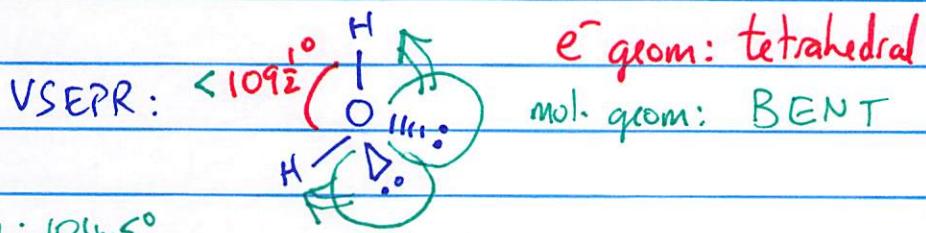
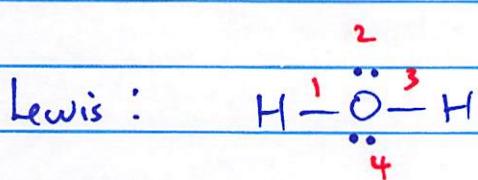
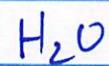
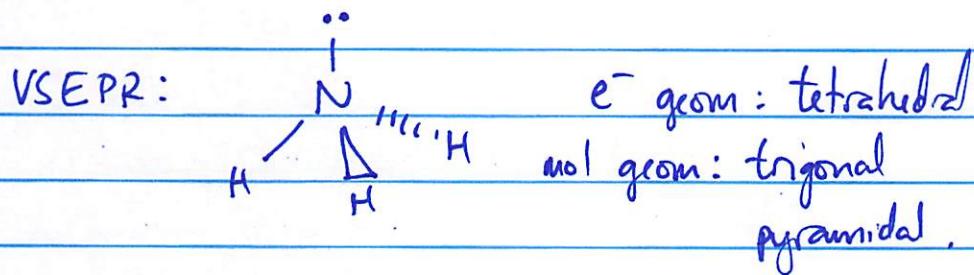
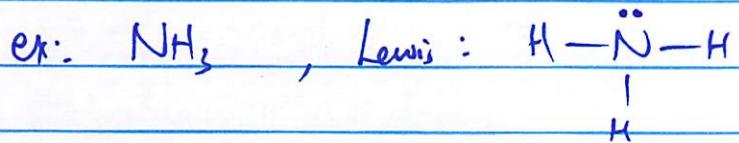


11/25/2019

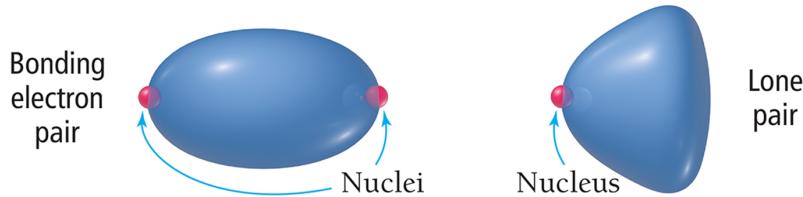
VSEPR

e^- geom: where e^- s are
molecular geometry: where atoms are !!



water: 104.5°

Effect of Lone Pairs



The bonding electrons are attracted to two nuclei whereas a lone pair is attracted to only one nucleus. The nonbonding electrons are localized on the central atom, so the area of negative charge takes more space.



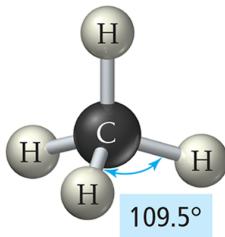
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27

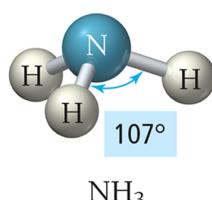
Bond Angle Distortion from Lone Pairs (1 of 3)

Effect of Lone Pairs on Molecular Geometry

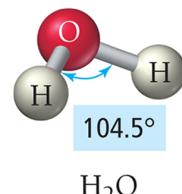
No lone pairs



One lone pair



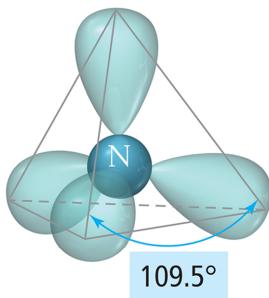
Two lone pairs



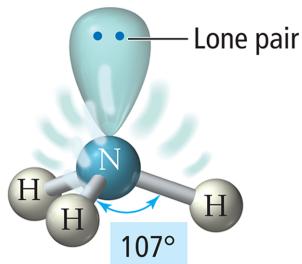
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28

