(28) **Today**

Section 9.1 - 9.3
Introduction to Coordination Chemistry,
Nomenclature and Ligands

Next Class (29)

Section 9.3 – 9.5
Nomenclature and Ligands, Isomerism,
Coordination Number and Structures

(30) **Second Class from Today**

9.5 Coordination Number and Structures

Chap 10

Third Class from Today (31)

Chap 10

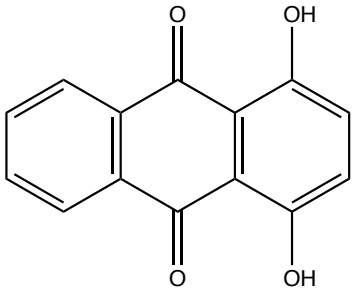
Prussian Blue
$KFe[Fe(CN)_6]$

https://en.wikipedia.org/wiki/Prussian_blue

Aureolin
$K_3[Co(NO_2)_6]$

https://en.wikipedia.org/wiki/Potassium_cobaltinitrite

Alizarin
Ca^{2+} salts of



https://en.wikipedia.org/wiki/Alizarin

what to do with a formula like $Co(NH_3)_6Cl_3$

cobalt(III) chloride, ok... like iron(III) chloride?

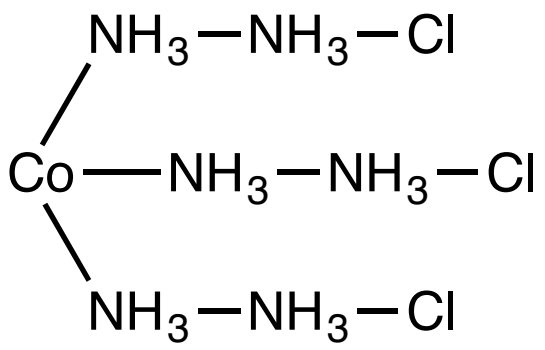
$CoCl_3$ $Co^{3+} + 3\,Cl^-$

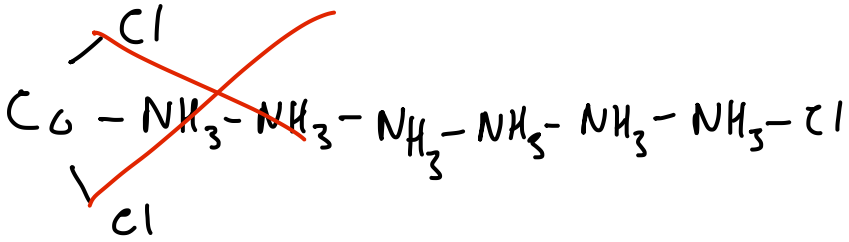
$FeCl_3$

Iron +3 oxidation state

coordination #

$NaCl = Na^+$ and Cl^-





ionic compound

$[Co(NH_3)_6]Cl_3$

complex cation anion

	Cl^- ions precipitated by Ag^+
$PtCl_4 \cdot 6NH_3$	4 ← Cl^- ions free in solution
$PtCl_4 \cdot 5NH_3$	3
$PtCl_4 \cdot 4NH_3$	2
$PtCl_4 \cdot 3NH_3$	1
$PtCl_4 \cdot 2NH_3$	0

this is a test to see how many Cl^- ions are in solution when the compound is dissolved

explain precipitation & conductivity by creating ion compounds made with "complex ions"

$[Pt(NH_3)_6]Cl_4$

$[Pt(NH_3)_5Cl]Cl_3$

$[Pt(NH_3)_4Cl_2]Cl_2$

$[Pt(NH_3)_3Cl_3]Cl$

$[Pt(NH_3)_2Cl_4]$

counter ion outer coordination sphere

metal complex

inner coordination sphere

$Co(NH_3)_4Cl_3$

two forms of $Co(NH_3)_4Cl_3$

$Co(NH_3)_4Cl_3$ purple

$[Co(NH_3)_4Cl_2]Cl$

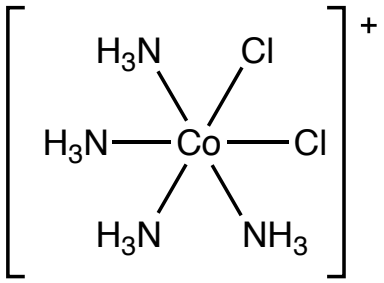
What shapes are possible when 6 ligands are coordinated (bonded) to a central metal atom/ion

