South Pasadena • AP Chemistry

Name_____
Period _____ Date ___/___/___

9 • Bonding & Molecular Structure

MORE FRQ PRACTICE

1. Consider the molecules PF_3 and PF_5.

(a) Draw the Lewis electron-dot structures for PF_3 and PF_5 and predict the molecular geometry of each.

(b) Is the PF_3 molecule polar, or is it nonpolar? Explain.

(c) On the basis of bonding principles, predict whether each of the following compounds exists. In each case, explain your prediction.

(i) NF_5

(ii) AsF_5

2. Answer the following questions using principles of chemical bonding and molecular structure.

(a) Consider the carbon dioxide molecule, CO_2, and the carbonate ion, CO_3^{2-}.

(i) Draw the complete Lewis electron-dot structure for each species.

(ii) Account for the fact at the carbon-oxygen bond length in CO_3^{2-} is greater than the carbon-oxygen bond length in CO_2.

(b) Consider the molecules CF_4 and SF_4.

(i) Draw the complete Lewis electron-dot structure for each molecule.

(ii) In terms of molecular geometry, account for the fact that the CF_4 molecule is nonpolar, whereas the SF_4 molecule is polar.

Answer 1:

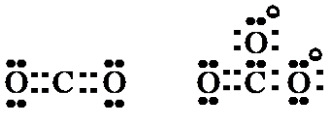
(a) PF_3 = tripod (pyramid); PF_5 = trigonal bipyramid

(b) polar; net dipole moment toward the non-symmetrical position of the fluorines.

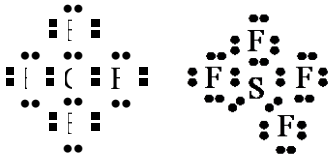
(c) (i) NF_5 - doesn't exist, nitrogen can't hybridize to form the *dsp*^{3} orbitals and is also too small to accommodate 5 fluorine atoms around it.

(ii) AsF_5 - does exist, arsenic can hybridize to form the *dsp*^{3} orbitals and is large enough to accommodate 5 fluorine atoms around it.

Answer 2:

(a) (i)  , there are two other similar resonance structures for the carbonate ion.

(ii) the pi O=C double bond in CO_2 is shorter than a single O-C resonance sigma-bond (all are identical and are about 1 1/3 bond) found in a carbonate ion.

(b) (i) 

(ii) in the tetrahedral CF_4, the polar C-F bonds are cancelled out by the equiangular pull of the 4 bonds. With an expanded octet and trigonal bipyramidal structure, SF_4 has a pair of unbonded electrons at the center of the bipyramid, this gives a "seasaw" shape to the molecule and an uneven pull to the polar S-F bonds.