

4.5 - Finish VSEPR

4.6 - Molecular polarity (net dipoles)

* - Skip Chapter 5 entirely

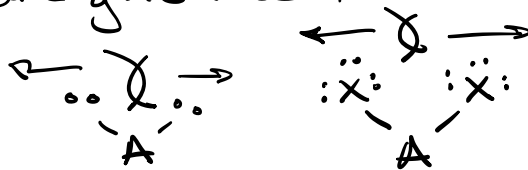
- Chapter 6 Stoichiometry
Chemical equations

VSEPR Theory

Very simple

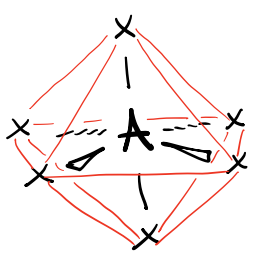
Valence Shell Electron Pair Repulsion Theory

- Valence e^- repel one another in a molecule
and give rise to certain 3-D shapes

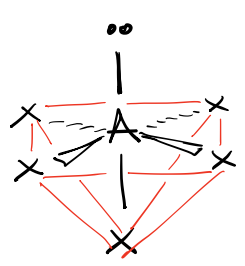


Both lone pairs & atoms w/ electrons
push each other apart

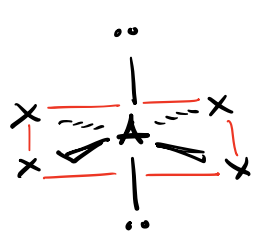
Starts by looking at Parent Geometries



octahedral
8 Sides = octahedral
 AX_6



Square pyramidal
 AX_5E



Square planar
 AX_4E_2

Geometry related to chemistry
and types of reactions molecules
undergo.

Geometry Family Tree

# of groups attached to Central	6	5	4	3	2
Parent	octahedral AX_6	Trigonal Bipyramidal AX_5	Tetrahedral AX_4	Trigonal Planar AX_3	Linear AX_2
# of possible geometries	AX_5E	AX_4E	AX_3E	AX_2E	
	AX_4E_2	AX_3E_2	AX_2E_2		
	AX_3E_3	AX_2E_3			
	AX_2E_4				

← Chem IA
Transition metal
Complexes

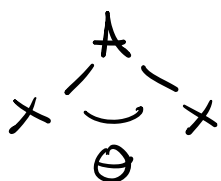
→ Chem 3
main group
Elements
octets $8e^-$
 $S+P = 8e^-$

$S+p+d = 18e^-$ $18e^-$ rule

A = Central Atom

X = Atom bound to Central (Substituent, Ligand)

E = Lone pair e⁻ on central (Ä)

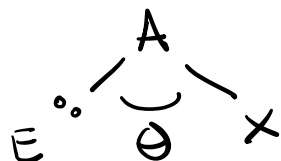


Θ = Geometry

Tetrahedral = 109.5°

Trigonal planar = 120°

Linear = 180°

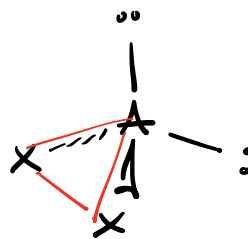
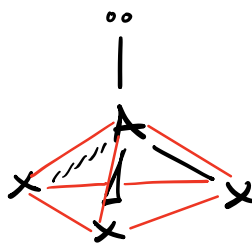
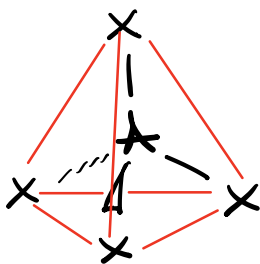


Electronic Geometry

Tetrahedral Family

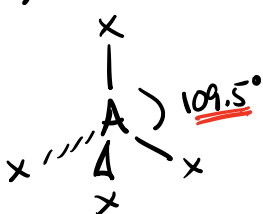
AX₄

Θ = 109.5°

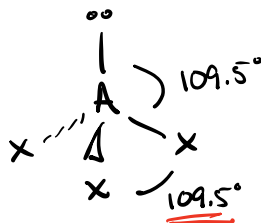


molecular geometry →

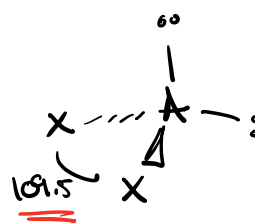
Tetrahedral



Trigonal pyramidal
"3
Pyramid"



