

LEWIS STRUCTURES

Rules for Writing Lewis Structures

1. Determine the total number of valence electrons in the molecule.
 - a. sum the valence electrons of each atom in the molecule.
 - b. add an electron for each negative charge or subtract one for each positive charge on a molecular ion.
2. Draw the bond skeleton of the molecule showing single bonds connecting the atoms.
3. Assume that each bond in the skeleton requires two valence electrons (an electron-pair bond). After subtracting two electrons for each bond from the total number of valence electrons, assign the remaining electrons to give each atom an octet of eight electrons. H, Be, and B do not form an octet.
4. If after each atom has been given a share of eight electrons, there remaining additional electrons, assign the extra electrons to the central atom of the molecule.
5. If there are not enough electrons to complete all of the octets, then move electrons pairs to form multiple bonds between atoms.
6. Determine the formal charge of each atom in the resulting structure(s) and eliminate any structures with unlikely charge distributions (adjacent atoms with the same charge).

$$\text{Formal Charge} = (\text{group \#}) - (\# \text{ of bonds}) - (\# \text{ of unshared electrons})$$

7. See if there are possible equivalent resonance structures. These occurs whenever there are two or more Lewis structures that have identical positions for the nuclei but have different electron arrangements.

EXCEPTIONS TO THE OCTET RULE:

1. *Hydrogen* : For hydrogen atoms, the maximum valence orbital capacity is two electrons.
2. *Beryllium and Boron*: In compounds of beryllium and boron, experiments show that when these atoms form two and three bonds respectively, the bonds are single bonds.
3. *Expanded Octets*: The central atom of some molecules may have more than an octet of electrons. This occurs in cases where the central atom had more than four atoms bonded to it, as in PCl_5 and SF_6 , or where there are more than enough electrons to satisfy the octets of all atoms, as in XeF_2 .
4. *Odd-Electrons Molecules*: Molecules that contain an unpaired electrons are known as free-radicals and tend to be quite reactive.

Exercises:

Draw the Lewis structure of the following : CF_4 , NH_3 , PO_4^{-3} and C_2H_4