

Today

9.1 Introduction to Coordination Chemistry

9.2 Nomenclature

Next Class

9.2 Nomenclature

9.3 Isomerism

Test on Wednesday Dec 1

Prussian Blue  
 $\text{KFe}[\text{Fe}(\text{CN})_6]$



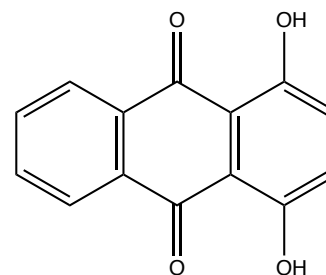
[https://en.wikipedia.org/wiki/Prussian\\_blue](https://en.wikipedia.org/wiki/Prussian_blue)

Aureolin  
 $\text{K}_3[\text{Co}(\text{NO}_2)_6]$



[https://en.wikipedia.org/wiki/Potassium\\_cobaltinitrite](https://en.wikipedia.org/wiki/Potassium_cobaltinitrite)

Alizarin  
 $\text{Ca}^{2+}$  salts of



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

what to do with a formula like  $\text{Co}(\text{NH}_3)_6\text{Cl}_3$

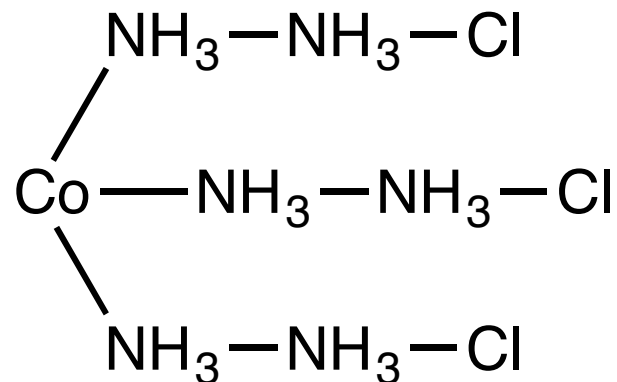
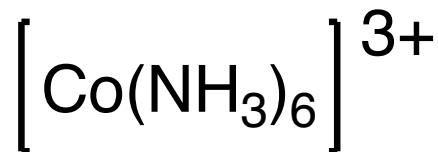
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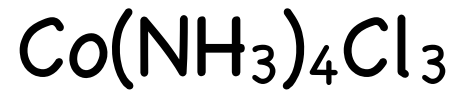
cobalt(III) chloride, ok... like iron(III) chloride?



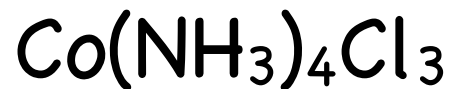
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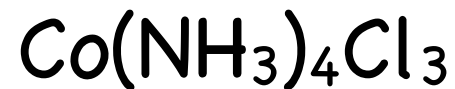