$Co(NH_3)_4Cl_3$ green

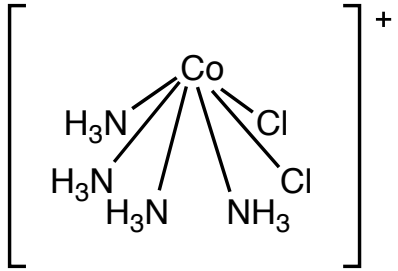
$[Co(NH_3)_4Cl_2]Cl$

(are the things (atoms, ions, molecules) bonded to the metal

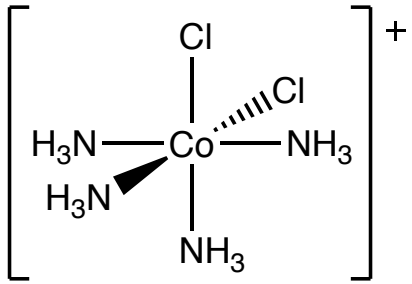
possible 6-coordinate models



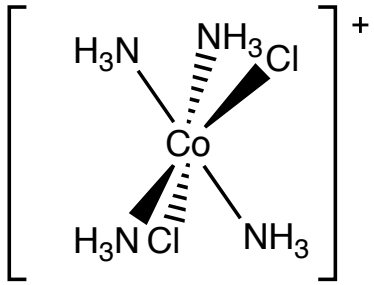
hexagonal



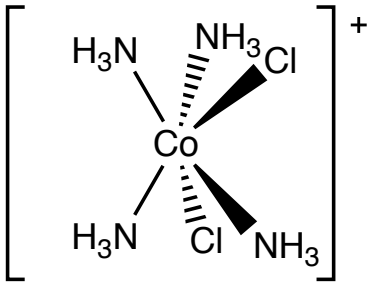
hexagonal pyramidal



Octahedral

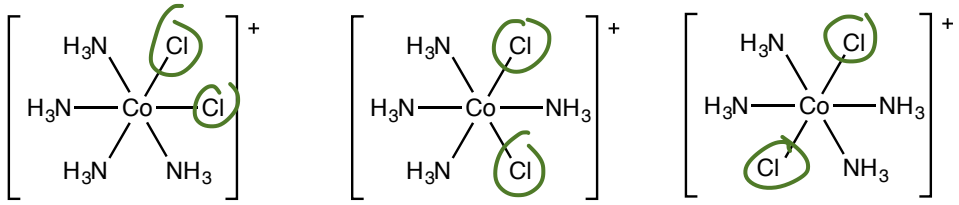


trigonal antiprismatic



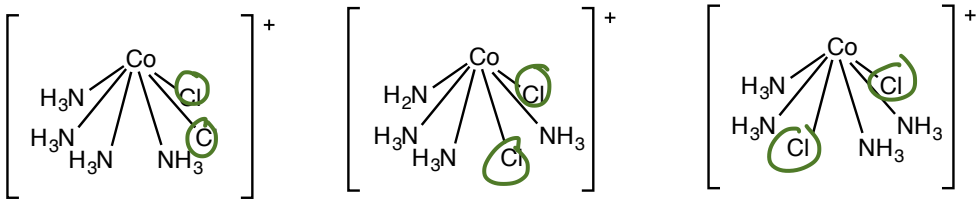
trigonal prismatic

possible 6-coordinate models



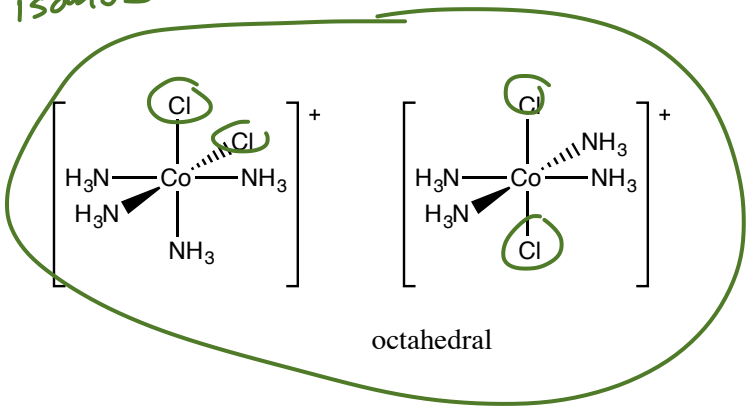
hexagonal

3 isomers ... can only make 2

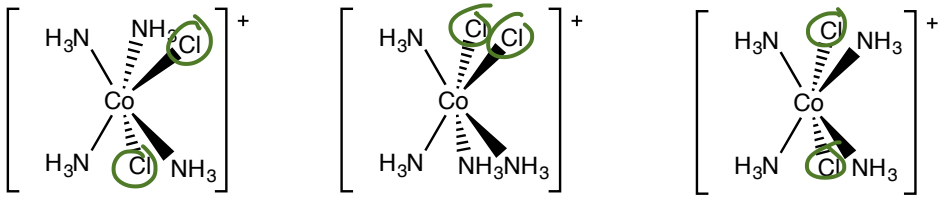


hexagonal pyramidal

