(31) **Today**

9.5 Coordination Number and Structures

Next Class (32)

Test 3
Chap 6 and Section 9.1

(33) **Second Class from Today**

Chap 10

Third Class from Today (34)

Chap 10

VSEPR cannot explain all shapes

factors in determining shape

VSEPR considerations

pairs of e^-'s repel + try to have the largest bond angles possible between them ... but uneven e^- distribution in d orbitals can be a problem

occupancy of d orbitals

d^0, d^5, d^{10} have roughly spherical e^- distribution so VSEPR rules can help us predict these structures d^8... no so much

steric interference

consider the volume of the ligand. Large ligands take up a lot of space + can influence the shape.

crystal packing effects

in solids, the effects of crystal packing can also complicate our ability to predict shapes.

1, 2, and 3 Coordinate Compounds

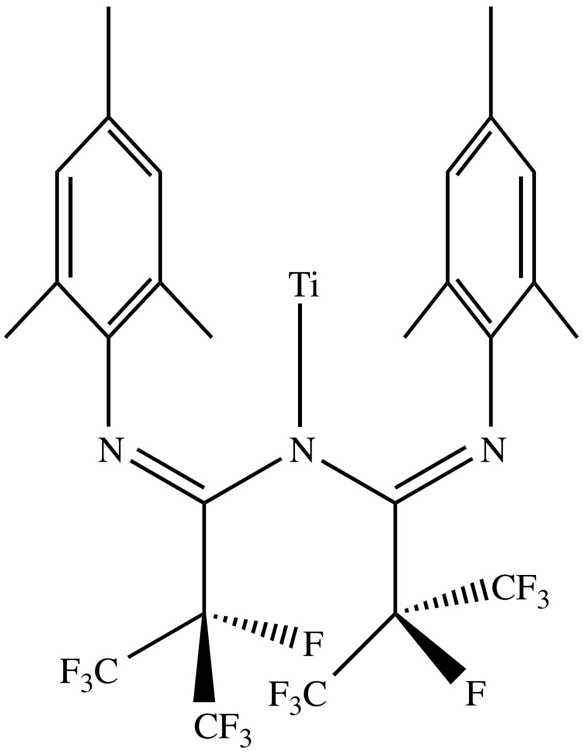
Section 9.4.1

One Coordinate metals complexes are rare.

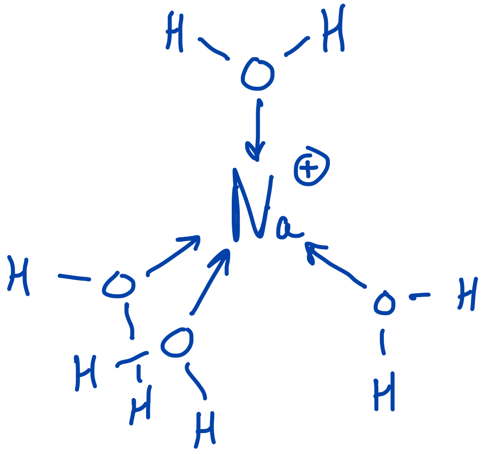
$NaCl_{(s)} \xrightarrow{H_2O} Na^{\oplus}_{(aq)} + Cl^{\ominus}_{(aq)}$

Bulky ligands are needed to keep metals from forming bonds with each other.

Solvents often coordinate to the metal and increase the coordination number



typically very lage ligands that block access to the metal are requred



even when simple salts dissolve in H_2O, the H_2O molecules coordinate to the metal

In solution, 4 to 6 water molecules are likely to be coordinated to the sodium ion.

1, **2**, and 3 Coordinate Compounds

Section 9.4.1

Some well known 2 coordinate complexes

$[Ag(NH_3)_2]^+$ $H_3N \rightarrow Ag^+ \leftarrow NH_3$

Following VSEPR rules... 2 bonding pairs are as far away from each other as possible

$[CuCl_2]^-$ $Cl^{\ominus} \rightarrow Cu^{\oplus} \leftarrow Cl^{\ominus}$

d e⁻'s can complicate the VSEPR interpretation

Ag⁺ and Cu⁺ are d# ?