two forms of  $\text{Co}(\text{NH}_3)_4\text{Cl}_3$



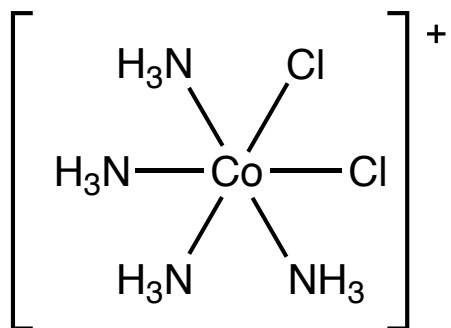
purple



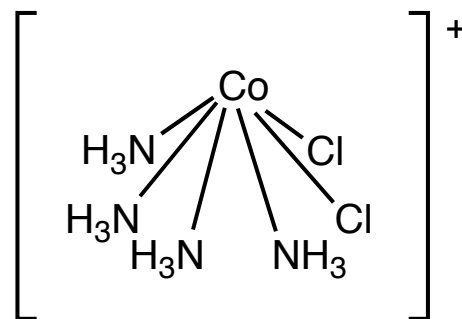
green

these are two isomers

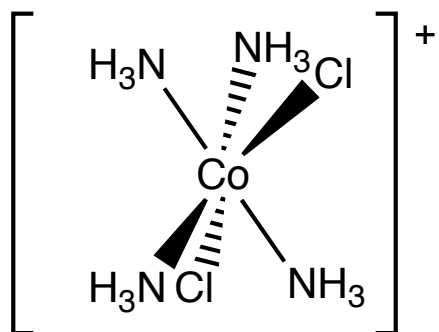
# possible 6-coordinate models



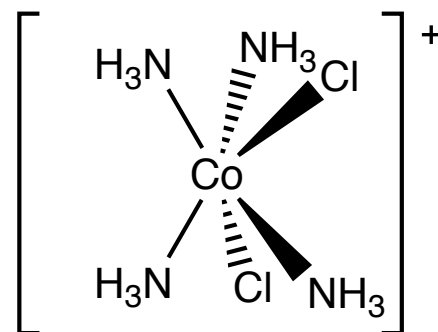
hexagonal



hexagonal  
pyramidal

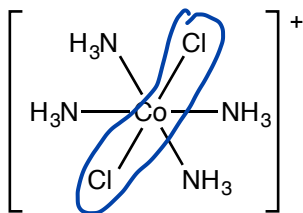
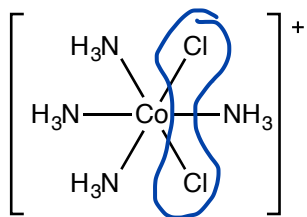
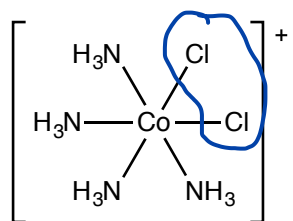


trigonal  
antiprismatic



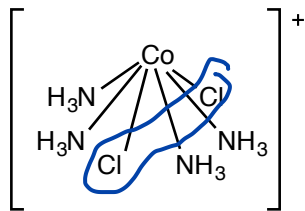
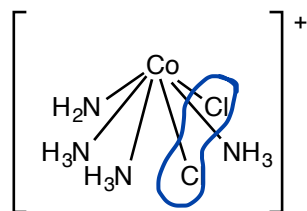
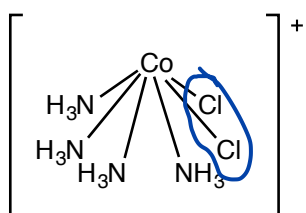
trigonal  
prismatic

# possible 6-coordinate models

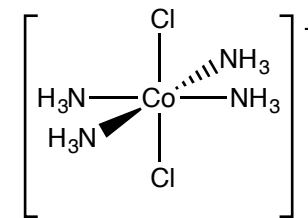
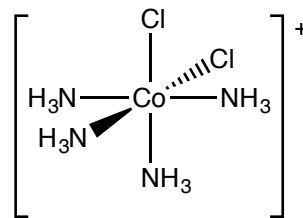


hexagonal

hypothesis predicts 3 isomers

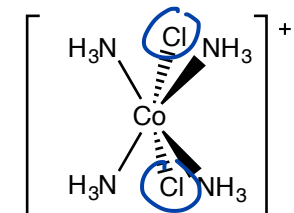
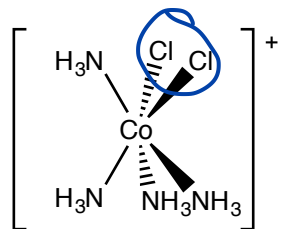
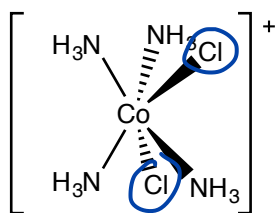


hexagonal pyramidal

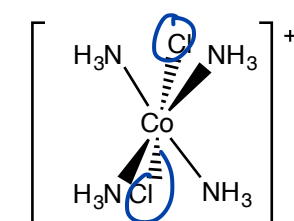
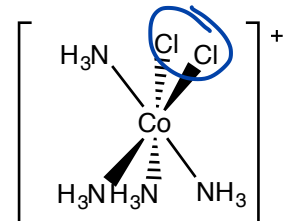
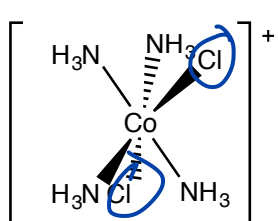


