NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
END OF SECOND SEMESTER EXAMINATIONS – JUNE 2010
INORGANIC CHEMISTRY II – SCH 1201
TIME: (3) THREE HOURS

INSTRUCTIONS TO CANDIDATES

MATERIAL
Periodic Table

INSTRUCTIONS TO STUDENTS
Answer All questions in section A and All questions in Section B.
Answer each question on a FRESH page.

SECTION A *Answer ALL questions. Each question carries 10 marks*

1 .(a) A coordination compound can be defined according to its structure and also according to its reaction chemistry. Give two definitions that collectively satisfy this statement. [4 marks]

(b) Draw the structure of the following complex:

Bis(ethylenediamine)cobalt(III)-μ-amido-μ-superoxobis(ethylenediamine)cobalt(III) [2 marks]

(c) Name three common geometries associated with the seven-coordination. Draw the structure of one of them [4 marks]

2 .(a) State with appropriate definitions the four concepts of defining acids and bases. [8 marks]

(b) State any two major properties of solvents that are considered when selecting a solvent. [2 marks]

3. (a) What do you understand by the term *inert-pair effect*. [2 marks]

(b) State any four common properties of the transition elements. [4 marks]

(c) Sulphur forms both discrete polyatomic molecules and extended structures.
(i)Name one discrete polyatomic molecule of sulphur.
(ii) What is *catenasulphur*
[4 marks]

4. (a) Give one working definition of the crystal field theory and use the octahedral complex to illustrate the theory [7 marks]

(b) Bonding. What is metal-to-ligand bonding? What is the other type of bonding? [3 marks]

SECTION B

Answer ALL questions from this section.

5. (a) Calculate, in units of Δ_o, the LFSEs of the following low-spin ions in their octahedral complexes Fe^{2+}, Mn^{2+}, Mn^{3+}, Co^{2+} [8 marks]

(b) One advantage of the ligand field theory is that it can extend to include π-bonding. Which kind of π-bonding increases the magnitude of the LFSE? Explain. [4 marks]

(b) Draw the six metal orbitals with σ-symmetry (sigma –symmetry) and ligand group orbitals(□) that overlap properly with those metal orbitals to form σ-type MOs in ML_6 metal complex [8 marks]

6. (a) Substitution reactions of Octahedral complexes. There are four main mechanisms that have been established for these reactions. Name these four mechanisms and use the substitution of ligand X by ligand Y in the ML_5X complex to illustrate each. [8 marks]

(b) Name the following complex compounds and ions:
(i) $[Pt(NH_3)_5Cl](NO_3)_3$
(ii) $Mg[Ni(Cl)_4]$
(iii) $Fe(NH_3)_3Cl_3$
(iv) $[Fe(NH_3)_6]Cl_3$
[6 marks]

(c) What is a *strong trans director* ligand?
Use the synthesis of the cis and trans isomers of $[Pt(NH_3)_2Cl_2]$ to demonstrate and discuss this phenomena [6 marks]

7. (a) In discussing solubility of solutes in solvents there are three main energy factor that are considered to determine solubility. State these energies and use a simple energy diagram to show how they relate to determine the solubility [8 marks]

(b) HCl, HNO_3, and H_2SO_4 are relatively strong Bronsted acids. What is the name of the phenomenon that makes it impossible to show which acid is

the strongest when water is used as the solvent. How can these acids be distinguished according to strength?

[3 marks]

(c) What is the advantage of the solvent system concept over the Bronsted-Lowry's concept of defining acids and bases? What is the main limitation of the solvent system concept? [2 marks]

(d) What is a superacid? Give two important uses of superacids.

[3 marks]

(e) Sulphuric acid is one of the most common protic acids. The equilibria of pure sulphuric acid is known to be complex, write down its self-ionization reaction and any three hydration-dehydration equilibrium reactions.

[4 marks]

END OF QUESTION PAPER!!!