Chapter 9 HW pp. 390 – 397 Set 1: 16, 18, 22, 26; Set 2: 36, 40, 44, 48; Set 3: 54, 64, 72, 78, 88; Set 4: 90, 92, 110, 126.

1. Chemical Bonding
    a. Elements use their __________ electrons by __________, __________ or __________ these electrons.
    b. The rest of the atom not including the valence electrons is the __________.
    c. Two main types of bonds
        i. __________ - transfer of electrons; the bond is the electrostatic attraction between the cation and anion.
        ii. __________ - sharing valence electrons
            1. Three types
                a. __________ covalent - totally equal sharing
                b. __________ covalent - almost equal sharing
                c. __________ covalent - unequal sharing
2. Ionic Bonding a closer look
    a. Both atoms usually attain a __________ ________ configuration (octet)
    b. Electronegativity difference is __________ and higher
    c. Orbital notation
        i. Orbital notations of each atom is drawn
        ii. Valence electrons that are to be transferred are circled and an arrow is drawn to open space orbital in receiving atom.
        iii. The cation ion and anion orbital notations are then drawn including charges
    d. Lewis dot structures
        i. Proper dot notations are drawn then follow 2 & 3 above.

ii. Be certain that the cation's dot notation only represents the valence electrons. If these have been transferred then there are **<u>no</u>** dots.

e. Lattice Energy of Ionic Compounds

i. Lattice Energy - energy needed to __________ one mole of a solid ionic compound into __________ __________.

ii. Can be determined using __________ law

1. See page 361 Chang 9th Ed Chemistry.

iii. We will use the Born-Haber Cycle

1. Relates __________ energy to __________ energy, __________ __________, and other atomic and molecular properties. It is based on __________ law.

2. Basically, the overall change in energy __________ the __________ of all the __________ __________ to make the crystal. This may involve many steps.
   a. Convert solid to gas; dissociation of molecules into single atoms; removing and adding electrons; combining ions to form crystal

iv. The __________ the lattice energy the __________ stable the ionic compound.

v. Lattice energy is always __________ because the separation of the ionic crystal from solid to gas is, by Coulomb's Law, __________.

vi. There is __________ attraction between ions with __________ charges than between ions of __________ charge.

vii. Lattice Energy can help explain __________ of ionic compounds. Basically, if the lattice energy is __________ than the energy required to make the formula ,then the formula is __________.

viii. Usually _________ solids at room temp.

ix. _________ melting points

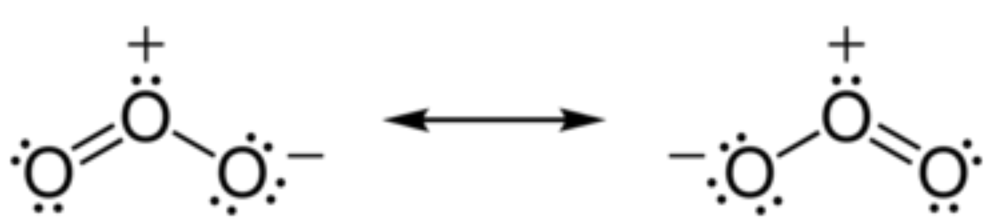
x. _________ electric current when molten

xi. If soluble in water they will also _________ electricity – called _________

3. Covalent Bonding – the friendly bond
   a. Valence electrons a __________ by two atoms
   b. The two shared electrons (with opposite spins) effectively fill an __________ in each atom. This makes a covalent electron pair.
   c. Atoms bond until a __________ configuration is established. The most preferable is __________. The Octet Rule (ominous music plays).
   d. One bond between two atoms is a __________ bond (__________, σ), two = __________ bond (__________, σ and __________, π) and three = __________ bond (σ and 2 π's)
   e. Single bonds are __________ than double which are __________ than triple. Single bonds are __________ than double bonds which are __________ than triple bonds.
   f. There are three types of covalent bonds which depend on the difference in __________.
      i. __________ **covalent** – electronegativity difference of __________ – completely equal sharing of electrons. Exist mainly between two of the same atoms i.e. the diatomic elements.
      ii. __________ **-**__________ **Covalent –** electronegativity difference of __________ – almost equal sharing electrons.
      iii. __________ **Covalent -** electronegativity difference of __________ – unequal sharing of electrons.
   g. Special covalent bond – __________ **covalent bond** – formed when shared electrons come from the __________ atom to achieve __________ rule (ominous music plays).
   h. Properties – Usually __________, __________ or __________ __________ solid since __________ forces are __________ than ionic compounds.
   i. Orbital notation
      i. Electrons that are shared are boxed.
      ii. Each box represents one covalent bond.
   j. Electron Dot Notation

i. Shared electrons are placed in between atoms sharing those electrons. These can be replaced with a dash.
ii. Left over valence electron pairs are placed around the corresponding atom, evenly spaced.

