(29) **Today**

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

Next Class (30)

9.5 Coordination Number and Structures

Chap 10

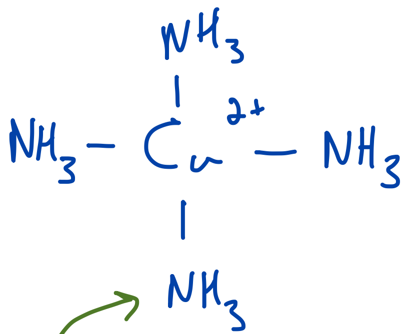
(31) **Second Class from Today**

Chap 10

Third Class from Today (32)

Chap 10

Monodentate and Chelating Ligands



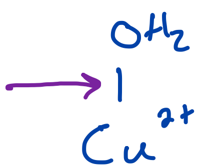
these ligands are monodentate. The ligand makes 1 bond with the metal

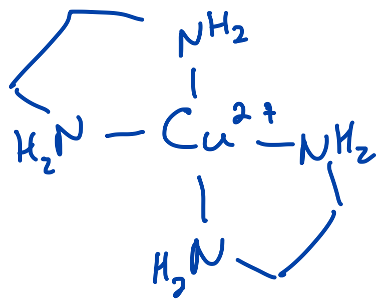
H_2O ← can make 1 bond

$Cl^{\ominus}$

$CN^{\ominus}$

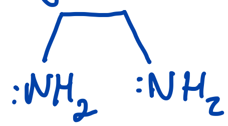
dative bond →



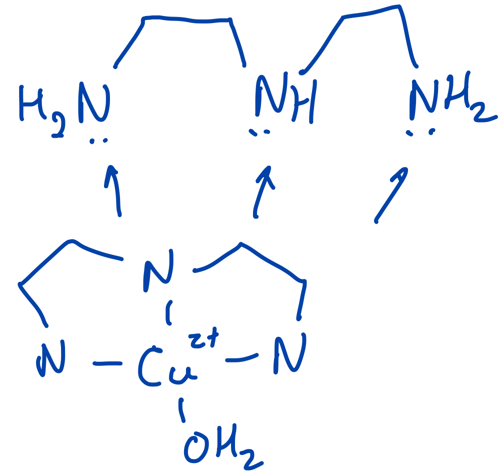