octahedral

octahedral geometry predicts the correct # of isomers



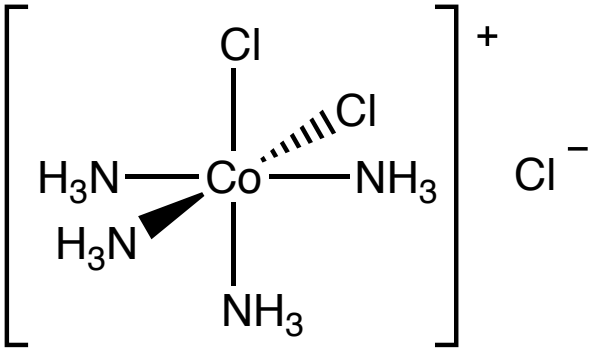
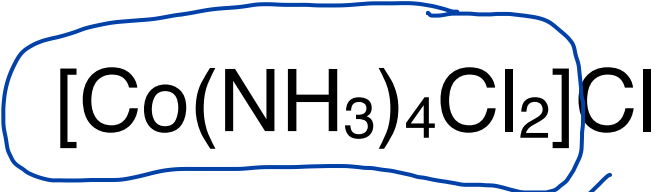
trigonal prismatic



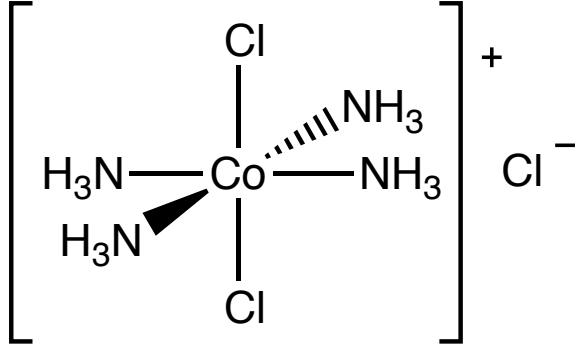
trigonal anti prismatic

all of these predict too many isomers



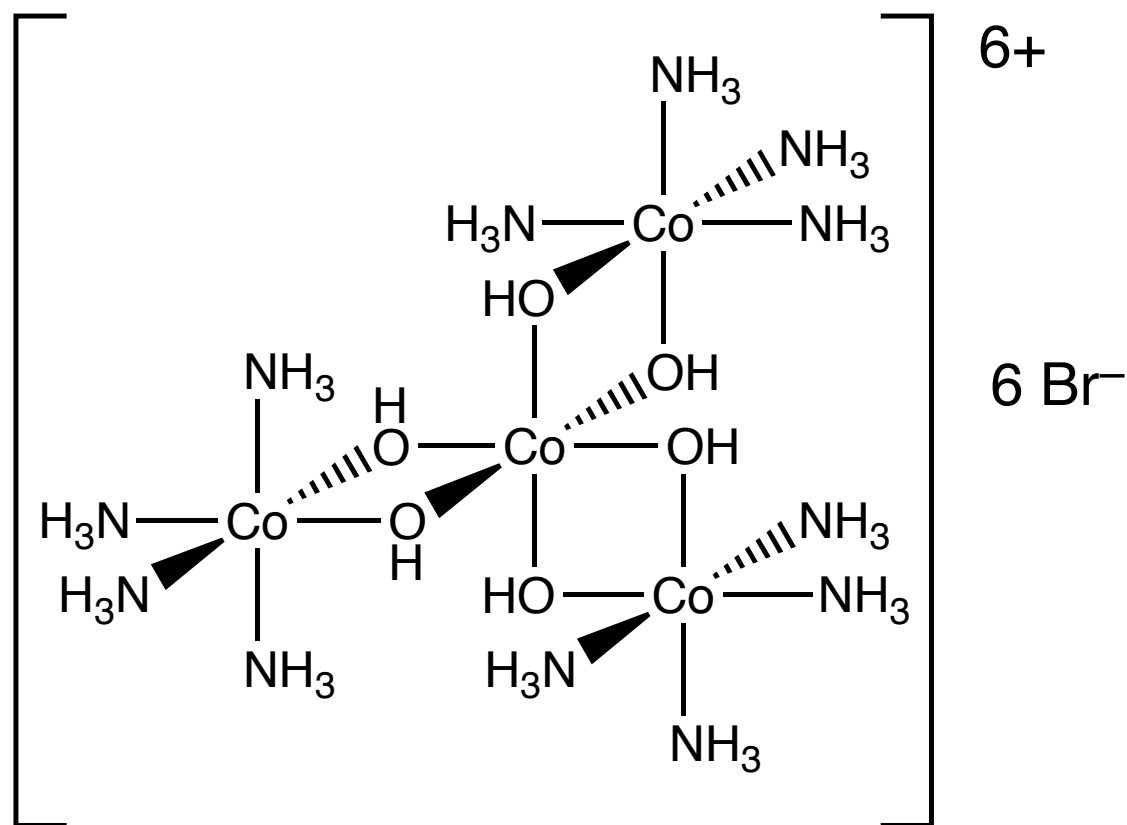


