Chemistry Review- Unit 4 – Chemical Bonding

The Nature of Chemical Bonding, Directional Nature of Covalent Bonds, Intermolecular Forces

Bonding

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.

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

- ✓ Ionic substances have high melting and boiling points, form crystals, dissolve in water (dissociation), and conduct electricity in solution and as a liquid.
- ✓ Covalent or molecular substances have lower melting and boiling points, do not conduct electricity.
- ✓ Polar substances are dissolved only by another polar substance. Non-polar substances are dissolved only by other non-polar substances.

4. 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.

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

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

- ✓ Polar molecules must have polar bonds.
- ✓ Polar molecules are asymmetrical.
- ✓ Nonpolar molecules are symmetrical and/or have no polar bonds.

7. When an atom gains an electron, it becomes a negative ion and its radius increases.

8. When an atom loses an electron, it becomes a positive ion and its radius decreases.

9. 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 gasses (group 18) have filled valence levels. They do not normally bond with other atoms.

10. Electron-dot diagrams (Lewis structures) represent the valence electron arrangement in elements, compounds and ions.

- ✓ Electrons in Lewis structures are arranged by their orbitals.
- ✓ The first two electrons are placed together in the "s" orbital.
- ✓ The remaining electrons are spread among the 3 "p" orbitals.
- ✓ The "s" orbital must be filled first. Then each "p" orbital must have one electron before another "p" orbital gains a second.

11. Electronegativity indicates how strongly an atom of an element attracts electrons in a chemical bond. These values are based on an arbitrary scale.

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

0.0 - 0.4 = non-polar covalent
0.4-1.7 = polar covalent
1.7+ = ionic

13. 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.

14. 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 atoms.
- ✓ Hydrogen bonds exist between atoms of hydrogen and oxygen, fluorine, or nitrogen.
- ✓ Substances with hydrogen bonds tend to have much higher melting and boiling points than those without hydrogen bonds.

15. 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.