NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
SUPPLEMENTARY EXAMINATION –AUGUST 2013
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) In naming coordination compounds prefixes such as *cis*-, *fac*-, *trans*- and *mer*- are used. In what circumstances are these prefixes used? Use a simple example to illustrate your answer. [6 marks]

(b) Draw the structure of the following complex:

Di-μ-bromobis(diaquaplatinumt(II)) Nitrate

[2 marks]

(c) Name the following three geometric arrangements common for coordination number 6.

[2 marks]

2 .(a) What two properties are generally important in a solvent for electrochemical reactions. [2 marks]

(b) State with satisfactory definitions the four concepts of classifying acids and bases. Show the overlaps between the concepts [8 marks].

3. (a) Why are the chemical consequences of partially filled d orbitals so much more pronounced for d-block elements than the consequences of partially filled f orbitals for the f-block elements? Within the f-block also give a comparison and contrast of the two groups of elements in this respect [6 marks]

(b) Carbon, Lead, Germanium, and Tin are elements in the same group. Explain why CH_2 is unstable while $PbCl_2$ is stable. Compare also the stabilities of $GeCl_2$ and $SnCl_2$.

[4 marks]

4. (a) Why are tetrahedral complexes usually not low spin while their octahedral counterparts may be high spin? [2 marks]

(b) What is the relationship the ligand's field strength and the type of spin? [2 marks]

(c) 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. [6 marks]

SECTION B

Answer ALL questions from this section.

Question number five (5) must be answered on the tear-off sheet which must be detached from the question paper and attached to the answer book.

5. The diagram on the tear-off sheet shows the d-orbital splitting in various geometries of complex compounds.

(a) In each section of the diagram from (a) to (f) identify and label the d-orbitals in their energy levels [8 marks]

(b) In each section of the diagram from (a) to (f) state the geometry (or geometries) that coincides with the pattern of d-orbital splitting. [8 marks]

(c) The symbols ***e***, ***t***, and ***a*** are symmetry labels defined in the group theory of orbitals. State what each symbol signifies. [4 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. [4 marks]

(b) Name the following complex compounds and ions:
(i) $[Co(NH_3)_5Cl]Cl_2$
(ii) $Na[Fe(CO)_4H]$
(iii) $[(NH_3)_5–NC–Co(CN)_5]$
(iv) $(NH_4)_2[Ni(C_2O_4)_2(H_2O)_2]$
[8 marks]

(c) Discuss the two general mechanisms for electron transfer reactions. Use reaction equations to illustrate your answers. [6 marks]

7. (a) HBr, $HClO_4$, and HI are relatively strong Bronsted acids. For these acids to be distinguished according to acid strength they have to be studied in solvents such as sulphuric acid. What is a Bronsted acid? Write the Bronsted equilibrium for the solvent sulphuric acid indicating the strongest acid and strongest base that can exit in it.

[2 marks]

(b) Identify the Lewis acids and bases in the following reactions and predict the products. Briefly justify your answers.

i. $FeCI_3 + CI^-$

ii. $BF_3 + N(CH_3)_3$

iii. $NaH + NH_3$

iv. $KH + CH_3CH_2OH$

v. $I^- + I_2$

vi. $Na[:SnCI_3] + (CO)_5MnCI$ [12 marks]

(c) Separate the following solvents into protic and non-protic groups. For the protic group, write the possible Bronsted and Lowry pairs.
NH_3, HCI, BrF_3, IF_5, CI_3PO, $AsCI_3$, CH_3CONH_2. [6 marks]

END OF QUESTION PAPER!!!

P.T.O

Tear off this page and attach it to your answer sheet.

Candidate's Registration No:……

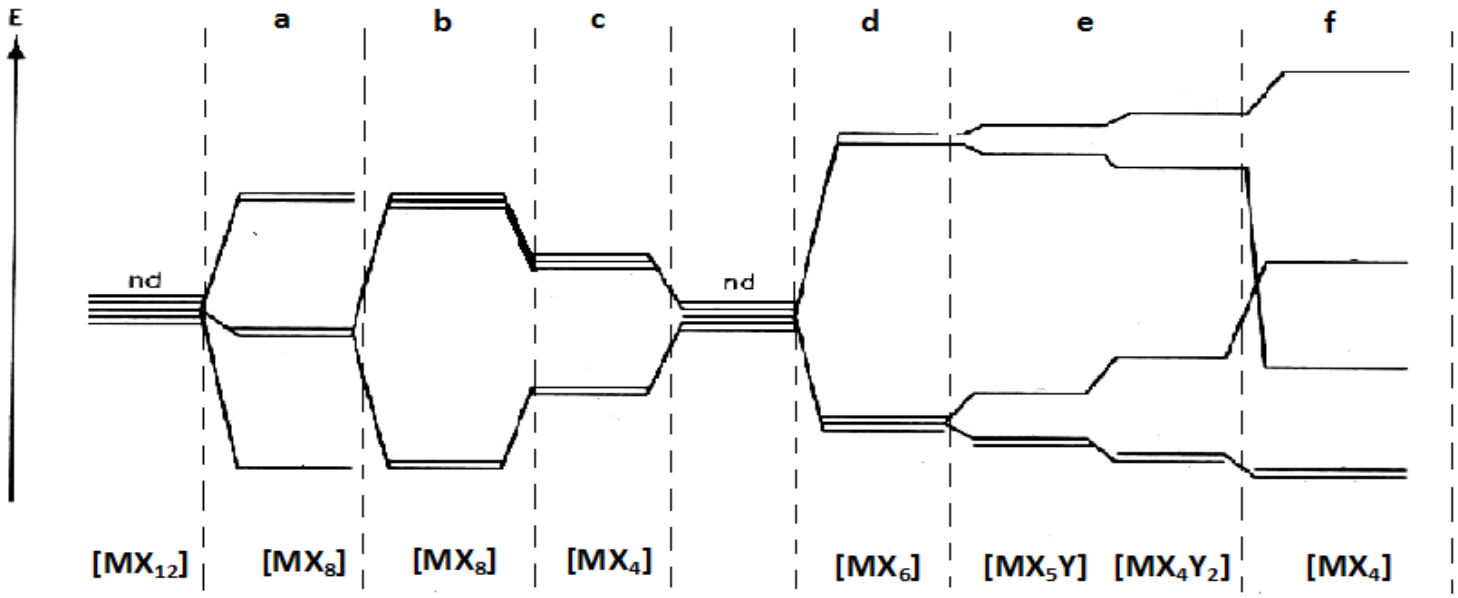

Fig: Splitting of d-orbital energy levels in ligand fields of different symmetries.

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