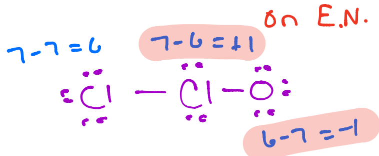
Central Atoms are NOT always the least electronegative.

Minimizing Formal charge is more important

OCl_2 ← this is a neutral molecule. If we can draw it with no formal charge, that would be most ideal

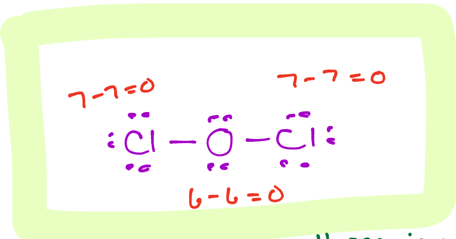
EN → 3.5 3.0

We would predict that Cl would be a central atom based on E.N. values



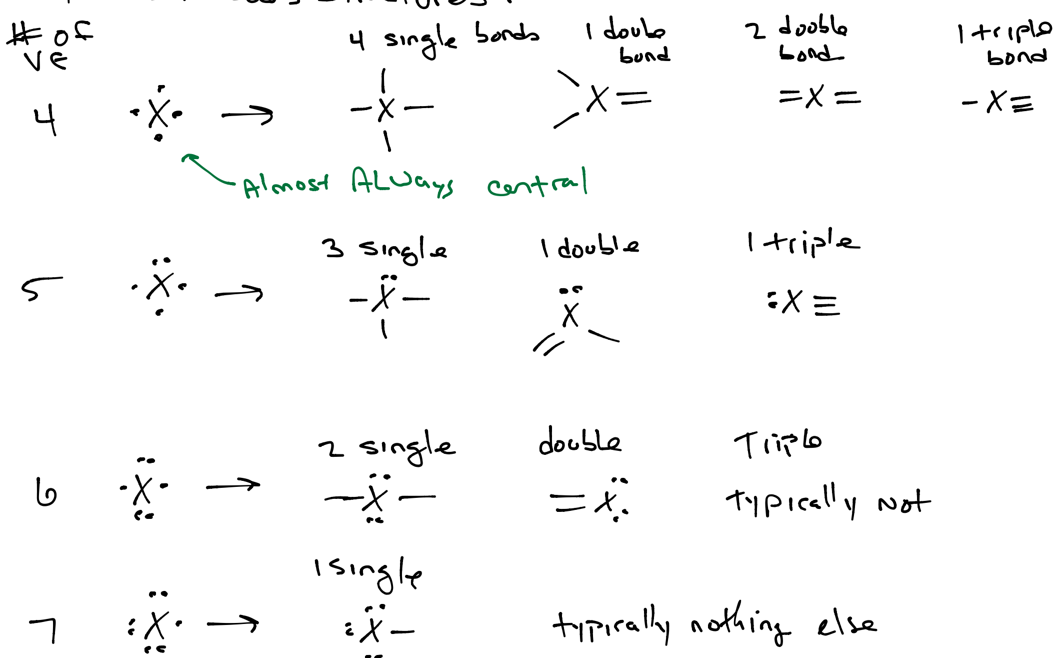
- formal charge adds up to ∅? yes
- correct # of ve? yes
- all octets? yes

so this is an acceptable structure, but it is NOT the most stable because we can draw OCl_2 so that there is ∅ formal charge

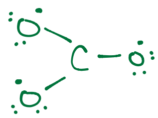


- all requirements (FC, # of e⁻, + octets) are met AND there is no F.C., so this is more stable

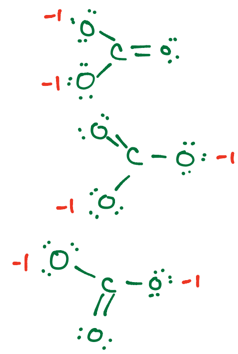
Themes in Lewis Structures:



Lets think about carbonate: CO_3^{2-}



there are multiple ways to connect the dots to satisfy our rule



Carbonate has 3 resonance forms/structures

All three of the structures are perfectly equivalent

Resonance Structures: two or more stable conformations of the same molecule

Since each of these structures are equally stable, each will exist. The physical properties of each bond/atom is an average of all structure

Are the CO bonds single or double? single bond in $2/3$ + double in $1/3$

$$\frac{2}{3}(1) + \frac{1}{3}(2) = \frac{4}{3}$$

each CO bond is partially single ($2/3$) and partially double ($1/3$)

- so each CO bond will be shorter than a single bond but longer than a double bond. Also, weaker than a double bond + stronger than a single

What is the charge on each oxygen? $2/3(-1) + 1/3(\emptyset) = -2/3$

Consider nitrite (NO_2^-). Determine the charge on each atom.

