Honors Chemistry Lab #16- Molecular Structure & Bonding

Introduction: Explaining the shapes of molecules is important in understanding how molecules react. The valence shell electron pair repulsion (VSEPR) model is based on the premise that in order to attain the lowest energy scenario, electron pairs around the central atom will position themselves to allow for maximum separation. The purpose of this lab is to construct a series of compounds using the VSEPR model and to use your model to determine the type of bonding and the geometry around each central atom. During this lab you will 1). Construct a series of compounds, using the VSEPR model, 2). Relate each constructed model to the electron dot structure around the central atom, 3). Describe and name the molecular geometry of each model. 4). Work to complete a table that details the intermolecular forces between different compounds.

Procedure: 1). For each of the molecules or ions, determine the number of lone pairs and bonded pairs around the central atom by drawing the Lewis Dot Structure. Remember that double and triple bonds count as one effective pair (or cloud) each around the central atom. 2). Build a model for each compound or ion using the Molymod sets. Arrange the atoms to maximize the distance between all the electron pairs. Remember that lone pair electrons cause more repulsion than electrons between atoms. 3). Describe the structure you have created based on your "shape sheet". 4). Estimate the angle between the atoms attached to the central atom. 5). Calculate the formal charge. 6). Identify the inter- and intra-molecular forces present within and among like molecules.

Qty.	Element	Colour	Holes
6	Carbon (C)	Black	4
14	Hydrogen (H)	White	1
1	Boron (B)	Beige	3
1	Nitrogen (N)	Blue	3
2	Nitrogen (N)	Blue	4
6	Oxygen (O)	Red	2
1	Oxygen (O)	Red	4
1	Sulphur (S)	Yellow	2
1	Sulphur (S)	Yellow	6
1	Phosphorus (P)	Purple	5
1	Phosphorus (P)	Purple	3
6	Halogen (Cl,F)	Green	1
2	Metal (Na)	Grey	1
2	Metal (Ca,Mg)	Grey	2
1	Metal (Be)	Grey	2
1	Metal (Al)	Grey	3
1	Metal (Si, Cu)	Grey	4
1	Metal	Grey	6
1	** sp3	Beige	4
1	** dsp3	Beige	5
1	** d2sp3	Beige	6
3	Lone pair electron cloud		
Qty.	**Links**		
20	Medium	Grey	
12	Long flex.	Grey	
5	Medium	Purple	

Molymod Instructions:

1). Please do not open bags that contain items that will not be utilized during this lab.

2). Make sure that you read the table to the right to determine the color scheme for various elements and bond types. Note that elements may vary in the number of holes they have depending on the bond types.

3). It is imperative that you do not misplace any of these contents. Make sure to check the floors and sinks to ensure all materials are returned upon completion of the lab.

4). The medium grey links are single covalent bonds. The long, flexible grey links are used for double or triple bonds. The beige paddles are lone electron pairs for the central atom. You may need two Molymod sets to build some of the molecules.

Q1. Create a full-page table to collect your data. In 8 columns organize the following: molecule/ion name, number of lone pairs on the central atom, number of effective pairs around the central atom (i.e., electron clouds, electron groups), electron-group shape, formal charge, resonance (yes/no), angle between bonds around central atom, geometry (shape) of

molecule. In 17 rows you will have the following molecules/ions: hydrogen cyanide, carbon dioxide, water, ammonia, carbonate, ozone, carbon tetrachloride, phosphine (PH_3), nitrate, nitrogen dioxide, sulfur dioxide, ammonium, phosphorus pentachloride, sulfur tetrafluoride, xenon tetrafluoride, formic acid (CHOOH), and sulfur hexafluoride.

Q2. Draw the Lewis structures for each of the 17 molecules listed in your data table. Build each of the molecules/ions using the Molymod sets. Complete your data table as you finish each molecule/ion.

Q3. Compare the intermolecular forces that exist between the two substances (a-g) and indicate which substance would have a higher boiling point.

Substance #1	**Predominant Intermolecular Force**	**Substance #2**	**Predominant Intermolecular Force**	**Substance with Higher Boiling Point**
(a) HCl(g)		I_2		
(b) CH_3F		CH_3OH		
(c) H_2O		H_2S		
(d) SiO_2		SO_2		
(e) Fe		Kr		
(f) CH_3OH		CuO		
(g) NH_3		CH_4		

Please self-assess your lab report using the checklist/rubric.