



# UNIVERSITY EXAMINATIONS

**SECOND SEMESTER 2023/2024 ACADEMIC YEAR**

**THIRD YEAR EXAMINATION FOR THE DEGREES OF  
BACHELOR OF SCIENCE (GENERAL) & BACHELOR  
OF EDUCATION (SCIENCE)**

**CHEM 321: CHEMISTRY OF COORDINATION COMPOUNDS**

***STREAM: R***

***TIME: 2 HRS***

***DAY: FRIDAY[8.30A.M-10.30A.M]***

***DATE: 19/04/2024***

**THIS QUESTION PAPER CONSISTS OF THREE (3) PAGES**

**PLEASE DO NOT OPEN UNTIL THE INVIGILATOR SAYS SO.**



**INSTRUCTIONS**

Answer **All** the questions.

**QUESTION ONE (30 MARKS)**

- a) Write the IUPAC names of the following coordination compounds:
- |   |  |
|---|--|
| i) $[\text{Ag}(\text{NH}_3)_2]\text{Cl}$                          | iv) $\text{K}_4[\text{Fe}(\text{SCN})_6]$            |
| ii) $[\text{Cu}(\text{NH}_3)_4(\text{H}_2\text{O})_2]\text{SO}_4$ | v) $\text{K}_2[\text{CoCl}_4]$                       |
| iii) $[\text{Ni}(\text{C}_2\text{O}_4)_2]^{2-}$                   | vi) $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Cl}_2$ |
- (6 Marks)**
- b) Highlight three roles in which coordination compounds play in our lives. **(3 Marks)**
- c) Construct a well-labeled  $\sigma$ -only molecular orbital diagram for a  $[\text{Co}(\text{NH}_3)_6]^{3+}$  complex. **(4 Marks)**
- d) State two factors that affect the stability of coordination compounds. **(2 Marks)**
- e) Explain the macrocyclic effect of polydentate ligands. **(5 Marks)**
- f) Calculate the spin only magnetic moment of  $[\text{FeCl}_6]^{4-}$  complex and comment on its magnetic nature. **(4 Marks)**
- g) Describe briefly the Faraday's method of measuring magnetic susceptibility. **(3 Marks)**
- h) Arrange the Russell-Saunders terms,  $^3\text{F}$ ,  $^1\text{D}$ ,  $^3\text{P}$ ,  $^1\text{G}$ ,  $^1\text{S}$  in order of increasing energy and identify the ground term. **(3 Marks)**

**QUESTION TWO (20 MARKS)**

- a) Outline the main ideas of Werner's theory of coordination compounds. **(3 Marks)**
- b) Draw a well labeled diagram of the splitting of d-orbitals in:
- Octahedral field. **(3 Marks)**
  - Tetrahedral field. **(3 Marks)**
  - Square planar field. **(3 Marks)**
- c) Discuss, with the aid of relevant diagrams and calculations, the Jahn-Teller effect in  $[\text{CuCl}_6]^{4-}$  complex. **(6 Marks)**
- d) State the selection rules for electronic transitions. **(2 Marks)**

**QUESTION THREE (20 MARKS)**

- a) Draw the structures of all the isomers of each of the following species and state the type(s) of isomerism exhibited by each species:
- $\text{Pt}(\text{NH}_3)_2\text{Cl}_2$
  - $[\text{Co}(\text{en})_3]^{2+}$

- b) Discuss the factors that influence the ligand field splitting parameter,  $\Delta_o$ .  
**(4 Marks)**
- c) Describe bonding in the  $[\text{Pt}(\text{NH}_3)_6]^{4+}$  ion using the valence bond theory. (Atomic number of Pt=78).  
**(7 Marks)**
- d) A metal **complex ion** is found in which the **coordination number** is six, with four  $\text{H}_2\text{O}$  and two  $\text{NH}_3$  **ligands**. Define the underlined phrases in this sentence.  
**(3 Marks)**
- e) Calculate the effective atomic number of  $[\text{Fe}(\text{CN})_6]^{4-}$  complex. (Atomic number of Fe =26).  
**(2 Marks)**

