5.111 Principles of Chemical Science: Week 4

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Progress Update

Over the past week I have been introduced to:

1. Ionic and covalent bonds.
2. Lewis structures.

Ionic and covalent bonds.

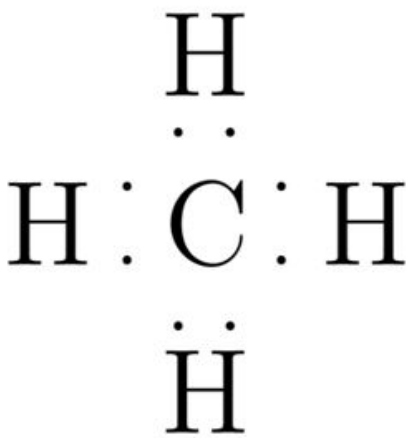
Two definitions:

1. Ionic bonds - A bond in which an atom (or atoms) gives up valence electrons so that the other in the bond can have a full valence shell.
2. Covalent bonds - A bond in which atoms share electrons to have a full valence shell.

Examples follow.

Lewis Structures

Lewis structures are a quick, albeit not 100% accurate, way of describing the structure of a covalent molecule. Consider methane (CH_4):



We found this structure by:

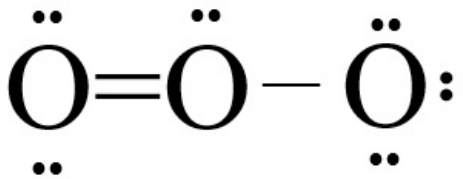
1. Summing valence electrons.
2. Placing elements.
3. Filling valence shells from interior of molecule to exterior.

Olympiad problem

Problem: In the Lewis structure of ozone, O_3, what is the formal charge on the central oxygen?

1. 2-
2. 1-
3. 0
4. 1+

Solution: There are 18 valence electrons and 20 would be spent filling octets; so a double bond forms between 2 of the oxygens:



Calculating formal charge with the formula "Valence - lone pairs - 1/2 bonding", we see that the central oxygen has formal charge $+1$.

Example Problem

Problem: Based on Lewis structures, arrange the following molecules in order of increasing bond order (a single bond has a bond order of one, a double bond has a bond order of two, etc.). Circle any molecules that are likely free radicals.
(a) C-C bond in C2H2, C2H4, C2H6;
(b) Cl-O bond in ClO2-1and ClO3-1
Solution: Solve on the spot, why not.