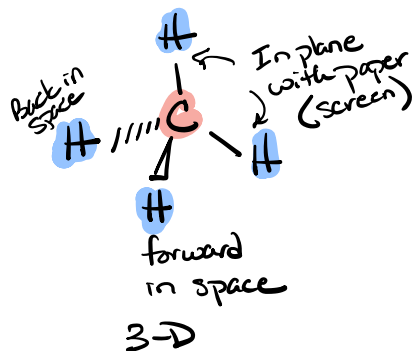
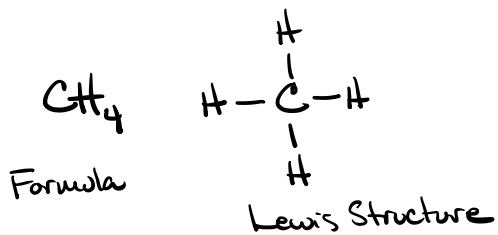
Bent - 109.5°



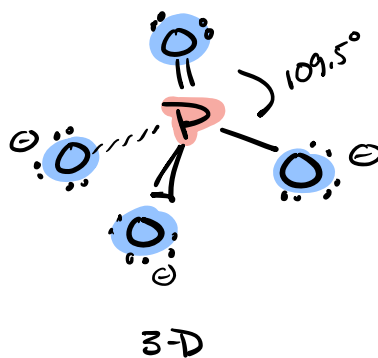
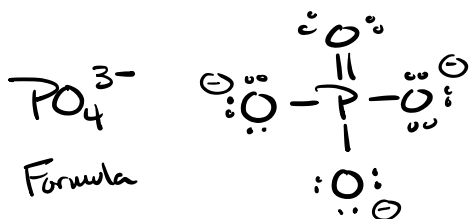
Electronic
Tetrahedral

molecular
Tetrahedral

AX_4



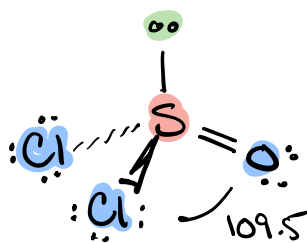
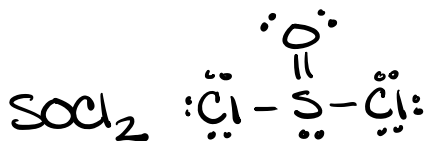
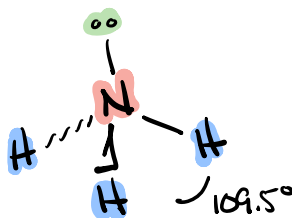
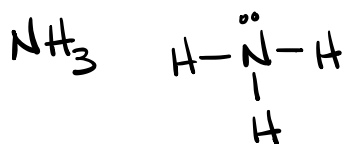
AX_4



