Kafr El-Sheikh University
Faculty of Science
Chemistry Department

Suggested research topics
Winter semester of the academic year 2019/2020

Course name: Chemistry of Metal Complexes
Professor Dr.: Abd Al-Motaleb Mosad Ramadan
Level: Third
Program: Chemistry

Title: Nomenclature Rules of Metal Complexes

Complex Cations

Complex Anions

Molecular neutral form of the anionic complexes

Acidic form of the anionic complexes

Naming ligands

Write the scientific name of the following isomeric ligands
M - NO_2
M - ONO
M - SCN
M - NCS

- What is the difference between the ferric alum [$(NH_4)_2SO_4$ $Fe_2(SO_4)_3.24H_2O$] and the Potassium Ferro cyanide $K_4[Fe(CN)_6]$?

- What is the difference between d^2sp^3 and sp^3d^2?

- What is the crystal field theory point of view of metal complex?

- What is the valence bond theory point of view of metal complex?

- Define some relevant terms such as: Ligand, Coordination number, Oxidation number, metal chelate, primary valence, secondary valence

- Write the molecular formula of the following metal complexes
Hexaamminechromium(III) ion ……..……
tetracarbonylnickel(0) ……..
Hexacyanoferric(III) acide ……..
tetrachloroplatinic(II) acide …….
tris(ethylenediamine)chromium(III) chloride ……
dichloroaquahydraziniumplatinum(II) ion ……..……
potasium bromochloronitrito−O−ammineplatinate(II) ……...……
potasium hexaisothiocyanato-N-cobalt(III) ……
sodium hexathiocyanato-S-cobalt(III) ……
sodium bromochloronitro-N-ammineplatinate(II) ……..…
bis-(dithiooxalato -S,S') platinate(II) ……

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Title: Valance Bond Theory

- Postulates of Valence Bond Theory in details

- Hybridization of Atomic Orbitals

- Types of hybridization in metal complexes

- Spatial distribution of the hybridized orbitals

- Spin-only magnetic moments of metal complexes

(a) Tetrahedral complexes, give examples

(b) Square-planar complexes

(c) Octahedral complexes

- Outer – orbital octahedral complex

- What is the difference between d^2sp^3 and sp^3d^2?

- Defects of the valence bond theory

- What is the crystal field theory point of view of metal complex?

- Write a brief account of the chelation process and the metal chelates. Give example of the cheated ligand and the metal chelate to clarify your answer.

- Based on the IUPAC write the chemical name of the following metal complex species:

$[Cr(NH_3)_6]Cl_3$ …….....……

$[CoSO_4(NH_3)_4]NO_3$ …….....……...

$[PtCl_6]^{2-}$ …….....……..

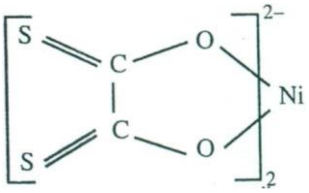
$[Fe(CN)_6]^{4-}$ …….....…….....

$Na_2[ZnCl_4]$ …….....

$[PtCl_2(H_2O)(NH_2NH_3)]^+$ …….....

$[PtCl_2(H_2O)(NH_2NH_3)]NO_3$ …….

$[Co(NH_3)_3(H_2O)_3]Cl_3$ …….....



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Title: Crystal Field Theory

Assumptions of the Crystal Field Theory

Crystal Field Splitting of d Orbitals

Crystal Field Splitting of d Orbitals in Octahedral Complexes

Crystal Field Splitting in the tetrahedral geometry

Splitting of d Orbitals in Square-planar Complexes

Splitting of d Orbitals in Square pyramidal Complexes

Splitting of d Orbitals in Trigonal bipyramidal Complexes

Limitations of Crystal Field Theory

- What is the valence bond theory point of view of metal complex?

- What is the difference between the classical and non classical ligands?

- Define some relevant terms such as: Ligand, Coordination number, Oxidation number, metal chelate, primary valence, secondary valence

- Based on the IUPAC write the chemical name of the following metal complex species:

$[Cr(NH_3)_6]Cl_3$ …….....……

$[CoSO_4(NH_3)_4]NO_3$ …….....……...

$[PtCl_6]^{2-}$ …….....……..

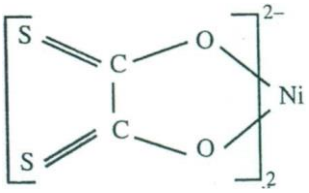
$[Fe(CN)_6]^{4-}$ …….....…….....

$Na_2[ZnCl_4]$ …….....

$[PtCl_2(H_2O)(NH_2NH_3)]^{+}$ …….....

$[PtCl_2(H_2O)(NH_2NH_3)]NO_3$ …….

$[Co(NH_3)_3(H_2O)_3]Cl_3$ …….....



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Title: Werner's Coordination Theory

- Postulates of Werner's theory in details
- Defect of Werner's theory
- What is the difference between the double salt and complex salt?
- What is the crystal field theory point of view of metal complex?
- What is the valence bond theory point of view of metal complex?
- What is the difference between the classical and non classical ligands?
- Write a brief account of the chelation process and the metal chelates. Give example of the cheated ligand and the metal chelate to clarify your answer.
- On treatment the aqueous solution of the various chemical formulae cited in the following Table with $AgNO_3$ various numbers AgCl molecules were precipitated. As well the molar conductance measurements indicated the number of ions in solution for each chemical formula. Complete the missed information of the following Table.

Original formulation	No. of AgCl precipitated	No. of ions in solution	Molecular formula
$CoCl_3.6NH_3$	……	……	……
$CoCl_3.5NH_3$	……	……	……
$CoCl_3.4NH_3$	……	……	……
$CoCl_3.4NH_3$	……	……	……
$CoCl_3.3NH_3$	……	……	……
$IrCl_3.3NH_3$	……	……	……

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Title: Crystal Field Stabilization Energy (CFSE)

The high-spin and low-spin states

Measurement of Δ_o

Reasons for Smaller Δ_t / over Δ_o

Determination of Crystal Field Stabilizations Energy (CFSE)

Factors affecting the magnitude of Δo or 10Dq

Occupancy of d Orbitals by Electrons in Octahedral Complexes:

Weak-field and Strong-field Cases

Limitations of Crystal Field Theory

- Write a brief account on the chelation process and the metal chelates. Give examples of the cheated ligand and the metal chelate to clarify your answer.

- Define some relevant terms such as: Ligand, Coordination number, Oxidation number, metal chelate, primary valence, secondary valence

- Based on the IUPAC write the chemical name of the following metal complex species:

$[Cr(NH_3)_6]Cl_3$ …….....……

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$[PtCl_6]^{2-}$ …….....……..

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$Na_2[ZnCl_4]$ …….....

$[PtCl_2(H_2O)(NH_2NH_3)]^+$ …….....

$[PtCl_2(H_2O)(NH_2NH_3)]NO_3$ …….

$[Co(NH_3)_3(H_2O)_3]Cl_3$ …….....

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