

Chapter 9: Lewis Structures

- Goal: Depict all the valence electrons of a covalent “species” (neutral or charged)
⇒ first count up the number of valence electrons in the species
- Always pair up electrons (one has $m_s = +\frac{1}{2}$, the other has $m_s = -\frac{1}{2}$)
 - Between atoms: “shared pair” (that is, a covalent bond!)
 - On one atom: “lone pair”
- In Chapter 10, we will see that Lewis structures will allow us to predict the shape of molecules, which largely determines their physical properties and reactivity!

Rules for Drawing Lewis Structures

- (1) Give every atom a noble gas configuration (if possible)
H: duet (isoelectronic with He) All other main group atoms: octet
- (2) Note that electrons are “double-counted” when checking the duet/octet rule
⇒ the very idea of a covalent bond: a shared electron pair “belongs” to each atom
- (3) Make reasonable connections between atoms
 - (a) Know the common “valences” (that is, the number of connections):

Valence:	1	2	3	4
Groups:	17	2 and 16	13 and 15	14

- (b) Put the atom with the highest valence at the center of the structure
 - (c) Some octet rule exceptions are stable (especially for Groups 2 and 13)
- (4) **Always** label non-zero formal charge on each atom

formal charge = # of valence electrons - # of lone pair electrons - # of shared electron pairs
 - (5) Sum of formal charges must equal overall (real) charge on species
 - (6) Valence expansion (also known as hypervalency) is allowed for atoms in the 3rd period (and below) of the periodic table (why?)
 - (7) Maximize bonding (that is, the number of shared electron pairs in the compound) and minimize formal charge without violating the octet/hypervalency rules
 - (8) Species with an odd number of electrons will have one unpaired electron
 - (a) Species is called a radical (or a monoradical)
 - (b) Location of unpaired electron directs reactivity

(9) Resonance structures

- (a) Draw when there is an ambiguity in the location of electron pairs
- (b) They are often required by the symmetry of the species
- (c) A “movement” or “pushing” of electrons, not of nuclei