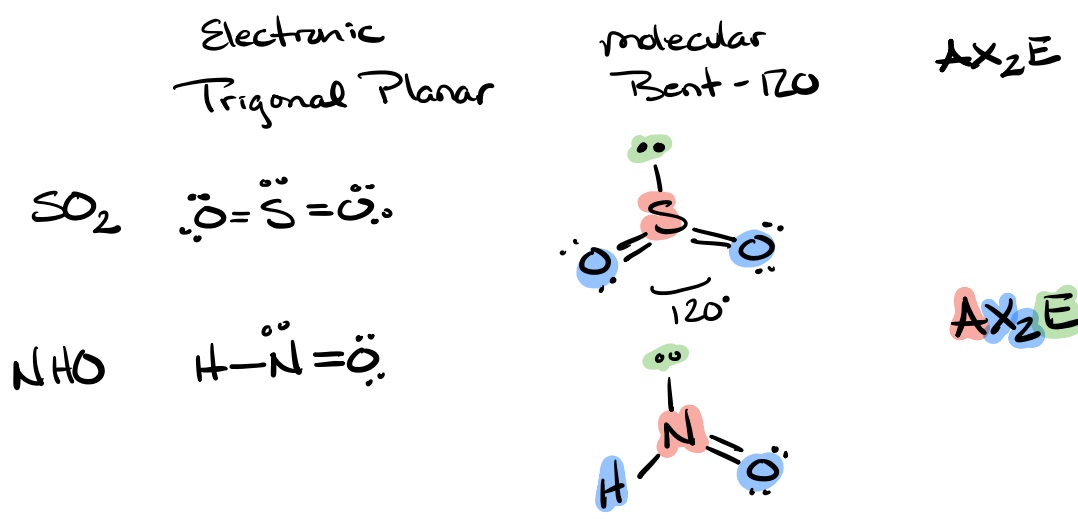
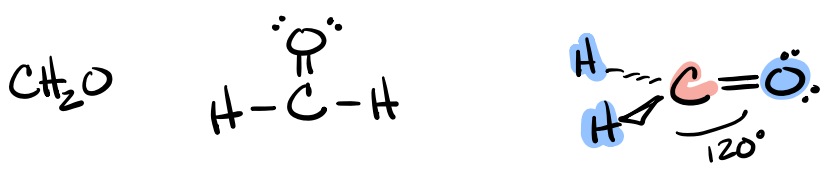
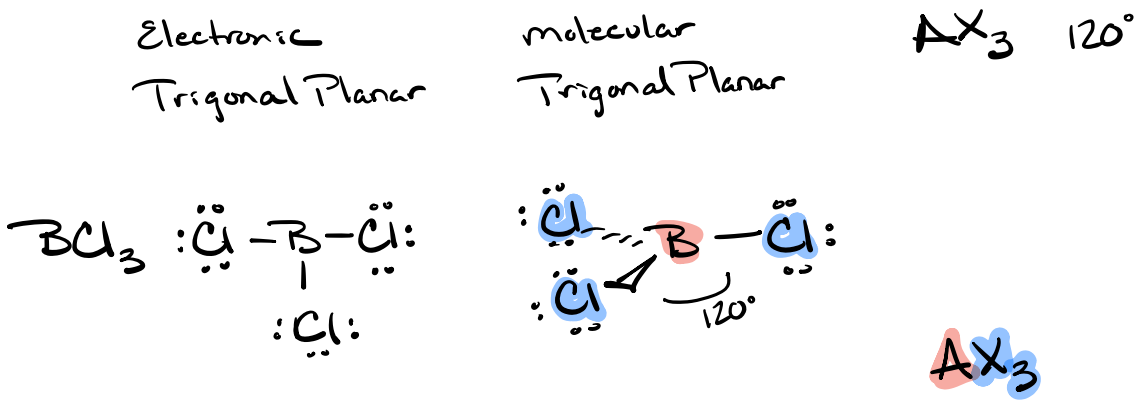
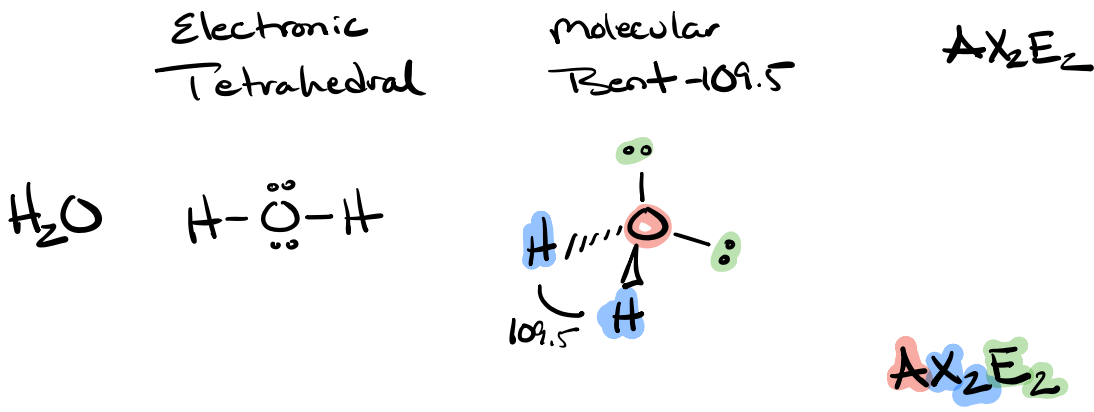
Electronic
Tetrahedral

