

Name of the Student: _____

Max. Marks : 23 Marks

Time : 23 Minutes

Q1.

This question explores some reactions and some uses of cobalt compounds.

- (a) Ethanal is oxidised to ethanoic acid by oxygen. The equation for this reaction is



This redox reaction is slow at room temperature but speeds up in the presence of cobalt compounds.

Explain why a cobalt compound is able to act as a catalyst for this process.

Illustrate your explanation with **two** equations to suggest how, in the presence of water and hydrogen ions, Co^{3+} and then Co^{2+} ions could be involved in catalysing this reaction.

(4)

- (b) In aqueous solution, the $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ ion reacts with an excess of ethane-1,2-diamine to form the complex ion Y.

- (i) Write an equation for this reaction.

Explain, in terms of the chelate effect, why the complex ion Y is formed in preference to the $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$ complex ion.

(3)

- (ii) Draw a diagram that shows the shape of the complex ion **Y** and shows the type of bond between the ethane-1,2-diamine molecules and the cobalt.

(3)

- (c) Compound **Z** is a complex that contains only cobalt, nitrogen, hydrogen and chlorine.

A solid sample of **Z** was prepared by reaction of 50 cm³ of 0.203 mol dm⁻³ aqueous cobalt(II) chloride with ammonia and an oxidising agent followed by hydrochloric acid.

When this sample of **Z** was reacted with an excess of silver nitrate, 4.22 g of silver chloride were obtained.

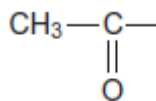
Use this information to calculate the mole ratio of chloride ions to cobalt ions in **Z**.

Give the formula of the complex cobalt compound **Z** that you would expect to be formed in the preparation described above.

Suggest **one** reason why the mole ratio of chloride ions to cobalt ions that you have calculated is different from the expected value.

Q2.

The triiodomethane reaction is often used as a test for aldehydes and ketones that contain the CH_3CO group shown.



The aldehyde or ketone is reacted with an alkaline solution of iodine. Triiodomethane (CHI_3) is formed as a precipitate. Compounds that contain a group that can be oxidised to the CH_3CO group will also give a positive result in this test.

- (a) State, with a reason, whether or not ethanol will give a positive result in the triiodomethane reaction.

(1)

- (b) The equation for the reaction of ethanal with an alkaline solution of iodine is



In an experiment using this reaction, the yield of triiodomethane (CHI_3) obtained by a student was 83.2%.

Calculate the minimum mass of iodine that this student would have used to form 10.0 g of triiodomethane.

Give your answer to the appropriate precision.

Show your working.

(5)

- (c) Triiodomethane can be separated from the reaction mixture by filtration.
State **one** reason why the solid residue is then washed with water after the filtration.

(1)

- (d) State **one** reason, other than cost or availability, why water is suitable for washing this solid residue after the filtration.

(1)

(Total 8 marks)