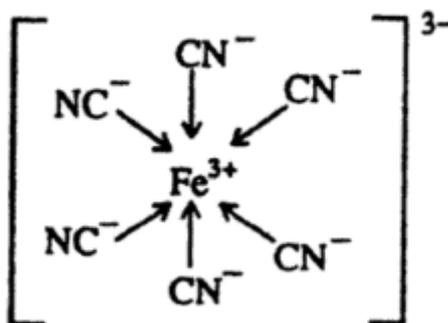


COORDINATION CHEMISTRY

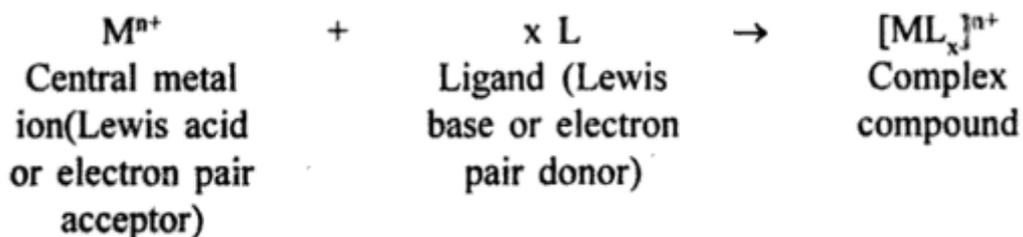
COORDINATION CHEMISTRY CONCEPT

Coordination chemistry is the study of compounds that contain a central atom or ion (usually a metal) which is chemically bonded to various groups is called the acceptor and the attached groups are known as donor groups or ligands. For example, in the complex ion $[\text{Fe}(\text{CN})_6]^{3-}$, Fe^{3+} ion is the central metal ion or acceptor while the CN^- ions are ligands. The ligands are attached to the central atom by dative bonds, also known as coordinate bonds, in which both electrons in the bond are supplied by the same atom on the ligand.



COORDINATION COMPOUNDS (Coordination complexes, complexes)

They are compounds consisting of a cation in the center and a different number of charged or uncharged groups bound to it according to the properties of this cation. This definition includes organometallic compounds containing metal-carbon bonds. The name of the coordination compound comes from the coordinate covalent bond. Since the coordination compounds are usually formed by introducing an electron pair into the metal from the ligand, it is considered appropriate to give this name. The coordination compound is also an acid-base addition compound and is also referred to as the complex. If there is a load, it is called the complex ion.

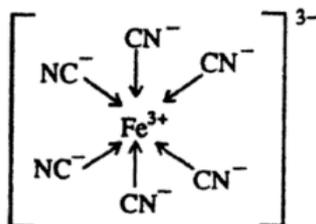


PROF. DR. SELEN BİLGE KOÇAK

CHM0308 INORGANIC CHEMISTRY II

LIGANDS

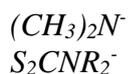
Neutral molecules or ions (usually anions) which are attached to the central ion in coordination compounds are called ligands or coordinating groups. For example in complex ion, $[Fe(CN)_6]^{3-}$ the six CN^- ions which are attached with the central Fe^{3+} ion act as ligands.



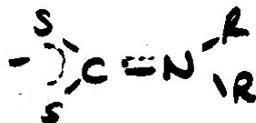
Negative ligands

F^-	Fluoro
Cl^-	Chloro
Br^-	Bromo
I^-	Iodo
O^{2-}	Oxo
O_2^{2-}	Peroxo
S^{2-}	Thio
SH^-	Mercapto
H^-	Hydrido
OH^-	Hydroxo
CH_3COO^-	Acetato
NH_2^-	Amido
NH^{2-}	İmido
N^{3-}	Azido
NO_3^-	Nitrato
NO_2^-	Nitro
ONO^-	Nitrito
SO_4^{2-}	Sulfato
ClO_3^-	Chlorato
ClO_2^-	Chlorito
$H_2NCH_2COO^-$	Glisinato
SO_3^{2-}	Sulfito
$S_2O_3^{2-}$	Thiyosulfato
CN^-	Cyano
NC^-	İsocyano
SCN^-	İsothiocyanato
CO_3^{2-}	Carbonato
$C_2O_4^{2-}$	Oxalato
$NHOH^-$	Hydroksilamido

PROF. DR. SELEN BİLGE KOÇAK
CHM0308 INORGANIC CHEMISTRY II



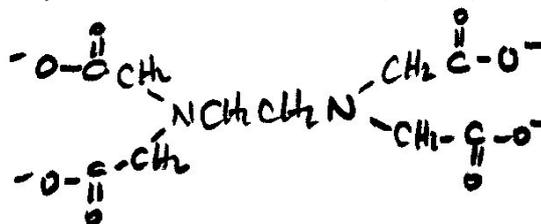
Dimethylamido
 Dialkyldithiocarbamato (dte)



