Strategy for Writing Lewis Structures (Revised)

These "rules" will work for a large majority of organic compounds. Those systems that may <u>not</u> work using this method include: a) some carbocations (meaning, a compound that looks like this: $C_mH_n^+$); b) any compound with an odd number of valence electrons (i.e., radicals).

1. Determine the total number of valence electrons by adding the valence electrons in the constituent atoms (adjust for charge if needed).

2. Write the skeletal structure linking the necessary atoms with single covalent bonds. This structure has the minimum number of bonding electrons.

3. For each bond, subtract two electrons from the total number of valence electrons to give the total number of electrons that can exist as non-bonded electrons or forms of multiple bonds (if the number here is zero, you can skip to step 7!).

4. Determine the number of electrons required to fill the octet around each* (except hydrogen, which requires two electrons). If the number equals the number calculated in Step 3, place the electrons as non-bonded electron pairs around the appropriate atoms to complete the structure.

5. If the number of electrons determined in Step 3 does not provide all atoms with octets, we must use multiple bonds. Subtract the number from Step 3 from Step 4, and then divide by two. If this number is 1, a double bond must be used. If the number is 2, either two double bonds or a triple bond must be used. (etc., etc.)

6. Modify the structure with the appropriate number of multiple bonds. The remaining electrons are non-bonded electrons that satisfy the individual electronic requirements of each atom.

7. Indicate all formal charges that are non-zero:

   formal charge = number of valence e^- – (number of nonbonding e^- +1/2 number of bonding e^-)

*Also note: some organic molecules contain atoms beyond the second row, such as sulfur and phosphorus. These types of atoms can have more than eight bonded and non-bonded electrons in a Lewis structure.

If you have more than one Lewis structure generated following the above rules, these are known as resonance structures. In order to evaluate which of these structures is the best Lewis structure, follow the guidelines given on the other side of this sheet.

"Non-equivalent Resonance Structures"

To decide which resonance form is more important, use the following four "rules", applied with priority 1 > 2 > 3 > 4.

1. Lewis structures with the maximum number of Lewis octets are the most stable.

2. Avoid charge separation if possible. If needed, preferred structures have charges located on atoms with the most appropriate electronegativity characteristics (e.g., negative charges are placed on more electronegative elements).

3. If charge separation is needed, structures with opposite charges located on atoms with minimum separation are better than those structures with opposite charges on atoms spread farther apart.

4. Charges can be separated if Lewis octets result.

(modified slightly from "Organic Chemistry", by Ouellette and Rawn)