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1 Introduction

The experiment aims to determine the concentration of unstandardised KIO_3 using a redox titration. We do so by reacting the potassium iodate with excess potassium iodide in an acidic solution. The product is then titrated with sodium thiosulfate with the aid of starch as an indicator, as per the following equations:

$$KIO_3(aq) + 5\,KI(aq) + 6\,H^+ \longrightarrow 3\,I_2(aq) + 6\,K^+(aq) + 3\,H_2O(l) \tag{1}$$

$$2\,Na_2S_2O_3(aq) + I_2(aq) \longrightarrow 2\,NaI(aq) + Na_2S_4O_6(aq) \tag{2}$$

We rely on recognising colour changes in order to assess whether the reactions have taken place. For (1), the iodine should give the solution a yellow-brown colour, while for (2) we should expect a change from dark blue to colourless when the iodine has been fully reacted.

2 Procedure

1. Into a conical flask, pour about 10 ml of 1.00 mol dm^{-3} of KI and 10 ml of 2.0 mol dm^{-3} HCl. Utilising a burette, add (5.00 ± 0.05) ml of the unstandardised KIO3(aq). The reaction will commence immediately.

2. Titrate the solution with 0.10 mol dm^{-3} with the thiosulfate, $Na_2S_2O_3$.

3. When the shade of yellow disappears from the reaction, 2 ml of starch is added, and the titration continues until the blue colour disappears. Expect about 30 ml.

3 Data

Index	Start[1] (ml ± 0.05 ml)	End[1] (ml ± 0.05 ml)	Start[2] (ml ± 0.05 ml)	End[2] (ml ± 0.05 ml)	Total Volume (ml ± 0.20 ml)
0	0.00	24.50	0.00	5.90	30.40
1	0.30	23.95	0.50	8.20	31.35
2	0.30	24.00	0.20	6.20	29.70
3	0.10	24.65	1.10	6.15	29.60

Table 1: Volume of $Na_2S_2O_3$ in each titration. Notice they were subdivided due to limitation of the burette's size. The final uncertainty reflects this.

4 Analysis

For 0th titration, we can find the amount of sodium thiosulfate(n) from its concentration (c) and volume (V):

$$n(\mathrm{Na_2S_2O_3}) = V \cdot c = 0.003\,040\,\mathrm{mol}$$

From (2) we can calculate the amount of $\mathrm{I_2}$ reacted:

$$n(\mathrm{I_2})(\mathit{reacted}) = \frac{1}{2} n(\mathrm{Na_2S_2O_3}) = 0.001\,520\,\mathrm{mol}$$

Equation (1) tells us that each mol of $\mathrm{I_2}$ came from a 1:3 ratio from $\mathrm{KIO_3}$, which we can then divide by the initial volume and find our concentration:

$$n(\mathrm{KIO_3}) = 3 \cdot n(\mathrm{I_2}) = 0.004\,560\,\mathrm{mol}$$
$$\therefore c(\mathrm{KIO_3}) = \frac{0.004\,560\,\mathrm{mol}}{5.00\,\mathrm{ml}} = 0.9120\,\mathrm{mol\,dm^{-3}}$$

Finally, we may add the relative uncertainties in the volume of the titrant and volume of $\mathrm{KIO_3}$:

$$\frac{0.20\,\mathrm{ml}}{30.40\,\mathrm{ml}} + \frac{0.05\,\mathrm{ml}}{5.00\,\mathrm{ml}} = 0.016$$

Repeating this process for all titrations:

Index	$\mathrm{c(KIO_3)\ mol\,dm^{-3}}$
0	$(0.91 \pm 0.01)\,\mathrm{mol\,dm^{-3}}$
1	$(0.94 \pm 0.02)\,\mathrm{mol\,dm^{-3}}$
2	$(0.89 \pm 0.01)\,\mathrm{mol\,dm^{-3}}$
3	$(0.89 \pm 0.01)\,\mathrm{mol\,dm^{-3}}$

5 Conclusion and reflection

References