Dr. Sandblom's Notes for Chemistry 201 – Friday, October 20, 2005.

Picking up from last class…
Imagine a continuum between these two types:

Ionic <--> **Covalent**

ions	atoms
$A^{+}\ {}^{-}B$	A-A
electrons transferred	electrons shared

In the middle somewhere: electrons not equally shared

9.2 The Ionic Bond (relate this to 8.6)

$$2\ Na_{(s)} + Cl_{2(g)} \rightarrow 2NaCl_{(s)}$$

- here we make Na^{+} and Cl^{-}
- electron **transferred** from sodium to chlorine
- draw Lewis of these ions

Exercises: 9.18 (just do products), 9.20

9.4 The Covalent Bond
How are electrons shared? repulsive and attractive forces need to be balanced

In this MODEL:

- electrons in bonds are *localised* between atoms – single bond is a ***bonding pair*** (also double bond is **two *bonding pairs*,** triple bond is **three *bonding pairs*)**
- some electrons *localised* on atoms will not participate in bonding - ***lone pairs***

How strong is the glue?

- **bond energy** and **bond length** Figure 9.3

9.5 Electronegativity
χ - Definition: the ability of an atom in a molecule to attract shared electrons to itself.
Not measurable!

Pure covalent bond between two identical atoms

Polar covalent bond between two different atoms

How to quantify this? Pauling scale in textbook.
Mulliken scale: $\chi \propto 0.5\ (IE + EA)$

Note: this scale defines the idea for the MODEL via experimental values (OBSERVATIONS).

Where in the periodic table is it the *hardest* to make a cation, and the *easiest* to make an anion?

Periodic Trends Figure 9.5

- whole table slanted towards F (χ = 4.0)
- down the group – smaller χ
- across the row – larger χ - note Cl, Br!

Convention: H-F

χ_H=2.1; χ_F=4.0 $\Delta\chi$=1.9

δ^+ δ^-

$\vdash\!\!\longrightarrow$

This is a ***polar covalent*** bond.

How big a difference is necessary?
In practice, a difference of 0.4 is *essentially* non-polar and a difference of 2.0 *usually* corresponds to an ionic bond with electron transfer.

Look at the atoms involved, and any OBSERVATIONS of conducting behaviour of the aqueous ionic compound (Expt 4 and Demo 2)

HC χ_H=2.1; χ_C=2.5 $\Delta\chi$=0.4
NaCl χ_{Na}=0.9; χ_{Cl}=3.0 $\Delta\chi$=2.1

Exercises: 9.36, 9.40

Electronegativity relates to our rules for oxidation numbers – Read bottom of page 359 and top of 360. Come back to this later.

9.6 Writing Lewis ~~Structures~~ – DIAGRAMS

Attention: C20 vs C201

We tally the number of **valence** electrons.

"Where" are the electrons?
need to know where the atoms are AKA CONNECTIVITY or SKELETON

DR. SANDBLOM'S ESSENTIAL STEPS FOR LEWIS DIAGRAMS

STEP 1

- sum the valence electrons for each atom in the molecule to get an electron count (EC)
- for ions – add electrons for each negative charge and subtract electrons for each positive charge

STEP 2

- put bonds between each pair of atoms (CONNECTIVITY or SKELETON must be known or deduced – see Tips below)

STEP 3

- put any remaining electrons (RE) on most electronegative element as lone pairs

STEP 4

- make sure H satisfies the duet rule, and other elements satisfy the octet rule

STEP 5 – **9.7 Formal Charge**: FC = valence-dots-sticks

- determine the number of valence electrons the atom *should* have
- count the dots around an atom
- count the sticks around an atom

IMPORTANT: all formal charges should sum up to the overall charge

Pauling's Rule: (we will add this later)

Exercises: 44, 46

Dr. Sandblom's Tips for building a SKELETON in Chemistry 201

- sometimes the way the formula is written will provide a **hint** (especially for larger molecules in organic chemistry)

- H **can't** be a central atom since it can only be bonded to one thing

  -H

- usually **less** electronegative elements are more likely to be the central atom

- halogens **often** end up as terminal atoms with 3 lone pairs

  -X

- **always** draw single bonds first and make multiple bonds **if necessary later**