Honors Chemistry Unit 3 - Bonding Notes

Introduction

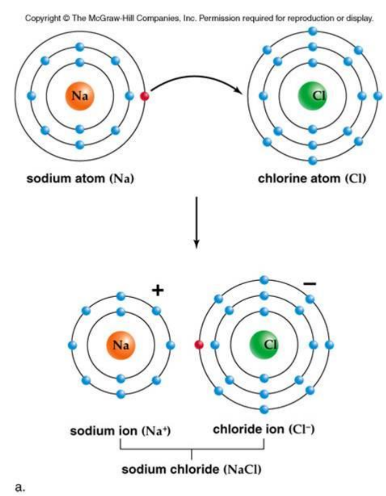
1. What is a chemical bond?

2. Atoms bond to _________________ ________________. How many valence electrons do most atoms want? ____

3. Three Types of Bonds
    a. _______________ - electrostatic force of attraction between (+) and (-) ions
    b. _______________ - sharing of electrons between ________________ atoms
        i. Four sub types:
            1.
            2.
            3.
            4.
    c. ______________ - attraction between metal cations and outer mobile electrons

4. Main questions for each bond type:
    a. What atoms combine to make the bond?
    b. How do the atoms combine together?
    c. What properties result from the bond type created?

Ionic Bonding



1. What is ionic bonding?

2. Key things to remember:

Metals	Nonmetals

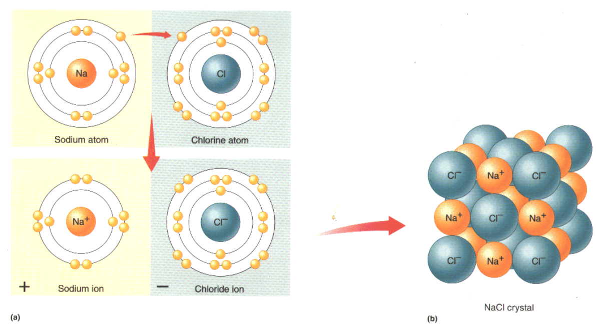
3. Let's try it! **REMEMBER:** **<u>Overall charge must be: _________________________!</u>**
Li and F   Ca and Cl   Na and S   Mg and P   Be and O

4. Lewis dot structures!
    a. Calcium and chlorine

    b. Sodium and sulfur

    c. Beryllium and oxygen

5. Ionic bonding results in the formation of:



6. What is a formula unit?

7. These ions align with each other to create a ________________ _______________:

8. Lattice energy:

9. Properties of ionic compounds
    a. __________ melting points and boiling points. Why?

    b. Soluble in ____________. Why?

    c. Hard crystalline solids but can fracture. Why?

    d. ___________ ___________________ in liquid or dissolved states. Why?

    e. ___________ ___________________ in solid state. Why?

<u>**Covalent Bonding**</u>

1. What is covalent bonding?

2. Ionic or covalent?
    a. CH_4 ionic or covalent
    b. Fe_2O_3 ionic or covalent
    c. I_2 ionic or covalent
    d. H_2O ionic or covalent
    e. $BeCl_2$ ionic or covalent

3. Lewis dot structures

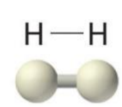
    Helpful hints:
    - Least electronegative compound goes in the middle
    - Must follow the Octet Rule: atoms tend to gain, lose, or share valence electrons so that they have 8 valence electrons
        - Exceptions: H (2 e-), Be (4 e-), B (6 e-)
    - Before and after: count total number of valence electrons

    Let's try it!
    a. H_2O

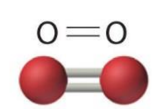
    b. NF_3

    c. CH_2O

    d. N_2

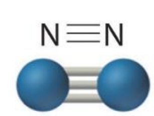


Single bond



Double bond

Label each bond with facts about each →



Triple bond

Polyatomic ions

1. What are they?

2. Let's try it!
   a. ClO_4^-

   b. NH_4^+

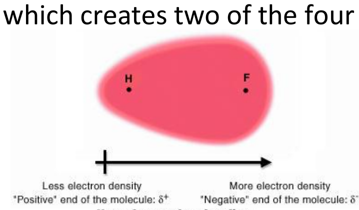
3. Start memorizing these! Found in your Reference Tables!