Bond Angle Distortion from Lone Pairs (2 of 3)



Ideal tetrahedral geometry



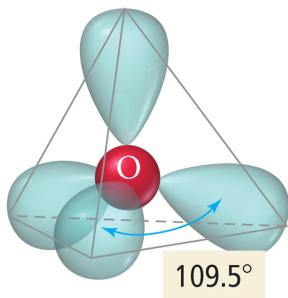
Actual molecular geometry

P Pearson

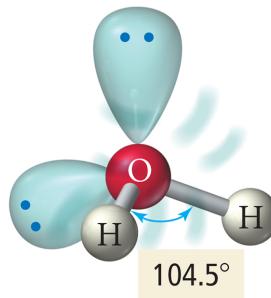
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29

Bond Angle Distortion from Lone Pairs (3 of 3)



Ideal tetrahedral geometry

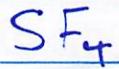


Actual molecular geometry

P Pearson

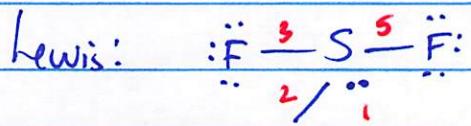
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30



|
4

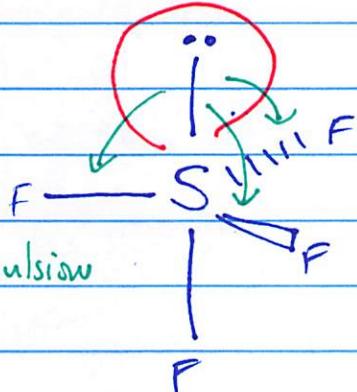
5 rep



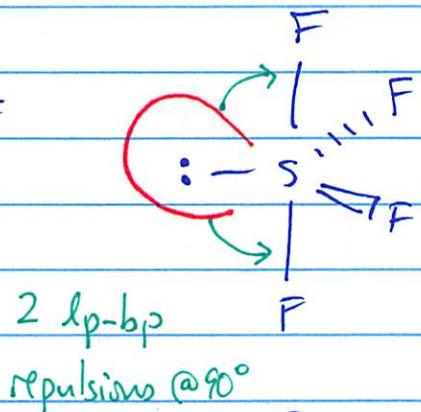
- trigonal bipyramidal e^- geom.



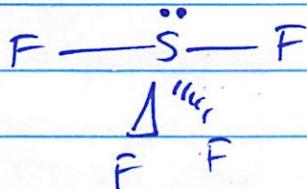
3 lp-bp repulsion
 $\text{@ } 90^\circ$



(X)



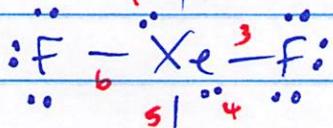
(V)



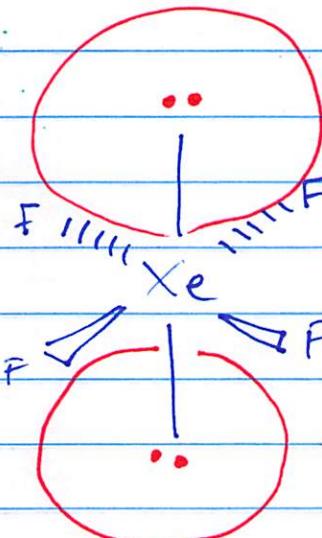
mol geom: see-saw



|
2



..