these ligands are bidentate. The ligand makes 2 bonds with the metal

ethylene diamine

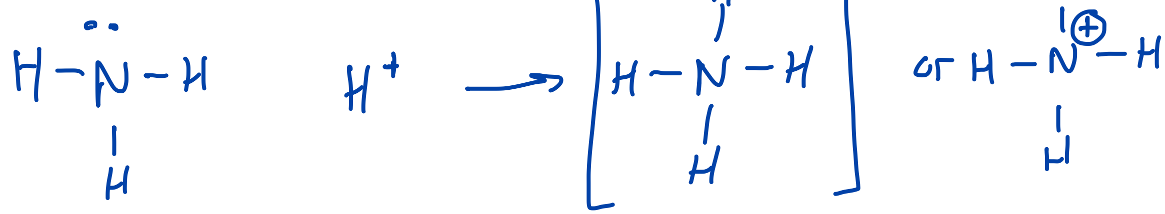


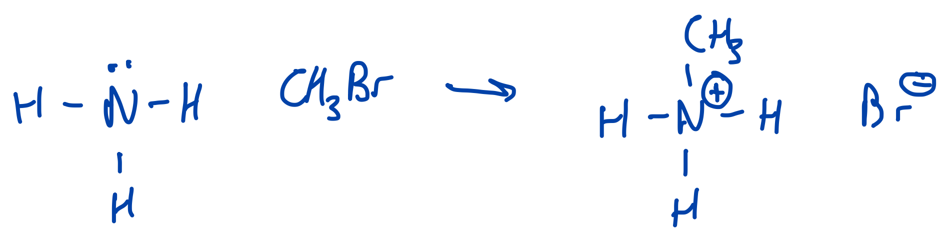
diethylene triamine

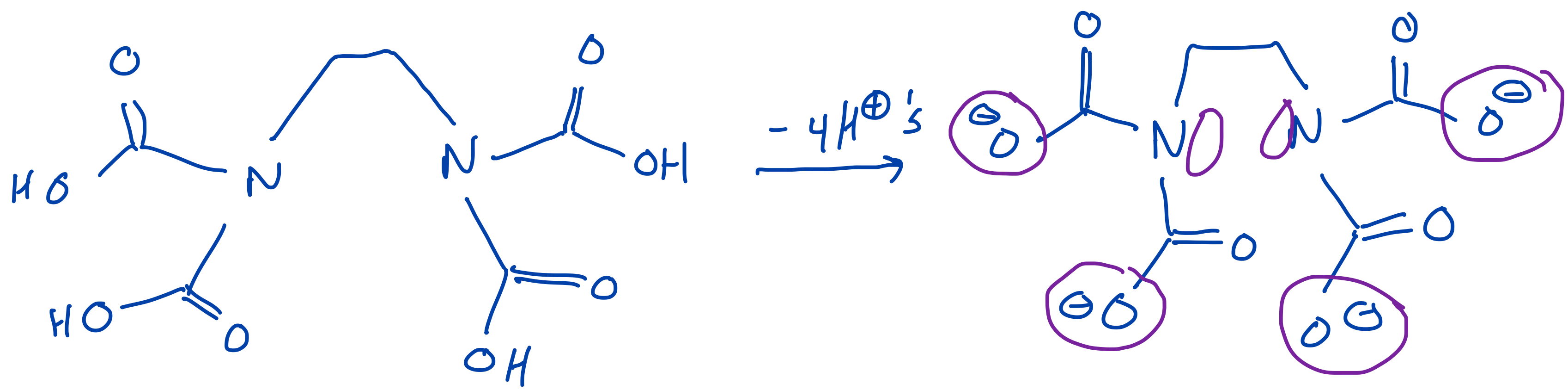


tridentate

can be used to make a bond







hexadentate

very good at latching onto metals

treat heavy metal

more than one bond to metal and the ligand is referred to as a chelating agent

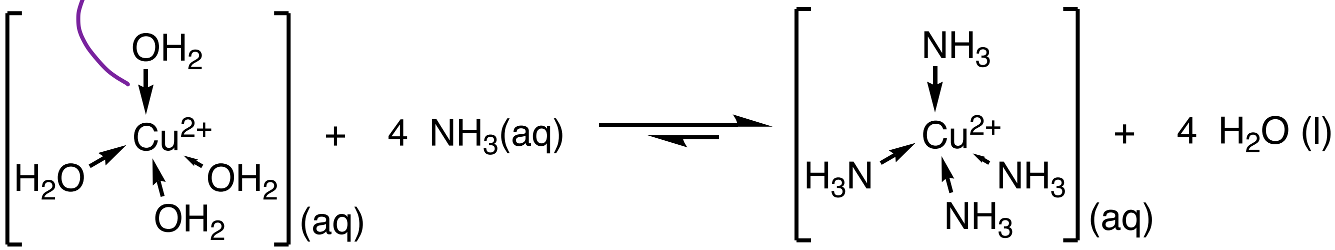
$Na^{\oplus}$ $Cl^{\ominus}$ Na–Cl

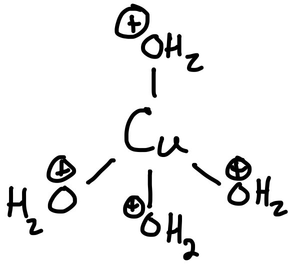
Monodentate vs Chelating Ligands: The chelation effect

