IUPAC Nomenclature of Coordination Compounds

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Rules for Systematic Nomenclature:

1. The name of the cationic part is written first followed by the anionic part.
   e.g. $K_4[Fe(CN)_6]$ The cation K^+ is named first followed by anion $[Fe(CN)_6]^{4-}$
   $[Co(NH_3)_6]Cl_3$ The cation $[Co(NH_3)_6]^{3+}$ is named first followed by anion chloride.

2. The name of the ligand is listed before the name(s) of the central atom(s).
3. No space is left between the names that refers to the same coordination entity.
4. Ligand names are listed in the alphabetical order
5. (a) When there are several ligands of the same kind prefixes like di, tri, tetra, penta, hexa, etc. are used before the name of the ligand to indicate their number.

   (b) When the name of the ligand terms like di, tri, tetra etc. then prefixes like bis, tris, tetrakis, pentakis etc. are written before the name of the ligand & the ligand name is kept within brackets to avoid ambiguity. e.g.
   $(NH_3)_2$ - diammine
   Me_2NH dimethylamine
   $(en)_2$ - bis(ethylenediamine)
   $(MeNH_2)_2$ - bis(methylamine) To make it distinct from dimethylammine

   (c) There is no deletion of vowels or use a hyphen.
   e.g. $(NH_3)_4$: tetraammine
6. The name of the cationic ligands are ended with 'ium', e.g. NO^+ nitrosylium
   $NH_2-\overset{+}{N}H_3$ hydrazinium

7. The neutral ligand names have no special ending.
   e.g.

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H_2O: aqua
NH_3: ammine
CO: Carbonyl
NO: nitrosyl
$MeCONH_2$ acetamide
Me_2O dimethyl ether
Me_2S dimethyl thioether
C_6H_6 Benzene

O^{2-} oxo
O_2^{2-} Peroxo
O_2^- superoxo

8. The names of anionic ligands are ended with 'o'. e.g.

(a). Ligand names ending with 'ate' are changed to 'ato'.

NO_3^- nitrato
CO_3^{2-} carbonato
$acac^-$ acetylacetonato

(b). Ligand names ending with 'ite' are changed to 'ito'.

SO_3^{2-} sulphito
ClO_2^- Chlorito
NO_2^- nitrito

(c) Ligand names ending with 'ide' are changed to 'ido'.

e.g. F^- fluorido
Cl^- Chlorido
Br^- Bromido
I^- Iodido
CN^- cyanido
H^- hydrido
OH^- hydroxido
NH_2^- amido
D^- Deuteride or $[^2H]$ hydrido

(d). The anionic organic ligands where C atom is the donor atom are not ended with 'o'. e.g.

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CH_3^- methyl

$^-CH_2-CH=CH_2$ allyl

Ph^- phenyl

$CH_2=CH^-$ vinyl

 cyclopropyl

(e). For the π-donors, the prefix like η^x is to be used where η indicates π electron donation and x is known as the hapticity of the ligand. eg.

$C_5H_5^-$ η^5 cyclopentadienyl or pentahaptocyclopentadienyl

C_6H_6 η^6 Benzene or hexahaptobenzene

$C_3H_5^-$ η^3- allyl or trihaptoallyl

(f) Ambidentate ligands are named as follows:

$\leftarrow ^-CN$ cyanido or cyanido-C

$\leftarrow :NC^-$ isocyanido or cyanido-N

$\leftarrow :NO_2^-$ nitrito-N

$\leftarrow ONO^-$ nitrito-O

$\leftarrow ^-SCN$ thiocyanato-S

$\leftarrow :NCS^-$ isothocyanato-N

g. For anionic complexes metal names are ended with 'ate'.

Aluminium → Aluminate

Platinum → Platinate

Molybdenum → Molybdate

Zinc → Zincate

Nickel → Nickelate

Cobalt → Cobaltate

Iron → Ferrate

Manganese → Manganate

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10. The oxidation number of the central atom is written in Roman numbers within brackets, after the name of the central atom. e.g.
e.g.
$K_4[Fe(CN)_6]$ Potassium hexacyanidoferrate(II)
$K_2[OsCl_5N]$ potassium pentachloridoosmate(VI)
$[CoCl(NH_3)_5]Cl_2$ pentaamminecobalt(III) chloride

11. If there is any water of crystallization, it is to included in the name. e.g.
$[Cr(H_2O)_4Cl_2]Cl \cdot 2H_2O$ tetraaquadichloridochromium(III) chloride dihydrate.

$[Co(NH_3)_6]Cl_3$ Hexaamminecobalt(III) chloride
$[CoCl(NH_3)_5]^{2+}$ Pentaamminechloridocobalt(III) ion
$[CoSO_4(NH_3)_4]NO_3$ Tetraamminesulphatocobalt(III) nitrate
$[Co(NO_2)_3(NH_3)_3]$ Triamminetrinitritocobalt(III)
$[CoCl \cdot CN \cdot NO_2 \cdot (NH_3)_3]$ Triamminechloridocyanidonitritocobalt(III)
$[Zn(NCS)_4]^{2+}$ Tetrathiocyanato-N-zinc(II)
$[Cd(SCN)_4]^{2+}$ Tetrathiocyanato-S-cadmium(II).

