



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
SUPPLEMENTARY EXAMINATIONS – OCTOBER 2009
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 Any Three questions in Section B.

Answer each question on a **FRESH** page.

SECTION A Answer ALL questions. Each question carries 10 marks

1. (a) Write the definitions of the following terms: *Bronsted and lowry acid, lewis base, and protic acid.* [6 marks]
- (b) Give four examples of protic acids [4 marks]
2. (a) Why are elements in the first row not good representatives of elements under them in their respective groups? [2 marks]
- (b) Name the coinage metals. Give a full definition of a transition metal. [3 x 2 marks]
- (c) Give four basic categories of metals on the periodic table. [2 marks]
3. (a) What is the major bond in coordination compounds that distinguishes them from other groups of compounds? [2 marks]
- (b) Name and draw any two common geometries associated with the six coordination. [4 marks]
- (c) Name the following complexes:
(i) $\text{Na}_2[\text{FeCl}_4]$
(ii) $\text{Ni}(\text{CO})_4$ [4 marks]
4. (a) Define the following terms: *crystal field theory, ligand field theory, strong field ligand and, high spin complex.* [8 marks]
- (b) State two energy factors that are used to predict the most stable configuration for a given octahedral complex. [2 marks]

SECTION B

Answer ALL THREE questions from this section.

5. (a) Explain why tetrahedral complexes always have high spin complexes. Also give an explanation why Δ_{tet} is $4/9 \Delta_0$. [8 marks]
- (b) What is meant by (i) metal-to-ligand bonding and ligand-to-metal bonding. [4 marks]
- (c) Draw the six metal orbitals with σ -symmetry (sigma symmetry) and ligand group orbitals (Σ) that overlap properly with those metal orbitals to form σ -type MO's in an ML_6 complex. [10 marks]
6. (a) State and define the three (3) important substitution reactions of octahedral complexes. [12 marks]
- (b) The rate laws of substitution reactions in complex compounds are not exact representatives of the mechanisms because of additional steps in the overall substitution, which obscure the simple first and second order rate laws expected from the unimolecular and bimolecular processes. Name three such cases of additional steps and briefly describe the steps. [8 marks]
7. (a) Separate the following solvents into protic and non-protic groups. For the protic group, write the Bronsted and Lowry pairs. H_2O , NH_3 , H_2SO_4 , HCl , BrF_3 , HF , IF_5 , Cl_3PO , N_2O_4 , AsCl_3 , CH_3CONH_2 . [10 marks]
- (b) List three physical properties of metals and give a brief explanation for each. [6 marks]
- (c) Carbon forms both discrete polyatomic molecules and extended structures.
- (i) What is catenation?
- (ii) The third allotropic form of carbon consists of large spheroidal C_n molecules, with $n = 60$ or more. What is the umbrella name of these molecules. [4 marks]

END OF QUESTION PAPER!!!