EXPERIMENT: 16

AIM:

TO PERFORM ASSAY OF HYDROGEN PEROXIDE (REDOX TITRATION) BY PERMANGNATOMETRY AND STANDARDIZATION OF TITRANT

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REQUIREMENTS

A. Glassware & Instruments

1. Volumetric glassware
2. 250 mL burette
3. Titration beakers

B. Chemicals & Reagents

1. Concentrated sulfuric acid
2. Potassium permanganate
3. Potassium oxalate
4. Manganous sulfate

THEORY

As an oxidising agent, potassium permanganate is used to determine the amount of hydrogen peroxide in a solution. In sulfuric acid, hydrogen peroxide converts permanganate into a colourless compound. This is an excellent illustration of a redox reaction. This reaction typically begins slowly. However, the presence of manganous ions acts as a catalyst and expedites the titration process. This method is suitable for measuring H_2O_2 concentrations in aqueous solutions ranging from 0.25 to 70 weight percent.

Hydrogen peroxide is a mild antiseptic used to prevent infection of minor cuts, scrapes, and burns on the skin. Additionally, it can be used as a mouth rinse to help remove mucus and soothe minor mouth irritation. This product functions by releasing oxygen into the affected area when applied. The release of oxygen causes foaming, which assists in the removal of dead skin cells and cleansing of the area.

PRINCIPLE

The oxidation states of manganese range from +2 to +7. Manganese II combines with all common anions to form salts. They are predominantly light pink in hue. Manganese VII is found in the permanganate ions MnO_4^-, which are intensely violet in colour. As long as your solution contains hydrogen peroxide, permanganate will always be reduced to a clear solution. As soon as the hydrogen peroxide evaporates, however, the permanganate will reveal its intense purple hue.

It is essential that the solution of hydrogen peroxide be acidic. As reactants, the hydrogen ions participate in the reaction. Protons are required for water formation. It is also essential to use sulfuric acid instead of hydrochloric acid because permanganate is such a potent oxidant that it would oxidise chloride ions to form chlorine if hydrochloric acid were used.

PROCEDURE

Preparation of 0.1 N Potassium Permanganate Solutions

1. Accurately weigh approximately 3.2 g of potassium permanganate using a watch glass.
2. Transfer the contents to a 250 ml beaker containing cold water and rapidly stir with a glass rod to expedite dissolving.
3. Decant the solution into a 1 litre volumetric flask through a small plug of glass wool supported by a funnel, leaving the undissolved residues in the beaker.
4. Pour additional DW into the beaker and continue the preceding steps until all of the potassium permanganate has dissolved.

5. Finally, bring the volume to the graduated line and vigorously shake to ensure uniform mixing.

Standardization of potassium permanganate

1. Weigh precisely 6.3 grammes of pure oxalic acid into a 1 litre volumetric flask, dissolve in adequate DW, and fill to the mark.
2. Pipette out 25 ml of this solution, add 5 ml of concentrated H_2SO_4 along the side of the flask, carefully swirl the mixture, and heat to 70 °C.
3. Adjust this with the potassium permanganate solution from the burette until the pink hue persists for approximately 20 seconds.

Assay of Hydrogen peroxide

1. In a volumetric flask, dilute 10 ml of hydrogen peroxide solution to 250 ml with DW.
2. Add 5 ml of 5 N H_2SO_4 to 25.0 ml of this solution and titrate with 0.1 N $KMnO_4$ to a permanent pink endpoint.
3. Each ml of 0.1 N potassium permanganate is equal to 0.001701 grammes of hydrogen peroxide.

REACTION

$2\ KMnO_4 + 3H_2SO_4 + 5H_2O_2 \rightarrow 2\ MnSO_4 + K_2SO_4 + 5O_2 + 8H_2O$

or

$5\ H_2O_2 + 2MnO_4^- + 6H^+ \rightarrow 5O_2 + 2Mn^{2+} + 8H_2O$

CALCULATION

Observation table

S no.	Volume of $KMnO_4$ solution (ml)	Burette reading (ml)		Volume of oxalic acid used (ml)
		Initial	Final	
1.				
2.				
3.				

S no.	Volume of Hydrogen peroxide solution (ml)	Burette reading (ml)		Volume of Potassium permanganate used (ml)
		Initial	Final	
1.				
2.				
3.				

Calculation and factor calculation

Calculation for preparation of 0.1N Potassium permanganate solution

Molecular weight of $KMnO_4$= 158g/mol

$$N = \frac{weight * 1000}{molecular\ weight * volume\ taken}$$

$$Weight = \frac{0.1N * \frac{158g}{mol} * 250ml}{1000}$$

Weight= 3.2g

Calculation of actual normality of Hydrogen peroxide

N1V1 (Oxalic acid) = N2V2 ($KMnO_4$)

0.1 * 25 = N2 * 24.8

N1= 0.1008

Factor calculation of H_2O_2

Molecular weight of H_2O_2= 34 g/mol

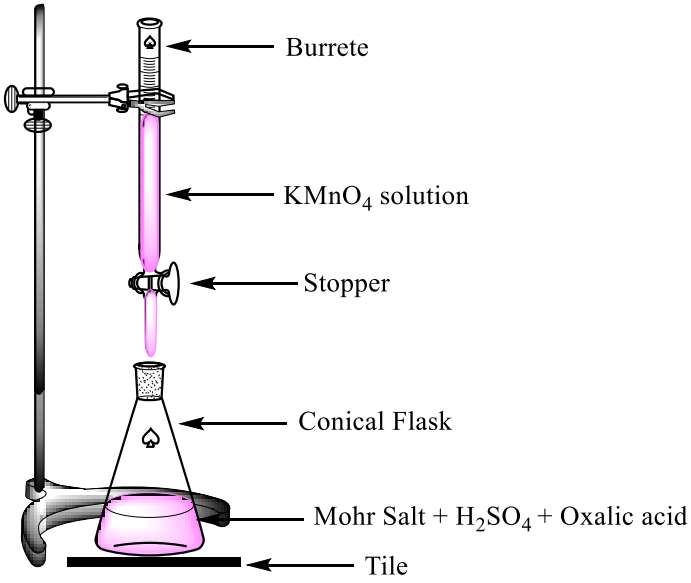
1N 1000ml H_2O_2= 34

0.1 N 1ml H_2O_2= 34/10000= 0.0034

Percentage purity calculation of Hydrogen peroxide

$$\% \quad H_2O_2 \quad (\text{by} \quad \text{weight}) = \frac{Observed\ normality\ (KMnO4) * Volume\ of\ KMnO4\ (burette\ reading) * Factor * 100}{Theoritical\ normality\ (KMnO4) * Weight\ (H2O2)}$$

DIAGRAM



APPLICATIONS

1. Hydrogen peroxide is a mild antiseptic used to prevent infection of minor cuts, scrapes, and burns on the skin.
2. Additionally, it can be used as a mouth rinse to assist clear mucus and soothe minor mouth discomfort.
3. The use of commercial hydrogen peroxide in pulp & paper bleaching boosts brightness levels, improves brightness stability, and decreases production costs, as it is the only chemical required.

RESULT

Percentage purity of H_2O_2 sample is ……%