Lab Lewis Dot Structures Scholars

Objective:
Dot Structures for molecules and polyatomic molecules
To build 3-D molecules
Utilizing the VSEPR Theory to predict electronic geometry and molecular geometry

Introduction:
Generation of molecular models can be accomplished by first predicting Lewis Structures and then using Model Kits to construct 3-D models. The 3-D models aid in understanding the polarity, reactivity and geometry of the covalently bonded species.

Lewis Structures are based on the following method:

1. Count valence electrons for all atoms
2. Write the symbols for the atoms to show which atoms are attached to which, and connect them with a single bond (use a dash to represent two electrons).
    a. Arrange atoms in molecule/ion symmetrically. Hydrogens are always on the outside, least electronegative atoms tend to be in the center and atoms that are fewest tend to go in the central place.
3. Complete the octets of the atoms bonded to the central atom
4. Place any leftover electrons on the central atom, even if doing so results in more than an octet.
5. If there are not enough electrons to give the central atom an octet, try multiple bonds.

Breaking the Octet Rule:

1. Unpairing Electrons: If there are not enough to provide a minimum number of single bonds to hold the structure, move some unpaired electrons to the paired electron pool.
2. Extra Lone Pair Electrons: If there are unshared electrons left after all atoms have met the octet rule, you will need to dump the extra electrons on the central atom.
3. Odd Electrons: The least electronegative atoms come out "one electron short" since electrons won't all come in pairs.

VSEPR Theory:

Valence Shell Electron Pair Repulsion Theory is used to predict the geometry of a molecule. The total number of regions of electron density determines the electron-pair geometry in which the central atom is embedded in 3-D.

Electron Pair Geometries:

# regions	electron-pair geometry
2	linear
3	trigonal planar
4	tetrahedral
5	trigonal bipyramid
6	octahedral

If all valence shell electron pairs are used in bonding, then the resulting molecule has the same molecular geometry as its electronic geometry because all regions attach to an atom. However, if 1 or more of the valence shell electron pair regions is nonbonding, these pair will not be visible when looking at the molecular geometry and the molecular geometry will not be identical to the electronic geometry. Structures that obey the octet rule will have the 2, 3, or 4 geometries while the structures that break the octet rule will have the 5 or 6 geometries.

Molecular Geometries:

Valence Electron Pairs	Bonding Electron Pairs	Nonbonding Electron Pairs	Electron Pair Geometry	Molecular Geometry	Approximate Bond Angles
2	2	0	Linear	Linear	180
3	3	0	Trigonal planar	Trigonal planar	120
	2	1		Bent or angular	
4	4	0	Tetrahedral	Tetrahedral	109.5
	3	1		Trigonal pyramidal	
	2	2		Bent or angular	
5	5	0	Trigonal bipyramidal	Trigonal bipyramidal	120, 90
	4	1		See-saw	
	3	2		T-Shape	
6	6	0	Octahedral	Octahedral	90
	5	1		Square pyramidal	
	4	2		Square Planar	

Molecular Polarity:
There are two criteria a molecule must meet if it is to be polar molecule.

1. The molecules must contain at least one polar covalent bond.
2. The molecular geometry must not be symmetrical. This means the bonds may not be arranged in such a way that dipoles cancel.

A good example of nonpolar molecule is CO_2. While each of the C=O bonds is polar, the linear arrangement is symmetrical, causing the bond dipoles to cancel one another to yield no net molecular dipole.

Molecular Models:

Black atoms = Carbon, Silicon, or any other member of Family IVA
Blue atoms = Nitrogen, phosphorus or any other member of Family VA
Red atoms = Oxygen, sulfur or any other member of Family VIA
Green, orange or purple atoms = Halogens
Yellow or white atoms = Hydrogen

Be sure to make single, double and triple bonds with the model kit.

Procedures:

A. Draw the Lewis Structure for each of the Formulas (items #9, #10, #16, #17, #18 break the octet rule). In #6, the N is central and H attaches to O while in #20, the 2 carbons are linked in the center.
B. Construct models using the Model Kit.
C. After each model is built, Sketch it in 3-D perspective using:
   ____ using solid line for bonds in page
   ------ using dotted lines for bonds behind page
   --**----** using wedge lines for bonds coming out of paper
D. Use VSEPR Theory to determine the Electron Pair Geometry for each structure.
E. Use VSEPR Theory to determine the Molecular Geometry for each structure.
F. Predict whether each molecule and ion should be Polar or Nonpolar.
G. Give the approximate Bond Angles in your predicted geometry.

