



NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF APPLIED SCIENCE

DEPARTMENT OF APPLIED CHEMISTRY

INORGANIC CHEMISTRY I

SCH 1201

Supplementary Examination Paper

August 2015

This examination paper consists of 4 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements: Periodic Table

Examiner's Name: DR H. Chiririwa

INSTRUCTIONS

Answer All questions in section A and Any Three questions in Section B.

Answer each question on a FRESH page.

MARK ALLOCATION

SECTION	MARKS
A	40
B	60
TOTAL	100

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

1. (a) State with appropriate definitions the three systems of defining acids and bases. [6 marks]
- (b) State three classes of non-protic solvents. [4 marks]
2. (a) What is the octet rule? Why does it apply strictly only to elements of the first short period? [2 marks]
- (b) (i) What is the practical definition of a transition metal?
- (ii) What is the common name given to transition metals?
- (iii) Why are Cu, Ag, and Au considered as transition elements?
- (iv) What is the name given to the other special group of elements in the d-block? [6 marks]
- (c) Give four basic categories of metals in the periodic table. [2 marks]
3. (a) What is a coordination compound? [2 marks]
- (b) Name and draw the two common geometries associated with the five coordination [4 marks]
- (c) Name the following complexes:
- (i) $[\text{Co}(\text{NH}_3)_5][\text{Fe}(\text{CN})_5\text{H}_2\text{O}]$
- (ii) $\text{Na}_2[\text{Fe}(\text{CN})_6] \cdot 2\text{H}_2\text{O}$ [4 marks]
4. (a) With the aid of orbital splitting diagrams, show which d^n electron configurations are capable of giving both low spin and high spin configurations in an octahedral ligand field. [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 *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 phenomenon. [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 catenasulphur?
- (ii) Name and draw the most stable form of the element sulphur. [4 marks]
8. Solution behaviour can be 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!!!