Guidelines for Writing Lewis Dot Structures for Molecules and Polyatomic Ions: (Modified and expanded from: Kroschwitz, Winokur and Lees, 1995)

1. Determine *t*, the sum of the number of electrons that each atom must have to satisfy the octet rule (or duet rule for H).

   Example: For H_20, *t* = 8 for Oxygen, + 2 for Hydrogen, + 2 for Hydrogen = 12

   Example: For CO_2, *t* = 8 for Carbon, + 8 for Oxygen, + 8 for Oxygen = 24

   Example: For NH_4^+, *t* = 8 for Nitrogen, + 4 x 2 for four Hydrogen = 16

2. Determine *v*, the sum of the number of valence electrons in each atom.

   Example: For H_20, *v* = 6 for Oxygen, + 1 for Hydrogen, + 1 for Hydrogen = 8

   Example: For CO_2, *v* = 4 for Carbon, + 6 for Oxygen, + 6 for Oxygen = 16

   [Note: Subtract one from *v* for every positive charge or add one to *v* for every negative charge in a polyatomic ion.]

   Example: For NH_4^+, *v* = 5 for Nitrogen, + 4 for four H, – 1 for charge = 8

3. Find the number of covalent bonds (*b*) in the molecule or polyatomic ion by using the equation $b = (t - v) / 2$. [Note: Each single covalent bond has two electrons.]

   Example: For H_2O, $b = (12 – 8) / 2 = 2$

   Example: For CO_2, $b = (24 – 16) / 2 = 4$

   Example: For NH_4^+, $b = (16 - 8) / 2 = 4$

4. Identify the central atom in the molecule or polyatomic ion by considering the following:
   a. The first atom listed, or the atom other than Hydrogen that appears only once in the chemical formula, is usually the central atom in a molecule or polyatomic ion with only two types of atoms (e.g., N is central in NH_4^+, O is central in H_20).
   b. Carbon is the central atom in a carbon-containing compound (e.g., C is central in CO_2.)
   c. Some atom other than Hydrogen (H) and Oxygen (O) is usually central in a molecule or polyatomic ion with H, O, and a third kind of atom (e.g., S is central in HSO_4^-).

(continued →)

5. Arrange the atoms of the molecule or polyatomic ions around the central atom using the correct number of covalent bonds (*b*) to join these atoms.

Example: H_20 → H – O – H

Example: CO_2 → O = C = O

Example: NH_4^+ →

```
      H
      |          1+
H – N – H
      |
      H
```

6. Complete the Lewis dot structure by assigning nonbonding pairs of electrons to atoms so as to satisfy the octet rule (or duet rule for Hydrogen).

Example: H_20 → H – $\underline{\overline{O}}$ – H

Example: CO_2 → |$\underline{O}$ = C = $\underline{O}$|

Example: NH_4^+ →

```
      H
      |          1+
H – N – H
      |
      H
```

7. Double-check your work by making certain that the total number of electrons in your Lewis dot structure is equal to *v*.

Practice problems (Source: Kroschwitz, Winokur and Lees, 1995)

1. Write Lewis dot structures for the following molecules:

a. CO_2 b. $HClO_3$ c. CO d. C_2H_6 e. OF_2 f. H_2O_2
g. CH_4S h. H_2CO_3 i. SO_3

2. Write Lewis dot structures for the following polyatomic ions:

a. NH_4^+ b. HS^- c. SO_3^{2-} d. PO_4^{3-} e. ClO^- f. HCO_3^-
g. $C_2H_3O_2^-$ h. H_3O^+ i. OH^-