

Assignment 7 and Practice Third Exam

Study Guide:

We're not going to be able to cover all the material shown in the original syllabus on the web site, so here's a summary of the sections in the text that we will cover on the last exam.

Ionic bonding, Lewis diagrams, Formal charge: 3.2, 3.3, 3.4

Electronegativity, Dipole moments, and Percent ionic character: 3.5

Molecular structure and VSEPR theory: 3.6

Diatomic molecular orbitals: 16.1

Hybridization: 16.2

Bonding in simple organic molecules: 17.1

Problems from the book:

Chapter 16:

Problems 3, 5 & 7 (which go together), 11, 15 & 17 & 19 (and consider what VSEPR has to say about the molecules in each of these three), 23, and especially 25, which brings several ideas to one molecule. Problems 50 and 51 provide good practice, too.

Chapter 17:

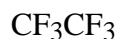
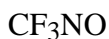
Problems 1 and 3 are typical of the type we'll discuss in lecture and in some of the practice problems below.

1. Draw the structures of the following molecules, and don't forget their lone pairs!
 - (a) thiocyanide anion, SCN^-
 - (b) acetone, $(\text{CH}_3)_2\text{CO}$
 - (c) thioacetamide, CH_3CSNH_2
 - (d) oxalic acid, $\text{H}_2\text{C}_2\text{O}_4$ (which will make more sense to you if written HOOCCOOH)
2. Some short answer or fill-in-the-blank questions:
 - (a) Why is chlorine pentafluoride polar but phosphorus pentafluoride isn't?
 - (b) Why is the PH_3 dipole moment less than that for NH_3 ?
 - (c) There are _____ distinctly different molecules with the empirical formula C_2HFCl_2 .
 - (d) The molecule PBr_2Cl_3 (must have, could have, could never have) a dipole moment.
 - (e) The molecular orbital electron configuration of the carbide ion, C_2^{2-} , is _____.
3. The molecule CF_3NO is a lovely pale blue gas that decomposes when irradiated according to the net reaction

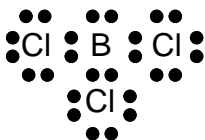
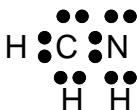


forming hexafluoroethane, CF_3CF_3 , and nitric oxide, NO . Draw the Lewis electron dot structure of CF_3NO , and then answer the following questions.

- (a) CF_3NO has (0 1 2 3) π bond(s). (Circle the correct choice.)
 (b) The hybridization scheme used by the N atom is _____ .
 (c) The hybridization scheme used by the C atom is _____ .
 (d) The hybridization scheme used by the O atom is _____ .
 (e) The molecule has _____ lone pair(s) of electrons.
 (f) The C–N–O bond (is is not) linear. (Circle the correct choice.)
 (g) The formal charge on the N atom is _____ .
 (h) The strongest bond in CF_3NO is most likely between the atoms _____ and _____ .
 (i) The following are paramagnetic: (Circle all that are.)



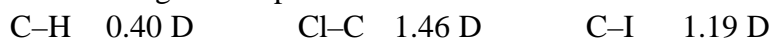
4. Each of the following Lewis dot structures has one or more deficiency that makes it somewhere between less than optimal or dead wrong. Draw the optimum structure and state what is bad about the structures below.

(a) BCl_3 (b) NO_2 (c) OCS (d) CH_2NH 

5. Some dipole moment questions:

(a) The dipole moment of ClF is $0.8881 \text{ D} = 2.96 \times 10^{-30} \text{ C m}$, and the bond is 11.3% ionic. What is the ClF bond length?

(b) Given the following bond dipole moments:



predict the magnitude and direction for the dipole moments of the linear molecules:

(i) $\text{Cl-C}\equiv\text{C-H}$ (ii) $\text{I-C}\equiv\text{C-H}$ (iii) $\text{I-C}\equiv\text{C-Cl}$

(c) The molecule Cl_2CO , phosgene, has a net dipole moment that points one way or another along one bond in the molecule. Which bond is it, and how can you tell? (Don't worry about its direction along that bond.)

(d) There are many compounds that contain Pt with four things bonded to it in a square planar arrangement. (The chemotherapy drug called cisplatin is one such.) Consider the two generic types of compounds with empirical formulas PtAB_3 and PtA_2B_2 in which A and B are atoms bonded to the Pt. Let's assume A is more electronegative than B. Draw all possible isomers of these compounds, and indicate the direction of the net dipole moment (if there is one).

6. Give the electron pair geometry and the molecular geometry of each of the following oxides. Draw molecular structures for each, showing all single bonds, multiple bonds, and lone pairs to support your geometry assignments.

- (a) CO_2 electron pair geometry: _____ molecular geometry: _____
(b) SO_3 electron pair geometry: _____ molecular geometry: _____
(c) XeO_4 electron pair geometry: _____ molecular geometry: _____