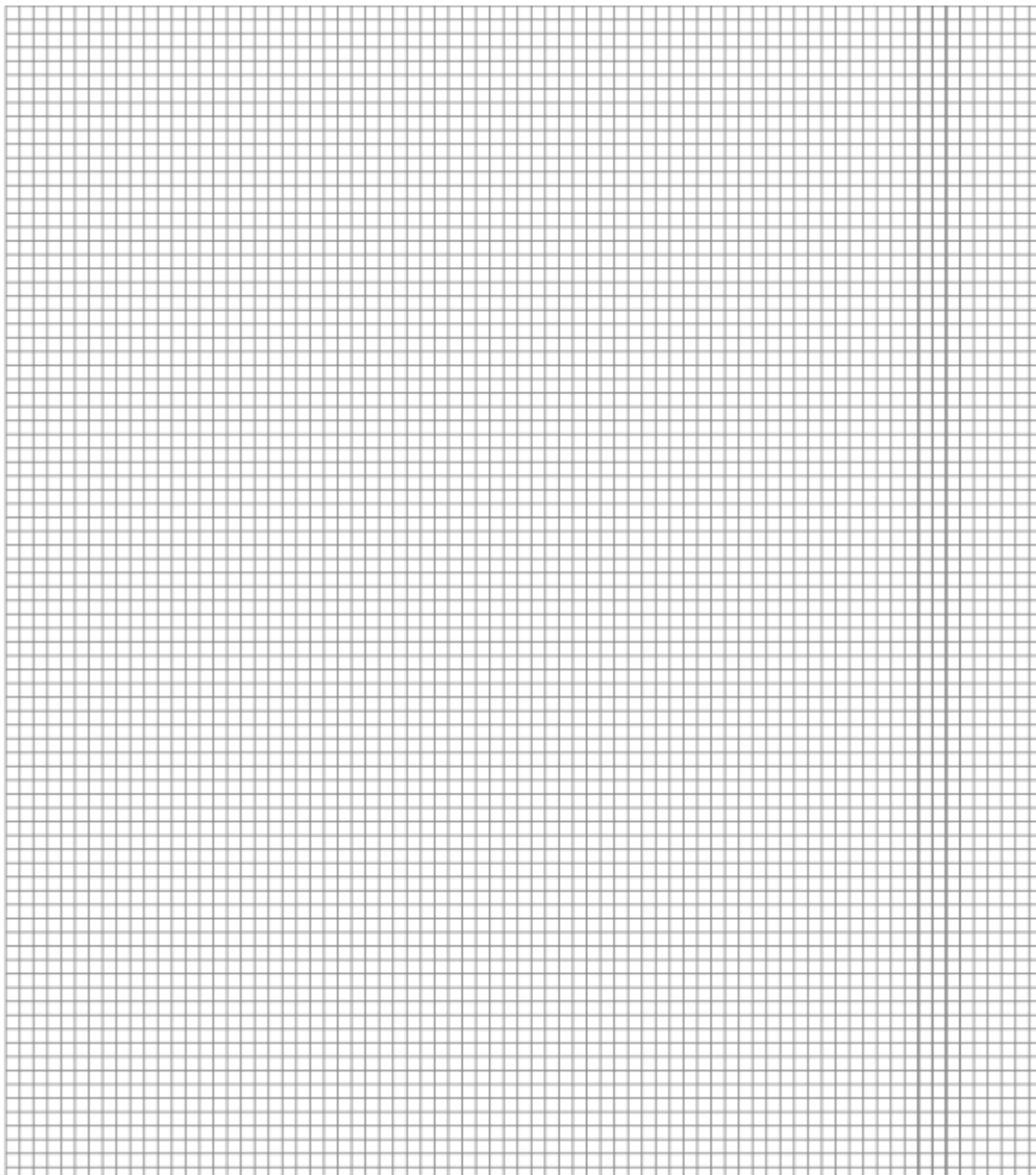


- Q1.(a)** The concentration of iron(III) ions in a dilute solution can be determined by visible spectrometry. The absorption of light by a number of solutions of iron(III) sulfate, $\text{Fe}_2(\text{SO}_4)_3(\text{aq})$, was measured. The results are shown in the table below.

Concentration of $\text{Fe}_2(\text{SO}_4)_3(\text{aq})$ / mol dm⁻³	Absorbance / %
0.020	2.2
0.040	4.7
0.060	7.0
0.080	9.4
0.100	11.8

- (i) Use these results to plot a graph of percentage absorbance (*y*-axis) against concentration of iron(III) sulfate solution on the grid below. Draw a straight line of best fit.