Name _____ Date _____
Lab Partner _____

Lewis Structure 3-D Sketch Other Information

1) NCl_3

valence e- pair on central atom _____
Electronic Geometry _____
Molecular Geometry_____
Bond Angles (Approx) _____
Polar/Nonpolar Molecule _____

2. HCN

valence e- pair on central atom _____
Electronic Geometry _____
Molecular Geometry_____
Bond Angles (Approx) _____
Polar/Nonpolar Molecule _____

3. H_2S

valence e- pair on central atom _____
Electronic Geometry _____
Molecular Geometry_____
Bond Angles (Approx) _____
Polar/Nonpolar Molecule _____

4. CO_2

valence e- pair on central atom _____
Electronic Geometry _____
Molecular Geometry_____
Bond Angles (Approx) _____
Polar/Nonpolar Molecule _____

5. SeO_3^{2-}

valence e- pair on central atom _____
Electronic Geometry _____
Molecular Geometry_____
Bond Angles (Approx) _____
Polar/Nonpolar Molecule _____

Lewis Structure 3-D Sketch Other Information

6. HNO_3

valence e- pair on central atom _____

Electronic Geometry _____

Molecular Geometry_____

Bond Angles (Approx) _____

Polar/Nonpolar Molecule _____

7. CH_2Cl_2

valence e- pair on central atom _____

Electronic Geometry _____

Molecular Geometry_____

Bond Angles (Approx) _____

Polar/Nonpolar Molecule _____

8. SCl_2

valence e- pair on central atom _____

Electronic Geometry _____

Molecular Geometry_____

Bond Angles (Approx) _____

Polar/Nonpolar Molecule _____

9. ICl_4^-

valence e- pair on central atom _____

Electronic Geometry _____

Molecular Geometry_____

Bond Angles (Approx) _____

Polar/Nonpolar Molecule _____

10. SCl_6

valence e- pair on central atom _____

Electronic Geometry _____

Molecular Geometry_____

Bond Angles (Approx) _____

Polar/Nonpolar Molecule _____

Lewis Structure 3-D Sketch Other Information

11. H_3O^+

valence e- pair on central atom _____

Electronic Geometry _____

Molecular Geometry_____

Bond Angles (Approx) _____

Polar/Nonpolar Molecule _____

12. ClO_3^-

valence e- pair on central atom _____

Electronic Geometry _____

Molecular Geometry_____

Bond Angles (Approx) _____

Polar/Nonpolar Molecule _____

13. PCl_4^+

valence e- pair on central atom _____

Electronic Geometry _____

Molecular Geometry_____

Bond Angles (Approx) _____

Polar/Nonpolar Molecule _____

14. SiH_4

valence e- pair on central atom _____

Electronic Geometry _____

Molecular Geometry_____

Bond Angles (Approx) _____

Polar/Nonpolar Molecule _____

15. NO_2^-

valence e- pair on central atom _____

Electronic Geometry _____

Molecular Geometry_____

Bond Angles (Approx) _____

Polar/Nonpolar Molecule _____

Lewis Structure 3-D Sketch Other Information

16. BrF_3

valence e- pair on central atom _____

Electronic Geometry _____

Molecular Geometry_____

Bond Angles (Approx) _____

Polar/Nonpolar Molecule _____

17. SeF_4

valence e- pair on central atom _____

Electronic Geometry _____

Molecular Geometry_____

Bond Angles (Approx) _____

Polar/Nonpolar Molecule _____

18. BrF_5

valence e- pair on central atom _____

Electronic Geometry _____

Molecular Geometry_____

Bond Angles (Approx) _____

Polar/Nonpolar Molecule _____

19. PO_4^{3-}

valence e- pair on central atom _____

Electronic Geometry _____

Molecular Geometry_____

Bond Angles (Approx) _____

Polar/Nonpolar Molecule _____

20. C_2H_4

valence e- pair on central atom _____

Electronic Geometry _____

Molecular Geometry_____

Bond Angles (Approx) _____

Polar/Nonpolar Molecule _____