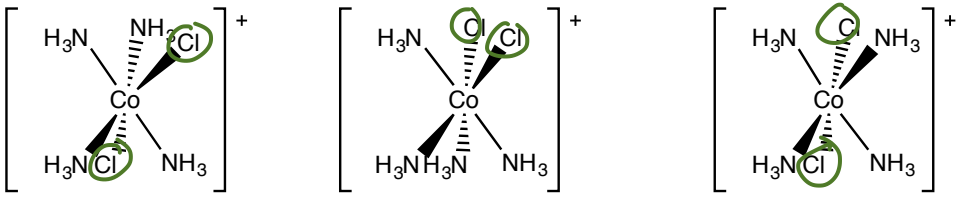
3 isomers



octahedral



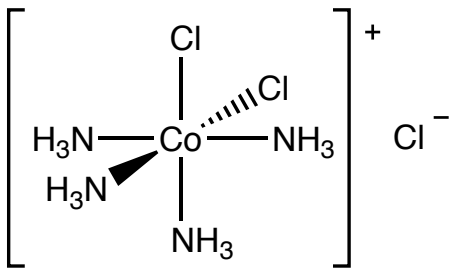
trigonal prismatic



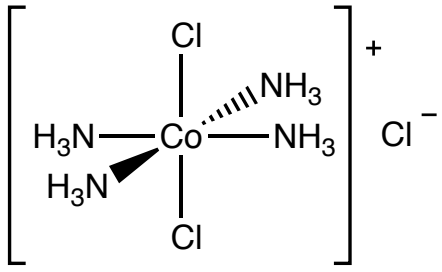
trigonal anti prismatic

need a structure that would provide for 2 dif isomeric form

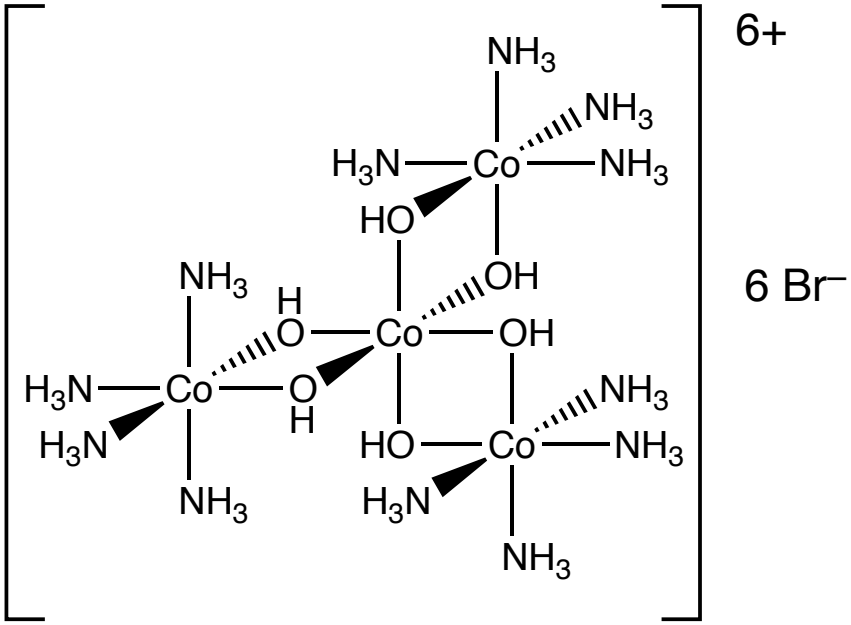
$[Co(NH_3)_4Cl_2]Cl$

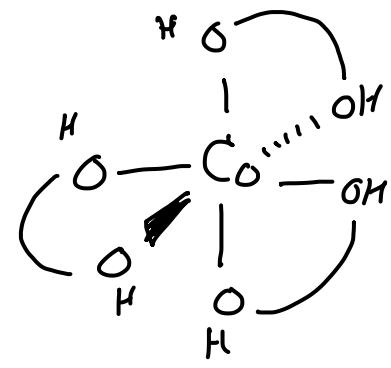


cis



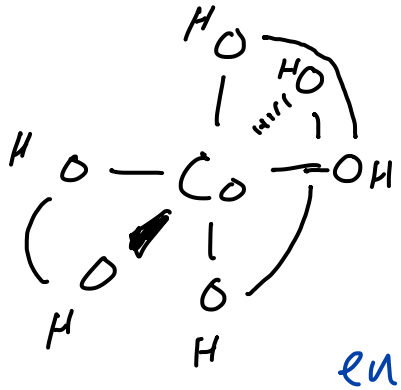
trans





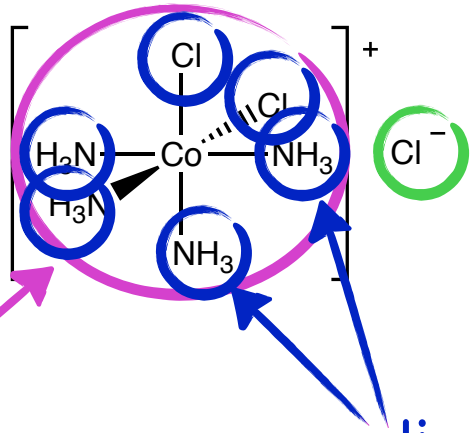
these are fans or propellers

top / bottom mirror



enantiomers

only this structure explains how nonsuperposable mirror images exist for this molecules



counterion

