Modern Chemistry
Chapter 6
Chemical Bonding
Chemical Bond

- A link between atoms that results from the mutual attraction of their nuclei for electrons
  - Electrostatic attraction between proton and electron
  - Classified by the way the valence e- are distributed around nuclei of combined atoms
Types of Bonds

• Ionic
  – A chemical bond resulting from electrostatic attraction between cations and anions

  – In a pure ionic bond, one atom completely gives up one or more e- to another atom (rarely happens)
  – Illustration:

    \[ A + B \rightarrow A^+ + B^- \]
• Covalent
  – Chemical bond resulting from the sharing of valence electrons between two atoms

  – In a pure covalent the electrons are shared equally between the two atoms (called nonpolar covalent)

  – Most covalent result in the electrons being shared unequally between atoms (called polar covalent)
• No bond is completely ionic and is rarely completely covalent
  – Bonds range between the two extremes
  – Degree of ionic or covalent estimated by comparing electronegativities (ionic character)
    • Greater the difference, the more ionic the bond
      – Range of 1.71—4.0 considered ionic
      – Examples:
        Cs + F
        4.0 (F electroneg.) - 0.7 (Cs electroneg) = 3.3 Ionic bond formed
        Cs becomes cation, F becomes anion
Covalent bonds occur if the difference is less than 50%

• A bond between 2 identical atoms is completely covalent (BrINClHOF)

• Types of covalent
  – Nonpolar
    » A covalent bond in which the bonding electrons are shared equally by bonded atoms, with a resulting balanced distribution of electrical charge
    » Occur with a 0% to 5% ionic character
    » Range of difference falls between 0-0.3
- Polar
  - Pole = unequal distribution of charge
  - Polar covalent bond is a bond where united atoms have an unequal attraction for the shared electrons
  - Occur between 5%-~50% ionic character
  - Range of difference ~.4 - 1.7
Examples

- H to H
  2.1 - 2.1 = 0  nonpolar covalent bond

- H to Cl
  3.0 - 2.1 = 0.9  polar covalent bond
  Because Cl is more electronegative, it has a stronger attraction for the e⁻, thus an uneven pull of electrons occurs—however e⁻ still shared

  Uneven sharing causes a partial positive, partial negative pole
• Metallic Bonding
  – In a liquid or solid state, metals readily give up electrons
  – When only other metal atoms are around, electrons are not accepted and held, they are free to move
  – Free moving electrons called an electron sea—reason for metallic properties of luster, malleability, ductility, and conductivity
Quick Trick

• Polar covalent and nonpolar covalent bonding most readily occurs between nonmetals

• Ionic most readily occurs between metals and nonmetals

• Metallic occurs between metals
Why do atoms bond?

- Atoms will bond in order to lower their potential energy.
- Atoms strive to reach an octet by bonding (ie: can take on the configuration of a noble gas)
Determine the electronegativity difference, bond type, and more electronegative element with respect to the following atoms.

1. H and F
2. Br and Br
3. Al and S
4. Na and S
5. At and Cl
6. Ba and O
7. Si and O
8. Cr and Cl
9. Fe and I
10. K and Br