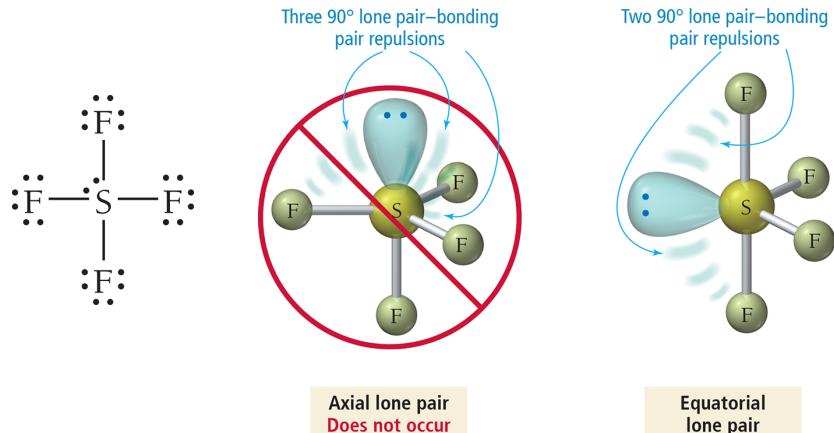
e^- geom

octahedral

Mol. geom

square planar

Seesaw

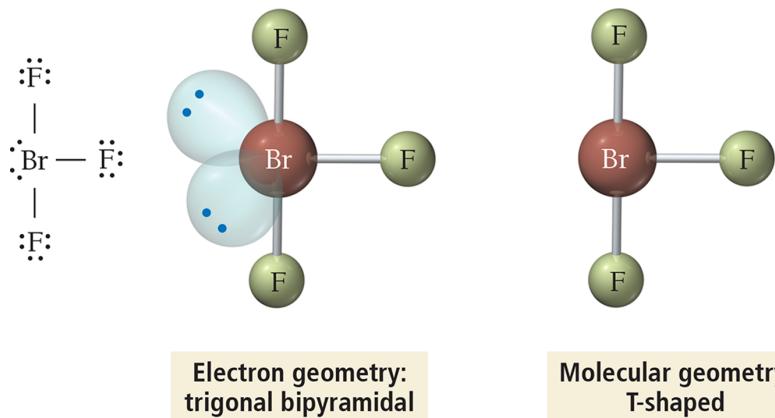


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34

T-Shape

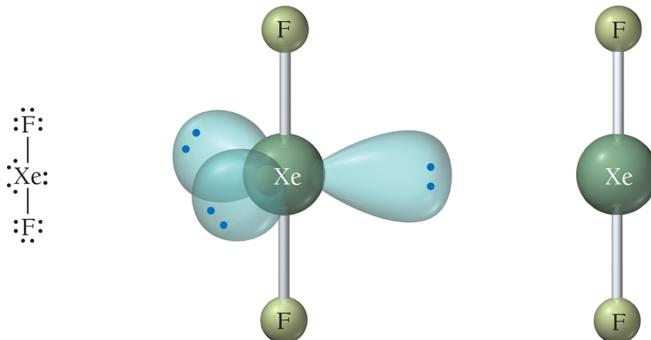


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35

Linear



Electron geometry:
trigonal bipyramidal

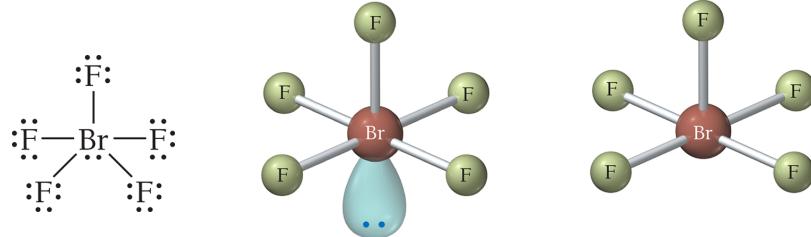
Molecular geometry:
linear

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36

Square Pyramidal



Electron geometry:
octahedral

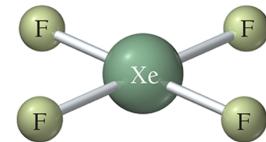
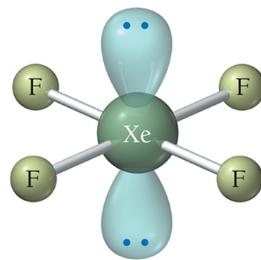
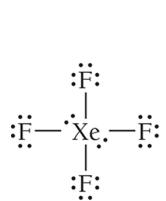
Molecular geometry:
square pyramidal

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38

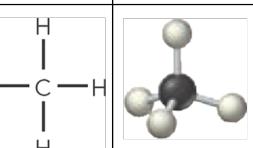
Square Planar



Electron geometry:
octahedral

Molecular geometry:
square planar

Electron and Molecular Geometries (1 of 4)

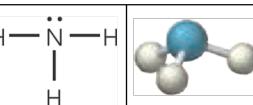
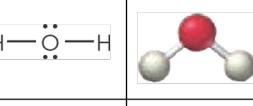
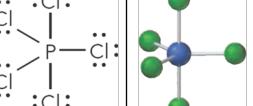
Electron Groups*	Bonding Groups	Lone Pairs	Electron Geometry	Molecular Geometry	Approximate Bond Angles	Example
2	2	0	Linear	Linear	180°	
3	3	0	Trigonal planar	Trigonal planar	120°	
3	2	1	Trigonal planar	Bent	<120°	
4	4	0	Tetrahedral	Tetrahedral	109.5°	