Section 9.3

dative bond: electrons are not shared evenly

dative or coordinate covalent bond ↑

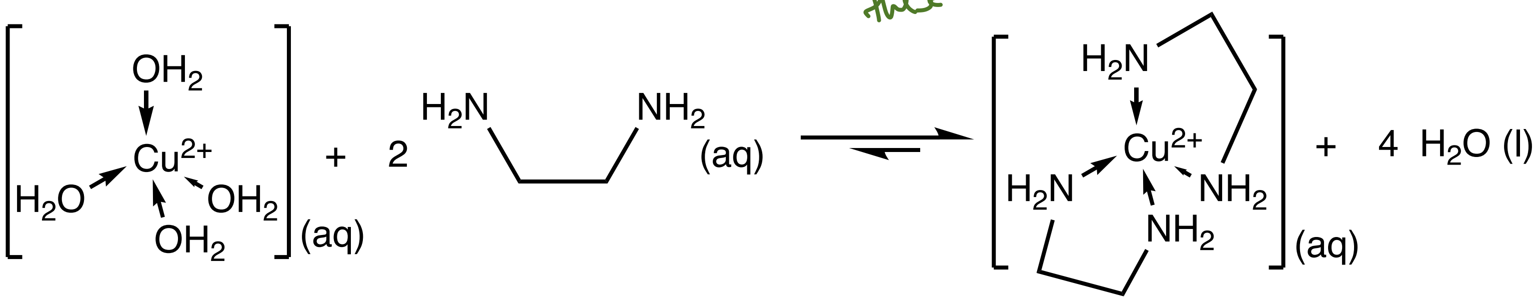


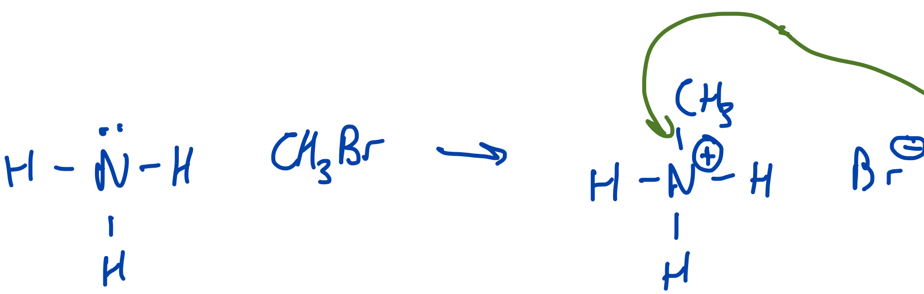


+4 + −2 = +2

↑ H_2O ligands ↑ Cu

not oxidized any more? No, not true these water molecules would be strongly acidic, so but they aren't…





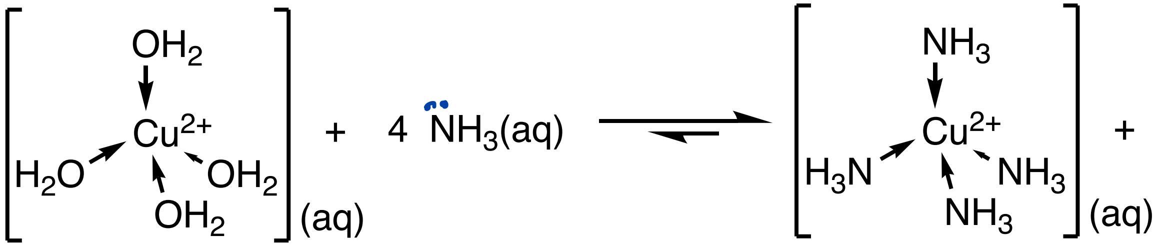
e⁻'s shared in a covalent bond

K_f = 1.1 x 10^{13}, 1.0 x 10^{20} https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_and_Websites_(Inorganic_Chemistry)/Coordination_Chemistry/Complex_Ion_Equilibria/Complex-Ion_Equilibria

