MACHAKOS UNIVERSITY

University Examinations 2017/2018

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

SECOND YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF EDUCATION (SCIENCE)

SCH 301: COORDINATION AND ORGANOMETALLIC CHEMISTRY

DATE: 19/12/2017 **TIME:8.30-10.30 AM**

INSTRUCTIONS:

ANSWER YOUR QUESTIONS IN ANSWER BOOKLET PROVIDED.

ANSWER QUESTION ONE [COMPULSORY] AND ANY OTHER TWO QUESTIONS.

QUESTION ONE (THIRTY MARKS)

a) Define the following terms (4 marks)

i. Ligand

ii. Coordination sphere

iii. Organometallic compound

iv. Chelate

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

c) Distinguish between bidentate and polydentate ligands. Give an example of each of these. (2 marks)

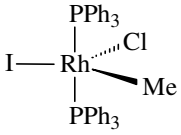
d) Calculate the charge on the transition-metal ion in the following complexes. (2 marks)

(a) $Na_2[Co(SCN)_4]$

(b) $[Ni(NH_3)_6](NO_3)_2$

(c) $K_2[PtCl_6]$

d)



e) Calculate the Crystal Field Stabilization Energy in $[Ni(en)_3]^{2+}$ whose electron distribution is $t_{2g}^6e_g^2$. (2 marks)

f) State THREE factors that favour tetrahedral over octahedral complexes (1.5 marks)

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

h) State FOUR Factors that affect the stability of coordination complexes (2 marks)

i) Chelated complexes are more stable than non-chelated complexes. Explain (2 marks)

j) Describe how a high-spin complex is formed (2 marks)

k) Give any 3 limitations of valence bond theory (VBT) (1.5 marks)

l) State the successes and limitations of crystal field theory (CFT) (3 marks)

m) Using an example, explain what Jahn-Teller distortion is all about. (2 marks)

n) What is the nephelauxetic effect? (2 marks)

QUESTION TWO (20 MARKS)

a) Give FOUR examples of Organometallic Compounds of transition metals, their structures and functions (8 marks)

b) With relevant examples, describe any FOUR methods of synthesizing organometallic compounds (12 marks)

QUESTION THREE (20 MARKS)

a) Using the valence bond theory, describe the formation of tetrahedral and octahedral complexes. Clearly show that d^2sp^3 and sp^3d^2 complexes are octahedral. (10 marks)

b) Describe Octahedral Ligand field splitting and discuss THREE factors that determines the degree of splitting of the d orbitals (10 marks)

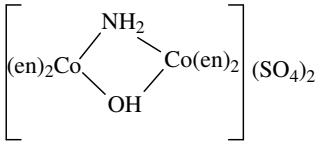
QUESTION FOUR (20 MARKS)

a) Provide the correct names or formulae of the following complexes (6 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. $K_2[Mn\{NH(CH_3)_2\}_4(C_2O_4)_2]$

b) Provide the formulae of the following complexes (4 marks)

i. Decammine-μ-amidodicobalt(III) nitrate

ii. Tetraaquadichlorochromium(III) chloride

iii. Tris(ethylenediamine)cobalt(III) sulfate

iv. Pentaaquathiocyanatoiron(III) sulfate

c) Discuss each of the following types of isomerism in reference to coordination complexes

i. Geometric or stereoisomerism

ii. Linkage isomerism

iii. Coordination isomerism

iv. Ionization isomerism

v. Solvate isomerism (10 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. (12 marks)

b) Describe Crystal Field Splitting in Tetrahedral and Square Planar Complexes (8 marks)