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40

Electron and Molecular Geometries (2 of 4)

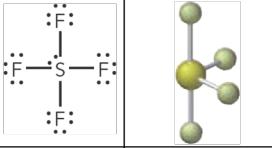
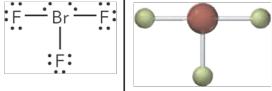
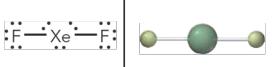
Electron Groups*	Bonding Groups	Lone Pairs	Electron Geometry	Molecular Geometry	Approximate Bond Angles	Example
4	3	1	Tetrahedral	Trigonal pyramidal	<109.5°	
4	2	2	Tetrahedral	Bent	<109.5°	
5	5	0	Trigonal bipyramidal	Trigonal bipyramidal	120° (equatorial) 90° (axial)	

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41

Electron and Molecular Geometries (3 of 4)

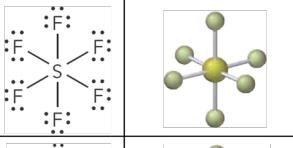
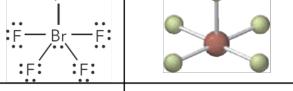
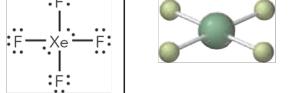
Electron Groups*	Bonding Groups	Lone Pairs	Electron Geometry	Molecular Geometry	Approximate Bond Angles	Example
5	4	1	Trigonal bipyramidal	Seesaw	<120° (equatorial) <90° (axial)	
5	3	2	Trigonal bipyramidal	T-shaped	<90°	
5	2	3	Trigonal bipyramidal	Linear	180°	

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42

Electron and Molecular Geometries (4 of 4)

Electron Groups*	Bonding Groups	Lone Pairs	Electron Geometry	Molecular Geometry	Approximate Bond Angles	Example
6	6	0	Octahedral	Octahedral	90°	
6	5	1	Octahedral	Square pyramidal	<90°	
6	4	2	Octahedral	Square planar	90°	

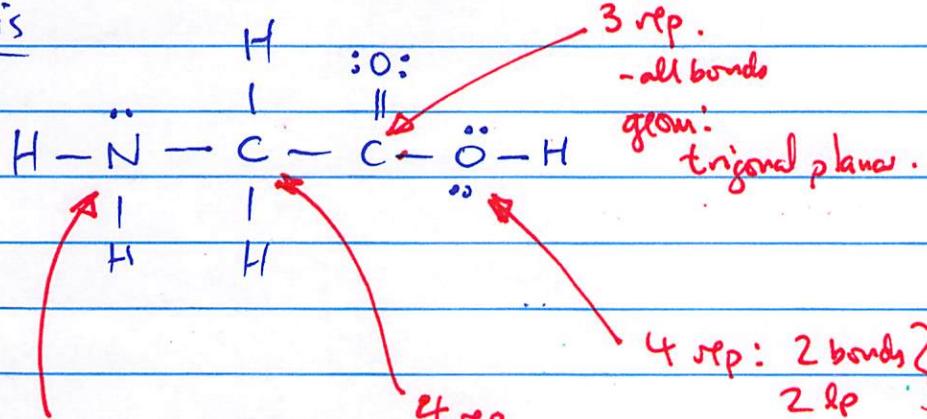
*Count only electron groups around the central atom. Each of the following is considered one electron group: a lone pair, a single bond, a double bond, a triple bond, or a single electron.

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43

Lewis

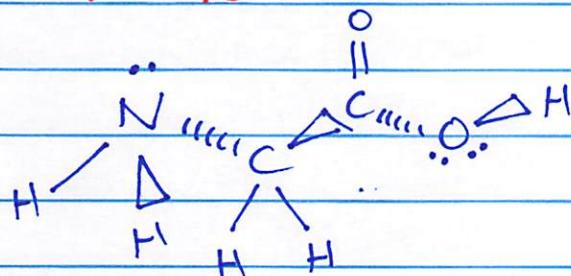


4 rep. } mol. gram
 -3 bp } trigonal
 -1 lp } pyramidal

3 rep.
 - all bonds
 geom: trigonal planar.