cis

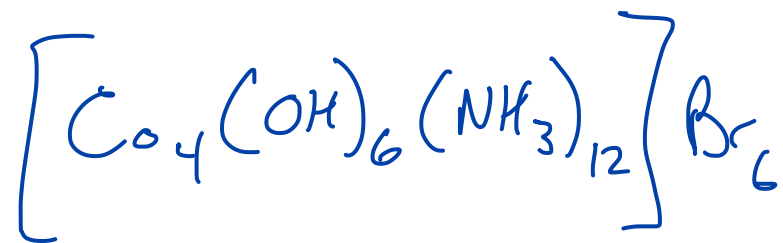


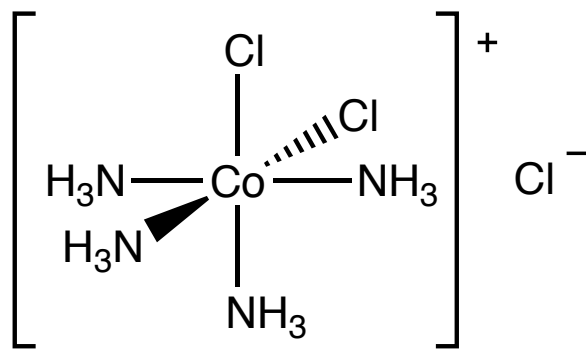
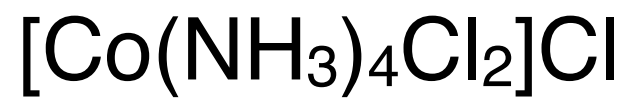
trans

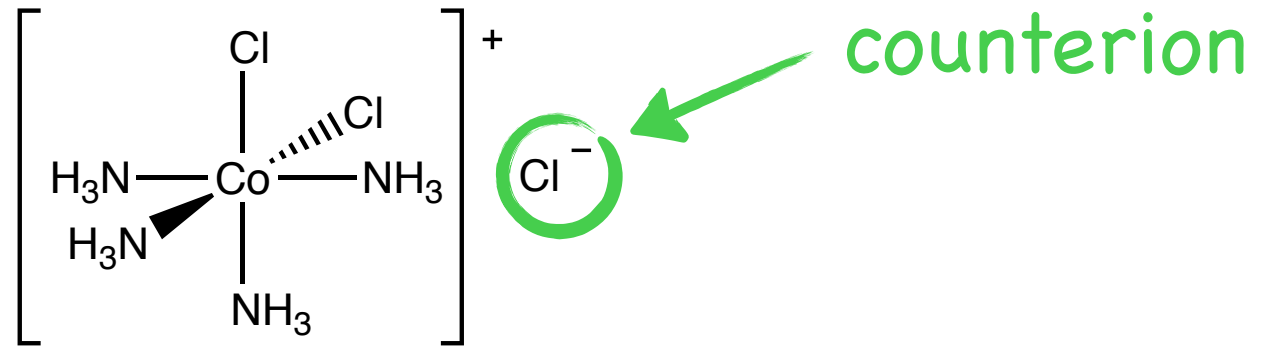
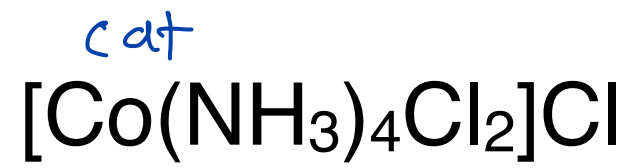
other possible 6-coordinate models fail  
because they cannot explain the chirality