Acetylacetonato (acac)



Ethylenediaminetetraacetato (EDTA)



Neutral ligands



Aqua



Carbonyl



Thiocarbonyl



Nitrocyl



Dioxygene



Trialkylphosphine



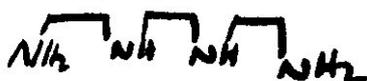
Ethylenediamine (en)



Diethylenediamine (dien)



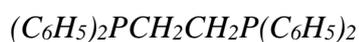
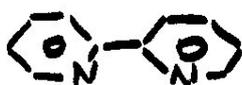
$H_2NCH_2CH_2NHCH_2CH_2NHCH_2CH_2NH_2$ Triethylenediamine (trien)



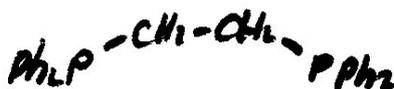
Pyridine (py)



2,2'-Bipyridine (bipy)



1,2-Bis(diphenylphosphino)ethane (dppe)



Ammine



Dinitrojen

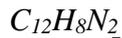


Dihidrojen

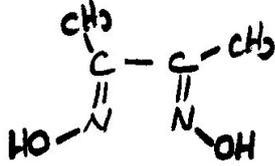
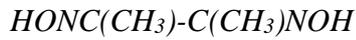


Methylamine

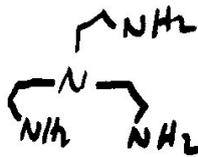
PROF. DR. SELEN BİLGE KOÇAK
CHM0308 INORGANIC CHEMISTRY II



1,10-Phenanthroline (phen)



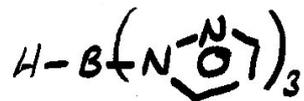
Dimethylglyoxime (DMG)



β,β',β'' -Triaminotriethylamine (tren)



Terpyridine (terpy)



Pirazolilborat

Positive ligands



Nitronium



Hydrazinium



Dioxygenyl

Another criterion used in the classification of ligands is the number of donor atoms.

a) *Monodentate ligands*

b) *Polydentate ligands*

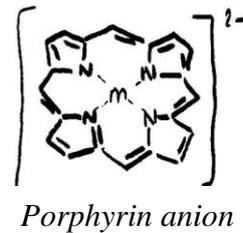
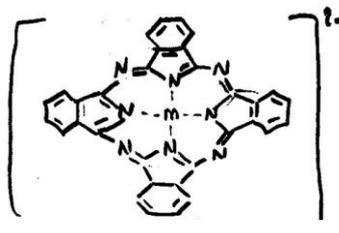
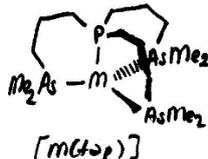
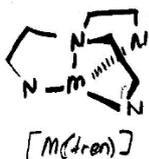
bidentate ligand

tridentate ligand

tetradentate ligand

kinkidentate ligand

seksedentate ligand



Although the explanation of the reactions of the coordination compounds and the bond theories were assumed to have begun with Alfred Werner (Father of coordination chemistry, 1866-1919, Nobel Prize in Chemistry in 1913), these compounds were already known. Examples of coordination compounds has used as a dyestuff since ancient times are Prussian blue (found in the 18th century by Diesbach) $[KFe(Fe(CN)_6)]$, aurolin $\{K_3[Co(NO_2)_6 \cdot 6H_2O]$, yellow} and alizarin red {calcium and aluminum salts of 1,2-dihydroxy-9,10-anthraquinone}. The structure of the blue colored dye known as tetramine(II) ion $\{[Cu(NH_3)_4(H_2O)_2]^{2+}$, its structure in solution} is known in prehistoric times. In ancient times, however, chemistry was dominated by the valence bond theory, and according to this theory, the cations could only bind as much as their valence. This thought prevented the development of coordination chemistry. Coordination compounds obtained during the rule of valence theory were generally used in the production of painter's paint. Some of them are:

$CoCl_3 \cdot 6H_2O$ (yellow)

$CoCl_3 \cdot 5H_2O$ (purple)

$CoCl_3 \cdot 4H_2O$ (violet)

$CoCl_3 \cdot 4H_2O$ (green)

$CoCl_3 \cdot 5NH_3 \cdot H_2O$ (pink)

$CoCl_3 \cdot 3NH_3$ (blue-green)

$CoCl_3 \cdot 6NH_3$ (yellow)

$CoCl_3 \cdot 5NH_3$ (purple)

$CoCl_3 \cdot 4NH_3$ (green)

$CoCl_3 \cdot 4NH_3$ (violet)

PROF. DR. SELEN BİLGE KOÇAK

CHM0308 INORGANIC CHEMISTRY II

For the illumination of the complex structure, the first theory was chain theory proposed by C.W. Blomstrand (1826-1894) and developed further by S.M Jørgensen (1837-1914).

