

Solutions

Original marking guidance: M1 method, A1 accuracy, B1 explanation.

2.1 $\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \rightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}$. Correct O/H balance, electron count, charge/overall equation.

2.2 Chloride can be oxidised, consuming extra titrant; first persistent faint pink is slight manganate(VII) excess.

2.3 Absolute uncertainty = 0.10 cm^3 ; $100(0.10/16.00) = 0.625\%$.

3.1 $n(\text{MnO}_4^-) = 0.0200 \times 0.02240 = 4.48 \times 10^{-4} \text{ mol}$. Fe^{2+} amount is five times this, 0.00224 mol . Concentration = $0.00224/0.02500 = 0.0896 \text{ mol dm}^{-3}$.

3.2 Thiosulfate = 0.001860 mol ; iodine = half, 0.000930 mol . X:iodine is 1:1, so $c(X) = 0.000930/0.02500 = 0.0372 \text{ mol dm}^{-3}$.

3.3 Add near pale yellow to avoid strong iodine/starch binding at high iodine concentration. Water changes volume but not moles of transferred analyte. A systematic error such as incorrect titrant concentration remains.