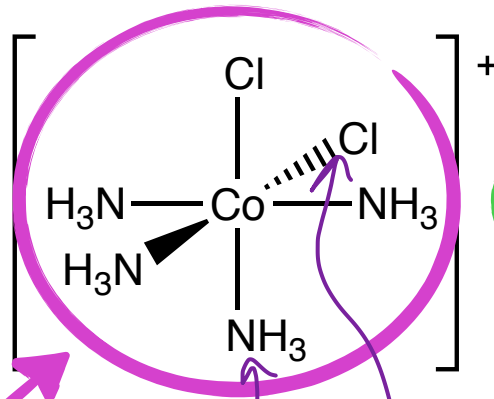
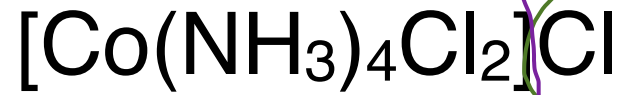


of this compound.





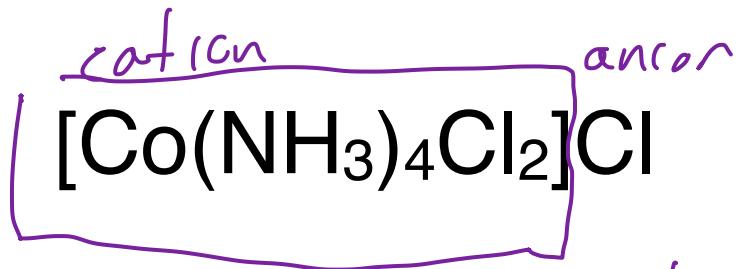




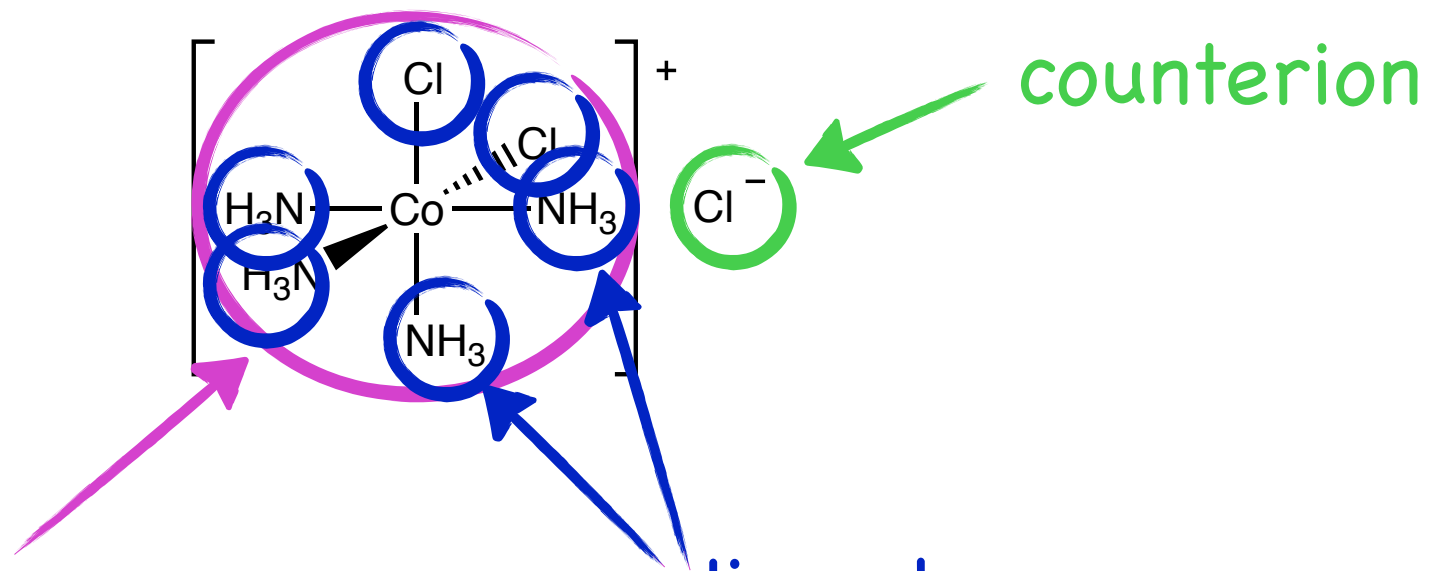
counterion

complex ion  
a.k.a.  
coordination sphere

these atoms + molecules  
are within the coordination  
sphere of the metal.  
These things are coordinated  
or bonded to the metal!



