MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF APPLIED SCIENCES

UNIVERSITY ORDINARY EXAMINATION

2017/2018 ACADEMIC YEAR

EXAMINATION FOR MASTER OF SCIENCE IN CHEMISTRY

ACH 604: ADVANCED CO-ORDINATION CHEMISTRY

DURATION: 3 HOURS

DATE: 22ND AUGUST, 2018

TIME: 9.00 – 12.00 NOON

Instructions to Candidates:

1. Answer **Any Four** questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

QUESTION ONE (25 marks)

a) The absorptions for the complex ion $[Co(NH_3)_6]^{3+}$ occurs at 470nM

i. Predict the colour of the complex (2 marks)

ii. Calculate the crystal field stabilization energy in KJ/mol (2 marks)

b) $[N_i(CN)_4]^{2-}$ ion has a square planner geometry and has been found to be diamagnetic whereas the $[N_{\ i}Cl_4]^{2-}$ ion is tetrahedral geometry and is paramagnetic. Show the crystal field diagrams for these two complexes (6 marks)

c) 3d transitimal metals complexes are mostly high spin while 4d and 5d metal complexes are mostly low spin. Explain and give reasons for this observation (5 marks)

d) Write a mechanism showing the following transformation

(10 marks)

QUESTION TWO (25 marks)

a) Chromium (III) Chloride forms six-coordinate complexes with bipyridine including $\text{Cis} - [\text{Cr}(\text{bipy})_2\text{Cl}_2^+]$ which reacts slowly with water to produce two products, $\text{Cis}[\text{Cr}\ (\text{bipy})_2(\text{H}_2\text{O})\text{Cl}]^{2+}$ and $\text{Cis}[\text{Cr}\ (\text{bipy})_2(\text{H}_2\text{O})_2]^{3+}$. Determine the complex with largest splitting energy (Do) (4 marks)

b) Using Ligand Field Theory and suitable splitting diagram, discuss and outline how electrons populate Ligand field diagram of Mn^{3+} complex in a low spin and high spin state in octahedral complex (8 marks)

c) The total electron pairing energy πtotal has two components, πc and πe. Determine the total pairing energy of the following complexes.

i. d^4 high spin complex (2 marks)

ii. d^8 (2 marks)

iii. d^6 low spin complex (2 marks)

d) Give a mechanism to show the following transformation

(7 marks)

QUESTION THREE (25 marks)

a) Consider the following complex

If the complex has splitting energy (Δ_o) of 9,350 cm^{-1}. Unstablishing coulombic term (nc) of 19,600 cm^{-1} and exchange stablishing term (ne) of -2,000 cm^{-1}. Determine if the complex is high spin or low spin (10 marks)

b) Using Ligand Field Theory and MO suitable diagram, explain how $\bar{x}$ – donor and acceptor ligands affects splitting energy and its relationship to spectrochemical series. Use suitable examples where necessary (10 marks)

c) The octahedral crystal field energy Δ_o of $Co(CN)_6^{3-}$ is found to be 6.74 x 10^{-19}. …..
Determine:

i. The absorption wavelength of the complex (3 marks)

ii. Predict the colour of the solution (2 marks)

QUESTION FOUR (25 marks)

a) Write detailed chemical mechanism for the following ring closing metathesis (RCM)

b) Explain any two methods commonly used to form/prepare carbenes (5 marks)

c) Consider the following chromium complex

Determine:

i. The oxidation number of chromium ion (2 marks)

ii. The d- count (2 marks)

iii. The d^n electronic configuration using crystal field theory at strong field (3 marks)

iv. The Crystal Field Stabilization Energy (CFSE) (3 marks)

QUESTION FIVE (25 marks)

a) Use the following sonogashiva coupling reaction to explain oxidative and reductive elimination reaction steps of transition metal catalysts

(7marks)

b) Write detailed chemical mechanism for the following reaction

(8 marks)

c) i. Consider a complex of Cr^{3+} ion. Determine the d-count and draw its d^n electronic configuration (4 marks)

ii. If the complex is a compound $[CrCl_6]^{3-}$ and the wavelength of most intensely absorbed light is 740nM. Predict the splitting energy and the colour of the complex (6 marks)