how many e⁻'s are in the d orbitals

Cu^+ + Ag^+ are d^{10} ← approximately spherical distribution of e⁻

d^5

$Cu = [Ar]\ 4s^1\ 3d^{10}$

$Cu^{\oplus} = [Ar]\ 4s^0\ 3d^{10}$

d^0

$Ag^{\oplus} = [Kr]\ 5s^0\ 4d^{10}$

Fe^{2+} is d^6

Fe^{3+} is d^5

Fe is $4s^2\ 3d^6$

1, **2**, and 3 Coordinate Compounds

Section 9.4.1

Some well known 2 coordinate complexes

$[Ag(NH_3)_2]^+$

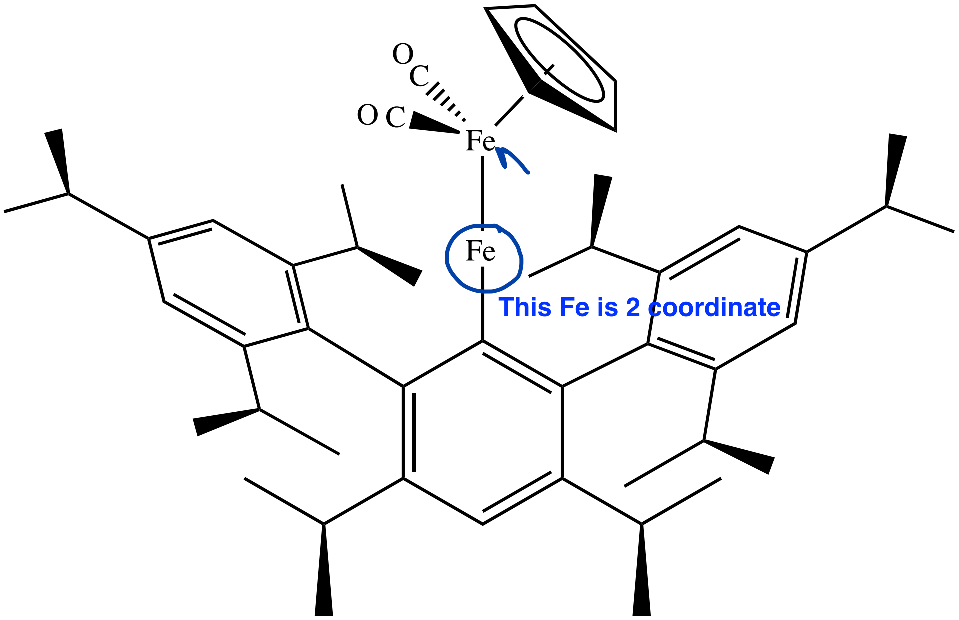
$$\left[H_3N \rightarrow Ag \leftarrow NH_3 \right]^{\oplus}$$

