KABARAK UNIVERSITY

EXAMINATIONS

2008/2009 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: **CHEM 321**

COURSE TITLE: **CO-ORDINATION CHEMISTRY**

STREAM: **Y3S2**

DAY: **FRIDAY**

TIME: **9.00 – 11.00 A.M.**

DATE: **27/03/2009**

INSTRUCTIONS:
Answer **ALL** questions

PLEASE TURN OVER

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

(i) Coordination compound (ii) Crystal field stabilization energy

(iii) Coordination number (iv) Soft base [4 marks]

(b) Draw the shapes of the *d* orbitals indicating clearly their electron densities distribution with respect to x, y and z axes [2.5 marks]

(c) Write the electron configurations of the following atoms or ions;

(i) Sc (ii) Fe (iii) Co^{3+} (iv) Cu^{2+}

[Atomic numbers: Sc = 21, Fe =26, Co =27 and Cu = 29] [4 marks]

(d) Briefly explain why Zn is not considered as a transition metal

[Atomic numbers: Zn = 30] [1 mark]

(e) The table below shows properties of cobalt aqua flourides. Study it and answer the questions that follow.

Compound	Number of particles as determined by cryoscopic measurements	Molar conductivity ($ohm^{-1}cm^2$)
$CoF_2 \cdot 4H_2O$	3	230
$CoF_2 \cdot 3H_2O$	2	97
$CoF_2 \cdot 2H_2O$	1	0

(i) Explain the above observation on the basis of Werner's coordination theory [4 marks]

(ii) What is the possible geometry of the compounds above? Briefly explain your answer [2 marks]

2. (a) Draw the structures of the following complex ions;

(i) $[Mg[EDTA]^{2-}$ (ii) $[VO(acac)_2]$ (iii) $[Zn(OH)_4]^{2-}$ (iv) $[Co(en)_2Cl_2]Cl$ [4 marks]

(b) Give the I.U.P.A.C names of the following compounds;

(i) $K_2[Fe(CN)_4]$ (ii) $[Cr(NH_3)_2\ Cl_3H_2O]$ (iii) $[Pt(NH_3)_4][PtCl_4]$

(iv) $[(en)_2Fe(NH)_2Fe(NH_3)_4]Br_2$ [4 marks]

(c) Write short notes on the following subjects giving an example in each case:

(i) Chelating ligands (ii) ionization isomerism (iii) effective atomic number [6 marks]

(d) Distinguish between;

(i) Spectrochemical series and nephelauxetic series

(ii) Outer orbital and inner orbital complexes [4 marks]

3. The complex $[Ni(H_2O)_6]^{2+}$ is octahedral and paramagnetic with a μ spin only value of 2.83 Bohr Magneton. Account for the bonding in this complex using;

(a) Valence bond theory (b) Crystal field theory (iii) Molecular orbital theory

[Atomic number of Ni =28] [10 marks]

(b) Draw the splitting patterns of d orbitals in the following fields;

(i) Square planar (ii) tetragonal (iii) tetrahedral [7.5 marks]

(c) Compare and contrast crystal field and molecular orbital bonding theories

[Hint: Give **two** similarities and **two** differences of the theories]

[4 marks]

4. (a) What is the experimental evidence of Jahn Teller distortion ? [2 marks]

(b) Will $[Mn(H_2O)_6]^{2+}$ undergo Jahn Teller distortion? Briefly explain your answer [Atomic numbers: Mn =25] [3 marks

(c) Account for the following observations;

(i) Ligand field splitting parametric for octahedral (Δ_{oct}) is larger than that of tetrahedral (Δ_{tert})

(ii) $[Ti(H_2O)_6]^{3+}$ is coloured but

$[Ti(H_2O)_6]^{4+}$ is not

(iii) d^9 metal ions in a strong field rarely form square planar complex

[Atomic number of Ti = 22] [6 marks]

(d) Give two properties of a transition element [2 marks]