$$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$

Monodentate vs Chelating Ligands: The chelation effect

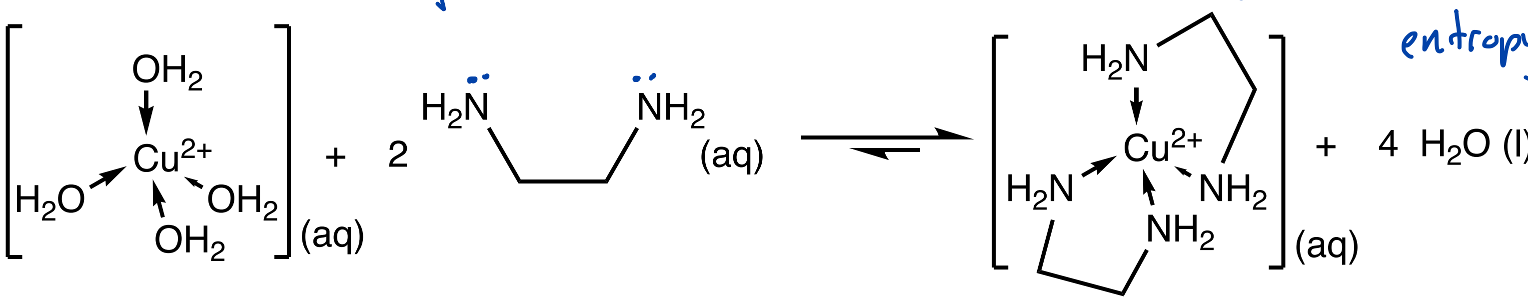
5 things — 5 things — no large change in entropy



55.5 M

$$K_f = \frac{[Cu(NH_3)_4]}{[Cu(OH_2)_4][NH_3]^4} = 1.1 \times 10^{13}$$

3 things — 5 things in solution — entropy increases



$$K_f = \frac{[Cu(en)_2]}{[Cu(OH_2)_4][en]^2} = 1.0 \times 10^{20}$$

entropy advantage increases K_f by 10^7

K_f = 1.1 x 10^{13}, 1.0 x 10^{20} https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_and_Websites_(Inorganic_Chemistry)/Coordination_Chemistry/Complex_Ion_Equilibria/Complex-Ion_Equilibria

Isomerism: Constitutional isomers

$Cr(H_2O)_6Cl_3$

Hydrate/Solvate

different connectivity

outer/secondary coordination sphere

$[Cr(H_2O)_6]Cl_3$ violet

$[CrCl(H_2O)_5]Cl_2 \cdot H_2O$ blue-green

$[CrCl_2(H_2O)_4]Cl \cdot 2\ H_2O$ dark green

CH_3-O-CH_3

CH_3-CH_2-OH

$[CrCl_3(H_2O)_3]$ yellow-green

Ionization Isomerism

+1 -1 +2 -2

$[Co(NH_3)_5SO_4]NO_3$ vs $[Co(NH_3)_5NO_3]SO_4$

$Cl^{\ominus}$ $NO_2^{\ominus}$

$[Co(NH_3)_4(NO_2)Cl]Cl$ vs $[Co(NH_3)_4Cl_2]NO_2$

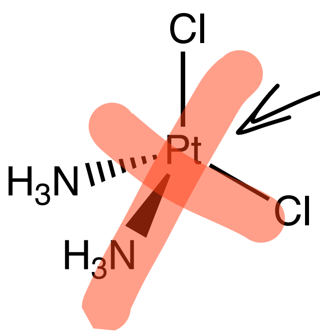
Coordination isomerism

Total ratio of ligands to metal remains the same, but the actual arrangement changes

$[Pt(NH_3)_2Cl_2]$ vs $[Pt(NH_3)_3Cl]^{+1}[Pt(NH_3)Cl_3]^{-1}$ vs $[Pt(NH_3)_4]^{+2}[PtCl_4]^{-2}$

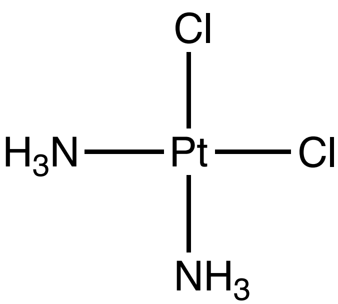
Isomerism: Stereochemistry

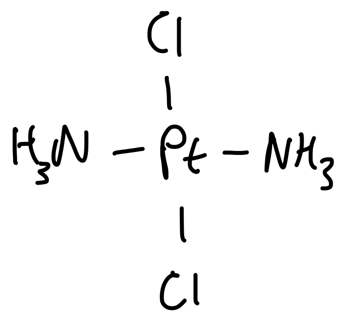
two stereoisomers for diammine dichloro platinum(II)