outer coordination sphere

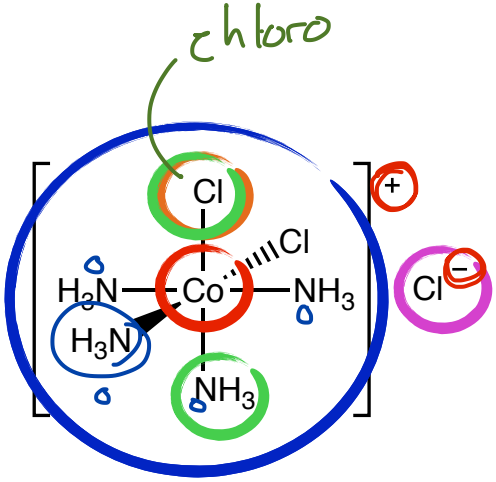
complex ion
a.k.a.
coordination sphere
metal complex
complex

ligands

molecules NH_3 and ions $Cl^{\ominus}$ directly bonded to the metal

$:NH_3$

$Cl^{\ominus}$



$[Co+L] = +1$ to balance with $Cl^{\ominus}$

$Co + (0) + (-1 + -1) = +1$

$Co + -2 = +1$

$Co = +3$

1. cation followed by anion
2. simple ion
   use standard ion nomenclature
3. complex ion
   ligands (alphabetically) followed by metal

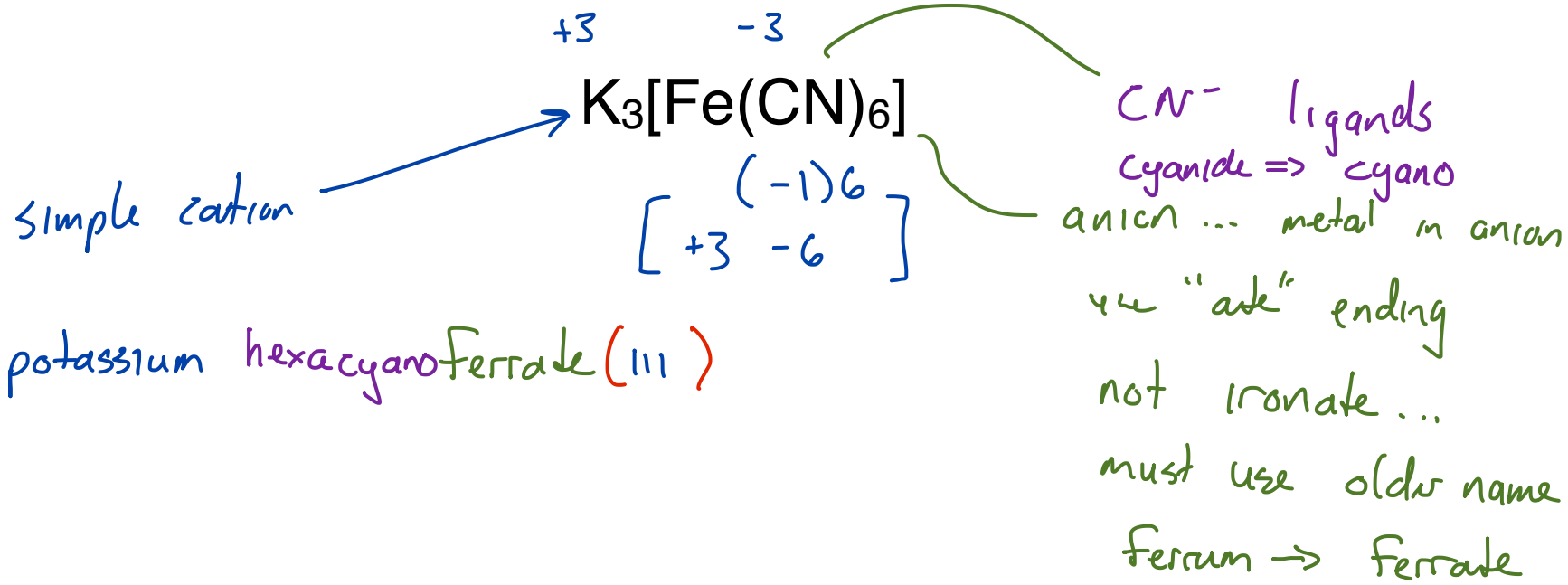
use prefixes for the number of ligands
(di, tri, tetra or bis, tris, tetrakis) — use these when the ligand has a di, tri, etc as part of its name

