

# 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<sup>-</sup> to another atom (rarely happens)

- Illustration:



- 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.) -  $.7$  (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  $\sim .4 - 1.7$

# 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