Pt can't be tetrahedral because there would only be 1 stereoisomer

square planar arrangement of ligands





cis arrangement

trans arrangement

cis-platin ← anti cancer agent

trans-platin

(30) **Today**

Section 9.4 – 9.5
Stereoisomers and a Tour through
Coordination Number and Geometry

Next Class (31)

9.5 Coordination Number and Structures

Chap 10

(32) **Second Class from Today**

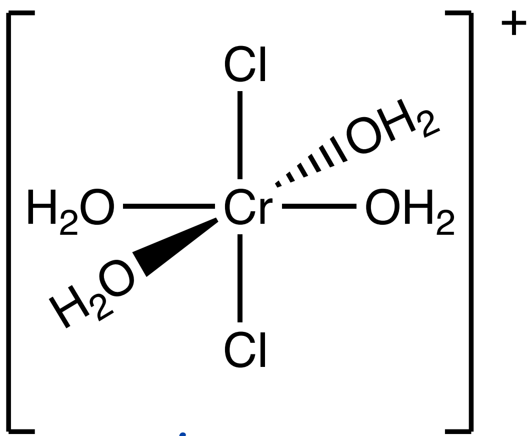
Test 3
Chap 6 and Section 9.1 + 9.2

nomenclature and oxidation states of metals

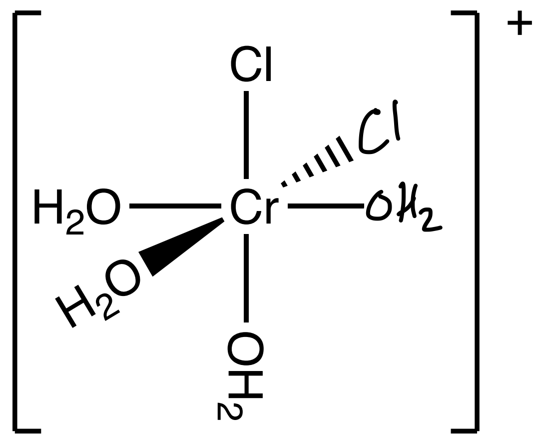
Third Class from Today (33)

