Republic of Iraq
Ministry of Higher Education & Scientific research
Al-Mustaqbal University
Science College
Biochemistry Department

Introduction in Chemistry

For

First Year Student/course 2

Lecture 8

By

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Coordination Chemistry

The rules for naming coordination compounds:

1. Order of Naming Ions In Arabic, the anion is named first, followed by the cation (as in simple salts). However, in English, the cation is named first, followed by the anion.

2. Naming Coordination Compounds

- ✓ Ligands are named first (in alphabetical order if they have similar charges), followed by the central metal.
- ✓ Within the coordination sphere, ligands are ordered as follows: anionic ligands first, then neutral ligands, and finally cationic ligands.
- ✓ Example: **[$CoCl(CN)(NO_2)(NH_3)_3$] → Chlorocyanonitrotriamminecobalt(III).

3. Ligand Naming Conventions

- Anionic ligands end with "-o" in English (e.g., chloro, cyano, hydroxo).
- Neutral ligands retain their molecular names, except:
- Water → "aqua"
- Ammonia → "ammine" (spelled with two *m*s to distinguish it from amines).
- Cationic ligands end with "-ium".

4. Prefixes for Ligand Multiplicity

- ❖ Simple ligands use prefixes like di-, tri-, tetra- (e.g., dibromo, trinitro).
- ❖ Complex ligands (e.g., ethylenediamine, EDTA) use bis-, tris-, etc.

5. Oxidation State of the Central Metal

- Written as a Roman numeral in parentheses after the metal's name.
- Negative oxidation states include a minus sign (e.g., -I).
- Zero is written as 0.

6. Naming Complex Anions

- If the complex is an anion, the metal name ends with "-ate" (often using Latin names, e.g., iron → *ferrate*, lead → *plumbate*).
- For neutral/cationic complexes, the metal name remains unchanged.

Mondentate (Neutral ligand):

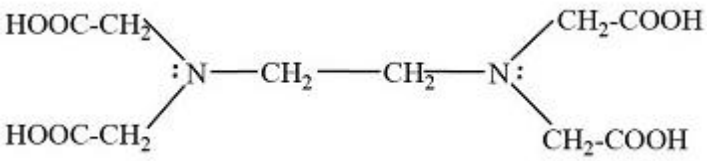
1-H_2O(agua) 2- NH_3(ammine) 3-CO(carbonyl) 4- NO(nitrosyl) 5- C_5H_5N (pyridine) 6- CH_3NH_2(ethylamine)

Bidentate (Neutral ligand):

1- NH_2NH_2 (Hydrazen) 2- CH_3COCH_2COCH3 (Acetylacetonate)

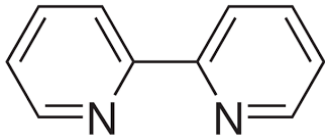
3- $NH_2CH_2CH_2NH_2$ (ethylenediamine) (en)

4-



ethylenediaminetetraacetato ((EDTA)

5- C_5H_4N-C_5H_4N (dipyridyl)



Anionic Ligands

Chloride (Cl^-)	**Chloro**	**$[CoCl(NH_3)_5]^{2+}$ → Pentaamminechlorocobalt(III) ion**	
Cyanide (CN^-)	**Cyano**	$[Fe(CN)_6]^{4-}$	**Hexacyanoferrate(II)** ion
Hydroxide (OH^-)	**Hydroxo**	$[Cr(OH)(H_2O)_5]^{2+}$ **Pentaaquahydroxochromium(III)** ion	
Nitrite (NO_2^-)	**Nitro** (if N-bonded)	$[Co(NO_2)(NH_3)_5]^{2+}$ **Pentaamminenitrocobalt(III)**	
Sulfate (SO_4^{2-})	**Sulfato**	$[Cu(SO_4)(NH_3)_4]$ **Tetraamminesulfatocopper(II)**	
Carbonate (CO_3^{2-})	**Carbonato**	$[Ni(CO_3)(NH_3)_4]$ **Tetraamminecarbonatonickel(II)**	
Oxalate ($C_2O_4^{2-}$)	**Oxalato**	$[Fe(C_2O_4)_3]^{3-}$ **Tris(oxalato)ferrate(III)** ion	
Thiocyanate (SCN^-)	**Thiocyanato** (S-bonded)	$[Co(SCN)(NH_3)_5]^{2+}$ **Pentaamminethiocyanatocobalt(III)**	

