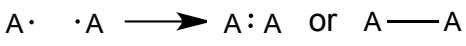
Lewis Dot Structures and Formal Charge

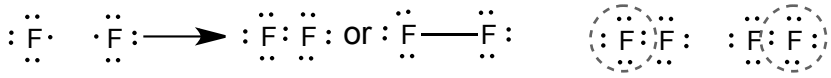
Lewis Dot Stuctures

Let's start with some Fundamental Concepts

A covalent bond is formed by the sharing of a pair of electrons between two atoms



Nonbonding or lone pair electrons can be used to complete each atoms octet



Note: *Each atom has 8 electrons surrounding it even though 2 of the are shared*

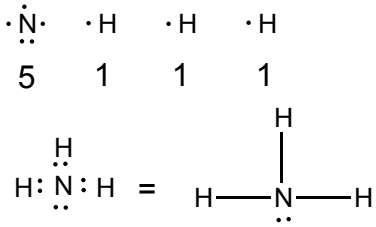
Steps for Writing Lewis Stucture

1. For each atom, calculate the number of valence electrons (For ions and charged species, add or subtract electrons to give the proper charge. **Remember:** Electrons contribute a -1 charge)

2. Combine electrons into pairs to form covalent bonds **Remember:** Hydrogen can only form 1 bond

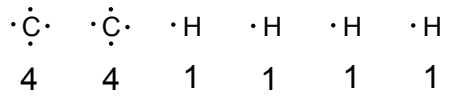
3. If necessary, use multiple bonds to give atoms noble gas configurations (3rd row elements such as P and S can exceed the octet rule by accesing d orbitals)

Ammonia (NH_3)



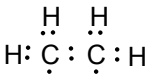
Example: (CH_2CH_2)

1)



Each carbon has 4 valence electrons and each hydrogen only has 1 valence electron

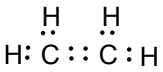
2)



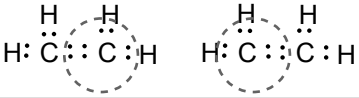
From the molecular formula we know that two hydrogen atoms are bound to each carbon atom

This leaves unpaired electrons and two carbons with incomplete octets

3)



Both issues can be solved by making multiple bonds between the carbons

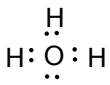


Calculating Formal Charge

1. Determine the number of protons (i.e. atomic #) in the atom of interest
(1 for hydrogen, 6 for carbon, 7 for nitrogen, etc.)

2. For atoms in the second row subtract 2 for the 1s electrons

3. Subtract 1 for each nonbonding electron and 1 for each bond (i.e. half of the shared pair of electrons)

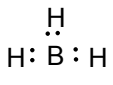


7 protons (O)

-2 1s electrons

-2 nonbonding
-3 bonds (3)

+1 = FC



5 protons (B)

-2 1s electrons

-0 nonbonding
-3 bonds (3)

+0 = FC

Practice Examples

Please draw a lewis structure and calculate the formal charge

1) NH_4

2) CH_3CH_2OH

3) CH_3 (sp3 hybridized)

4) CH_3 (sp2 hybridized)

5) $CH_3(CO)OCH_2CH_3$

6) $NH_3CH_2CO_2$