4 rep. } 2 bonds } mol. gram
 2 lp } bent

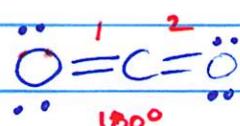
- all 4 bp.
 - tetrahedral.



Molecular shape + polarity

ex: CO_2

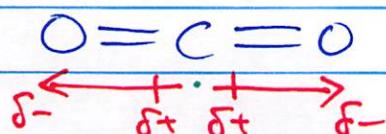
Lewis:



VSEPR:



linear



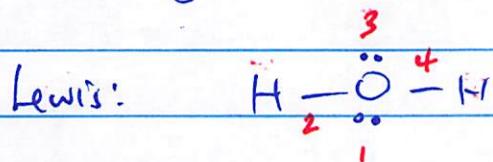
\uparrow = bond
dipole

overall dipole? = \sum bond dipoles.

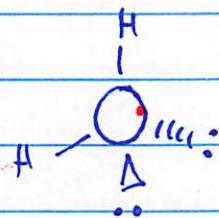
$$\text{overall dipole} = 0$$

$\mu = 0$ (everything cancels)
 NON-POLAR

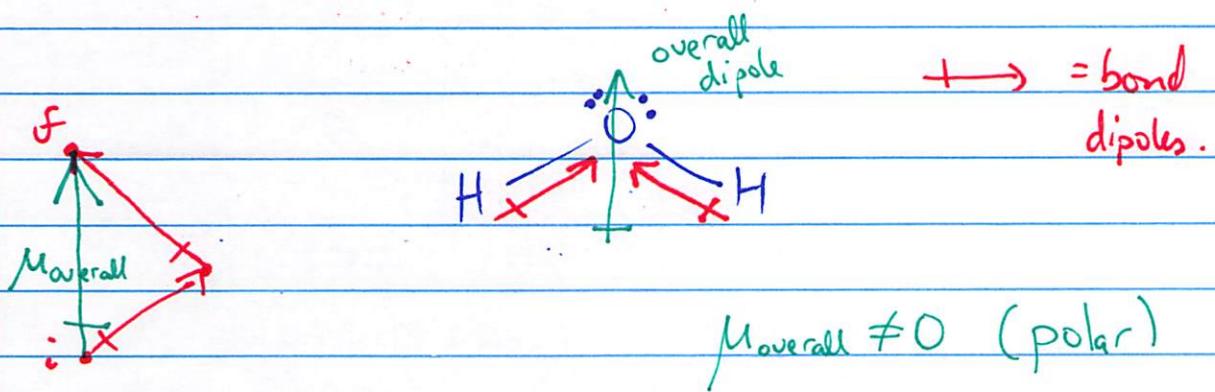
H_2O - polarity?



VSEPR:

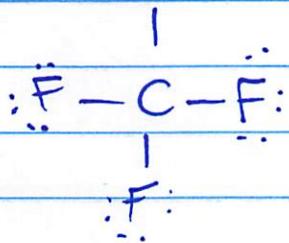


mol geom = bent.

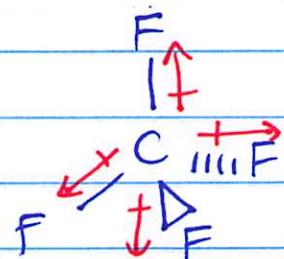


CF_4

Lewis:



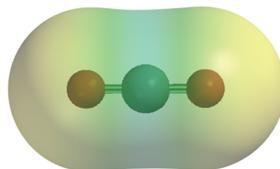
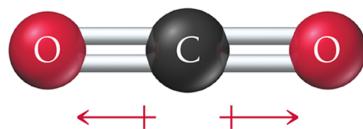
VSEPR.



$\mu_{\text{overall}} = 0$ NON-POLAR!

Molecular Polarity (2 of 2)

No net dipole moment



The O—C bond is polar. The bonding electrons are pulled equally toward both O ends of the molecule. The net result is a nonpolar molecule.

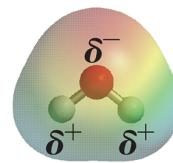
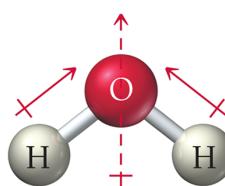
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59

Molecular Shape and Polarity

Net dipole moment



The H—O bond is polar. Both sets of bonding electrons are pulled toward the O end of the molecule. Because the molecule is **bent**, not linear, the net result is a polar molecule.

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60