



NATIONAL OPEN UNIVERSITY OF NIGERIA
University Village, Nnamdi Azikiwe Expressway, Plot 91, Cadastral Zone, Jabi, Abuja

FACULTY OF SCIENCE

JULY 2017 EXAMINATION

COURSE CODE: CHM 423

COURSE TITLE: COORDINATION CHEMISTRY

COURSE UNIT: 3 Units

TIME: 2 ½ hours

INSTRUCTION: Answer questions One and any other Four (4) questions

Q1.

a) State Alfred Werner's findings and conclusions as regards coordination Chemistry (2 marks)

b) What are the primary and secondary valencies as well as the possible shape of these coordination complexes? (4 marks)

i) $K_4[Fe(CN)_6]$

ii) $[Ag(NH_3)_2]Cl$

iii) $[Co(NH_3)_4Cl_2]Cl$

iv) $[Cu(H_2O)_6]^{2+}$

c) Explain the following terms: (2 marks)

i) Ligands

ii) Homoleptic and heteroleptic complexes

d) Describe any three uses of coordination compounds (3 marks)

e) Write the structure of these coordination compounds. (3 marks)

i) trans- diaminedichloroplatinum (II)

ii) tetraammineplatinum(II) tetrachloroplatinate(II).

iii) dichlorobis(ethylenediamine)cobalt(III) ion.

f) Write the IUPAC names of the following coordination compounds. (2 marks)

i) $[Cu(NH_3)_4(H_2O)_2]SO_4$

ii) $[Co(H_2NCH_2CH_2NH_2)_2Cl_2]Cl$

g) Discuss the following methods of metal complex preparation. (6 marks)

- i) Direct reaction
- ii) Substitution reaction
- iii) Redox reaction

Q2

- a) i. Outline four limitations of crystal field theory (4 marks)
 ii. what factors affect the crystal field splitting (5 marks)
- b) i) Distinguish between low spin complexes and high spin complexes according to Valency Bond Theory explanation of magnetic behaviour. (3 marks)

Q3

- a) Describe briefly the molecular orbital theory interpretation of bonding in coordination complexes
 (3 marks)
- b) Explain the term "Jahn-Teller effect". (6 marks)
- c) state any three factors that determine the shape of complexes (3 marks)

Q4

- a) Outline the 3 factors that affect electronic absorption bands in coordination compounds
 (2 marks)
- b) Classify the following ligands based on the number of donor atoms (sites) they possess:
 - i) H_2O
 - ii) $(\text{H}_2\text{NCH}_2\text{CH}_2\text{NH}_2)$,
 - iii) $(\text{H}_2\text{NCH}_2\text{CH}_2\text{NHCH}_2\text{CH}_2\text{NH}_2)$
 - iv) $(\text{H}_2\text{NCH}_2\text{CH}_2\text{NHCH}_2\text{CH}_2\text{NHCH}_2\text{CH}_2\text{NH}_2)$
 - v) SCN^- (5 marks)
- c) What are the notable vibrational modes in the I.R spectroscopy of coordination compounds. (5 marks)

Q5

- a) Outline five steps in which a coordination complex is formed according to the Valence Bond Theory. (6 marks).
- b) State reasons why the metal d-orbital splitting pattern in a tetrahedral ligand field is an inversion of that in an octahedral ligand field. (3 marks)
- c) Why is the splitting parameter in the tetrahedral field much smaller than that in an octahedral field. (3 marks)

Q6

- a) Write brief notes on each of the following (8 marks: 2 marks each)
 - i) Chelate effect
 - ii) Conjugate Base formation

iii) Ion-pair formations

iv) Geometric isomers

b) State any four techniques that can be used to monitoring the progress of inorganic reactions. (4 marks)