*complex ion in brackets*



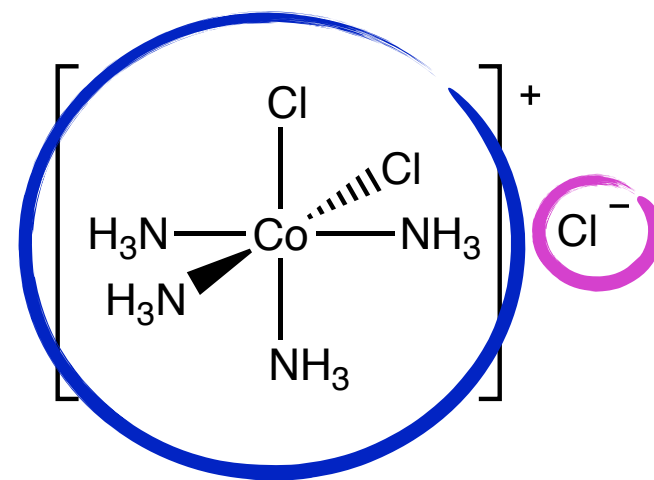
*complex ion*  
*a.k.a.*  
*coordination sphere*

*ligands*

*counterion*

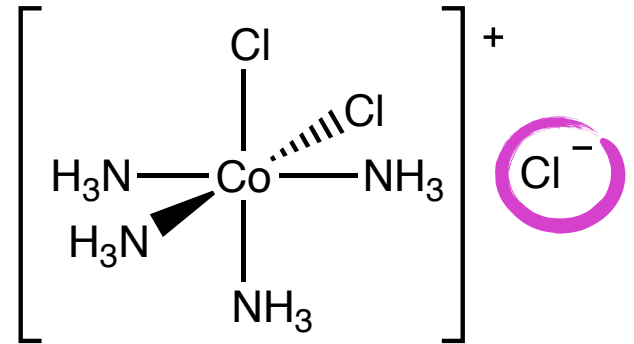
# nomenclature

1. cation followed by anion



# nomenclature

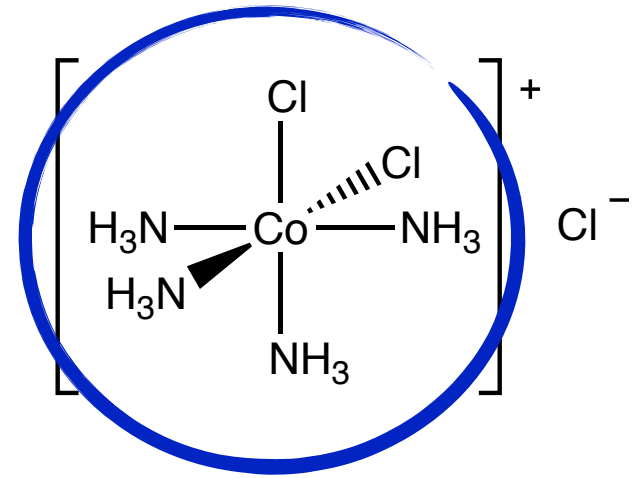
1. cation followed by anion
2. simple ion  
use standard ion nomenclature





