

KABARAK



UNIVERSITY

UNIVERSITY EXAMINATIONS

2009/2010 ACADEMIC YEAR

**FOR THE DEGREE OF BACHELOR OF SCIENCE IN
EDUCATION SCIENCE**

COURSE CODE: CHEM 321

COURSE TITLE: COORDINATION CHEMISTRY

STREAM: SESSION VII

DAY: SATURDAY

TIME: 2.00 – 4.00 P.M.

DATE: 28/11/2009

INSTRUCTIONS:

Attempt all questions

PLEASE TURN OVER

QUESTION ONE (17.5MARKS)

- a) Define the following terms:
- Ligand
 - Complex ion
 - Coordination sphere (6 marks)
- b) Assign IUPAC names to the following coordination compounds:
- $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4$
 - $\text{K}_2[\text{CoCl}_4]$
 - $[\text{Co}(\text{Phen})_2\text{Cl}_2]$
 - $[\text{Co}(\text{en})_2(\text{H}_2\text{O})\text{Cl}]\text{Cl}_2$
 - $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3] \cdot 3\text{H}_2\text{O}$ (10 marks)
- c) Give the proper formulae of the following coordination compounds.
- Diamminedichloroplatinate(II)
 - Dicyanobis(ethylenediamine)chromium(III)chloride.
 - Potassiumamminetetrachloroplatinate(II).
 - Trioxalatoferrate(III).
 - Hexaaminonickelate(II). (10 marks)
- d) When a metal such as Fe^{2+} is dissolved in water, the resulting $\text{Fe}^{2+}_{\text{aq}}$ ion is a coordination complex between iron(II) and water. Identify this complex. (3.5 marks)

QUESTION TWO (17.5MARKS)

- a) Identify the donor atoms from the following ligands. and classify each ligand as either monodentate, bidentate or polydentate: Ethylenediamine($\text{NH}_2\text{CH}_2\text{CH}_2\text{NH}_2$), Oxalate ion(O^-COCOO^-) and EDTA($(\text{CH}_2\text{COOH})_2\text{NCH}_2\text{CH}_2\text{N}(\text{CH}_2\text{COOH})_2$). (5.5 marks)
- b) Name any two biologically important compounds which can be classified as coordination complexes. (2 marks)

- c) Considering Pt(78), and using the orbital diagrams, illustrate the kind of hybridization that would result in the formation of the following coordination compounds.
- $[\text{PtCl}_4]^{2-}$ (3 marks)
 - $[\text{PtCl}_2(\text{NH}_3)_2]^{2-}$ (3 marks)
 - $[\text{PtCl}_2(\text{NH}_3)_4]^{2+}$ (4 marks)

QUESTION THREE (17.5MARKS)

- Enumerate any two limitations of valence bond (VB) theory of bonding in the formation of coordination complexes. (2 marks)
- State four factors that affect field splitting according to crystal field theory. (4 marks)
- Illustrate the octahedral field splitting of the d-orbitals according to the crystal field (CF) theory. (6 marks)
- Illustrate the existence of Jahn-Teller distortions in some coordination compounds. Give an example. (5.5 marks)

QUESTION FOUR (17.5MARKS)

- Explain the origin of colour in transition metal complexes. (4 marks)
- Explain the nature of Metal-Carbonyl (M-CO) bonding. (4 marks)
- Account for the following observations;
 - Zn^{2+} ions are colourless. (2 marks)
 - $[\text{CuCl}_4]^{2-}$ is paramagnetic but $[\text{NiCN}_4]^{2-}$ is diamagnetic although each of compounds the compounds has a square planar geometry. (4 marks)
- Explain what is meant by Nephelauxetic effect. (1.5 marks)