CLASS XII
CHEMISTRY PRACTICAL
PERMANGANOMETRY- (REDOX TITRATION)

Experiment Number: 01 **Date: ----------**

ESTIMATION OF $KMnO_4$ USING STANDARD MOHR'S SALT SOLUTION

Aim: - To determine the mass of potassium permanganate in one litre of the given solution using the given pure Ferrous ammonium sulphate [Mohr's salt, $(NH_4)_2SO_4.FeSO_4.6\ H_2O$] crystals of Analytical Reagent (A.R.) quality.

Principle: - The estimation is based on the reaction between $KMnO_4$ and Mohr's salt.

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

REQUIREMENTS: - Burette, Pipette, Conical flask, Weighing bottle, Ferrous ammonium sulphate (Mohr's salt) crystals (A.R. Grade), Balance, etc.

PROCEDURE: - First of all wash all the apparatus thoroughly with tap water and rinse with distilled water.

- **Preparation of Mohr's salt solution (standard 0.0500 M)**

Weigh **1.960 g** of Mohr's salt crystals (A.R. grade), accurately in a weighing bottle transfer and wash into a clean funnel placed over a **100 ml**. standard volumetric measuring flask. Add about 15ml (1 test tube) of 10% H_2SO_4 solution and then wash down the crystals carefully into the flask by a jet of distilled water. Wash the funnel also down into the flask. Dissolve the crystals completely and then make up the solution to 100 ml. mark. Shake well to make a homogeneous solution.
(Note: - Weigh **4.900 g** of Mohr's salt for a **250 ml**. flask**)**

Mass of Mohr's salt crystals = ---------- gms.
Volume to which the solution is diluted = Vs ml. = 100 ml.
Molarity of the Mohr's salt solution = $M_F = \frac{a \times 1000}{392 \times Vs} = \frac{\ldots\ldots\ldots\ldots x\ 1000}{392 \times 100} = \ldots\ldots\ldots\ldots\ldots M$

- **Estimation of Potassium permanganate solution**

Pipette out 20 ml. of Mohr's salt solution into a conical flask and add about 20 ml. (1 ½ test tubes) of Dil. Sulphuric acid to it. The solution is then titrated with $KMnO_4$ solution taken in the burette. The end point is indicated by the appearance of **pale pink colour** in the solution. The titration is repeated till concordant titre values are obtained.

Sl. No	Volume of F A S (ml)	Burette reading		Titre value (Volume of $KMnO_4$ consumed) (X – Y) ml
		Initial reading Y ml	Final reading X ml	

1	**20 ml**			
2	**20 ml**			

Calculation: -

Molarity of the Mohr's salt solution = $\mathbf{M_F}$ = ---------- **M**

Volume of FAS used = $\mathbf{V_F}$ = **20 ml**

Volume of $KMnO_4$ used up = $\mathbf{V_K}$ **ml.** = ---------- **ml.**

By law of equivalence: - $5\ M_K V_K = M_F V_F$		
$\mathbf{M_K}$ = Molarity of $KMnO_4$	$\mathbf{V_K}$ = Volume of $KMnO_4$ used up (Burette reading).	5 = Number of electrons consumed
$\mathbf{M_F}$ = Molarity of Mohr's salt used.	$\mathbf{V_F}$ = Volume of Mohr's salt (Volume of the pipette).	Only one electron is released

Molarity of the $KMnO_4$ solution = $\mathbf{M_K} = \frac{M_F V_F}{5\ V_K} = \frac{\ldots\ldots\ldots \times 20}{5 \times \text{-------}}$ = ----------**M**

Result: -

Molarity of the given $KMnO_4$ solution = ---------- **M.**

N.B: - (Do not enter in your journal)

1. ***If during the reaction a brown precipitate of hydrated manganese dioxide is observed, insufficient sulphuric acid is indicated. More acid should then be added to the solution.***
2. ***Since the lower meniscus cannot be seen clearly through the purple colour of the $KMnO_4$ solution, the burette readings are taken at the highest level of the liquid surface (upper meniscus).***
3. ***A burette, which has been used for $KMnO_4$ solution, should be emptied and cleaned, immediately after use. Any brown stain due to MnO_2 should be removed by oxalic acid solution or Mohr's salt solution.***

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Experiment Number: 02 **Date: ----------**

ESTIMATION OF $KMnO_4$ USING STANDARD OXALIC ACID SOLUTION.