# nomenclature

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



# nomenclature

1. **cation** followed by **anion**

2. simple ion

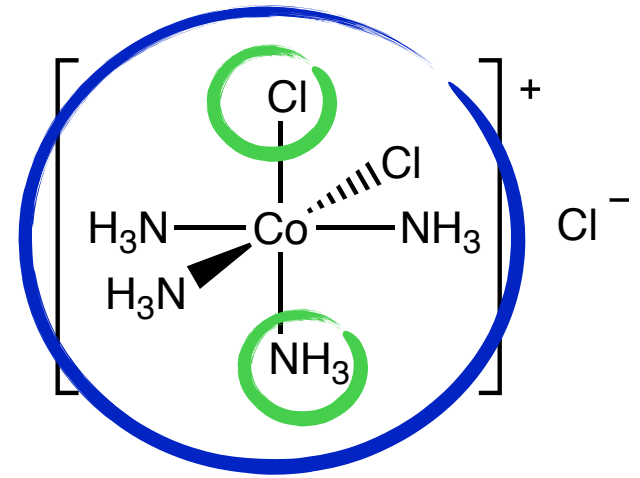
use standard ion nomenclature

3. complex ion

**ligands** (alphabetically) followed by **metal**

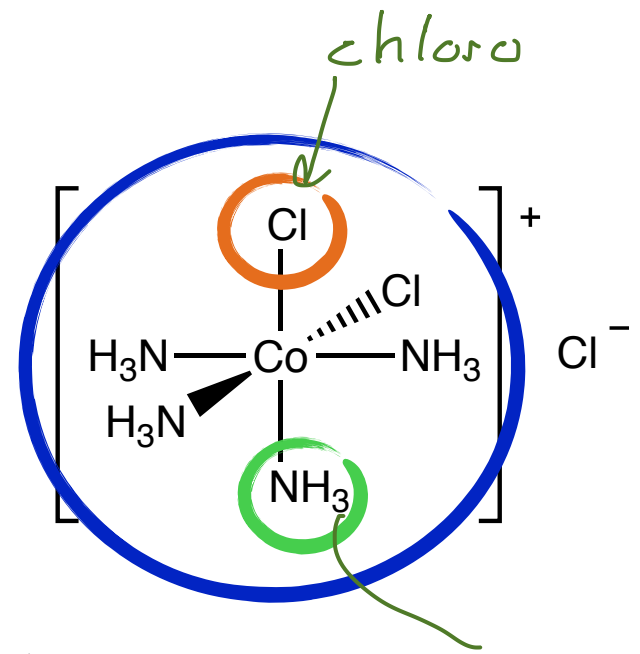
use prefixes for the number of ligands

(di, tri, tetra or <sup>2</sup>bis, <sup>3</sup>tris, <sup>4</sup>tetrakis)



# nomenclature

1. **cation** followed by **anion**
2. simple ion  
use standard ion nomenclature
3. complex ion



**ligands** (alphabetically) followed by **metal** *amine*

**use prefixes for the number of ligands**

(di, tri, tetra or bis, tris, tetrakis)