Chap 10

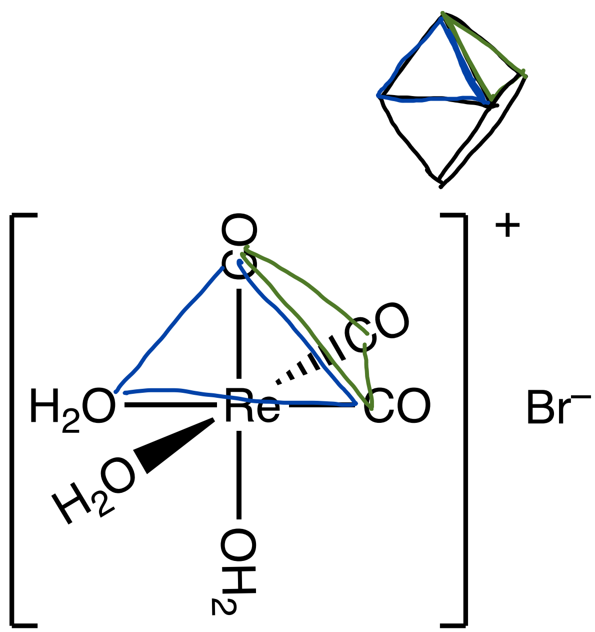
Isomerism: Stereoisomers



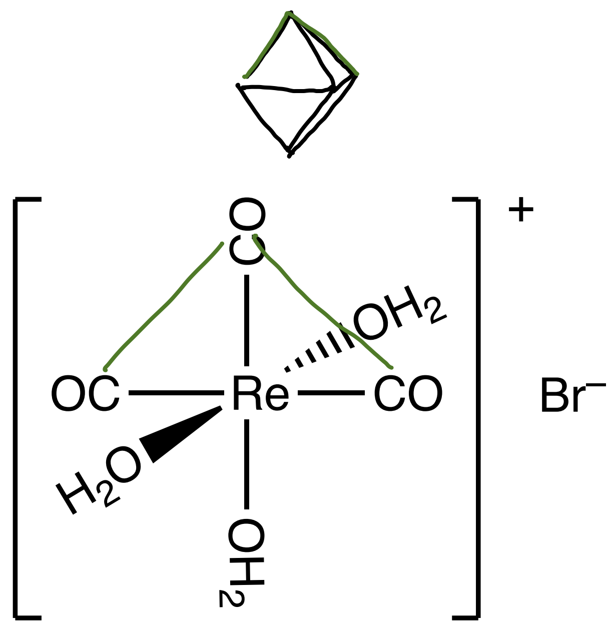
trans



cis



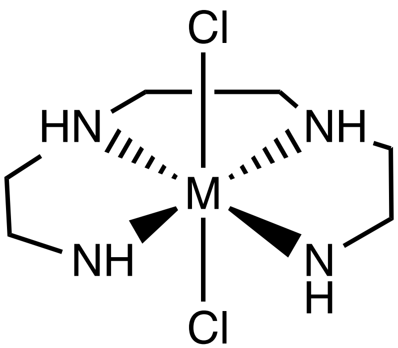
Facial fac



meridinal mer

Isomerism: Stereoisomers

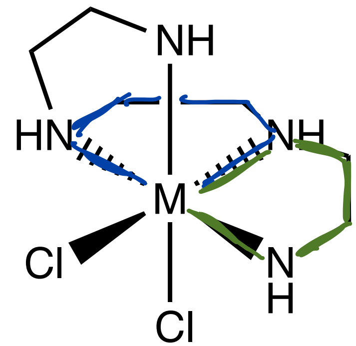
monodentate



tetradentate

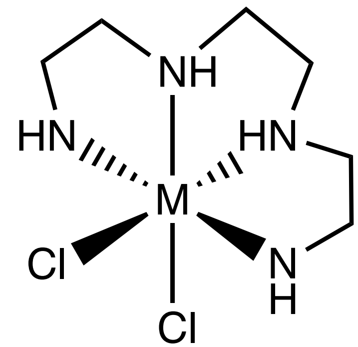
α

all in the same plane



β

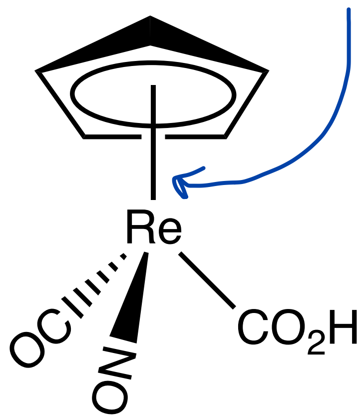
two rings in the same plane

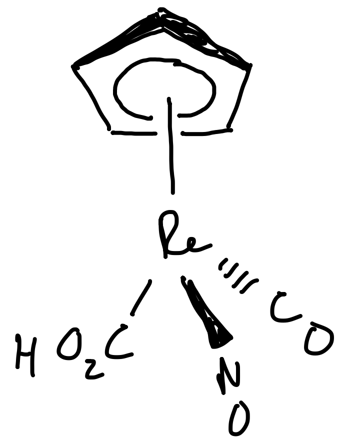


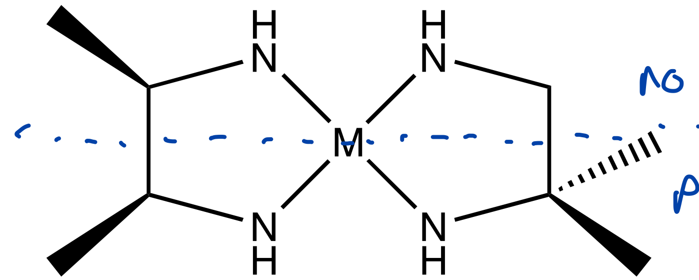
trans when none of the rings are in the same plane

