MACHAKOS UNIVERSITY

University Examinations 2018/2019

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

THIRD YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF EDUCATION (SCIENCE)

SCH 301: COORDINATION AND ORGANOMETALLIC CHEMISTRY

DATE: 17/4/2019 **TIME: 2.00-4.00 PM**

INSTRUCTIONS TO CANDIDATES

Answer Question One [Compulsory] And Any Other Two Questions.

QUESTION ONE (30 MARKS)

a) Provide appropriate names and formulae of the following compounds (4 marks)

i. Na $[PtCl_3(NH_3)]$

ii. Decammine-μ-amidodicobalt(III) nitrate

iii. $[PtCl_2(NMe_3)_2]$

iv. Tris(ethylenediamine)cobalt(III) sulfate

b) Define the following terms (3 marks)

i. Ligand

ii. *trans effect*

iii. Organometallic compound

c) Give TWO important applications of Coordination Chemistry (2 marks)

d) Give TWO differences between organometallic and coordination compounds (2 marks)

e) State THREE applications of macrocyclic coordination (3 marks)

f) Using relevant examples and equilibrium definitions, explain why chelate complexes have greater thermodynamic stability than non-chelated complexes. (3 marks)

g) Use valence-bond theory to explain how Fe^{2+} ions form the $Fe(CN)_6^{4-}$ complex ion. (3 marks)

h) With examples, describe two pairs of terms for identifying diastereomers (4 marks)

i) Define the following concepts

i. Hapticity of a ligand

ii. Jahn-Teller distortion (2 marks)

j) What determines the number of ligands an ion can coordinate? (2 marks)

k) Distinguish between a primary valence and a secondary valence of a transition metal according to Werner (2 marks)

QUESTION TWO (20 MARKS)

a) With relevant equations, describe any FOUR methods of synthesizing transition metal complexes (8 marks)

b) What are the principal sets of equilibrium constants for expressing the formation of a series of complexes ML, ML_2, ML_3 and so on. How are they related? (6 marks)

c) Describe how Chelate and Macrocyclic effects enhance stability of transition metal complexes (6 marks)

QUESTION THREE (20 MARKS)

a) Describe the formation of the following pairs of complexes

i. Inner orbital complex and outer orbital complex

ii. Low spin complex and high spin complex (8 marks)

b) Describe *tetragonal distortion* of octahedral complexes in detail (6 marks)

c) Discuss THREE factors that favour tetrahedral over octahedral complexes (10 marks)

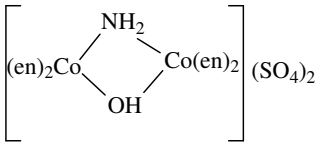
QUESTION FOUR (20 MARKS)

a) Provide the correct names or formulae of the following complexes (8 marks)

i. $K_3[Fe(CN)_6]$

ii. $[Co(NH_3)_6]Cl_3$

iii. $[Co(NH_3)_4SO_4]NO_2$

iv. 

v. $[Co(en)_2Br_2]Cl$

vi. Tetraaquadichlorochromium(III) chloride

vii. Tris(ethylenediamine)cobalt(III) sulfate

viii. Pentaaquathiocyanatoiron(III) sulfate

b) Discuss each of the following types of isomerism about coordination complexes

i. Linkage isomerism

ii. Coordination isomerism

iii. Ionization isomerism

iv. Solvate isomerism (12 marks)

QUESTION FIVE (20 MARKS)

a) Draw the seven Tanabe-Sugano diagrams corresponding to the configurations $d^2 – d^8$. Give the applications of this kind of diagrams. (6 marks)

b) Discuss the principles of crystal field theory and the ligand field theory citing merits and demerits of each theory. (8 marks)

c) Discuss the following concepts (6 marks)

i. Hole formalism

ii. Russell-Saunders L-S coupling