Example Recap:

1-$K_3[Fe(CN)_6]$ → Potassium hexacyanoferrate(III) (anionic complex, Latin name).

2-$Cu(NH_3)_4]SO_4$ → Tetra ammine copper(II) sulfate (cationic complex).

3- $Co(NH_3)_5Cl]Cl_2$ →[Chloropentaamminecobalt(III) chloride

4-$Cr(H_2O)_4Cl_2]Cl$ → [Dichlorotetraaquochromium(III) chloride

5-$K[PtNH_3\,Cl_3]$ → Potassiumtrichloroammineplatinate(II)

6-[$Pt\,(NH_3)_2\,Cl_2\,]$ → Dichlorodiammineplatinium (II)

7-$[Co(en)_3\,]Cl_3$ → tris(ethylenediamine)cobalt(III)chloride

8- $[Co(NH_3)_5H_2O]Cl_3$ → aguapentaammine cobalt(III)chloride

9 - $[Co(H_2O)_6]I_3$ → HexaaguaCobalt(III)Iodide

10-$K_2\,[PtCl_4]$ → PotassiumTetraChloro Palatinate(II)

11- $K_4[Ni(CN)_6]$ → potassiumHexaCyanoNickelate(II)

12- $[Co(NH_3)_4SO_4]NO_3$ → SulfatoTetraammineCobalt(III)nitrate

13-$[Co(NH_3)_3(NO_2)_3]$ → TriNitrotriammineCobalt(III)

14- $Ca_2[Fe(CN)_6]$ → CalciumHexaCyanoFerate(II)

15- $NH_4[Cr(NH3)2(NCS)_4]$ → TetrathioCyanatoDiammineChroumate(III) Amounum

16- $[Co(en)_2Cl]SO_4$ → Chlorobis(ethylenediamine) Cobilt(III)sulphate

17- $[Pt(NH3)_4(NO_2)Cl]SO_4$ → ChloronitroTetraamminePlatin (IV)Sulphate

18- $[CO(C_2O_4)_2(H_2O_2]^-$ → DiOxalatoDiaguaCobalt(III)Ion

19- $[Cr(en)(NH_3)_2I_2]^+$ → DiIodoDiamminebis(EthyleneDiamine)Chromum(III)Ion

20- $[Mn(NH_2CH_2CH_2NH_2)_3]Cl_2$ → tris(dimthyldiamine)manganese(II) Chloride

21-$[Co(NH_3)_5NO_2]SO_4$ → Nitropentaammineobalt (II) sulphate

22- $[Ni(DMG)_2]$ → Bis(dimethyl glyoximato) nickel(II)

23-$[Ti(H_2O)_6]Cl_3$ → Hexaaquatitanium(III)chloride

24- $[Co(en)3]^{3+}$ → Tris(ethylenediamine)cobalt(III)ion

25- $[ZnCl_5]^{-3}$ → Pentachlorozink(III)ion

26- $[pt(en)_3]Br_4$ → Tris(ethylenediamine)Platinum(IV)bromide

27 - $K_2[CuCl_4]$ → Potassium TetraChloroCuprate(II)

28- $[Fe(CO)_5]$ → pentacarbonyliron(0)

29-$K_4[Fe(CN)6]$ → potassiumhexacyanoferrate(II)

30- $[Pt(NH3)_4][PtCl_4]$ → Tetraammineplatinume(II) tetrachloroplatinate(II)
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