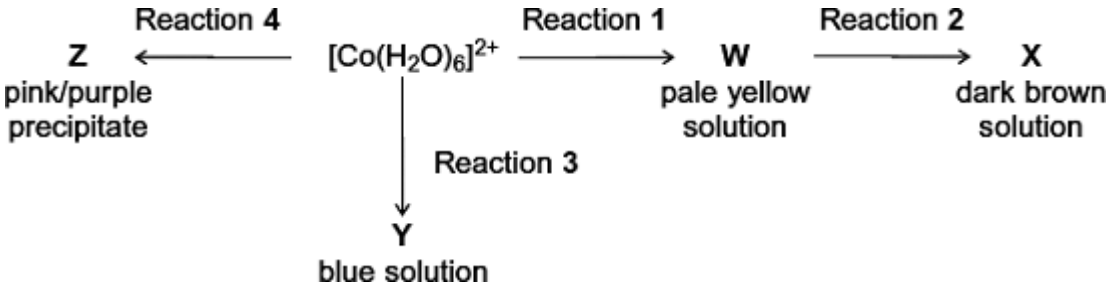
Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Q1.

This question is about cobalt chemistry.

(a) Consider the following reaction scheme that starts from $[Co(H_2O)_6]^{2+}$ ions.
W, **X** and **Y** are ions and **Z** is a compound.



For each of the reactions **1** to **4**, identify a suitable reagent.

Identify **W**, **X**, **Y** and **Z** and write an equation for each of reactions **1** to **4**.

(12)

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(b) A flue-gas desulfurisation process involves the oxidation, by oxygen, of aqueous sulfate(IV) ions (SO_3^{2-}) into aqueous sulfate(VI) ions (SO_4^{2-}). This reaction is catalysed by Co^{2+} ions in an acidic aqueous solution.

Write an equation for the overall reaction of sulfate(IV) ions with oxygen to form sulfate(VI) ions.

Suggest why this overall reaction is faster in the presence of Co^{2+} ions.

Suggest a mechanism for the catalysed reaction by writing **two** equations involving Co^{2+} and Co^{3+} ions. You will need to use H^+ ions and H_2O to balance these two equations.

(4)

(Total 16 marks)

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Q2.

(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, $Fe_2(SO_4)_3(aq)$, was measured. The results are shown in the table below.

Concentration of $Fe_2(SO_4)_3(aq)$ / 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.

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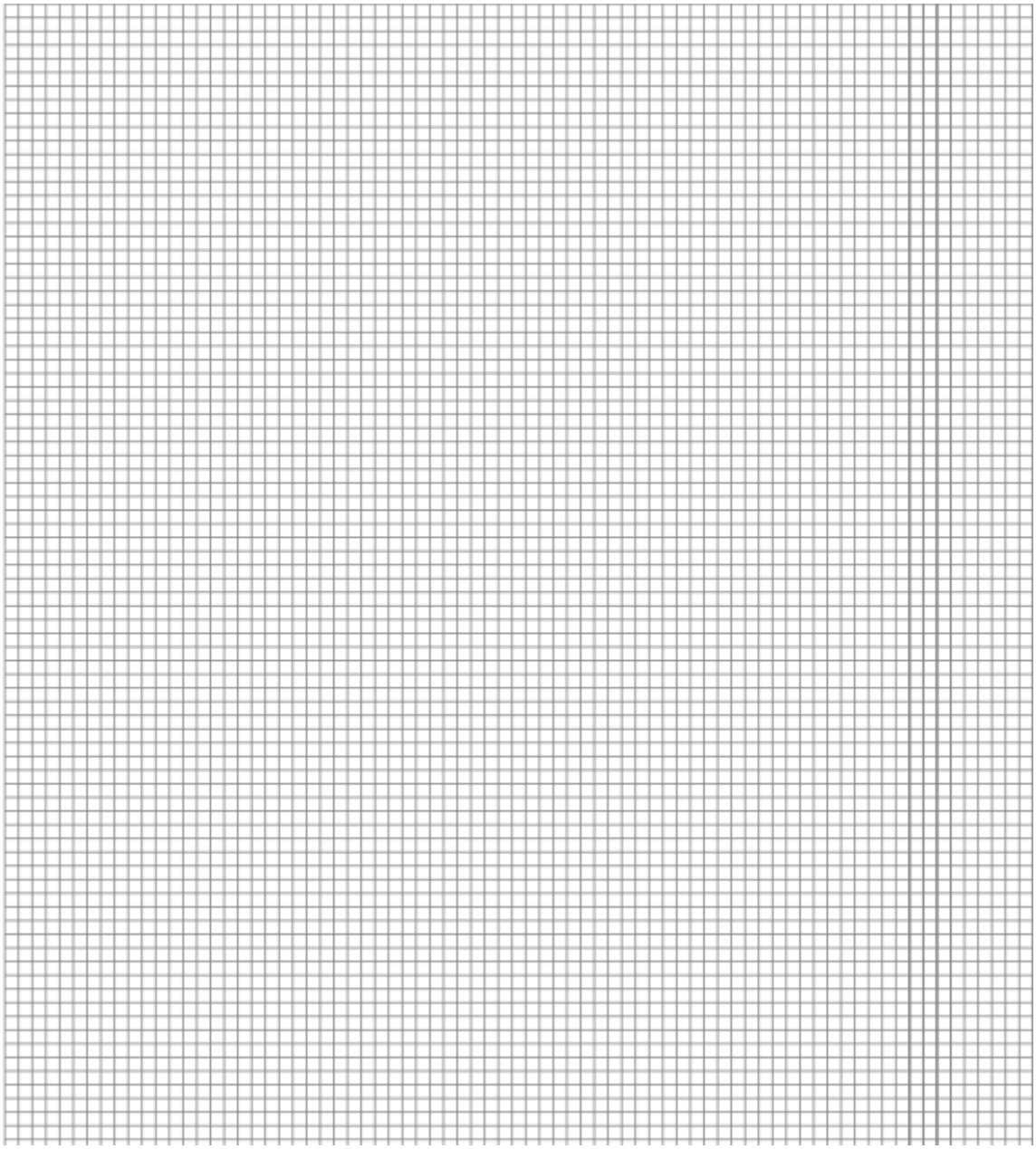

(2)

(ii) Use your graph to determine the concentration of iron(III) ions in a solution of $Fe_2(SO_4)_3$ that has an absorbance of 5.4%.

_____

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_____

(2)

(iii) Calculate the volume of water that should be added to 100 cm^3 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)

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