(2)

- (ii) Use your graph to determine the concentration of iron(III) ions in a solution of $\text{Fe}_2(\text{SO}_4)_3$ that has an absorbance of 5.4%.

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(2)

- (iii) Calculate the volume of water that should be added to 100 cm³ of a 0.10 mol dm⁻³ solution of iron(III) sulfate to make a 0.040 mol dm⁻³ solution. Show your working.

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(2)

- (b) Give **one** reason why well-water may be more beneficial to health than pure water.

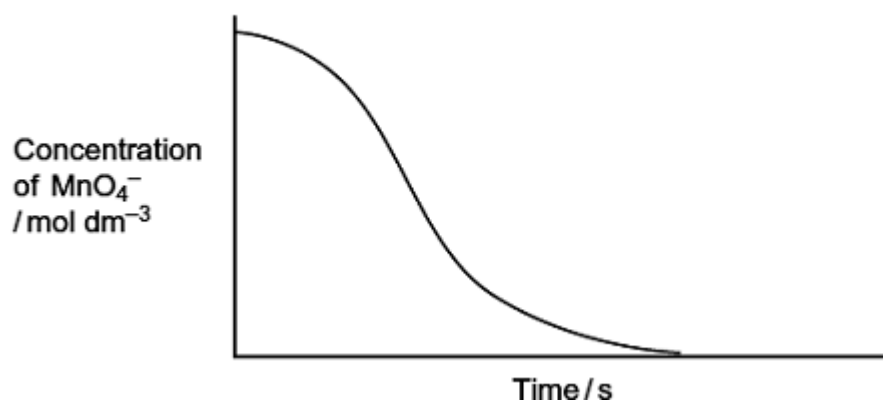
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(1)

(Total 7 marks)

Q2.An acidified solution of potassium manganate(VII) was reacted with a sample of sodium ethanedioate at a constant temperature of 60 °C. The concentration of the manganate(VII) ions in the reaction mixture was determined at different times using a spectrometer to measure the light absorbed.

The following results were obtained.



- (a) Write an equation for the reaction between manganate(VII) ions and ethanedioate ions in acidic solution.

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(2)

(b) By considering the properties of the reactants and products, state why it is possible to use a spectrometer to measure the concentration of the manganate(VII) ions in this reaction mixture.

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(2)

(c) This reaction is autocatalysed. Give the meaning of the term *autocatalyst*. Explain how the above curve indicates clearly that the reaction is autocatalysed.

Meaning of *autocatalyst*

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Explanation

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(3)

(d) Identify the autocatalyst in this reaction.

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(1)

(e) Write **two** equations to show how the autocatalyst is involved in this reaction.

Equation 1

Equation 2

(2)
(Total 10 marks)

Q3. This question is about copper chemistry.

(a) Aqueous copper(II) ions $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}(\text{aq})$ are blue.

(i) With reference to electrons, explain why aqueous copper(II) ions are blue.

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(3)

(ii) By reference to aqueous copper(II) ions, state the meaning of each of the **three** terms in the equation $\Delta E = h\nu$.

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(3)

- (iii) Write an equation for the reaction, in aqueous solution, between $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ and an excess of chloride ions.
State the shape of the complex produced and explain why the shape differs from that of the $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$ ion.

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(Extra space)
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(3)

- (b) Draw the structure of the ethanedioate ion ($\text{C}_2\text{O}_4^{2-}$).
Explain how this ion is able to act as a ligand.

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(2)

(c) When a dilute aqueous solution containing ethanedioate ions is added to a solution containing aqueous copper(II) ions, a substitution reaction occurs. In this reaction four water molecules are replaced and a new complex is formed.

(i) Write an ionic equation for the reaction. Give the co-ordination number of the complex formed and name its shape.

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(4)

(ii) In the complex formed, the two water molecules are opposite each other. Draw a diagram to show how the ethanedioate ions are bonded to a copper ion and give a value for one of the O–Cu–O bond angles. You are **not** required to show the water molecules.

