NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
DEPARTMENT OF APPLIED CHEMISTRY
BACHELOR OF SCIENCE HONOURS DEGREE
END OF SECOND SEMESTER EXAMINATIONS – MAY 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 any THREE in Section B from the FOUR questions given

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Section A *(Section carries 25 marks)*
Answer ALL questions

1. (a) Explain what is meant by the terms weak acid and weak base when applied to a non-aqueous protic solvent HA.Include equations. [4 marks]

   (b) Sulphuric acid is a weak acid in acetic acid.Show this by means of an equation. [2 marks]
   (c) Sodium acetate is a strong base in acetic acid.Explain. [2 marks]

2. (a) Name the following compounds according to IUPAC rules

   (i) $Na_2[ZnCl_4]$
   (ii) $[Cr(en)_3]Cl_3$ where en=$NH_2CH_2CH_2NH_2$ [4 marks]

   (b) Draw the structures of the following compounds:

   (i) cis-diamminetetraisothiocyanatochromate(III)
   (ii) Tris(oxalato)cobalt(III) nitrate [4 marks]

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

3. State with appropriate definitions the three concepts of defining acids and bases. [5 marks]

Section B *(section B carries 75 marks)*

Answer Three questions only

1. (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.
   (i).What is a Bronsted acid?
   (ii).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]

   (d) With the aid of examples, explain in detail the levelling effect. [5 marks]

2. (a) With the aid of a clearly and fully labeled diagram, describe and explain The Crystal Field Splitting of the d-orbitals in an octahedral ligand field. [12 marks]

   (b) Explain, with the aid of diagrams how the strength of the crystal field of ligands determine the paramagnetism of some complexes. [5 marks]

   (c) There are four (4) main types of isomerism in co-ordination compounds. Name and briefly describe each of these types. [8 marks]

3. (a) Determine (i) the electronic configuration and LFSE for each of the following complexes, (ii) where relevant use the spectrochemical series to decide whether the complex is likely to be para- or di-magnetic.

   (i) $[Fe(CN)_6]^{3-}$ [4 marks]
   (ii) $[Cr(NH_3)_6]^{3+}$ [4 marks]
   (iii) $[Ni(CO)_4]$ (tetrahedral). [4 marks]

(b) For each of the following species: (i) $Fe(CO)_5$,(ii)$Mn_2(CO)_{10}$,(iii)$V(CO)_6$ and (iv) $[Fe(CO)_4]^{2-}$

(i) Name the species and draw its structure. [8 marks]

4. (a) What is meant by the term *trans effect?*
Use the syntheses of the cis and trans isomers of $[Pt(NH_3)_2Cl_2]$ to demonstrate and discuss this phenomena. [8 marks]

(b) Explain the difference between kinetic inertness (or lability) and thermodynamic stability (or instability). [6 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? [3 marks]

END OF QUESTION PAPER!!!