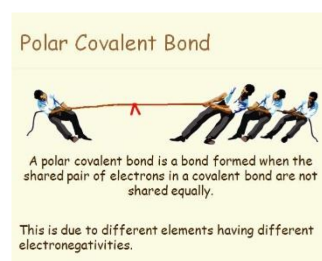
4. Let's try it! What ionic compound with form:
   a. Sodium and carbonate

   b. Calcium and hydroxide

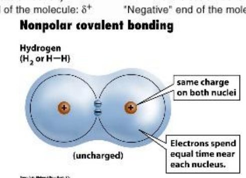
Polarity

1. Not all atoms share electrons equally!
2. The valence electrons can be shared equally or unequally, which creates two of the four types of covalent bonds.
   a. Polar covalent bond:



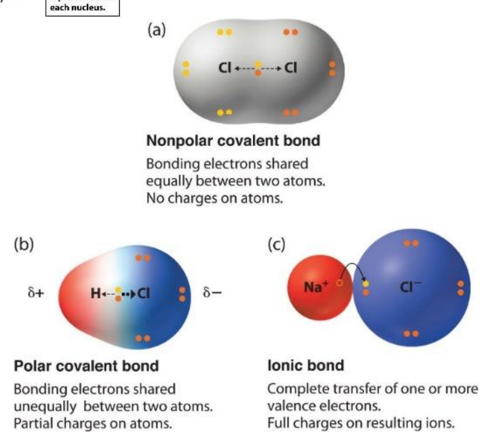


   b. Nonpolar covalent bond:



3. You can determine the bond type using ______________________ values!

   a. _________ - _________ Nonpolar covalent
   b. _________ - _________ Polar covalent
   c. _________ - _________ Ionic



4. Let's try it!
    a. H – S (2.1, 2.5)

    b. S – Cl (2.5, 3.0)

    c. Cs – S (0.7, 2.5)

    d. O – O (3.5, 3.5)

<u>Covalent Bonding continued</u>

1. Molecular compound:

2. Molecule:

3. Diatomic Molecules:

4. When molecules form, the resulting bond has a length, energy and angle associated with it.
    a. Bond Length:

    b. Bond angle:

    c. Bond energy:

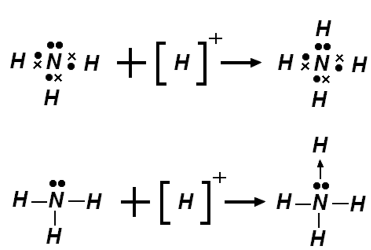
5. _____________ __________: weakest bond, longest bond, least amount of energy

    _____________ __________

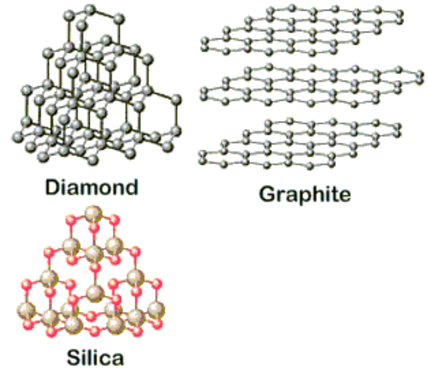
    _____________ __________: strongest bond, shortest bond, most amount of energy

Bond strength increases as the amount of e- shared increases resulting in shorter bonds with greater energy

6. Coordinate covalent bond:



7. Network covalent bond
    a. Definition:



    b. Examples:

    c. Properties:

8. Properties of molecules:

    a. __________ or dull, brittle ________

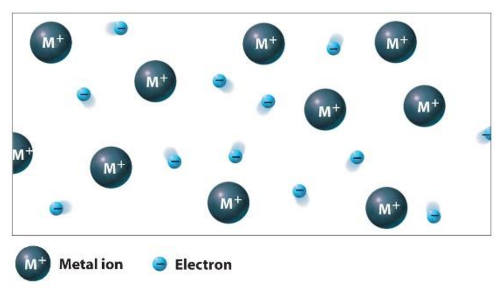
    b. __________ conductors of heat and electricity. Why?

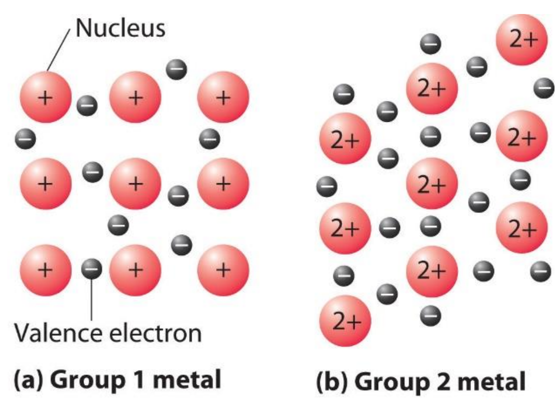
    c. ________ melting and boiling points. Why?

    d. Solubility depends on "______ ___________ ______." What does that mean?