*H<sub>2</sub>O → aquo*

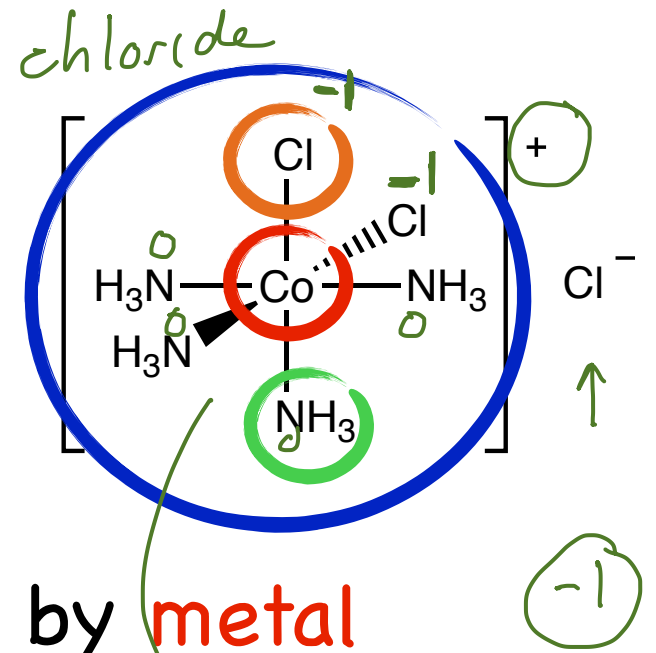
**negative ligands end in "o", neutral ligand no change**



# nomenclature

tetraammine dichloro cobalt(III) chloride

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)

$$(\text{Co}) + -2 = +1$$

$$\text{Co} = +3$$

negative ligands end in "o", neutral ligand no change

indicate oxidation number of metal using Roman numerals in parentheses

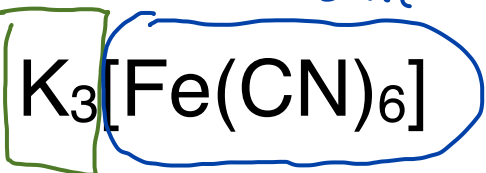
if metal is part of the anion, use "fancy" names and change "um" ending to "ate" - IRON => ferrate

ammine inorganic spelling for  $\text{NH}_3$   
as a ligand

amine organic amines where N is  
covalently bonded to a C



zation anion - metal complex as anion ... use "ate" ending



potassium hexacyano ferrate(III)

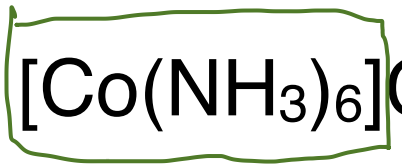
complex ion

+3

-6

+3

= 0



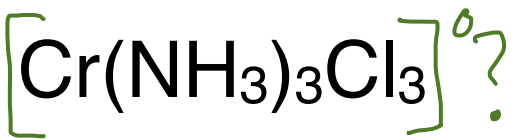
hexaamminecobalt(III)

chloride

+0

-3

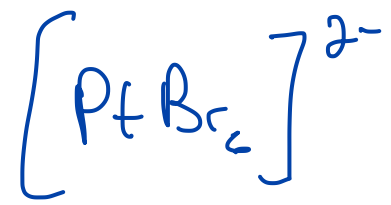
= 0



triamminetrichlorochromium(III)

neutral metal complex

hexabromoplatinate(2-)

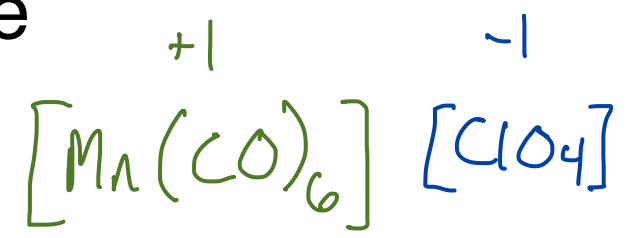


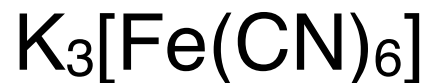
↑ charge of the complex

hexacarbonylmanganese(I) perchlorate

carbon monoxide

↑ charge of metal

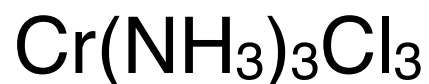




potassium hexacyanoferrate(III)



hexamminecobalt(III) chloride



triamminechromium(III)chloride

hexabromoplatinate(2-)



hexacarbonylmanganese(I) perchlorate