$Li[AlH_4]$ Lithium tetrahydridoaluminate(III)
$K_4[Fe(CN)_6]$ Potassium hexacyanidoferrate(II)
$K_3[Fe(CN)_5NO]$ Potassium pentacyanidonitrosylferrate(II)
Sodium nitroprusside
$K_2[OsCl_5N]$ Potassium pentachloridonitridoosmate(VI)
$Na_3[Ag(S_2O_3)_2]$ Sodium bis(thiosulphato)argentate(I)
$K_2[Cr(CN)_2O_2(O_2)NH_3]$
Potassium amminedicyanidodioxoperoxochromate(VI)
$Na_2[CrF_4O]$ Sodium tetrafluoridooxochromate(IV)
$Hg[Co(SCN)_4]$ Mercuric tetrathiocyanatocobaltate(II)
$Fe_4[Fe(CN)_6]_3$ Ferric hexacyanidoferrate(II)
(Prussian blue)
$K_2[Zn(OH)_4]$ Potassium tetrahydroxidozincate(II)

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$[HgI_3]^-$ Triiodidomercurate (II)

$Cu_2[Fe(CN)_6]$ Copper hexacyanidoferrate (II)

$K_2[HgI_4]$ Potassium tetraiodidomercurate (II)

$Na[Co(CO)_4]$ Sodium tetracarbonylcobaltate (-I)

$Na_2[Ni(EDTA)]$ Sodium ethylenediaminetetraacetatonickelate (II)

$[Fe(C_5H_5)_2]$ bis(cyclopentadienyl)iron (II)

$[Cr(en)_3]Cl_3$ Tris(ethylenediamine)chromium (III) chloride

$[CuCl_2(CH_3NH_2)_2]$ Dichloridobis(methylamine)copper (II)

$[Cr(C_6H_6)_2]$ bis(benzene)chromium (0)

$[CuCl_2(NH_2CONH_2)_2]$ Dichloridobis(urea)copper (II)

$[Ag(NH_3)_2]OH$ Diammine silver (I) hydroxide

Tollen's Reagent

$[Cr(PPh_3)(CO)_5]$ Pentacarbonyltriphenylphosphinechromium (0)

$[Pt(PPh_3)_3]$ Tris(triphenylphosphine)platinum (0)

$[Ni(CO)_4]$ Tetracarbonylnickel (0)

$[Ni(dmg)_2]$ bis(dimethylglyoximato)nickel (II)

$(NH_4)_2[Pt(NCS)_4]$ Ammonium tetraisothiocyanatoplatinate (II)

IUPAC Names of Complexes Containing Complex cation and Complex anion:

$[Pt(NH_3)_4][PtCl_4]$ Tetraammineplatinum (II) tetrachloridiplatinate (II)

$[Pt(NH_3)_4Cl_2][PtCl_4]$ Tetraamminedichloridoplatinum (IV) tetrachloridoplatinate (II)

$[Cr(NH_3)_6][CoF_6]$ Hexaammine chromium (III) hexafluoridocobaltate (III)

$[Co(en)_3][Cr(CN)_6]$ tris(ethylenediamine)cobalt (III) hexacyanidochromate (III)

$[Pt(py)_4][PtCl_4]$ Tetrapyridylplatinum (II) tetrachloridoplatinate (II)

$[Co(NH_3)_6][Cr(NH_3)_2Cl_4]$ Hexaammine cobalt (III) diamminetetrachloridochromate (III)

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$[Cr(NH_3)_5(NCS)][ZnCl_4]$

Pentaammine isothiocyanatochromium (III) tetrachloridozincate (II)

$[Ag(NH_3)_2][Ag(CN)_2]$

Diammine silver (I) dicyanidoargentate (I)

$[Ru(NH_3)_5N_2][PtCl_4]$

Pentaammine dinitrogen ruthenium (II) tetrachloridoplatinate (II)

$[Cr(en)_3][Ni(CN)_5(H_2O)]$

Tris (ethylenediamine) chromium (III) aquapentacyanidonickelate (II)

$[Ph_4As]_2[PtCl_2(H)(CH_3)]$

Tetraphenylarsonium dichloridohydridomethylplatinate (II)

Give the IUPAC Names of the following complex species.

$[ZnO_2]^{2-}$ Dioxozincate (II) ion

$H[BF_4]$ Hydrogen tetrafluoridoborate (III)

$H[AuCl_4]$ Hydrogen tetrachloridoaurate (III)

$Na[PCl_6]$ Sodium hexachloridophosphate (V)

CH_3MgI Methylmagnesium (II) iodide.