

Name of the Student: _____

Max. Marks : 26 Marks

Time : 26 Minutes

Q1.

- (a) Explain the meaning of the terms *ligand* and *bidentate* as applied to transition metal complexes.

(2)

- (b) Aqueous cobalt(II) ions react separately with an excess of chloride ions and with an excess of ammonia.

For each reaction, draw a diagram to illustrate the structure of, the shape of and the charge on the complex ion formed.

In each case, name the shape and indicate, on the diagram, a value for the ligand-metal-ligand bond angle.

(6)

- (c) The complex ion formed in aqueous solution between cobalt(II) ions and chloride ions is a different colour from the $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ ion.

Explain why these complex ions have different colours.

(3)

- (d) In aqueous ammonia, cobalt(II) ions are oxidised to cobalt(III) ions by hydrogen peroxide. The H_2O_2 is reduced to hydroxide ions.

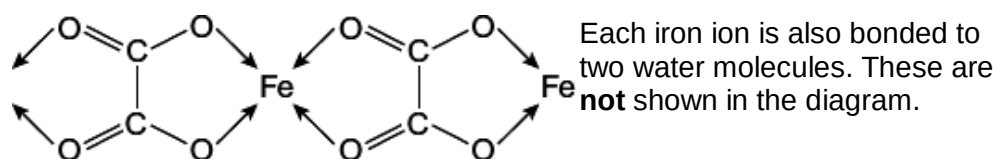
Calculate the minimum volume of $5.00 \text{ mol dm}^{-3} \text{ H}_2\text{O}_2$ solution required to oxidise the Co^{2+} ions in 9.87 g of $\text{CoSO}_4 \cdot 7\text{H}_2\text{O}$

(5)

(Total 16 marks)

Q2.

Solid iron(II) ethanedioate dihydrate ($\text{FeC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$) has a polymeric structure. Two repeating units in the polymer chain are shown.



- (a) Name the type of bond that is represented by the arrows.

(1)

- (b) In terms of electrons explain how the water molecules, **not** shown in the diagram, form bonds to the iron.

(2)

- (c) Predict the value of the bond angle between the two bonds to iron that are formed by these two water molecules.

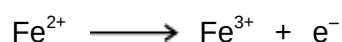
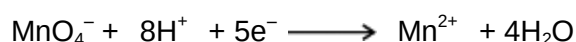
(1)

- (d) Iron(II) ethanedioate dihydrate can be analysed by titration using potassium manganate(VII) in acidic solution. In this reaction, manganate(VII) ions oxidise iron(II) ions and ethanedioate ions.

A 1.381 g sample of impure $\text{FeC}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ was dissolved in an excess of dilute sulfuric acid and made up to 250 cm^3 of solution.

25.0 cm^3 of this solution decolourised 22.35 cm^3 of a $0.0193 \text{ mol dm}^{-3}$ solution of potassium manganate(VII).

- (i) Use the half-equations given below to calculate the reacting ratio of moles of manganate(VII) ions to moles of iron(II) ethanedioate.



- (If you have been unable to answer part (d)(i) you may assume that three moles of manganate(VII) ions react with seven moles of iron(II) ethanedioate. This is **not** the correct ratio.)

[illegible]

(Total 10 marks)