

Molecular Models 1

Post-Lab Questions

1. Why can we ignore the disposition of the lone pairs on terminal atoms?
2. How does bonding change for O_2 , N_2 and F_2 ? How do you expect this to affect their chemistry? Why?
- 3a. Describe the structural changes that occur for the molecules BH_3 , CH_4 , NH_3 , H_2O , HF as the central atom changes. According to the Lewis/VSEPR theory of bonding why do these changes occur?
 - b. What are the ideal bond angles in each compound? Which ones are expected to be distorted?
 - c. Give the hybridization of the central atom in each molecule.
4. Borane, BH_3 , actually exists as diborane, B_2H_6 , but the bonding in diborane can not be adequately described by a Lewis dot structure. Why?
- 5a. Compare the structures in Group A where the central atoms are in the same group of the periodic table (i. e., SiH_4 and CH_4 , NH_3 and PH_3 , and H_2O and H_2S). What structural similarities do you see for elements in the same group?
 - b. Now consider the compounds containing P and S in Group C. What structural differences do you observe within a group in the periodic table? How are these differences explained in Lewis theory? In valence bond theory?
 - c. How do you expect the chemistry of the elements to change descending a group, given the different structures available to the heavier elements?
- 6a. Calculate the formal charges and oxidation numbers on each atom for the following chemical species CO , CO_2 , CO_3^{2-} .
 - b. Describe the structural and electronic changes that occur when oxygen atoms are sequentially added to CO . According to VSEPR theory why must the structure change?
7. Describe the structural and electronic changes that occur when oxygen atoms are sequentially added to SO_2 to give SO_3 and then SO_4^{2-} .
8. What structural and electronic changes accompany protonation (adding an H^+ to) CO_3^{2-} (to form HCO_3^-) and SO_4^{2-} (to form HSO_4^-)?
9. Describe the structural and electronic changes that occur when an electron is removed from NO_2^- to give NO_2 and then another electron is removed to give NO_2^+ .
- 10a. Classify the molecules you have constructed in part F by their functional group.
 - b. Identify the hybridization about each carbon atom.