(2)

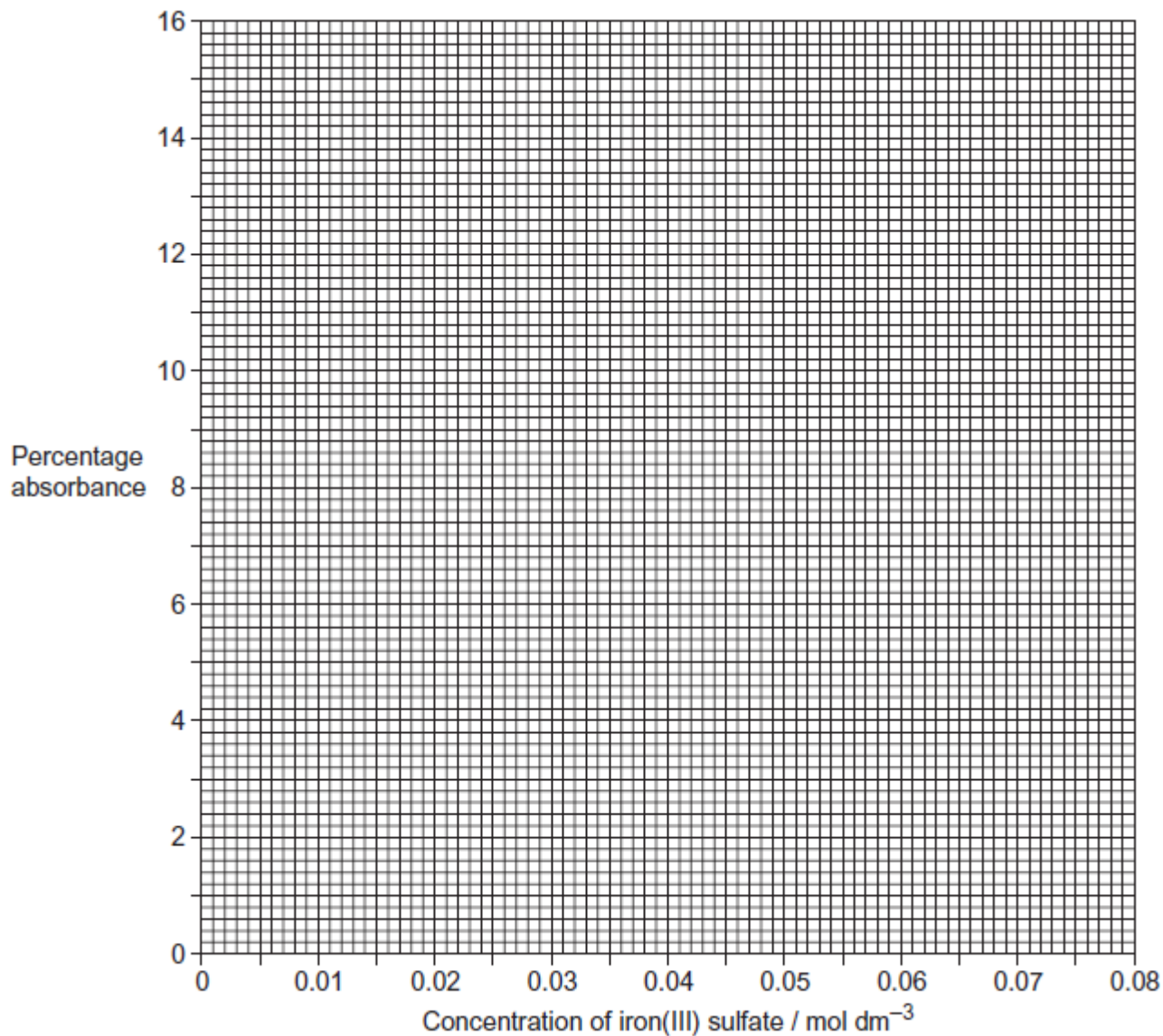
(Total 17 marks)

Q4. The concentration of iron(III) ions in a dilute solution can be determined by visible spectrometry. The absorption of light of a particular frequency by solutions of iron(III) sulfate of different concentrations was measured. The results are shown in the table

below.

Percentage absorbance	Concentration of iron(III) sulfate / mol dm ⁻³
1.0	7.5×10^{-3}
2.5	14.0×10^{-3}
5.0	27.5×10^{-3}
7.0	37.5×10^{-3}
10.0	54.0×10^{-3}
12.0	65.0×10^{-3}

- (a) Use these results to plot a graph of percentage absorbance (*y*-axis) against concentration of iron(III) sulfate on the grid below. Draw a straight line of best fit.



(2)

- (b) Use your graph to determine the concentration of an iron(III) sulfate solution that has a percentage absorbance of 14.0%.

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(1)

(Total 3 marks)