

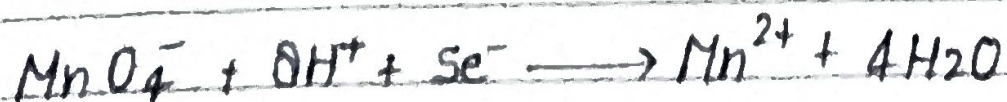
Experiment - 7

Aim- Estimation of oxalic acid by titrating it with potassium permanganate (KMnO_4).

Objective: To determine the strength of potassium permanganate (KMnO_4) solution by titrating it against a standard solution of N/10 oxalic acid ($(\text{COOH})_2 \cdot 2\text{H}_2\text{O}$).

Theory - the titration of potassium permanganate (KMnO_4) against oxalic acid ($\text{H}_2\text{C}_2\text{O}_4$) is an example of a redox reaction.

KMnO_4 is a powerful oxidizing agent that works more strongly in an acidic medium than in an alkaline medium. Therefore, for quantitative analysis, potassium permanganate is generally used in an acidic medium only. Its oxidizing action in an acidic medium can be represented by the following ionic half-reaction:



We use dilute sulfuric acid (H_2SO_4) in this titration to provide the necessary acidic medium for the KMnO_4 solution.

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Sno	Volume of Sample Solution taken.	Burette Reading.		Volume of oxalic acid consumed
		Initial	Final	
1	10 ml	0	3.4 ml	3.5 ml
2	10 ml	0	3.5 ml	
3	10 ml	0	3.5 ml	

Experimental Setup.

- Apparatus: Burette, pipette, conical flask, beaker, funnel, dropper, etc

Chemicals:

- Standard N/10 oxalic acid solution $[(\text{COOH})_2]$
- Unknown Sample Solution.
- Dilute Sulfuric acid (H_2SO_4)

Indicator: Potassium permanganate (KMnO_4), which acts as a self-indicator.

Procedure.

1. Pipette out some of the oxalic acid sample solution into a conical flask and add half a test tube of dilute sulfuric acid (H_2SO_4).
2. Fill the burette with the standard N/10 potassium permanganate (KMnO_4) solution up to the zero mark.
3. Potassium permanganate acts as a self-indicator.
4. Heat the mixture to approximately 60°C before starting the titration to accelerate the reaction rate.
5. Titrate the mixture by adding the KMnO_4 solution dropwise from the burette into the conical flask, swirling continuously, until the solution develops a permanent faint pink colour.

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6. Record this as the end point of the titration.
7. Repeat the process till three concordant reading are obtained,

Calculation -

Normality of standard oxalic acid:

$$N_1 = \frac{N}{10} = 0.1N$$

Volume of oxalic acid: $V_1 = 10\text{ml}$

Volume of KMnO_4 used: $V_2 = 3.5\text{ml}$

Volume of N. KMnO_4 be N_2 .

Using the formula

$$N_1 V_1 = N_2 V_2$$

Substituting the values:

$$0.1 \times 10 = N_2 \times 3.5$$

$$N_2 = \frac{0.1 \times 10}{3.5}$$

$$N_2 = 0.2857\text{ N.}$$

Therefore,

$$\text{Normality of } \text{KMnO}_4 = 0.2857\text{ N.}$$

Calculation of Molarity.

for KMnO_4 in acidic medium: $N = 5M$

Therefore,

$$\text{Molarity} = \frac{N}{5}$$

$$M = \frac{0.2857}{5} = 0.05714\text{ M.}$$

Therefore,

$$\text{Molarity of } \text{KMnO}_4 = 0.05714 \text{ M}$$

Calculation of Strength.

Molar mass of KMnO_4 :

$$\text{K} = 39.1$$

$$\text{Mn} = 54.9$$

$$\text{O}_4 = 16 \times 4 = 64$$

Therefore,

$$\begin{aligned} \text{Molecular mass} &= 39.1 + 54.9 + 64 \\ &= 158 \text{ g/mol.} \end{aligned}$$

Now,

$$\begin{aligned} \text{Strength} &= \text{Molarity} \times \text{Molar mass} \\ &= 0.05714 \times 158 \end{aligned}$$

$$\text{Strength} = 9.03 \text{ g/L}$$

Precaution -

1. Clean all the apparatus with distilled water before starting the experiment.
2. Potassium permanganate is dark in colour, so the upper meniscus should be read carefully.
3. Use dilute sulphuric acid for acidifying the KMnO_4 solution. Do not use HCl or HNO_3 .
4. Maintain the temperature of the oxalic acid solution at about $50-60^\circ\text{C}$.
5. Take the burette reading accurately when the end point is reached.

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