Chemistry
Chapter 8 – Covalent Bonding

Name ________________________
Date __________________________

Covalent Bonds

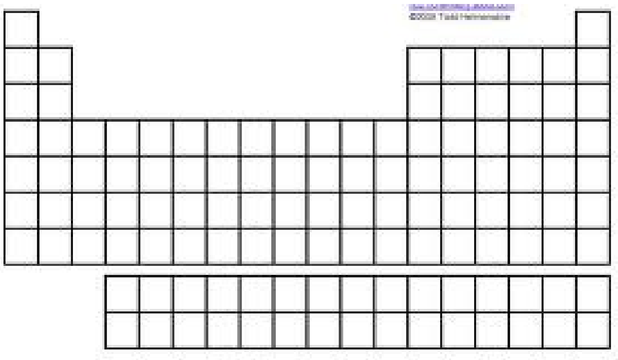
- Formed between __________________.
- Covlent compounds __________________ electrons so that each atom has an ____________ of electrons in its highest occupied energy level.
- Covalent compounds are often called ___________________.
    - *Whereas ionic compunds are called formula units.*

Properties of Molecular Compounds

- Do not ___________________ electric current in solution.
- Have ___________ solubilities.
    - *May or may not dissolve*
- Have lower _________________________________.
- Many are __________________ or _________________ at room temperature.

Diatomic Molecules

- Comprised of ______________ atoms.
- Gases that exist as diatomic molecules are often referred to as the ________________________.
    - **List of the "Super 7":**



Covalent Bond Formation

- Atoms will form single, double, triple or a combination of bonds to get to an octet of electrons.
- **The HONC Rule –**

  always put the element that wants to form the most bonds in the center and place the other elements around!

    - Hydrogen (and Halogens) form one covalent bond
    - Oxygen (and sulfur) form two covalent bonds
        - *One double bond, or two single bonds*
    - Nitrogen (and phosphorus) form three covalent bonds
        - *One triple bond, or three single bonds, or one double bond and a single bond*
    - Carbon (and silicon) form four covalent bonds.
        - *Two double bonds, or four single bonds, or a triple and a single, or a double and two singles.*

Creating Lewis Dot structures for Covalently Bonded Molecules

1. Determine the number of valence electrons from all atoms.
    - ➢ *Also include any charges on compounds* (*polyatomics*)
2. Put the atom that wants to form the most bonds in the center (if more than 2 elements)
    - ➢ *Usually the first atom in the compound*
3. Connect all atoms with a single bond
4. Fill the peripheral atoms with electron pairs to form an octet
5. Fill the central atom with enough electrons to form an octet
6. If there are not enough electrons, you might need to form a double or triple bond
7. In some cases, you will have electrons left over…place them around the central atom (even if they total more than 8).
    - ➢ *Exceptions to the rule are possible*

- **Single Covalent Bonds**
    - ○ 1 single bond = ______________ shared electrons.
    - ○ **Examples:**
        - ▪ H_2
        - ▪ F_2
        - ▪ I_2
        - ▪ H_2O
        - ▪ CH_4
        - ▪ SO_4^{2-}
    - ○ **Single Bond Practice**
        - ▪ Cl_2
        - ▪ C_2H_6
        - ▪ OH^-
        - ▪ NH_4^+
        - ▪ CH_3Cl
        - ▪ PH_3

- **Double Covalent Bonds**
  - 1 double bond = _______________ shared electrons.
  - **Unshared (lone) pairs:** a __________________ of valence _________________ that is NOT shared between atoms.
  - **Examples:**
    - O_2
    - CO_2

- **Triple Covalent Bonds**
  - 1 triple bond = _______________ shared electrons.
  - **Examples:**
    - N_2
    - HCN
    - CO

- **Mixed Practice**
  - H_2O_2
  - PCl_3
  - CN^-
  - MnO_4^-
  - H_2S
  - CCl_4
  - CH_2Cl_2
  - NCl_3

