Quadrant II – Transcript and Related Materials

Programme: Bachelor of Science (Second Year)

Subject: Chemistry

Course Code: CHC 104

Course Title: Physical Chemistry and Inorganic Chemistry (Section B)

Unit: 02

Module Name: IUPAC System of Nomenclature

Name of the Presenter: Dr. Madhavi Zilba Naik

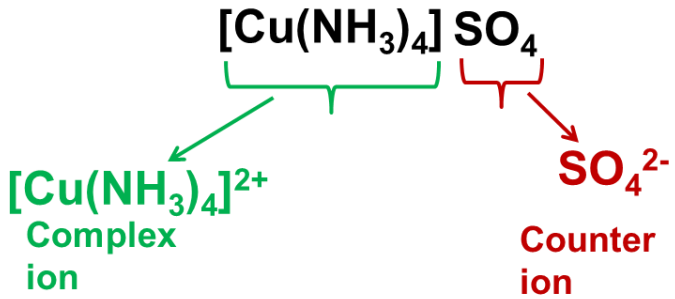
Notes

Coordination Compounds

Compounds that results from the combination of two or more stable chemical species and retains its identity in the solid as well as dissolved state. The bond formed in such compounds is known as **coordinate covalent bond.**

A water soluble coordination compound almost invariably contains a complex ion. **Complex ion** is an electrically charged ion which consists of a central metal atom or ion surrounded by a group of ions or neutral molecules.

Components of coordination compounds



Some coordination compounds do not contain a complex ion eg. $Fe(CO)_5$

Central ion is a metal/cation to which one or more neutral molecules or ions are coordinated.

Ligand is the ion or neutral molecule attached to the central atom in a coordination compound.

Coordination number is the total number of ligands that are directly attached to the central metal ion.

Coordination sphere consists of the central atom/ion and the ligands attached to it usually shown in a square bracket.

Overall charge on the complex ion is determined by

1) The oxidation state of the metal

2) Charges on the ligands

IUPAC system of nomenclature for coordination compounds

IUPAC is International Union of Pure and Applied Chemistry

Coordination compounds are named according to the following rules:

1) Order of naming of ions

In ionic coordination complexes, the cation is named first and then the anion.

The non-ionic coordination complexes i.e. neutral complexes are given a one word name.

2) Naming the Coordination sphere

The ligands are named first then the central metal ion.

3) Naming the ligands

Names of negative ligands end in -o eg. Cl^- as chloro/chlorido

Names of positive ligands end in -ium eg. NO^+ as nitrosonium

Neutral ligands are named as such eg. $NH_2CH_2CH_2NH_2$

ethylenediamine

Common monodentate ligands

Charge	Ligand	Formula	Name in Complexes
Neutral	ammonia	NH_3	ammine
	water	H_2O	aqua
	carbon monoxide	CO	carbonyl
	pyridine	pyr	pyridine
Negative (-1)	azide	N_3^-	azido/azo
	bromide	Br^-	bromido/bromo
	chloride	Cl^-	chlorido/chloro
	cyanide	CN^-	cyanido/cyano
	fluoride	F^-	fluorido/fluoro
	hydroxide	OH^-	hydroxido/hydroxo
	nitrite	NO_2^-	nitrito
	thiocyanate	SCN^- or NCS^-	thiocyanato

Common bidentate ligands

Charge	Ligand	Formula	Name in Complexes
Neutral	bipyridine	bipy	bipyridine
	ethylenediamine	en	ethylenediamine
Negative (-2)	carbonate	CO_3^{2-}	carbonato
	oxide	O^{2-}	oxo
	oxalate	$C_2O_4^{2-}$	oxolato
	sulfate	SO_4^{2-}	sulfato

4. Numerical Prefixes to indicate ligands

Prefixes di-, tri-, tetra-, penta-, hexa-, etc. are used to indicate the number of ligands of one type.

Eg:$K_4[Fe(CN)_6]$ is named as Potassium **hexa**cyanoferrate(II), where hexa is the prefix used to indicate number of cyanide ligands.

If the ligands have complex names such as ethylenediamine, triphenylphosphine, etc. which themselves contain affixes di, tri,etc. their numbers two, three, four are indicated by prefixes such as bis, tris, tetrakis, etc.