<u>**Metallic bonding**</u>

1. What is it?





2. Strength is determined by:

3. Properties of Metallic Crystals
    a. Hard, metallic crystals
    b. ________ conductors of heat and electricity. Why?

c. __________melting and boiling points. Why?

d. Shiny (___________). Why?

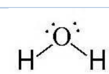
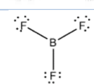
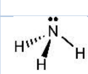
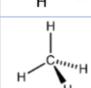
e. __________________(hammered in thin sheets) and ______________ (drawn into thin wires). Why?

f. ________________ in water. Why?

<u>Molecular Geometry – VSEPR Theory</u>

1. VSEPR Theory (____)
   a.

2. Memorize this!

Shape	**# Bonds to Central Atom**	**# Lone Pairs to Central Atom**	**Examples**	**Bond Angles**
Linear	2 atoms together or 2 bonds to central atom	0	H-Cl O = C = O	180°
Bent	2 2	2 1		104.5°
Trigonal Planar	3	0		120°
Trigonal Pyramidal	3	1		107.5°
Tetrahedral	4	0		109.5°

<u>Molecular Polarity</u>

1. What is it?

2. Molecular polarity depends on:
   a. Bond polarity:

   b. ***MORE IMPORTANTLY* Molecular shape:**

3. Molecular polarity influences intermolecular forces!
4. Nonpolar molecules are ___________________
5. Polar molecules are ____________________

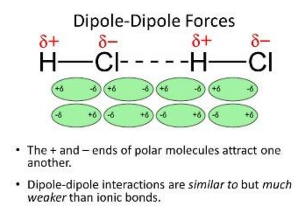
    a. Polar molecules are called ___________ because they have negative and positive ends of the molecules.
6. Let's try it! Name and sketch the shape of the following. Is it polar or nonpolar?
    a. H_2O

    b. CBr_4

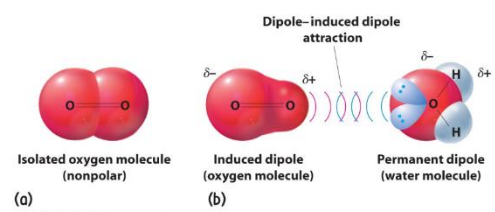
Intermolecular Forces (IMFs)

1. What are they?

2. Five types:
    a.
    b.
    c.
    d.
    e.
3. Dipole-dipole
    a. Exist between ___________ molecules
    b. Causes molecules to have _____________ melting points and boiling points than expected
    c. Substances exist mostly as ___________ or ___________ due to the strength of the imf



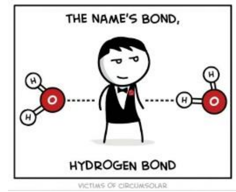
4. Dipole-induced dipole forces
    a. Exists between ____________ and ___________ molecules.
    b. How is it created?



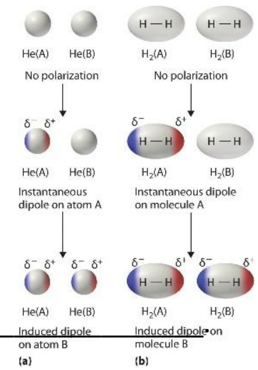
    c. Ex?
5. Ion-dipole forces
    a. Exists between an _______________ and a ____________ molecule.
    b. How is it created?

    c. Ex?

6. Hydrogen bonding
    a. This is a special dipole-dipole force that is the **strongest** of the dipole-dipole forces.
    b. When does it occur?



    c. This imf gives water its unusual properties:
        i.
        ii.
        iii.



7. London Dispersion Forces
    a. This is the ONLY type of imf that can occur in ________________ molecules.
    b. How is it created?

    c. This is the ______________ imf and its strength increases with ____________________________
    d. Causes molecules to have ________ melting and boiling points.
    e. Most of the substances with only LDF imfs are ___________.
    f. <u>Special note:</u>

8. Rank the intermolecular forces from strongest to weakest:

<u>Properties and bonding</u>

1. Melting point:

2. Boiling point:

3. Density:

4. Color:

5. Solubility:

6. Stronger bonds/imfs =

   Weaker bonds/imfs =