

Ex 5 Standardisation of potassium permanganate solution

Background

The standardisation of the KMnO_4 solution is carried out by titration against a standard solution of oxalic acid. Oxalic acid is a good primary standard because the compound is available in solid form, as $\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$, which can be prepared to a very high degree of purity and is not hygroscopic nor efflorescent.

The reaction is



Overall



The following points about this reaction should be noted:

1 The reaction occurs only in acid solution. Acidification is achieved by the addition of sulfuric acid.

2 The reaction rate is normally slow but in this experiment is increased;

a by warming the contents of the conical flask

b because the reaction is catalysed by the presence of manganese(II) ion, which is a product of the reaction.

3 No indicator is necessary in the titration. As the permanganate solution is run into the oxalic acid solution the purple MnO_4^- ion is reduced to the effectively colourless Mn^{2+} ion. When the addition of one drop of permanganate solution to the conical flask produces a permanent pink colour, this indicates that there is no remaining oxalic acid capable of reducing the MnO_4^- to Mn^{2+} , and therefore that the end point has been reached.

Equipment required

Balance

Beakers (two 100 mL, one 250 mL)

Volumetric flask (250 mL)

Storage bottle (approximately 250 mL)

Pipette (20 mL)

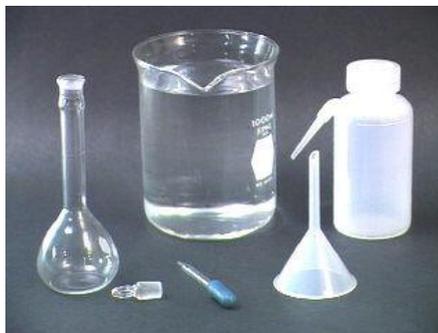
Pipette filler Burette and stand

Filter funnel

Conical flask (250 mL)

Potassium permanganate solution $[\text{KMnO}_4]$ 0.02 mol L⁻¹ prepared in Experiment 46 (150 mL)

Oxalic acid $[\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}]$ (2 g)



Procedure

A Preparation of Standard Oxalic Acid Solution

#1 Calculate the mass of oxalic acid crystals required to make up 250 mL of 0.05 mol L⁻¹ solution.

Safety Note

Oxalic acid is poisonous and must be handled with care.

Avoid contact of the H₂C₂O₄·2H₂O crystals and solution with your skin.

If contact does occur immediately wash the affected area with water.

#2 Weigh out accurately about this amount of oxalic acid, transfer quantitatively to a 250 mL beaker, and dissolve in about 150 mL of distilled water.

#3 Transfer this solution quantitatively to a 250 mL volumetric flask and dilute the solution to 250 mL with distilled water.

#4 Transfer the solution to a storage bottle, calculate the concentration and label the bottle appropriately.

B Standardisation of Potassium Permanganate Solution

#1 Fill a burette with the KMnO₄ solution to be standardised.

#2 Pipette 20 mL of the standard oxalic acid solution into a 250 mL conical flask and add about 20 mL of 2 mol L⁻¹ H₂SO₄.

#3 Warm the conical flask to about 80 °C and titrate the permanganate solution against the oxalic acid solution. Add the KMnO₄ solution fairly slowly or manganese(IV) oxide (a brown solid) may form instead of manganese(II) ion. The end point is reached when the addition of one drop of permanganate solution produces a permanent pink colour. Record your results in a table such as that shown below.

	Rough estimate	Accurate titrations		
		1	2	3
Final reading (mL)				
Initial reading (mL)				
Titration volume (mL)				

#4 Repeat the titration until consistent results are obtained.

Processing of results, and questions

1 From the average volume of KMnO_4 solution used, calculate the concentration of the solution.

2 Why is it necessary to heat the oxalic acid solution?

3 In this experiment oxalic acid is used as a reducing agent.

Could oxalic acid be used as a primary standard to standardise a solution of a base, such as sodium hydroxide? Explain.

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		1	2	3
Final reading (mL)				
Initial reading (mL)				
Titration volume (mL)				

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Final reading (mL)				
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