



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
SUPPLEMENTARY EXAMINATIONS – AUGUST 2014
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) In naming coordination compounds prefixes such as *fac-* and *mer-* are used. In what circumstances are these prefixes used? Use a simple general formula to illustrate your answer. [4 marks]
- (b) Draw the structure of the following complex:
Di- μ -chlorobis(diaquaplatinum(II)) Sulphate [2 marks]
- (c) Name the following geometry, and state the principal coordination number(s) that produce this geometric arrangement.



[4 marks]

- 2 .(a) What two properties are generally important in a solvent for electrochemical reactions. [2 marks]
- (b) Boric acid, $B(OH)_3$, acts as an acid in water, but does not do so via ionization of a proton. Rather, it serves as a Lewis acid towards OH^- . Explain with the use of a balanced equation [2 marks].
- (c) Briefly discuss Bronsted-Lowry definition and show how it is included as a special case in the solvent system definition [4 marks]

- (d) Distinguish between solvolysis and solubility. [2 marks]
3. (a) What is an icosahedron? For which element is it the most characteristic structural feature? [2 marks]
- (b) Germanium and Lead are elements in the same group (IVA). Both elements react with halides to form MX_2 molecule. Write the general formula of the other possible halide products. For a chosen halide, compare the stabilities of the MX_2 molecules of the two elements [4 marks]
- (c) Sulphur forms both discrete polyatomic molecules and extended structures.
 (i) Name the most thermodynamically stable polyatomic molecule of sulphur
 (ii) What is the general name for the S_n chains? [4 marks]
4. (a) Why are tetrahedral complexes usually not low spin? [2 marks]
- (b) What is a strong field ligand? Give one example [2 marks]
- (c) One advantage of the ligand field theory is that it can be extended to include π -bonding. Which kind of π -bonding increases the magnitude of the LFSE? Explain. [4 marks]
- (d) What is an acceptor π -ligand? Give two examples [2 marks]

SECTION B

Answer ONLY THREE questions from this section.

5. (a) Calculate, in units of Δ_0 , the LFSEs of the following high-spin ions in their octahedral complexes Fe^{2+} , Mn^{2+} , Mn^{3+} , Co^{2+} [8 marks]
- (b) According to the Crystal Field theory, the e_g and t_{2g} orbitals are purely metal d orbitals. How is this different from the approach of the Molecular Orbital theory (or ligand field theory) [2 marks]
- (c) With the aid of a diagram, trace with explanation, how the d-orbital splitting pattern changes as an octahedral complex is altered via a tetragonal distortion that is first weak and then reaches the extreme case where the square, four-coordinate complex is obtained. [10 marks]
6. (a) What is meant by the term *trans effect*

Use the syntheses of the cis and trans isomers of $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$ to demonstrate and discuss this phenomena [6 marks]

- (b) Explain the difference between kinetic inertness (or lability) and thermodynamic stability (or instability) [4 marks]
- (c) The extent to which a cation combines with ligands to form complex ions is a thermodynamic problem and can be treated in terms of appropriate expressions for equilibrium constants
Name these two constants and clearly show how they are related using the formation of the ML_4 complex [8 marks]
- (d) Why do many square complexes have two-term rate laws (second order) for ligand replacement reactions? [2 marks]
7. (a) There is an important property distinction, based on electronic structure, between the three classes of transition elements. Name these three classes and account for the distinction. [10 marks]
- (b) Metals form three basic solid structures. Name these structures and give the coordination number for each. [6 marks]
- (c) Sulphur forms both discrete polyatomic molecules and extended structures.
(i) What is catenasulfur
(ii) Name and draw the most stable form of the element sulfur. [4 marks]
8. The discussion of solution behaviour is divided into three sections: (i) solubility and solvolysis, (ii) acid-base behaviour, and (iii) oxidation- reduction behaviour.
- (a) Define to differential the terms solvation and solvolysis. What are these processes termed when the solvents are water and ammonia? [8 marks]
- (b) What two properties are generally important in a solvent for electrochemical reactions [2 marks]
- (c) Write the auto-ionization reactions for the following solvents
 H_2O , NH_3 , H_2SO_4 , BrF_3 , HF , IF_5 , Cl_3PO , N_2O_4 , AsCl_3 , CH_3CONH_2
[10 marks]

END OF QUESTION PAPER!!!