$[CuCl_2]^-$

$$\left[Cl \rightarrow Cu \leftarrow Cl \right]^{\ominus}$$

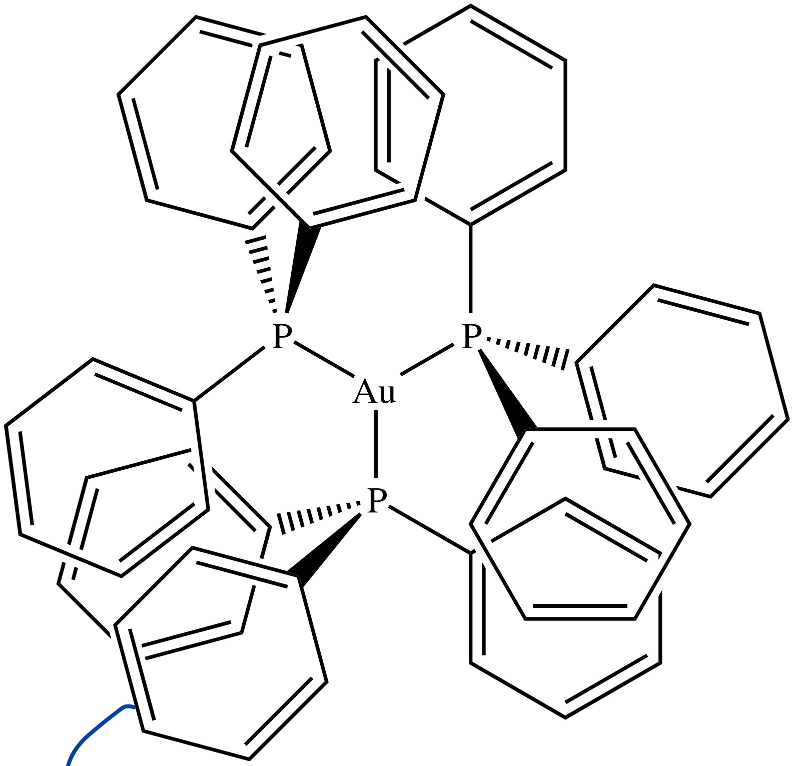
and then there's

the technique of using a giant ligand to prevent multiple ligands from coordinating

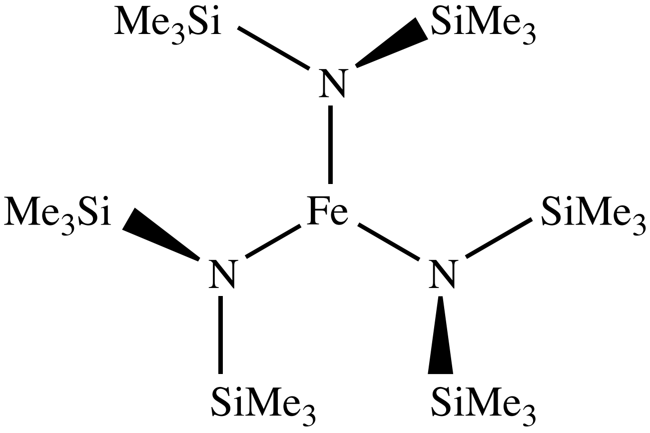


This Fe is 2 coordinate

1, 2, and **3** Coordinate Compounds



triphenyl phosphine



hexamethyldisilylimide

large ligands prevent more than 3 ligands from binding in these cases

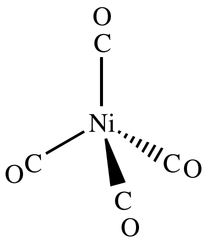
4 Coordinate Compounds

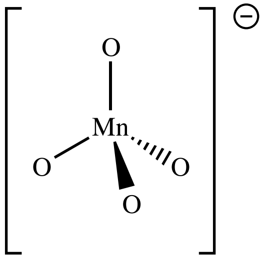
Section 9.4.2

tetrahedral

d^0, d^5,
and d^{10}

spherical e^- density in d shell



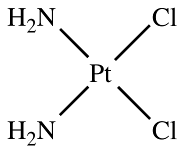


VSEPR ✓
tetrahedral

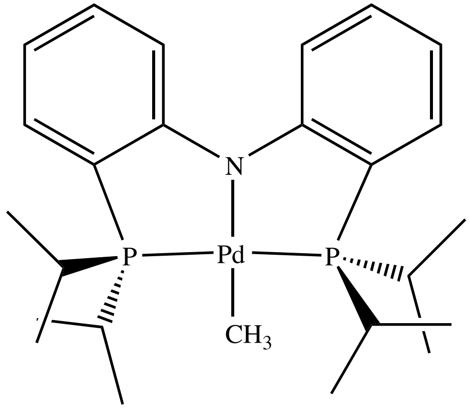
square planar

d^8

uneven e^- distribution of e^- in d shell



causes $e^- - e^-$ repulsion

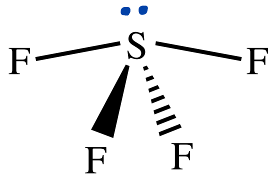


and now complexes are square planar

see-saw

four coordinate
main group atoms
with a steric
number of 5

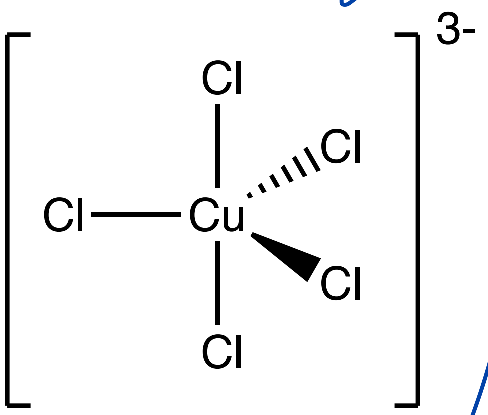
tend to follow VSEPR rules ....