Aim: - To determine the mass of potassium permanganate in one litre of the given solution using the given pure oxalic acid crystals of Analytical Reagent (A.R.) quality.
Principle: - The estimation is based on the reaction between $KMnO_4$ and Oxalic acid.

{ MnO_4^- + $8\,H^+$ + $5\,e^-$ → Mn^{2+} + $4\,H_2O$ } x 2 { $C_2O_4^{2-}$ → $2CO_2$ + $2\,e^-$ } x 5
$2MnO_4^-$ + $16\,H^+$ + $5\,C_2O_4^{2-}$ → $2\,Mn^{2+}$ + $8H_2O$ + $10CO_2$

REQUIREMENTS: - Burette, Pipette, Conical flask, Weighing bottle, Oxalic acid crystals (AR grade), Balance, etc.

PROCEDURE: - First of all wash all the apparatus thoroughly with tap water and rinse with distilled water

- **Preparation of oxalic acid solution (standard 0.0500 M)**

Weigh **0.6300 g** of Oxalic acid crystals (A.R. grade), accurately in a weighing bottle wash and transfer into a clean funnel placed over a **100 ml**. standard volumetric measuring flask. .Wash the funnel also down into the flask. Dissolve the crystals completely and then make up the solution to 100ml. mark. Shake well to make a homogeneous solution.
(Note: - Weigh **1.575 g** of oxalic acid for a **250ml**. flask**)**

Mass of oxalic acid crystals = ***X g***
Volume of solution prepared = ***Vs ml*** =100 ml.

Molarity of the Oxalic acid solution (**Mo**) = $\frac{X \times 1000}{126 \times Vs} = \frac{\ldots\ldots\ldots\ldots \times 1000}{126 \times 100}$ = ----------**M**

- **Estimation of Potassium permanganate solution**

Pipette out 20 ml. of oxalic acid into a conical flask, about 20 ml. (1 ½ test tubes) of Dil. Sulphuric acid is added and the mixture is **heated to 60^0 to 70^0 C** (bearable warmth). The solution is then titrated with $KMnO_4$ solution taken in the burette. The end point is indicated by the appearance of **pale pink colour** in the solution. The titration is repeated till concordant titre values are obtained.

Sl No	Volume of Oxalic acid used (ml)	Burette reading		Titre value (Volume of $KMnO_4$ consumed) (Z – Y) ml
		Initial reading Y ml	Final reading Z ml	
1	20 ml			
2	20 ml			

Calculation: -

Molarity of the Oxalic acid solution = **Mo** = ……**M**

Volume of oxalic acid used = **Vo** = **20 ml**

Volume of $KMnO_4$ used up = **V_K ml.** = ... **ml.**

By law of equivalence: - $5\ M_K V_K = 2\ M_O V_O$		
M_K = Molarity of $KMnO_4$	**V_K** = Volume of $KMnO_4$ used up (Burette reading).	5 = Number of electrons consumed
Mo = Molarity of Oxalic acid used.	**Vo** = Volume of Oxalic acid (Volume of the pipette)	2 = Number of electrons released.

Molarity of the $KMnO_4$ solution = $M_K = \frac{2\ M_O V_O}{5\ V_K} = \frac{2 \times \text{.....} \times 20}{5 \times \text{----------}}$ = ... **M**

Mass of $KMnO_4$ in one litre of the given solution= **M_K x 158** = ---------- **x 158** = …….. **g.**

Result: -

Molarity of the given $KMnO_4$ solution = ---------- M.

Mass of $KMnO_4$ in one litre of the given solution = ---------- g.

N.B: - (Do not enter in your journal)

1. ***If during the reaction a brown precipitate of hydrated manganese dioxide is observed, insufficient sulphuric acid is indicated. More acid should then be added to the solution.***
2. ***Since the lower meniscus cannot be seen clearly through the purple colour of the $KMnO_4$ solution, the burette readings are taken at the highest level of the liquid surface (upper meniscus).***
3. ***A burette, which has been used for $KMnO_4$ solution, should be emptied and cleaned, immediately after use. Any brown stain due to MnO_2 should be removed by oxalic acid solution or Mohr's salt solution.***

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