Isomerism: Chirality

a 6-center, 6 e⁻ bond (5 C atoms + 1 Re atom)



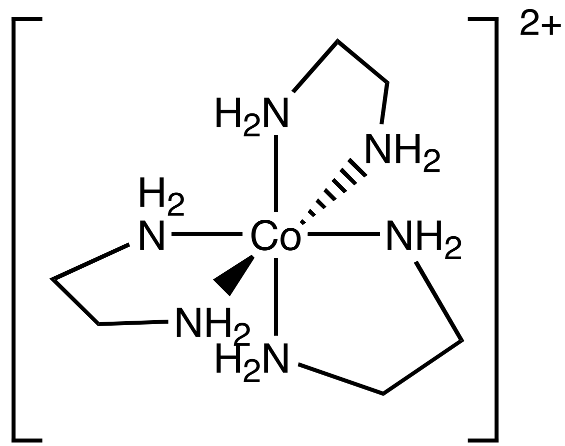




no internal plane of symmetry

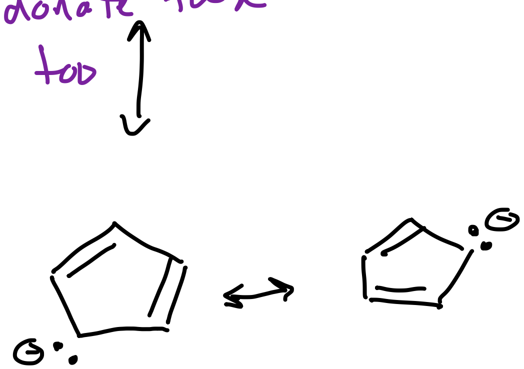
4 dif groups bonded to Re, so chiral like C atom with 4 diff group

