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MAIN EXAMINATION

JANUARY - APRIL 2017 TRIMESTER

FACULTY OF SCIENCE

DEPARTMENT OF CHEMISTRY

REGULAR PROGRAMME

CHEM 301: COORDINATION CHEMISTRY

Date: APRIL 2017	**Duration: 2 Hours**
INSTRUCTIONS: Answer Question ONE and any other Two Questions	

Q1.

a) Explain what you understand by each of the following (**3Marks**)
   i. Excitation
   ii. Atomic orbitals

b) Write the names of the following ligands as used in coordination Chemistry. (**3Marks**)
   i. $C_2O_4^{-2}$
   ii. NO
   iii. NCS^-

c) For each of the following complexes indicate coordination number, oxidation state and electronic configuration of the central metal ion. (**3Marks**)
   i. $[Co(en)_3]Cl_3$
   ii. $[Fe(CN)_6]^{-4}$

d) State any **FOUR** applications of ethylenediamminetetracetic acid. (**4Marks**)

e) i. Determine the oxidation number of ruthenium in

$[Ru(NH_3)_5(H_2O)]Cl_2$. (**2Marks**)

ii. Give the name of the compound in (i) above. (**1Mark**)

iii. Explain what you understand by "***oxidation number of the complex***". (**1Mark**)

f) Name the following compounds: (**3Marks**)
   i. $[Cr(NH_3)_3(H_2O)_3]Cl_3$
   ii. $[Co(H_2NCH_2CH_2NH_2)_3]_2(SO_4)_3$
   iii. $[Co(H_2NCH_2CH_2NH_2)_2Cl_2]Cl$

g) Define each of the following. Giving an example for each. (**4Marks**)
   i. Homoleptic complexes.
   ii. Heteroleptic complexes.

h) Outline **two** difference between a diamagnetic complex and a paramagnetic one. (**6Marks**)

Q2.

a) What is hybridization and why is it important? (**3Marks**)

b) Draw the shapes of the various d-orbitals, and **explain** why they are split into two groups t_{2g} and e_g in an octahedral field. (**7Marks**)

c) Describe briefly three main transitions, that occur in electronic spectra of transitions metal complexes. (**6Marks**)

d) State what causes each of the following in the compounds of transition elements. (**4Marks**)
   i. Colour
   ii. Formation of compounds in many oxidation states (variable valency).
   iii. Paramagnetic property.
   iv. Catalytic activity.

Q3.

a) i. Explain what you understand by "a racemic mixture". (**2Marks**)
   ii. Explain its effect on the plane polarized light and why? (**3Marks**)

b) Given $Na_3[Cr(CN)_6]$, which ions are:

   i. Covalently bonded?
   ii. Ionically bonded? (**2Marks**)

c) i. Write the name of $[Co(en)_2(NO_2)Cl]SCN$. (**1Mark**)

ii. Give the formulae of two other ionization isomers that can be obtained from $[Co(en)_2(NO_2)Cl]SCN$ and name them. (**4Marks**)

d) i. Name the type of isomerism shown by the following two compounds
$[Cr(NH_3)_4Cl_2]Br$ and $Cr(NH_3)_4ClBr]Cl$ (**1Mark**)

ii. Draw their structures and name them. (**4Marks**)

iii. Which of these two will form a white precipitate with $AgNO_3$ solution. Explain. (**3Marks**)

Q4.

a) Draw and label the shapes of p-orbitals. (**3Marks**)
b) State three Assumptions made in the Crystal Field Theory. (**3Marks**)
c) State and explain the factors that affect the Crystal Field Stabilization Energy (CFSE). (8**Marks**)
d) Give three failures or limitations of the Crystal Field Theory. (**6Marks**)

Q5.

a) With the help of balanced chemical equations, describe briefly how you would distinguish the compounds: $[Cr(H_2O)_6]Cl_3$, $[Cr(H_2O)_5Cl]Cl_2$ and $[Cr(H_2O)_4Cl_2]Cl$. (**6Marks**)

b) Explain the following, giving an example for each. (**4Marks**)
i. Counter ion
ii. Ambidentate ligand

c) State and explain **<u>any 5</u>** applications//importance of coordination compounds. (**10Marks**)

END