Announcements

Wednesday, December 02, 2009

Exam 3 is next Monday, Dec 7 covering 6.7-6.8, and chapters 7-9 (through today's lecture).

MasteringChemistry due dates (all at 11:59 pm)

- Ch 8: Wed, Dec 2 (tonight)
- Ch 9: now due Fri, Dec 11 - I will mark the questions that are Exam 3 material

Final exam information (including a list of topics to study) is posted to the webpage under handouts.

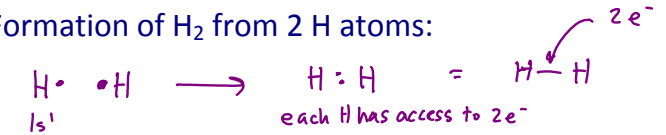
- Exam is comprehensive
- 70 multiple choice questions, 110 minutes
- **NO programmable calculators** - buy a non-programmable scientific calculator now if you have not yet
- Wed Dec 16 1:30 pm - 3:30 pm

Covalent bonding

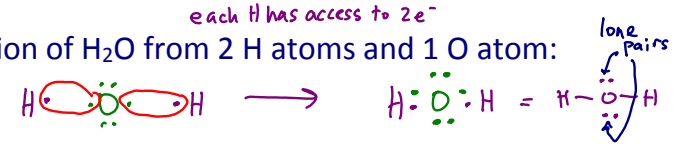
Covalent bond:

- pair of shared electrons between two nonmetal atoms, drawn as a line
- what holds the atoms together in a molecule

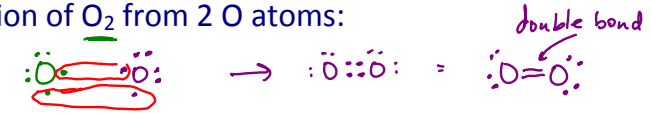
Formation of H_2 from 2 H atoms:



Formation of H_2O from 2 H atoms and 1 O atom:



Formation of O_2 from 2 O atoms:

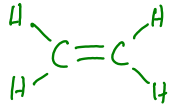


Formation of N_2 from 2 N atoms:

Notice the **octet rule** still applies to the main group elements (except H and He - they are stable with only 2 electrons - **duet rule.**)

Always be sure that all the atoms' original valence electrons are represented in the Lewis structure

C_2H_4: 2(4) + 4(1) = 12 v.e. total in this molecule

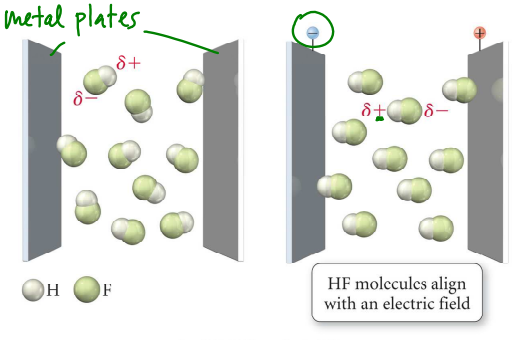


12 ve shown in structure.

Bond polarity

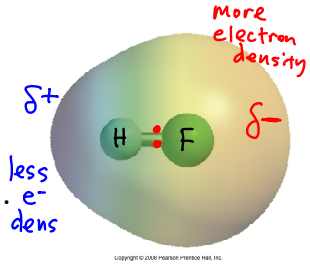
Lewis theory oversimplifies the behavior of shared electrons in many cases.

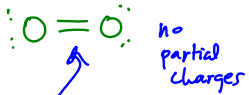
In H—F, the pair of electrons is **not** equally shared between H and F.



δ greek delta = "partial"

HF contains a **polar covalent bond**, where the fluorine has more electron density than the hydrogen.





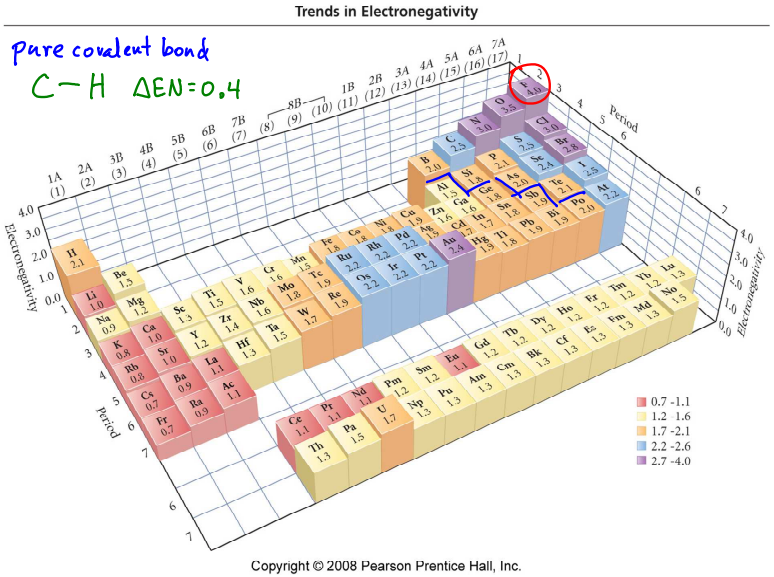
The polar covalent bond is an **intermediate** between:

- pure covalent bonds: e⁻ equally shared
- ionic bonds: e⁻ transferred $Na^+ :\ddot{Cl}:^-$

Electronegativity

Electronegativity: the ability of an atom to attract electrons to itself in a chemical bond

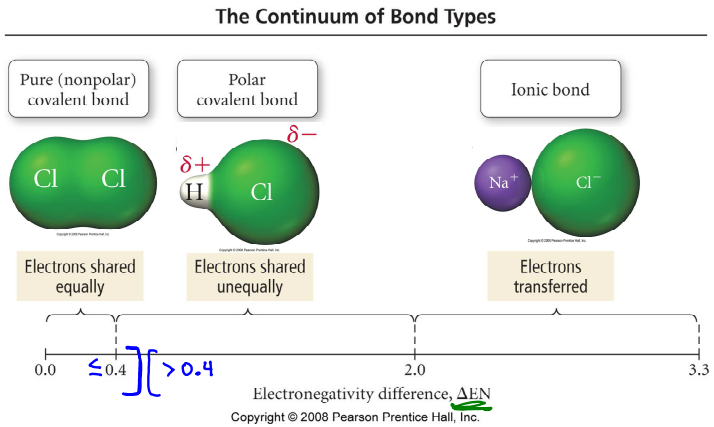
- Pauling scale: 4 is most electronegative (F) and 0 is the least electronegative



Electronegativity is another periodic property, opposite of atomic size:

- Going across a period, EN increases
- Going down a column, EN decreases

Electronegativity difference determines the polarity of the bond:



any identical atoms

Cl—Cl ΔEN = 0 - The bond is pure (nonpolar) covalent.

HCl: ΔEN = 0.9 - The bond is polar covalent.

3.0 - 2.1

NaCl: ΔEN = 2.1 - The bond is ionic.

Which molecule is more polar, HF or ClF?

δ+ H - F δ− (2.1, 4.0) ΔEN 1.9

δ+ Cl - F δ− (3.0, 4.0) ΔEN 1.0

→ dipole moment arrow points to more EN atom

1. Draw the correct skeleton structure, connecting atoms with single bonds. (H's are always terminal, more EN atoms tend to be terminal)

B C N O F →

CH_2O: HCN: H—C—N

2. Calculate the total number of valence electrons.

CH_2O: 4 + 2(1) + 6 = 12 HCN: 1 + 4 + 5 = 10

3. Distribute remaining electrons, filling octets.

too many e⁻

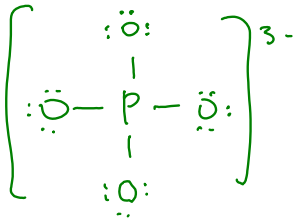
too many e⁻

4. Make double or triple bonds only if any atoms lack an octet.

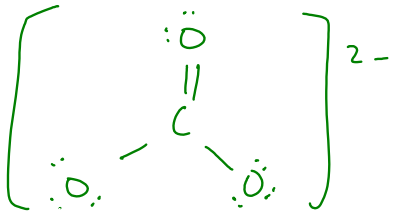
H—C≡N:

When calculating the total number of valence electrons, account for the charge by adding or removing electrons from the total.

PO_4^{3-}: $5 + 4(6) + 3$ (3 more e⁻) $= 32$ ve

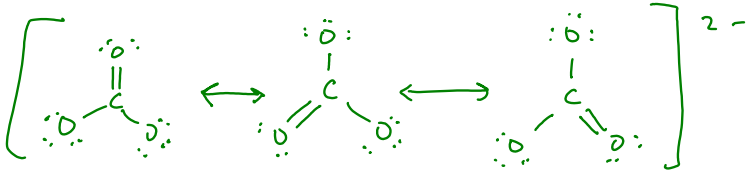


CO_3^{2-} : 24 ve



could have double bonded any O

<u>Resonance structures</u>: Lewis structures that are different only by the **location** of electrons in the structure.
(Same # e^-, same atom positions)



actual structure has 3 equal C-O bonds

3 equal resonance contributors to structure