

5. (16 pts.) Draw Lewis structures for the following molecules.

a. PCl_3

b. SCN^-

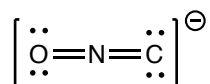
6. (6 pts.) When chemists talk about first molar ionization energies, what reaction are they talking about? Pick an element and write the reaction.

7. (8 pts.) Electron affinity for Li is -60 kJ/mol, whereas the electron affinity for Be is 241 kJ/mol. This seems odd since Be has a more positive nucleus. How can you rationalize the observation that adding an electron to Li is more favorable than adding one to Be.

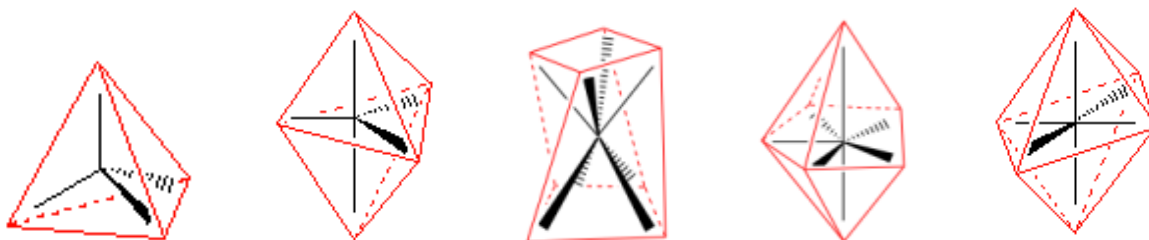
8. a. (4 pts.) Draw resonance structures for the molecule that is drawn below.

b. (4 pts.) Calculate the formal charges for the atoms (label all atoms, even those with a 0 formal charge) in all of the resonance structures.

c. (4 pts.) Rank the structures from lowest (#1) to highest (#2, #3, etc.) energy.



9. (12 pts.) Some possible arrangements for bonds around a central atom are drawn below. Assume that there are atoms at the ends of all the bonds and label each drawing with the appropriate name: tetrahedral, square antiprismatic, pyramidal, bent, v-shaped, trigonal bipyramidal, trigonal planar, pentagonal bipyramidal, octahedral, see-saw, T-shaped.



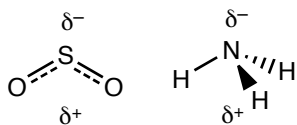
10. (12 pts.) In comparison to the repulsion between pairs of electrons in nonpolar σ bonds, explain how the following features affect the bond angles in a molecule. That is, consider a C–H bond and (i) describe whether the item listed below would require more or less space than a C–H bond, and (ii) describe what the feature would do to other bond angles in the molecule; in other words, would the bonds angles be larger or smaller than “ideal”.

a. lone pair electrons

b. π bonds

c. bonds to electronegative atoms

11. (10 pts.) In general chemistry you learned that NH_3 was is a polar molecule. This year you learned that the general chemistry method (a molecule is polar if bond dipoles concentrate opposite charges on opposite sides) is not universally applicable. For example, the dipole in SO_2 is not what the general chemistry method would predict. Describe under what conditions it is safe to use the general chemistry method, and when the general chemistry method may lead to the wrong conclusion. (Hint: Draw proper Lewis structures for the compounds below and draw dipole arrows on the polar bonds.)



12. (8 pts. ea.) Determine the three-dimensional shapes of the following molecules and explain your choice (lone pairs not on the central atom have been omitted for clarity).