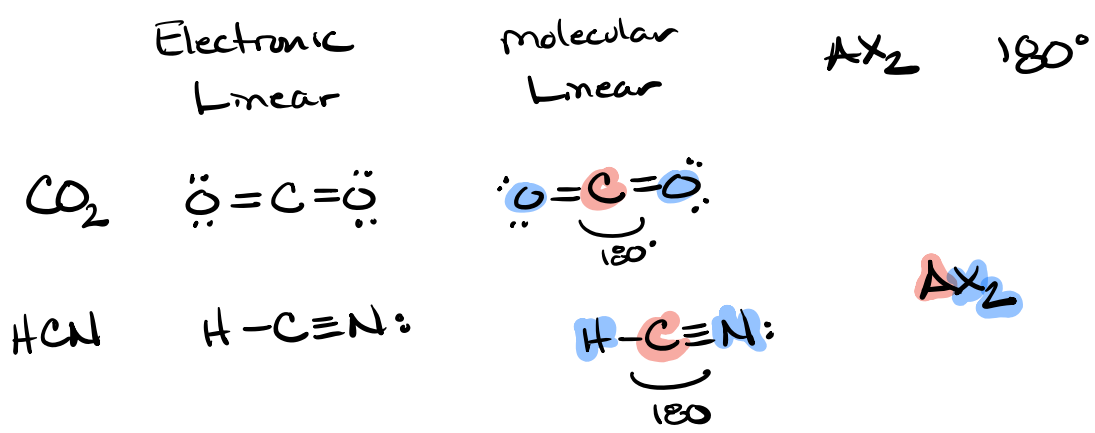
molecular
Trigonal pyramidal

AX_3E

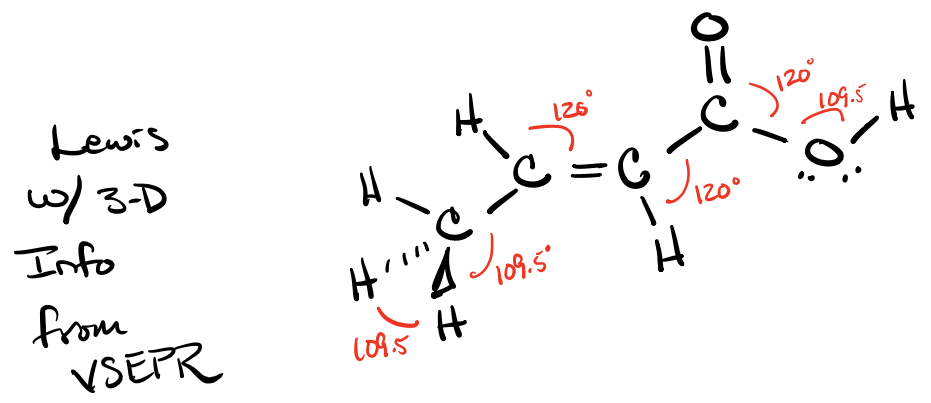
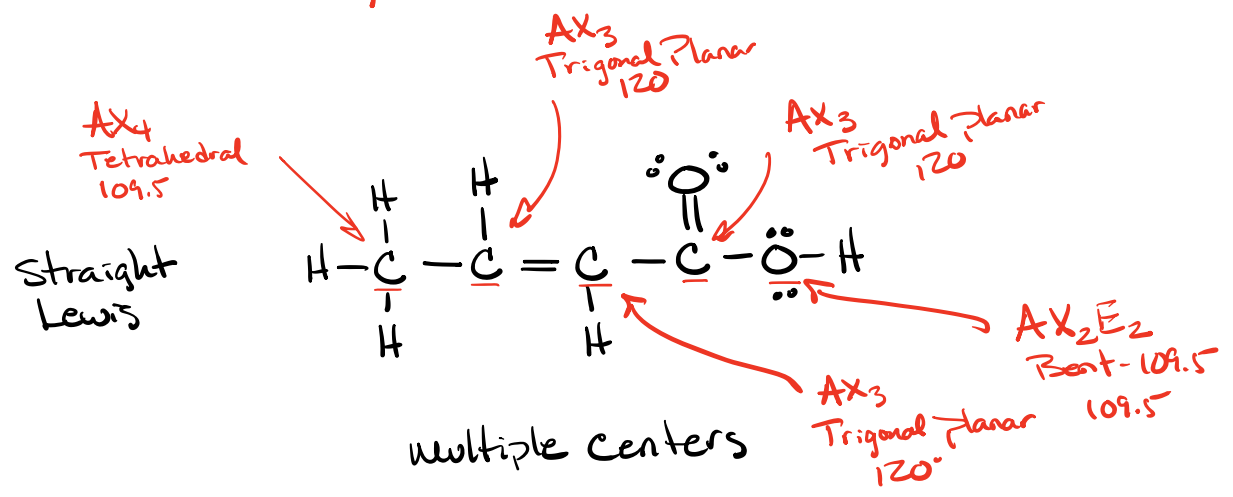


AX_3E





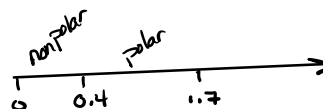
Give the AXE designation, the molecular geometry & the angle.