4. Lewis Dot Structures
   a. The best directions I can give as to how to write Lewis Dot Structures is to use your common sense and knowledge about electron stability.
   b. To start determine which atom is going to bond the most number of times. This will be the central atom, the atom most everything else is connected to. If carbon is in the formula it will probably be the central atom.
   c. Place the other atoms around the central atom and bond them to the central atom so that the octet rule is satisfied. If the octet rule cannot be satisfied, try another arrangement. If that still doesn't work count the total valence electrons and start to fill them in to satisfy the octet rule for as many atoms as possible. This may mean using coordinate covalent bonds.
      i. When counting valence electrons present remember to add or subtract electrons for anions(add) or cations(subtract).
   d. Official Lewis Rules – starting after (b.) above
      i. Sum the valence electrons
      ii. Draw single bonds to the central atom
      iii. Complete the octets of the atoms bonded to the central atom
      iv. Place any leftover electrons on the central atom
      v. Does the central atom have an octet? If yes then done. If no, then add a multiple bond (double first) to the central atom until an octet is achieved.
      vi. Try nitrogen trifluoride, nitric acid, and the carbonate ion. (See Chang pg. 373 – 374)
      vii. Now try carbon disulfide, formic acid (HCOOH), and the nitrite ion.
5. Formal Charge and Lewis Structure
   a. An atom's formal charge is the ___________ charge ___________ between the ___________ electrons in an isolated atom and the number of ___________ ___________ to that atom in a Lewis structure.
   b. In ozone, O_3, the O on the left with double bond has ___ valence electrons, as all O's have and _____ assigned electrons which gives a difference of zero. The middle O has 6 valence



electrons and only _____ assigned giving a difference of _____, the O on the right has _____ valence electrons and _____ assigned which gives a difference of _____. (The diagram is showing the resonance structure of ozone)

6. Resonance
    a. Using ___________ or ___________ Lewis structures to represent a particular molecule that ___________ be represented by ___________ structure. One Lewis Structure ___________ fully explain the ___________ structure and in reality ___________ does the resonance structures. The actual structure lies somewhere between.
    b. The reason we have resonance structures is that through experimentation the ___________ ___________ in molecules don't match the proposed Lewis structure. Looking at the Ozone structure above with the double bond and single bond. The ___________ bond should be ___________ than the ___________ bond however, from experimentation it has been found that the bonds in ozone are ___________ than ___________ bonds but ___________ than ___________ bonds.
    c. The resonance structures are sometimes replaced with one structure replacing the ___________ ___________ bond with a single bond and dashed other bond.
7. Exceptions to the Octet Rule – We LOVE exceptions!!!
    a. The ___________ Octet – Sometimes the atoms don't want eight electrons.
    b. ___________ ___________ Molecules – molecules contain an odd number of electrons, nitric oxide (NO) and nitrogen dioxide (NO_2). These molecules are called ___________ and are HIGHLY ___________. Can wreak havoc in body, causes aging (Baylor Theory)
    c. The ___________ Octet - Some atoms just like to break the rules and bond as many times as they have electrons floating around. These atoms use ___________ electrons to bond and form ___________ orbitals (combination of orbitals to make one that fits our theories)
8. ___________ ___________ – the enthalpy ___________ required to ___________ a particular ___________ in 1 ___________ of gaseous molecules. (Enthalpy and energy are just about the same thing.)
    a. It is possible to predict the enthalpy of a reaction using the ___________ bond enthalpies. Remember in order to break a bond energy is ___________, ___________, and when bonds form energy is ___________, ___________. Also remember that ___________ energy is added, is on the ___________ side of a reaction, is listed as ___________. ___________ energy is ___________, is on the ___________ side of a reaction, is listed as ___________.

b. One way to look at this – the change in enthalpy of a reaction is __________ to the __________ energy needed to __________ bonds __________ the __________ energy __________. Using this formula there is __________ __________ for assigning exothermic energy as negative.

c. Another way – incorporates the idea of endo = + energy and exo = - energy. The change in enthalpy of a reaction equals the __________ enthalpy minus the __________ enthalpy.

d. But Wait….There's more!! – we can __________ the actual equations like __________ equations to get the __________ reaction.

   i. __________ bond(s) of one reactant
      __________ bond(s) of other reactant
      __________ both broken reactants to form product
      __________ reaction

1. *1 mole H_2 + 435 kJ ==> ~~2 moles H atoms~~*
2. *1 mole Cl_2 + 243 kJ ===> ~~2 moles Cl atoms~~*
3. *~~2 moles H~~ + ~~2 moles Cl~~ => 2 moles HCl + 2(432 kJ)*
4. *1 mole H_2 + 1 mole Cl_2 ===>2 moles HCl +186 kJ*

This an __________ reaction since the overall energy is on the __________ side and would be reported as a __________ quantity. ΔH^o = __________