

Topic 5: Bonding Outline

1. Chemical compounds are formed when atoms are bonded together.

- ✓ Breaking a chemical bond is an endothermic process.
- ✓ Forming a chemical bond is an exothermic process.
- ✓ Compounds have less potential energy than the individual atoms they are formed from.

2. Two major categories of compounds are ionic and molecular (covalent) compounds.

- ✓ Ionic compounds tend to be a metal bonding with a nonmetal; or a metal with a polyatomic ion
- ✓ Molecular (covalent) compounds tend to be two or more nonmetals combined.

3. Compounds can be differentiated by their chemical and physical properties.

- ✓ Ionic substances have high melting and boiling points, form crystals, dissolve in water (dissociate), and conduct electricity in solution and as liquids.
- ✓ Covalent or molecular substances have lower melting and boiling points, do not conduct electricity.

4. Atoms gain a stable electron configuration by bonding with other atoms.

- ✓ Atoms are stable when they have a full valence level.
- ✓ Most atoms need 8 electrons to fill their valence level.
- ✓ H and He only need 2 electrons to fill their valence level.
- ✓ The noble gases (group 18) have filled valence levels. They do not normally bond with other atoms.

5. Chemical bonds are formed when valence electrons are:

- ✓ Transferred from one atom to another – ionic.
- ✓ Shared between atoms – covalent.
- ✓ Mobile in a free moving "sea" of electrons – metallic.

6. In multiple (double or triple) covalent bonds more than 1 pair of electrons are shared between two atoms.

- ✓ oxygen and it's family (group 16) form double bonds with each other (O₂)
- ✓ nitrogen and it's family (group 15) form triple bonds with each other (NH₃)
- ✓ carbon can form double and triple bonds with itself & group 16 and 15 elements (ex: CO₂)

7. Polarity of a molecule can be determined by its shape and the distribution of the charge.

- ✓ Polar molecules have an asymmetrical (uneven) distribution of electrons in them.
- ✓ As a result, polar molecules have (+) and (-) charged ends.
- ✓ Water is the most common substance composed of polar molecules; O end is (-), H ends are (+).
- ✓ Nonpolar molecules have symmetrical (even) distribution of electrons in them.
- ✓ Polar substances are dissolved only by another polar substance. Non-polar substances are dissolved only by other non-polar substances.

8. The electronegativity difference between two bonded atoms can determine the type of bond and its polarity.

0.0 = non-polar covalent

0.0 -1.7 = polar covalent

1.7+ = ionic

9. Bonding guidelines:

- ✓ Metals react with nonmetals to form ionic compounds.
- ✓ Nonmetals bond with nonmetals to form covalent compounds (molecules).
- ✓ Ionic compounds with polyatomic ions have both ionic and covalent bonds.

10. Intermolecular forces allow different particles to be attracted to each other to form solids and liquids.

- ✓ Hydrogen bonds are an example of a strong IMF between polar molecules.
- ✓ Hydrogen bonds exist between atoms of hydrogen on one molecule and atoms of either oxygen, fluorine, or nitrogen on a neighboring molecule.
- ✓ Substances with hydrogen bonds tend to have much higher melting and boiling points than those without hydrogen bonds. Water is one such substance
- ✓ Ordinary polar molecules simply attract each other as their oppositely charged ends line up.
- ✓ Nonpolar molecules use weak VanderWaal's forces of attraction and as a result tend to have lower melting points, and higher vapor pressures.

11. Metallic bonding occurs between atoms of metal. The valence electrons are loosely held by all atoms in a mobile "sea" of valence electrons.

- ✓ This type of bonding accounts for some of the unique properties of metals, such as their ability to conduct electricity, luster, and malleability.

12. Physical properties of a substance can be explained in terms of chemical bonds and intermolecular forces. These include conductivity, malleability, solubility, ductility, hardness, melting point and boiling point, vapor pressure