Molecular Polarity

Is the molecule as a whole polar or non-polar?

Does the molecule contain polar bonds? ΔEN



NO

Yes

Molecule not
polar

may be polar

Is the molecule Symmetrical,
is it AX_4 , AX_3 , AX_2 where
all the X are the same
atom.

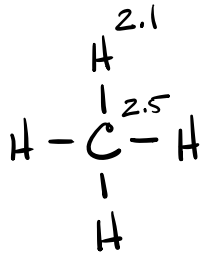
Not AX_3E or AX_2E_2 or AX_2E

Yes

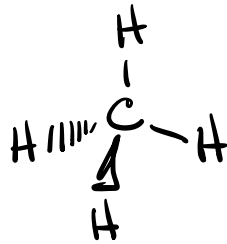
NO

By Symmetry
dipoles cancel
& molecule is
not polar

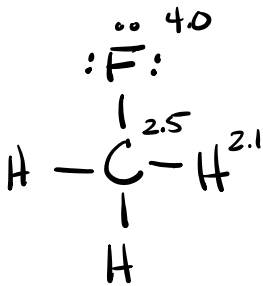
Dipoles do
not cancel &
molecule is polar



$$\Delta EN = |2.5 - 2.1| = 0.4 \Rightarrow \text{nonpolar}$$

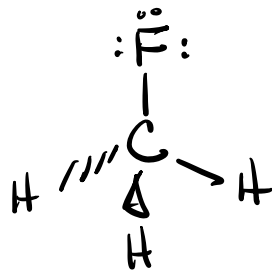


no polar bonds
molecule is not
polar



$$\text{C}-\text{F} \quad \Delta EN = 4.0 - 2.5 = 1.5 \text{ polar!}$$

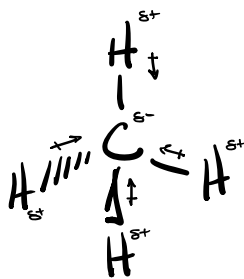
$$\text{C}-\text{H} \quad \Delta EN = 2.5 - 2.1 = 0.4 \text{ nonpolar}$$



