

**Continued from last Friday, Lewis Structure:**

To draw Lewis Diagrams of an molecular compounds:

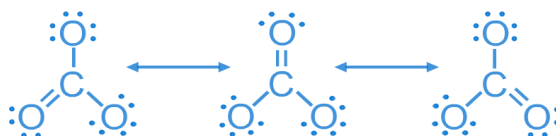
**Steps:**

1. Place the central atom in the centre and other atoms around it evenly spaced.
2. Count the total number of valence electron for all atoms involved in the bonding.
3. Placed the electrons in pairs between the central atom and each non-central atom
4. Place the remaining electrons around the non-central atom until each has 8 electrons (H atoms have only 2 electrons.)
5. If electrons remain they are placed in pairs around the central atom.
6. Exception: if the central atom is in group 14, 15, 16, 17, 18, the octet rule must be satisfied by moving electron pairs from non-central atoms, creating multiple bonds.
7. Exceptions of octet rule called overfilled octet may apply - **sulfur, phosphorus, silicon, and halogen**.

**Resonance structure:**

When several structures with different electron distributions among the bonds are possible, all the structures contribute to the electronic structure of the molecule. These structures are called resonance structures

For instance: carbonate anion



**Formal charge = Valence electron – NonBonding valence electrons – #of bonds**

|         |   |   |   |   |
|---------|---|---|---|---|
| Carbon: | 0 | 4 | 0 | 4 |
| Oxygen: |   |   |   |   |
| Oxygen: |   |   |   |   |



### Summary/Hint:

When considering the resonance structure...

- Formal charge closest to zero is favoured
- Negative formal charges on the more negative elements are favoured.

When drawing Lewis diagrams...

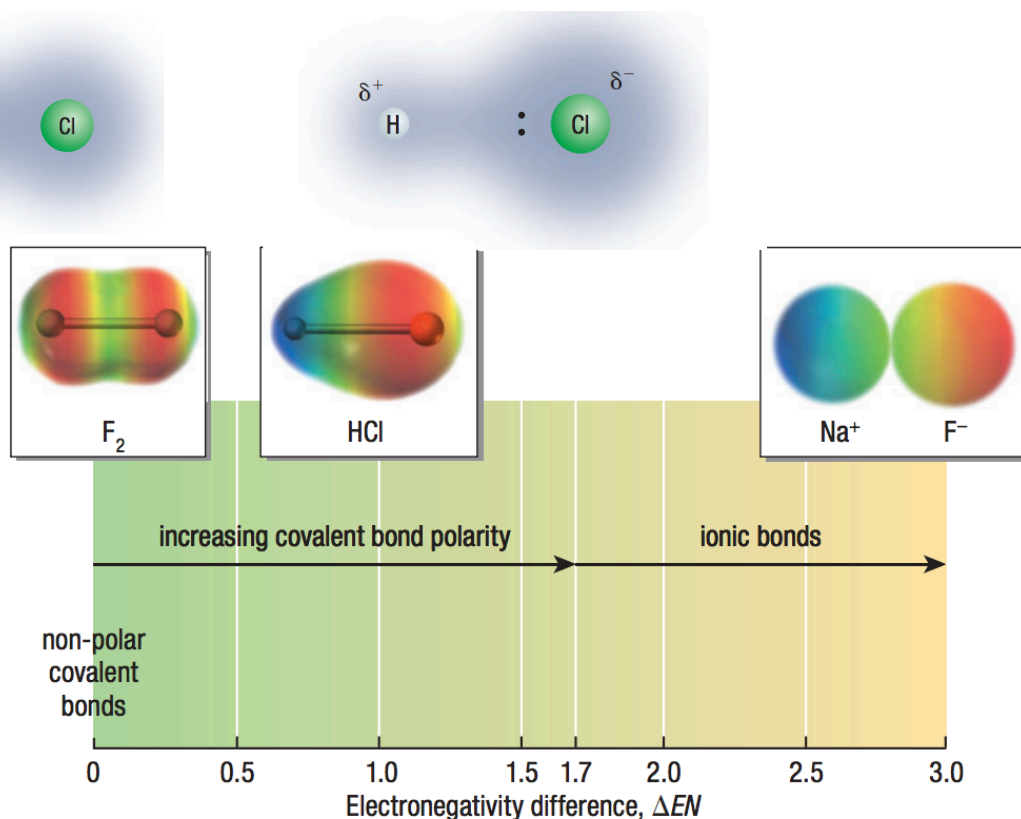
- Symmetrical arrangements are favoured
- Hydrogen is never a central atom
- The **least** electronegative element is usually the central atom

**Practice:** Draw Lewis structure for the following compounds.

- 1)  $CCl_4$
- 2)  $HCl$
- 3)  $NH_3$
- 4)  $OH^-$
- 5)  $SO_4^{2-}$
- 6) Nitrogen gas

## Lesson 5 (2.3): Chemical bonding and Electronegativity

We can use electronegativity and **electronegativity difference** between elements to classify whether the chemical bond is ionic or polar – covalent, or non-polar covalent.



**Figure 5** Electronegativity difference indicates the degree to which a chemical bond is ionic or covalent.

|                                  |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |    |    |
|----------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|----|----|
| Pauling Electronegativity Values |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |    | He |
| H<br>2.1                         |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |           |    |    |
| Li<br>1.0                        | Be<br>1.6 |           |           |           |           |           |           |           |           |           |           | B<br>2.0  | C<br>2.5  | N<br>3.0  | O<br>3.5  | F<br>4.0  | Ne |    |
| Na<br>0.9                        | Mg<br>1.3 |           |           |           |           |           |           |           |           |           |           | Al<br>1.5 | Si<br>1.9 | P<br>2.2  | S<br>2.6  | Cl<br>3.0 | Ar |    |
| K<br>0.8                         | Ca<br>1.0 | Sc<br>1.4 | Ti<br>1.5 | V<br>1.6  | Cr<br>1.7 | Mn<br>1.5 | Fe<br>1.8 | Co<br>1.9 | Ni<br>1.9 | Cu<br>1.9 | Zn<br>1.6 | Ga<br>1.8 | Ge<br>2.0 | As<br>2.2 | Se<br>2.6 | Br<br>2.8 | Kr |    |
| Rb<br>0.8                        | Sr<br>0.9 | Y<br>1.2  | Zr<br>1.3 | Nb<br>1.6 | Mo<br>2.2 | Tc<br>1.9 | Ru<br>2.2 | Rh<br>2.3 | Pd<br>2.2 | Ag<br>1.9 | Cd<br>1.7 | In<br>1.8 | Sn<br>2.0 | Sb<br>2.1 | Te<br>2.1 | I<br>2.5  | Xe |    |

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