

Name of the Student: _____

Max. Marks : 26 Marks

Time : 26 Minutes

Q1.

- (a) Use data from the table below to explain why dilute hydrochloric acid cannot be used to acidify potassium manganate(VII) in a titration.

	$E^\ominus / V$
$MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l)$	+1.51
$Cl_2(aq) + 2e^- \rightarrow 2Cl^-(aq)$	+1.36
$2H^+(aq) + 2e^- \rightarrow H_2(aq)$	0.00

(2)

- (b) Use information from the table in part (a) to determine the minimum volume, in cm^3 , of $0.500 \text{ mol dm}^{-3}$ sulfuric acid that is required for a titre of 25.0 cm^3 of $0.0200 \text{ mol dm}^{-3}$ potassium manganate(VII) solution.
Show your working.

(3)

- (c) In each titration using potassium manganate(VII), a large excess of dilute sulfuric acid is used to avoid any possibility of the brown solid MnO_2 forming.

- (i) Deduce a half-equation for the reduction of MnO_4^- ions in acidic solution to form MnO_2 .

(1)

- (ii) Give **two** reasons why it is essential to avoid this reaction in a titration between potassium manganate(VII) and iron(II) ions.

(2)

- (d) Potassium manganate(VII) is an oxidising agent.
Suggest **one** reason why a $0.0200 \text{ mol dm}^{-3}$ solution of potassium manganate(VII) does **not** need to be kept away from flammable material.

(1)

(Total 9 marks)

Q2.

Due to their electron arrangements, transition metals have characteristic properties including catalytic action and the formation of complexes with different shapes.

- (a) Give **two other** characteristic properties of transition metals. For each property, illustrate your answer with a transition metal of your choice.

(4)

- (b) Other than octahedral, there are several different shapes shown by transition metal complexes. Name **three** of these shapes and for each one give the formula of a complex with that shape.

(6)

- (c) It is possible for Group 2 metal ions to form complexes. For example, the $[\text{Ca}(\text{H}_2\text{O})_6]^{2+}$ ion in hard water reacts with EDTA^{4-} ions to form a complex ion in a similar manner to hydrated transition metal ions. This reaction can be used in a titration to measure the concentration of calcium ions in hard water.

- (i) Write an equation for the equilibrium that is established when hydrated calcium ions react with EDTA^{4-} ions.

(1)

- (ii) Explain why the equilibrium in part (c)(i) is displaced almost completely to the right to form the EDTA complex.

(3)

- (iii) In a titration, 6.25 cm^3 of a $0.0532 \text{ mol dm}^{-3}$ solution of EDTA reacted completely with the calcium ions in a 150 cm^3 sample of a saturated solution of calcium hydroxide. Calculate the mass of calcium hydroxide that was dissolved in 1.00 dm^3 of the calcium hydroxide solution.

(3)

(Total 17 marks)