KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

2008/2009 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: CHEM 321

COURSE TITLE: CO-ORDINATION CHEMISTRY

STREAM: SESSION VI & VII

DAY: TUESDAY

TIME: 2.00 – 4.00 P.M.

DATE: 11/08/2009

INSTRUCTIONS TO CANDIDATES:

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) Ligand. [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] [2 marks]

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

Compound	Conductivity
$CrCl_3.6H_2O$	high
$CrCl_3.5H_2O$	Medium
$CrCl_3.4H_2O$	low

(i) Determine the primary and secondary valence of chromium in the compounds [2 marks]

(ii) Comment on the trend of conductivity of the compounds [3 marks]

(iii) What is effective atomic number of chromium in the compounds?

[Atomic number of Chromium =24] [2 marks]

2. (a) Draw the structures of the following ligands;

(i) Ammine (ii) EDTA (iii) oxalato [3 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) $[Co(NH_3)_6]Cl_3$ [4 marks]

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

(i) Chelating ligands (ii) Ionization isomerism

(iii) Spectrochemical series [6 marks]

(d) Distinguish between;

(i) Ambidentate ligand and polydentate ligand

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

3. (a) The complex $[Ni(H_2O)_6]^{2+}$ is octahedral and paramagnetic with two unpaired electrons. Account for the bonding in this complex using;

(i) Valence bond theory (ii) 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) tetrahedral [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] [2.5 marks]

(c) Account for the following observations;

(i) Δ_{oct} is larger than Δ_{tert}

(ii) $[Ti(H_2O)_6]^{3+}$ is coloured but $[Ti(H_2O)_6]^{4+}$ is not

(iii) d^8 metal ion in a strong field prefer square planar geometry

[Atomic number of Ti = 22]

(iv) Transition metal ions form complexes [8 marks]

(d) What is meant by nephelauxetic effect? [2 mark]