1) Consider three possible structures for methylene fluoride (CH$_2$F$_2$); one tetrahedral (structure A), and two planar (structures B, and C). Based on the observation of a dipole moment in CH$_2$F$_2$, can any of these structures be eliminated? If so, which one(s)? Does the observation of the dipole moment permit one to choose only one structure? Why or why not?

![Structures A, B, and C]

2) The ionization energy of O$_2$ is smaller than the ionization energy of atomic O; the opposite is true for N$_2$ and atomic N. Explain this behavior in terms of the molecular orbital diagrams for N$_2$ and O$_2$.

For these next two problems, you should review Valence Bond Theory in the book. (pp. 410-423) [Table 10.2 (p. 413) will be helpful too.]

3) Fluorine gas, F$_2$(g), can be induced to react at 150$^\circ$C with bromine, Br$_2$(g), to give a compound BrF$_n$(g). If 423 mL Br$_2$(g) at 150$^\circ$C and 748 mm Hg produced 3.28 g BrF$_n$, what value does n have? Describe the bonding in the molecule, using valence bond theory.

4) The N$_2$O molecule is linear and polar.
   a) On the basis of this experimental evidence, which arrangement of atoms (NNO or NON) is correct? Explain your answer.
   b) On the basis of your answer to part (a), write the Lewis structure of N$_2$O (including resonance forms.) Give the formal charge on each atom, and the hybridization on the central atom.
   c) A possible resonance form for these atoms would be $\text{\downdownarrows}$. How would you describe the bonding in this form in terms of orbitals used?

5) Suppose that the ethane molecule, CH$_3$CH$_3$, is broken up so that each CH$_3$ fragment retains one of the two electrons which were present in the C-C bond. What sort of geometry would you predict for each of these identical fragments? Make a reasonable
estimate of the bond angle expected, and support your prediction. (This is the sort of question with which chemists often are asked to wrestle.)