Shapes

Name: ______________________________

Student ID: __________________________

Date: _______________________________

"What we observe as material bodies and forces are nothing but shapes and variations in the structure of space." — E. Schrödinger

1. VSEPR theory is based on the idea that electrons form groups around an atom and those groups push each other apart to form an optimal structure where each group has its own electronic domain. How many electronic domains are formed from each of the following? (write 0, 1, 2, 3, 4, 5, or 6)

_____ A pair of valence electrons

_____ A pair of core electrons

_____ Two electrons in a single covalent bond

_____ Four electrons in a double bond

_____ Six electrons in a triple bond

_____ A positive charge and single bond

_____ A lone pair and a single bond

_____ A single bond and two lone pairs

_____ Two single bonds and a double bond

_____ A triple bond and a lone pair

_____ A lone pair, double bond & an odd electron

_____ Two lone pairs, a positive charge, two single bonds, and a double bond.

2. There is only one electronic shape that results from a given number of electron domains. In this chapter we will only consider molecules that have 2-6 electronic domains. For each of the following, draw the electronic shape labeling the central atom A and each domain X. Write the name of that electronic shape. Show each unique bond angle once.

2 domains

Example: Linear

180°

X——A——X

3 domains

4 domains

5 domains

6 domains

3. For each substance below, draw a Lewis dot structure and use VSEPR to determine the electronic shape around the underlined atom. Then draw the molecular shape around the underlined atom that results from putting atoms in some or all of its electronic domains. Write the name of that molecular shape.

$\underline{C}O_2$	$\underline{O}_3$ (only central atom is underlined)
$\underline{Be}Cl_2$	$\underline{Al}H_3$

4. Solve for each underlined atom below as you did in problem #3.

$\underline{P}F_5$	$\underline{Cl}F_3$
$\underline{I}_3^{1-}$ (only central atom is underlined)	$\underline{S}Br_4$

5. Solve for each underlined atom below as you did in problem #3.

$\underline{C}H_4$	$\underline{P}F_3$
$H_2\underline{S}O_4$	$H_2\underline{O}$
$\underline{N}H_4^{1+}$	$\underline{Xe}O_2$
$\underline{P}O_4^{3-}$	$\underline{C}H_3CN$

6. Solve for each underlined atom below as you did in problem #3.

<u>S</u>F_6	<u>Br</u>F_5

<u>Xe</u>F_4

7. Solve for each underlined atom below as you did in problem #3.

<u>C</u>N<u>C</u>O<u>C</u>H_3

8. Not all substituents occupy the same space in an electron domain. Lone pairs take more space than any bond. Because of hybridization, triple bonds take more space than double bonds, and double bonds take more space than single bonds. Atoms with a larger atomic radius take more space than atoms with a smaller atomic radius. This effects what position each occupies around the central atom. It also causes bond angles to compress or stretch. For each structure below, draw the molecular structure and label each unique bond angle around the underlined atom. If the ideal bond angle is stretched, write “>” in front of it. If the ideal bond angle is compressed write “<“ in front of it (example “<120˚”).

$\underline{Xe}F_4$	$\underline{C}H_2O$
$\underline{P}ClF_4$	$\underline{Cl}F_5$
$\underline{P}OCl_3$	$\underline{S}Cl_2F_4$

9. Molecules with large net dipole moments are polar. Many physical properties can be predicted from a molecules polarity. Polar molecules' have higher boiling points, can be affected by e-m fields, can readily solvate ionic solids, and mix or dissolve well only with other polar substances. The net dipole of a molecule is the vector sum of each of its bond dipoles. Consider any bond dipole greater than 0.4 as significant. For each substance below, draw its molecular structure and draw the net dipole that results from any significant bond dipoles.

Note: EN of Al = 1.5, P = 2.1, S = 2.5, Xe = 2.6, Cl = 3.0

BeHF	PF_3
PCl_2F_3	BF_3
CH_2Cl_2	$XeCl_2F_2$