Eg:$[CoCl_2(en)_2]_2SO_4$ Dichloro**bis**(ethylenediamine)cobalt(III) Sulphate

5. Order of naming the ligands:

Ligands are named in alphabetical order irrespective of their charge

Eg:$[CoCl_2(en)_2]_2SO_4$

Chloride and ethylenediamine are the two ligands so following the alphabetical order chloride will be named first as dichloro then ethylenediamine as bis(ethylenediamine)

Prefixes like di, tri, tetra, bis that indicate the number of ligands, are not considered for alphabetical order.

6. Ending of names

When a complex is anionic, name of the central metal atom ends in -ate

Eg:$K[PtCl_5(NH_3)]$ Potassium amminepentacholorplatinate(IV)

Note: For anionic complex Latin names of the metals are commonly used, eg: Cuperate (Cu), Ferrate (Fe), Argentate (Ag), Stannate (Sn), Aurate(Au), etc.

For cationic and neutral complexes the name of the metal is given without any characteristic ending.

Eg:$[Fe(H_2O)_6]SO_4$ Hexaaquairon(II) sulphate

7. Oxidation state of the central ion

The oxidation state of the central ion is designated by a Roman numeral such as I, II, III, IV, V in parentheses at the end of the name of the complex without a space between the two.

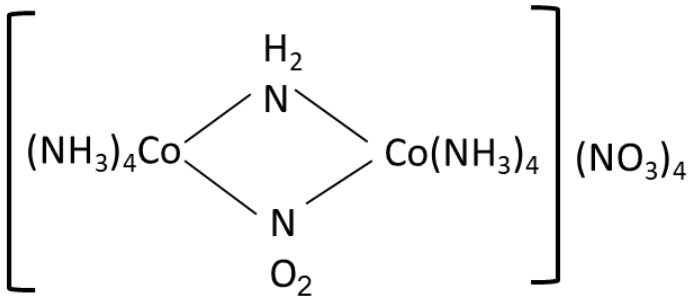
Eg: $K[PtCl_5(NH_3)]$ Potassium amminepentachloroplatinate(IV)

8. Bridging groups:

Ligands which act as bridges between two metal ions, the Greek letter μ is written before their names.

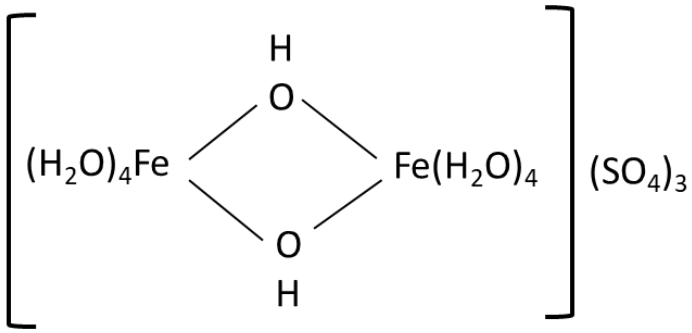
The prefix μ is repeated before the name of each kind of bridging ligand.

Eg:1



μ-amido- μ-nitrito-N-octaamminedicobalt(III) nitrate

Eg:2



di-μ-hydroxo-octaaquadiiron(III) sulphate

9. Point of attachment: If a ligand can coordinate through more than one atom, then the point of attachment of the ligand is indicated by putting the symbol of the atom coordinating, after the name of the ligand.

Eg. 1. NO_2 , it can coordinate through N or O.

(NO_2) - coordinating through N is called nitrito-N (Nitro)

(ONO^-)- coordinating through O is called nitrito-O (Nitrito)

a) $[Co(NO_2)_3(NH_3)_3]$

Triamminetrinitrito-N-cobalt(III)

b) $[Co(NH_3)_5(ONO)]SO_4$

Pentamminenitrito-O-cobalt(III) sulphate

Eg. 2. SCN- thiocyanato –S (thiocyano)

NCS- thiocyanato – N (isothiocyano)

Few solved Examples:

Anionic complex: $K_3[Al(C_2O_4)_3]$

Potassium trioxalatoaluminate(III)

Cationic Complex: $[Ag(NH_3)_2]Cl$

Diamminesilver(I) chloride

Neutral: $[Fe(CO)_5]$

Pentacarbonlyiron(0)