chirals

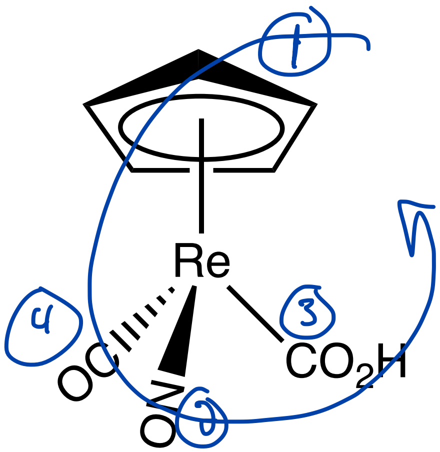


donate these to make a bond

donate these too

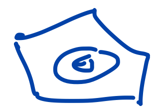


Isomerism: Chirality

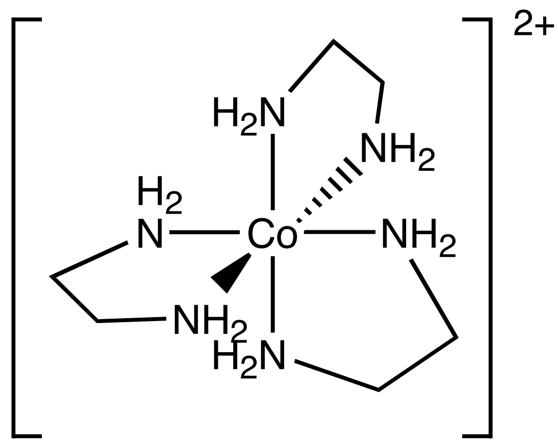


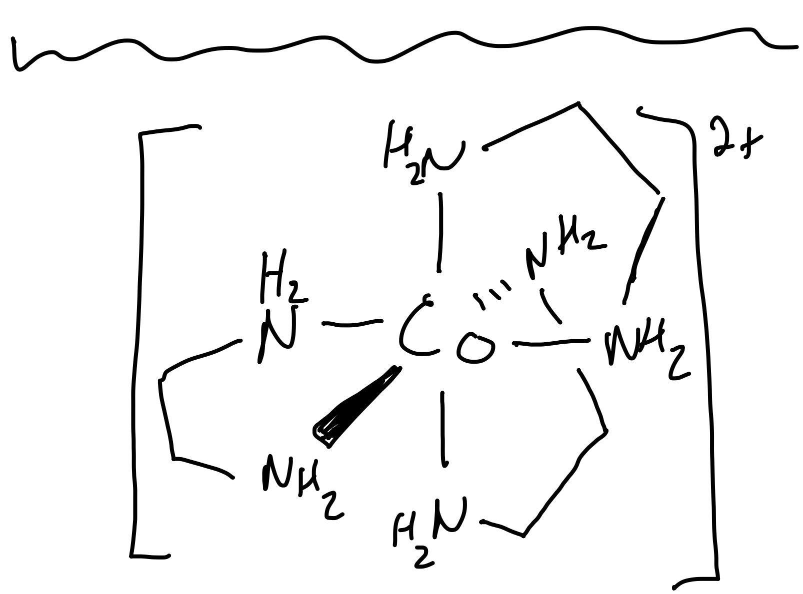
S enantiomer

same priority rules as for C chirality centers

except with multicenter attachments you consider them all together... thus the atomic number to use for the  ring is 5×6 = 30

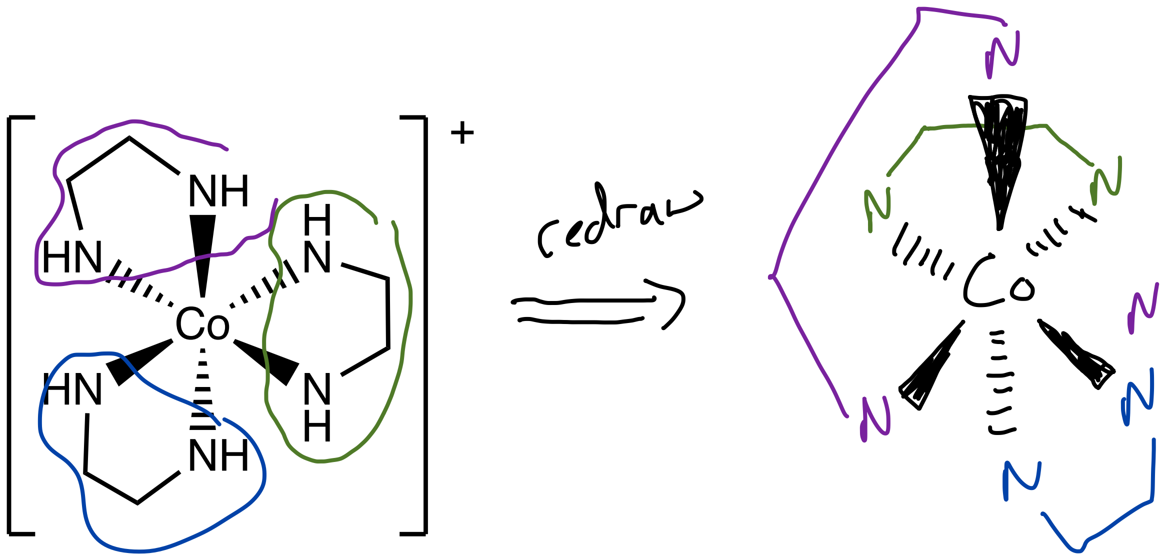
Isomerism: Chirality





not superposable
on original

Isomerism: Chirality



1. rotate figure to place ring horizontally across the back

2. imagine the ring in the front triangular face as having originally been parallel to the back ring. Determine what rotation of the front face is required to obtain the actual configuration

3. if rotation is counterclockwise Λ (lambda) [left, l], clockwise Δ (delta) [right, d].

righty tighty / lefty loosey

(if you turn it right and it screws away from you (into the object) it is Δ