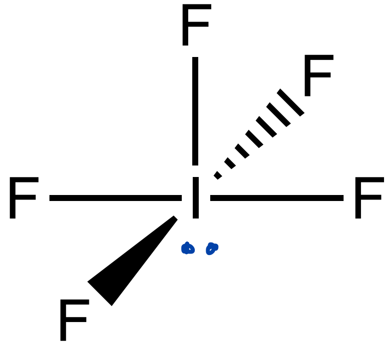


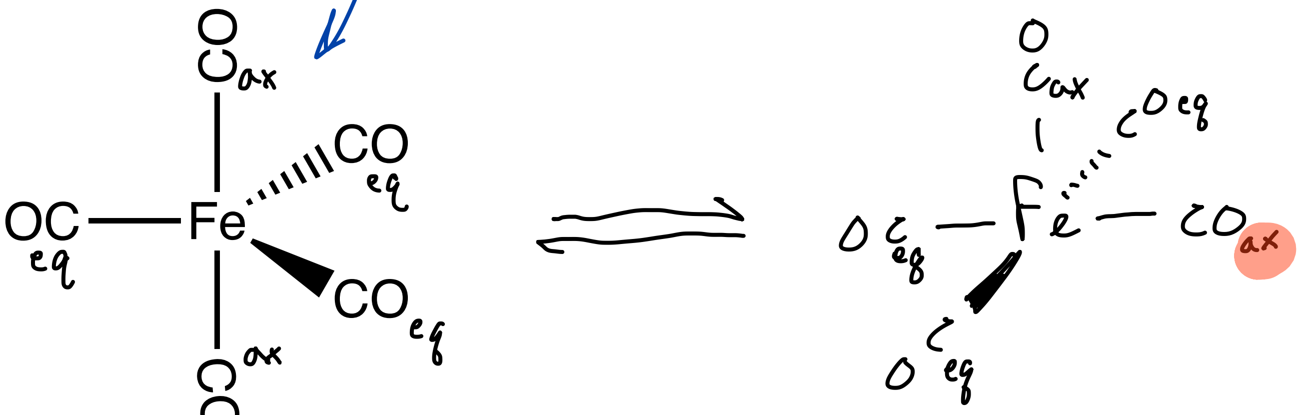
because of the spherical distribution of e^-'s in their d shell

5 Coordinate

trigonal bipyramidal



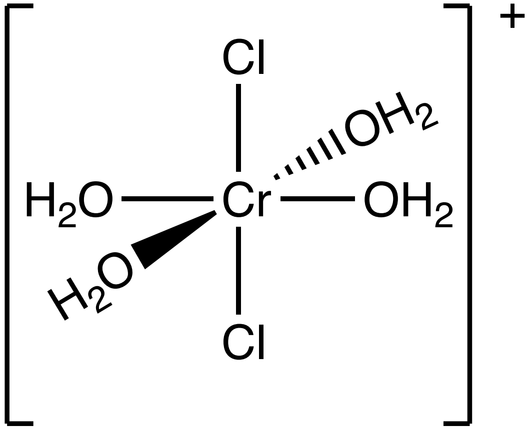




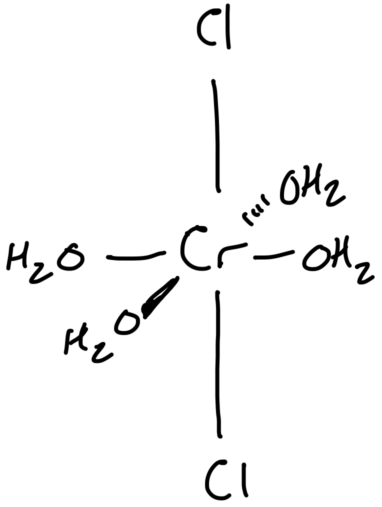
^{13}C NMR

even when we "know" the shape many transition metal compounds are "fluxional"... they change their shapes... the ligands are moving

6 Coodinate



octahedral



compounds can be distorted

trigonal prismatic

6 Coodinate