Warm-up

- First write the formulas, then draw Lewis dot structures for the following **IONIC or MOLECULAR** compounds.
    - Silicon tetrachloride
    - Chlorine monofluoride
    - Sodium chloride
    - Phosphorus tribromide
    - Zinc (II) sulfide
    - Nitrogen trihydride (ammonia)
    - Dicarbon dihydride (ethyne)
    - Dicarbon tetrahydride (ethene)

- **Exceptions to the Octet Rule**
    - Some atoms in a molecule can have ________________ or _______________ valence electrons.
    - **Examples:**
        - NO
        - BF3
    - Some atoms in a molecule, in particular, __________________ and __________________ sometimes expand the octet to include ______________ or ______________ electrons respectively.
    - **Examples:**
        - PCl_5
        - SF_6

- **Resonance (*HONORS only)***
    - Electrons rapidly ___________ back and forth between different electron dot structures.
        - *Seen primarily in compounds containing double bonds.*
    - **Examples:**
        - Carbonate
        - Nitrite
        - Nitrate

Polar Bonds – *not all sharing is equal*

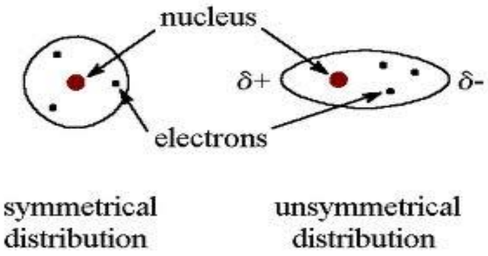
- **Nonpolar Covalent:**
- **Polar Covalent:**
  - The ________________________ atom attracts the electrons more strongly and gains a slightly _______________________ charge.
  - The _________________________ atom has a slightly ___________________ charge.
- **Electronegativity Differences**
  - Use the EN values from the periodic table to subtract the larger value from the smaller.
  - Look at the ranges to decide what type of bond.
    - 0.0-0.4 nonpolar covalent
    - 0.4-1.7 polar covalent
    - 1.7-4.0 ionic
  - **Examples:**
    - HCl
    - Cl_2
    - H_2O

Polar Molecules

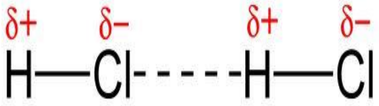
- The presence of a polar bond in a molecule_________________, not not always, makes the entire molecule polar.
  - *A dipole is a molecule that has 2 poles.*
- To decide if a molecule with polar bonds in overall polar you must look at the overall shape.
  - If the "pulls" cancel out because they are ________________________, then the molecule is _________________________.
  - If the "pulls" do not cancel out because they are __________________________, then the molecule is _______________________.
- **Examples:**
  - H_2O
  - SiO_2
  - CF_4
  - CH_2Cl_2

Intermolecular Attractions

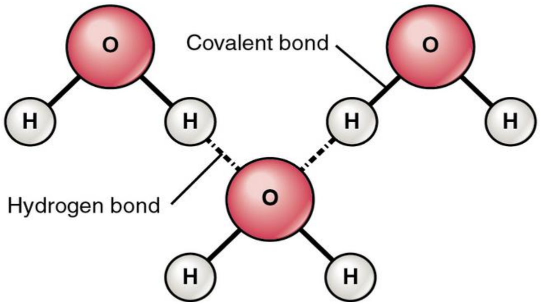
- Attractions between molecules, not ____.
  - *Weaker than either ionic or covalent bonds!*
- **London Dispersion forces (Van der Waals)**
  - Weakest
  - Caused by _______________________________.
  - __________ pairs of molecules experience this force – even nonpolar molecules.



- **Dipole Interactions (Van der Waals)**
  - Attraction between 2 _______________________________.
  - The slightly _______________________ region of a polar molecule is _________________ attracted to the slightly _______________________ region of another polar.



- **Hydrogen Bonding**
  - Strongest
  - Must be _________________ molecules
    - 1 atom must be H
    - 1 atom of O, N, Cl or F



Bond Dissociation Energy

- The energy required to __________________ a bond.
  - **Units:** kJ/mol
  - **Examples:**
    - Cl_2
    - H_2O
    - CH_4
    - CH_2Cl_2
    - CO_2
    - C_2H_2