AX_4 , but not all same

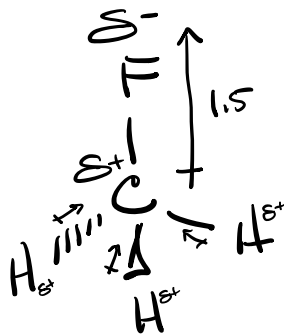
x \rightarrow so no

\Rightarrow polar molecule

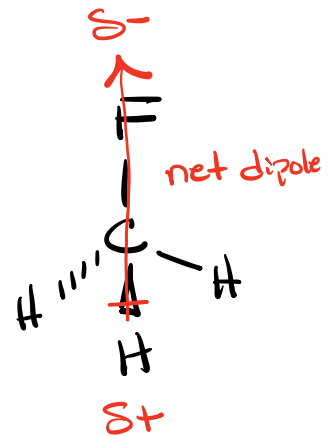


not polar

$$\Delta EN < 0.4$$

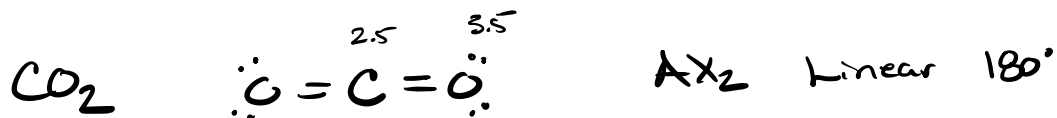
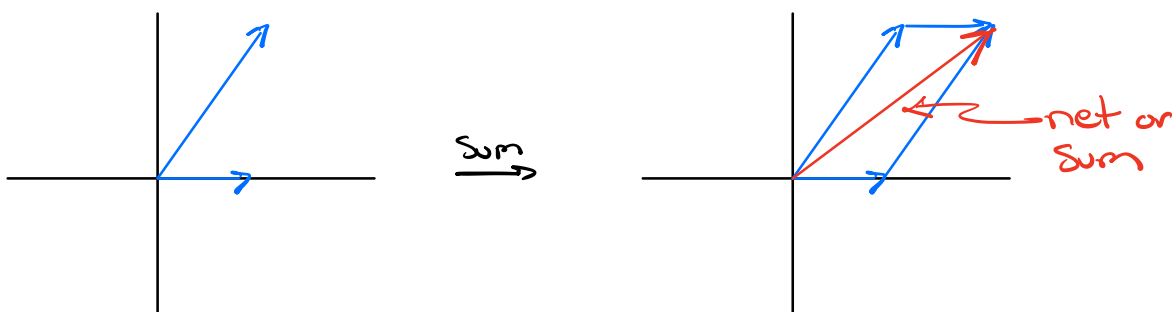
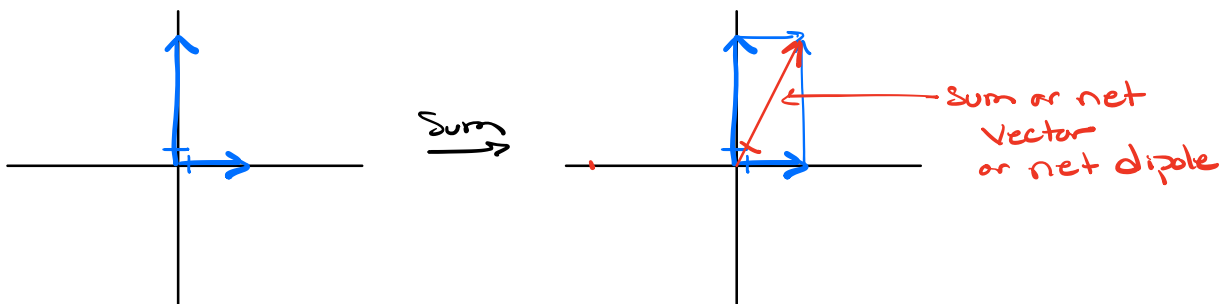


=



molecule
polar

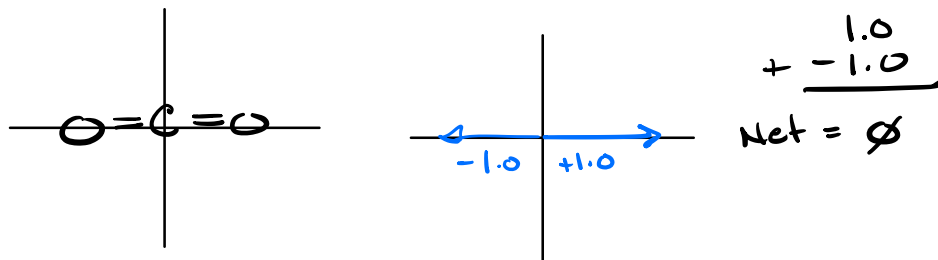
$$\Delta EN > 0.4$$



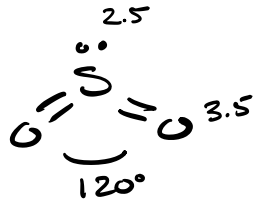
C-O $\Delta\text{EN} = 1.0 \Rightarrow$ polar

does it have polar bonds \Rightarrow yes

is it $\text{AX}_2, \text{AX}_3, \text{AX}_4$ where all X same \Rightarrow yes



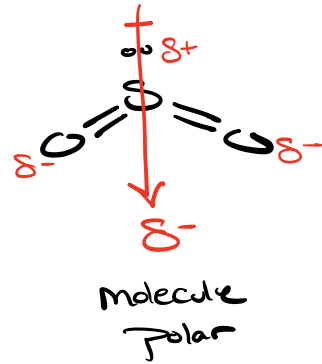
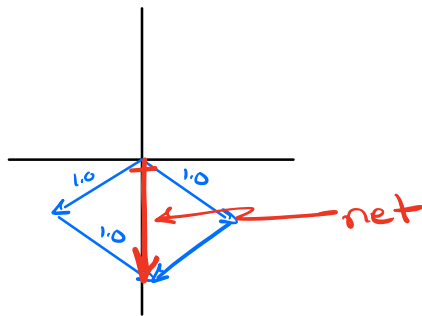
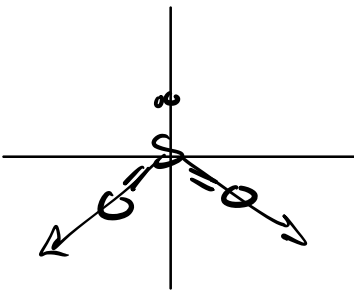
SO₂



AX₂E

$\Delta EN = 1.0$

polar bonds \Rightarrow yes



Like dissolves Like
Solubility