



THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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MAIN EXAMINATION

SEPTEMBER – DECEMBER 2019 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF CHEMISTRY

PART-TIME PROGRAMME

CHEM 301: CO-ORDINATION CHEMISTRY

Date: DECEMBER 2019

Duration: 2 Hours

INSTRUCTIONS: Answer Question ONE and any other Two Questions

Atomic Numbers: Cu – 29; Mn – 25; Cr - 24

- Q1. a) Use the CFT model to depict the high and low spin states for the following ions:
- Cu²⁺ ions
 - Mn³⁺ ions
 - Cr³⁺ ions
- (9 marks)**
- b) Depict the linkage isomers for the following complexes:
- $[Co(NH_3)_5(NO_2)]Cl_2$
 - $[FeCl_5(NO_2)]^{3-}$
- (8 marks)**
- c) Write the chemical formulas for the following compounds:
- Amminetetraaquachromium (II) ion
 - Potassium hexacyanoferrate (III) ion
 - Amminesulfatochromium (II) ions
- (6 marks)**
- d) Explain the application of coordination complexes in:
- Oxygen transport
 - Enzymes
 - Uptake and storage of transition metals
- (7 marks)**

- Q2. a) $[Fe(EDTA)_3]^{2-}$ has more unpaired electrons than $[Fe(CN)_6]^{3-}$ and therefore is more paramagnetic. Explain. (6 marks)
- b) Weak field and strong field ligands affect the Δ_o contributing to different colors in complexes. Explain (8 marks)
- c) Haemoglobin is composed of the heme group which a coordination complex contains a central Fe^{3+} coordinated to four pyrrole rings. Depict its structure. (6 marks)
- Q3. a) Tetraamminezinc (II) Tetrachlorocuprate (II) and Tetraamminecopper (II) Tetrachlorozincate(II) are coordination isomers. Using relevant structures, explain (6 marks)
- b) $[Al(H_2O)_6]^{3+}$ is a complex of aluminum. Use it to answer the questions that follow: (8 marks)
- Explain why the complex is optically inactive
 - Using this complex, describe the molecular orbital theory
- c) Using relevant examples, explain the differences between neutral and anionic ligands (6 marks)
- Q4. a) Using relevant structures, explain the difference between monodentate, bidentate and polydentate ligands (9 marks)
- b) Draw any two possible geometrical isomers for the following complex: $[Co(H_2O)_2(ox)BrCl]^{-}$ where $ox = O_2^{-}CCO_2^{-}$ (6 marks)
- c) EDTA is a chelating agent that can be used for the removal of heavy metals from water. Explain (5 marks)
- Q5. a) Using relevant diagrams, explain the concept of d- orbital splitting in the Crystal Field Theory (6 marks)

b) Using relevant structures, explain the difference between octahedral and tetrahedral complexes (8 marks)

c) cis- & trans- $Pt(NH_3)_2Cl_2$ could be termed as geometric planar isomers. Using relevant structures, explain. (6 marks)

END