CHEM 281. Home Work 3

Chapter 3.

1. Define the following terms: (a) LCAO theory; (b) σ orbital; (c) VSEPR theory; (d) hybridization
2. Define the following terms: (a) network covalent molecules; (b) intramolecular forces; (c) electronegativity; (d) hydrogen bonding.
3. Use a molecular orbital diagram to determine the bond order of the H_2^- ion. Would the ion be diamagnetic or paramagnetic?
4. Would you expect Be_2 to exist? Use a molecular orbital energy diagram to explain your reasoning.
5. Use a molecular orbital diagram to determine the bond order in the O_2^+ ion. Write an electron configuration $[KK(\sigma_{2s})^2, \ldots]$ for this ion.
6. Assuming that it has similar molecular orbital energies to those of carbon monoxide, deduce the bond order of the NO^+ ion.
7. Assuming that it has similar molecular orbital energies to those of carbon monoxide, deduce the bond order of the NO^- ion.
8. Construct electron-dot diagrams for: (a) the ammonium ion; (b) carbon tetrachloride; (c) the silicon hexafluoride ion, SiF_6^{2-}; (d) the pentafluorosulfate(IV) ion, SF_5^-.
9. Construct an electron-dot diagram for the nitrite ion. Draw the structural formulas of the two resonance possibilities for the ion and estimate the average nitrogen-oxygen bond order. Draw a partial bond representation of the ion.
10. The boron trifluoride molecule is depicted as having three single bonds and an electron-deficient central boron atom. Use the concept of formal charge to suggest why a structure involving a double bond to one fluorine, which would provide an octet to the boron, is not favored.
11. For each of the molecules and polyatomic ions in Exercise 3.8, determine the electron pair arrangement and the molecular shape according to VSEPR theory.

12. For each of the following covalent compounds, deduce their molecular shape and the possible hybridization of the central atom: (a) indium(I) iodide, InI; (b) tin(II) bromide, $SnBr_2$; (c) antimony tribromide, $SbBr_3$; (d) tellurium tetrachloride, $TeCl_4$; (e) iodine pentafluoride, IF_5.
13. Arsenic trifluoride and arsenic trichloride have bond angles of 96.2º and 98.5º respectively. Suggest reasons for the difference in angles.
14. Predict which of the following gas-phase reactions is the more favored and give your reasoning.

$NO + CN \rightarrow NO^+ + CN^-$

$NO + CN \rightarrow NO^- + CN^+$

15. In solid xenon tetrafluoride, XeF_4, the average Xe-F internuclear distance is 323 pm, The covalent radius of xenon is about 130 pm while its van dcr Waals radius is 217 pm. Discuss the Xe-F bond strength.