalate Solution.

Theory: In this experiment, potassium permanganate solution is standardizing with the help of standard sodium oxalate solution. The reaction that occurs here is oxidation and reduction reaction. An oxidation-reduction reaction (redox) is a reaction in which electrons are transferred between species or in which atoms change oxidation numbers. Oxidation is the half reaction in which there is loss of electrons by a species (or increase of oxidation number of an atom). Reduction is the half reaction in which there is a gain of electrons by a species (or decrease of oxidation number of an atom).

Reaction involved in this reaction is:





In this reaction, MnO_4^- is reduced to Mn^{2+} and $\text{Na}_2\text{C}_2\text{O}_4$ is oxidized to CO_2 .

The following equation is used to calculate the strength to Potassium Permanganate:

$$V_A \times S_A \times e_A = V_B \times S_B \times e_B$$

here,

V_A = Volume of Potassium Permanganate (KMnO_4)

S_A = Strength of Potassium Permanganate (KMnO_4)

e_A = equivalent of Potassium Permanganate (KMnO_4)

V_B = Volume of Sodium Oxalate ($\text{Na}_2\text{C}_2\text{O}_4$)

S_B = Strength of Sodium Oxalate ($\text{Na}_2\text{C}_2\text{O}_4$)

e_B = equivalent of Sodium Oxalate ($\text{Na}_2\text{C}_2\text{O}_4$)

The direction reaction is slow as one can see in a titration. The first few drops of permanganate added to the acidified oxalate solution

are not decolorized immediately.

Mn^{2+} ions produced in the reaction acts as a catalyst.

They react with permanganate to form intermediate oxidation states of manganese. These states, in turn, react rapidly with oxalate to give the products. So, $KMnO_4$ acts as an auto catalyst in this reaction. This is the advantage of $KMnO_4$ is that it serves as its own indicator, the pink color being distinguishable even if the solution is very dilute. Therefore, no indicator is used in this reaction.

Apparatus:

Potassium Permanganate Solution ($KMnO_4$),
Standard Sodium Oxalate Solution ($Na_2C_2O_4$),
Sulfuric Acid (H_2SO_4), Volumetric Flask,
Burette, Pipette, Conical Flask, Beakers,
Distilled Water, Bunsen Burner.

Data table:

Number of Observation	Volume of $\text{Na}_2\text{C}_2\text{O}_4$ (ml)	Burette Reading (ml)			Average (ml)	Strength of KMnO_4
		initial Reading	final Reading	Difference		
1	10	0	10	10	10	0.02M
2	10	10	19	9		
3	10	19	30	11		

Calculation:

Preparation of 0.05M Sodium Oxalate Solution ($\text{Na}_2\text{C}_2\text{O}_4$)

$$V_A \times S_A \times e_A = V_B \times S_B \times e_B$$

here,

Volume of acid, $V_A = 10 \text{ ml}$

Strength of acid, $S_A = 0.05 \text{ M}$

equivalent number of acid, $e_A = 2$

Volume of base, $V_B = 10 \text{ ml}$

Strength of base (KMnO_4), $S_B = ?$

equivalent number of KMnO_4 , $e_B = 5$

Now,

$$10 \times 0.05 \times 2 = 10 \times S_B \times 5$$

$$\therefore S_B = 0.02 \text{ M}$$

Result:

The Determined Strength of Potassium Permanganate (KMnO_4) solution is: $S_{\text{KMnO}_4} =$

Error:

Given strength of $\text{KMnO}_4 =$

$$\text{Percentage of error} = \frac{(\text{Known Value} - \text{Observed Value})}{\text{Known Value}} \times 100\%$$

Discussion:

1. All the apparatus were handled carefully and according to the rules.
2. The reaction between KMnO_4 and $\text{Na}_2\text{C}_2\text{O}_4$ involves KMnO_4 being reduced and $\text{Na}_2\text{C}_2\text{O}_4$ being oxidized.
3. Mn^{2+} ions speed up the reaction, improving titration accuracy.
4. Heating the solution to $60-70^\circ\text{C}$ speeds up the reaction.
5. Glassware was cleaned and rinsed, and the conical flask was placed on white paper to see the color change clearly.