
Experiment 11 – Lewis Dot Structures and Molecular Geometry

Discussion

The Valence Shell Electron Pair Repulsion (VSEPR) Theory states that bonds and lone pairs are regions of high electron density in an atom that repel each other until they get as far apart as possible. This effect determines the atom's geometry and bond angles. Two regions will be 180° apart, three regions will be 120° apart, and four regions will be 109.5° apart.

Geometry Determination

- A. Determine the Lewis dot structure of the molecule or ion.
- B. For each central atom in the structure, determine the areas of electron density that lie directly on that atom. An area of electron density may be:
 - a lone pair that lies on the central atom. (Lone pairs on other atoms don't count.)
 - a single bond.
 - a double bond.
 - a triple bond.
- C. Assign geometry according to the table on the next page.

Procedure

For each of the polyatomic ions or molecules:

- II. Draw the Lewis dot structure. You may include resonance structures, if needed.
- III. Use the model kit to build the structure.
 - Use white or yellow balls for hydrogens.
 - Use black or blue or red balls for other atoms.
 - Use short sticks for nonbonded electron pairs (lone pairs).
 - Use long sticks for single bonds.
 - Use springs for double and triple bonds. Two springs form a double bond. Three springs form a triple bond.
- IV. Sketch the shape of the structure in three dimensions. This is called the VSEPR structure.
- V. Give the name of the molecular geometry.
- VI. Determine the approximate bond angle on the central atom (if applicable).
- VII. Draw the bond dipole moments and VSEPR and state whether the molecule is polar, or nonpolar, if needed.

# of areas	# of bonds	# of lone pairs	Geometry and bond angles	Example
4	2	2	Angular or bent (109.5°)	
4	3	1	Pyramidal (109.5°)	
4	4	0	Tetrahedral (109.5°)	
3	2	1	Bent (120°)	2 resonance forms
3	3	0	Trigonal (120°)	3 resonance forms
2	2	0	Linear (180°)	
	1	any	Linear (Must be three or more atoms to form an angle.)	

Notice the convention for drawing bonds in 3-D space, where:

- the wedge () represents a bond coming out of the paper, and
- the dash () represents a bond going behind the paper.

Name: _____

Section: _____

Formula	Number of valence electrons	Lewis dot structure	VSEPR structure	Molecular Geometry	Bond angle on central atom(s)	Polar? Nonpolar?
I ₂						
H ₂ S						
PBr ₃						
CS ₂						

Name: _____

Section: _____

Formula	Number of valence electrons	Lewis dot structure	VSEPR structure	Molecular Geometry	Bond angle on central atom(s)	Polar? Nonpolar?
CHCl_3						
PO_3^{-3}						
PO_4^{-3}						
CH_2O						

Name: _____

Section: _____

Formula	Number of valence electrons	Lewis dot structure	VSEPR structure	Molecular Geometry	Bond angle on central atom(s)	Polar? Nonpolar?
SO_3						
SO_3^{2-}						
SO_4^{2-}						
NO_2^-						

Name: _____

Section: _____

Formula	Number of valence electrons	Lewis dot structure	VSEPR structure	Molecular Geometry	Bond angle on central atom(s)	Polar? Nonpolar?
CH_2Cl_2						
CO_2						
PH_3						
O_2						