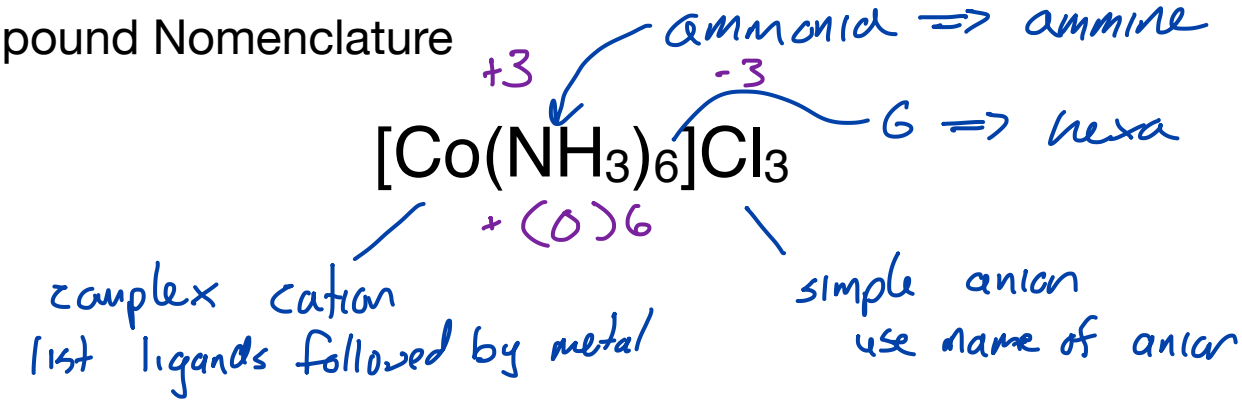
negative ligands end in "o", neutral ligand no change — except these two: ammonia => ammine, water => aquo

indicate oxidation number of metal using Roman numerals in parentheses – examine counterion & ligands

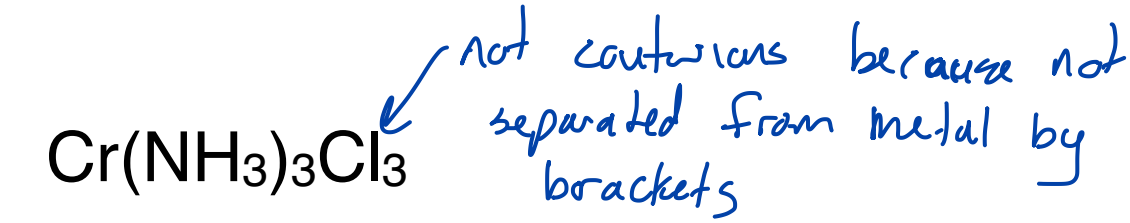
if metal is part of the anion, use "fancy" names and change "um" ending to "ate"

tetrammine dichloro cobalt(III) chloride


+3 -3
K3[Fe(CN)6]
(-1)6
[+3 -6]
simple cation
potassium hexacyanoferrate(III)
CN- ligands
cyanide => cyano
anion ... metal in anion
use "ate" ending
not ironate...
must use older name
ferrum -> ferrate



hexamminecobalt(III) chloride



triamminetrichlorochromium (III)

[complex ion] anion cation [complex ion]

[complex ion][complex ion]

hexabromoplatinate(2-)

hexacarbonylmanganese(I) perchlorate