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OFFICE OF THE DEPUTY PRINCIPAL
ACADEMICS, STUDENT AFFAIRS AND RESEARCH

UNIVERSITY EXAMINATIONS

2019/2020 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER REGULAR

EXAMINATION

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: **CHE 318**

COURSE TITLE: **COORDINATION CHEMISTRY**

DATE: 3RD NOVEMBER, 2020 **TIME: 0900 – 1200 HRS**

INSTRUCTION TO CANDIDATES

- **SEE INSIDE**

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REGULAR – MAIN EXAM

CHE 318: COORDINATION CHEMISTRY

STREAM: BED (Science) **DURATION: 3 Hours**

INSTRUCTIONS TO CANDIDATES

*i. Answer **ALL** questions.*

ii. Diagrams may be used whenever they serve to illustrate the answer.

Question One

a) Define the following terms as applied in coordination chemistry.

i) Coordination compound (1 Mark)

ii) Hard acid (1 Mark)

iii) Coordination number (1 Mark)

iv) Ligand (1 Mark)

v) Nephelauxetic effect (1 Mark)

b) Draw the shapes of the d orbitals indicating clearly their electron densities distribution with respect to x, y and z axes (2 Marks)

c) The table below shows some properties of chromium ammonate chlorides. Study it and answer the questions that follow;

Compound	Conductivity
$CoCl_3.6NH_3$	High
$CoCl_3.5NH_3$	Medium
$CoCl_3.4NH_3$	Low
$CoCl_3.3NH_3$	Low

i) Determine the primary and secondary valences of chromium in the compounds (1 Mark)

ii) Draw Werner's representations of the compounds and comment on the trend of conductivity of the compounds (4 Marks)

iii) What is the effective atomic number of Co in the compounds? (1 Mark)

Question Two

a) Molecular orbital theory is superior to crystal field theory in accounting for bonding in metal complexes. Give three reasons to defend this statement (3 Marks)

b) Give two advantages and two disadvantages of the crystal field theory (4 Marks)

c) Show how the *d* orbitals are perturbed in a square planar field (1 Mark)

d) State and explain three factors that determine the magnitude of $\Delta_{splitting}$ (3 Marks)

e) The $[Cr(H_2O)_6]^{3+}$ is paramagnetic with μspin-only value of 2.83 Bohr Magneton. ls the complex a high- spin (spin free/weak field) or low-spin (spin paired/Strong field)? Briefly explain your answer (3 Marks)

Question Three

a) Write short notes on the following types of isomerism in co-ordination compounds giving one example in each case:

i) Ionization isomerism (2 Marks)

ii) Linkage isomerism (2 Marks)

iii) Geometric isomerism (2 Marks)

b) The complex $[RhF_6]^{3-}$ is octahedral and paramagnetic with a calculated $\mu_{spin-only}$ value of 4.90 BM. Account for the bonding in this complex using the valence bond theory (3 Marks)

c) Describe the type of electronic transitions in metal complexes (3 Marks)

d) Describe the three special features in an electronic spectrum (3 Marks)

Question Four

a) What is the experimental evidence for the Jahn-Teller distortions in a metal complex? (1 Mark)

b) Which of the following octahedral complexes will undergo Jahn-Teller distortion? Briefly explain your answer

i) Low spin Fe^{2+} (1 Mark)

ii) Cu^{2+} (1 Mark)

(Atomic numbers: Fe = 26, Cu = 29)

c) Workout the ground state term symbols for the following ions

i) High spin octahedral Mn^{2+} (1 Mark)

ii) Octahedral Cr^{3+} (1 Mark)

d) Calculate the crystal field stabilization energy (CFSE) of a d^6 complex in,

i) Strong field (1 Mark)

ii) Weak field (1 Mark)

e) Briefly defend the following scientific observations

a) Δ_{oct} is greater than Δ_{tert} (2 Marks)

b) Square planar Au^{2+} complexes readily oxidize to Au^{3+} [Hint: Au^{2+} is a d^9] (2 Marks)

c) Low spin octahedral d^6 complexes are more stable than high spin complexes. (2 Marks)

d) d-d electronic transition in $(Co(H_2O)_6]^{2+}$ is spin allowed while in high-spin $[Mn(H_2O)_6]^{2+}$ is spin-forbidden (2 Marks)

Question Five

a) Draw the structure of the following ligands and indicate whether they are mono or polydentate

i) Oxalato (1 Mark)

ii) Pyridine (1 Mark)

iii) EDTA (1 Mark)

b) Give the systematic I.U.P.A.C names of the following complexes

i) $[Co(NH_3)_6][Cr(CN)_6]$ (1 Mark)

ii) $[Pt(NH_3)_4][PtCl_4]$ (1 Mark)

c) Explain briefly any two rules of an electronic transition (2 Marks)

d) State two applications of co-ordination compounds (1 Mark)

e) Account for the following observations

i) $[Ni(Cl)_4]^{2-}$ is paramagnetic but $[Ni(CN)_4]^{2-}$ is diamagnetic (4 Marks)

ii) In $[Cr(H_2O)_6]^{2+}$, two of Cr-OH_2 bonds are longer than others (1 Mark)

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