Two resonance forms are possible:

$N \rightarrow \emptyset(1/2) + \emptyset(1/2) = 0$

$O \rightarrow -1(1/2) + \emptyset(1/2) = -1/2$

Each oxygen has an average charge of $-1/2$

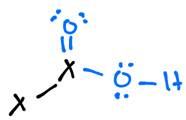
Resonance Structure are indicated by showing $\longleftrightarrow$ between the L.S.

this unambiguously identifies these as Resonance Structure

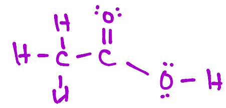
Common themes in L.S.

Acids commonly have H written at the beginning of molecular formulas

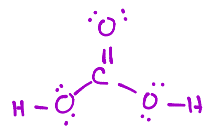
Acids :



example: CH_3COOH acetic acid



H_2CO_3 carbonic acid



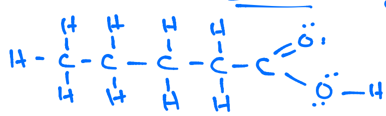
Cyanate : what atom has the (−) ?

4−5=(−1)

⊖:C≡N: ← 5−5=0

commonly see things like: $CH_3CH_2CH_2CH_2COOH$

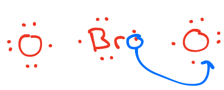
· You should be comfortable quickly recognizing patterns! H only gets one bond, so C-C



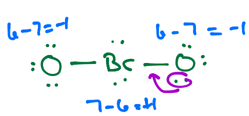
Expanded Octets

BrO^-

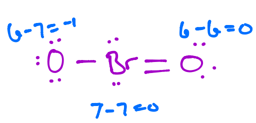
BrO_2^- ← central



feel free to shuffle electrons. After all, the bonds MUST be formed



Lots of formal charge! what if we do this



Less formal charge. Is this ok based on our rules? No!

- But — this IS the correct structure of BrO_2^-.

The octet rule works because covalent bonds are formed using valence atomic orbitals.

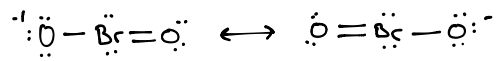
Hydrogen can only form 1 bond because it only has 1 valence orbital.

Atoms in shell 2 have 4 valence orbitals (2s $2p_x$ $2p_y$ $2p_z$), so they are restricted to 4 bonds (or 4 Lone pairs)

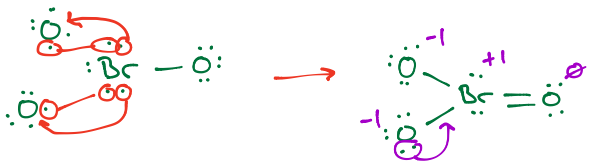
Bromine is in the 4^{th} shell, so it is not restricted to 4 bonds / Lone pairs. It can access the d orbitals to form a bond or occupy the LP.

More on this Later this week!

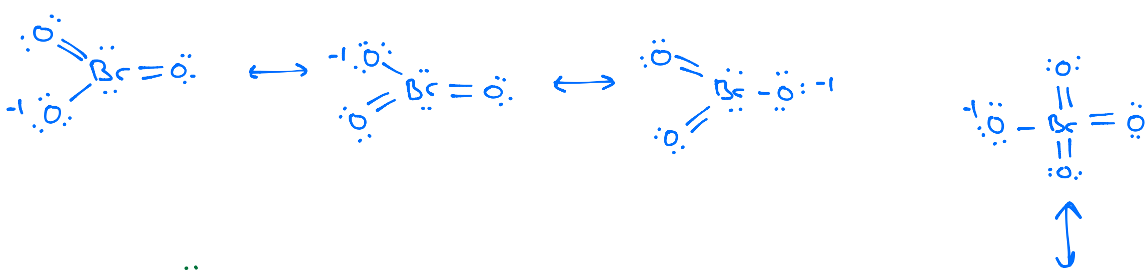
We call this an expanded octet.



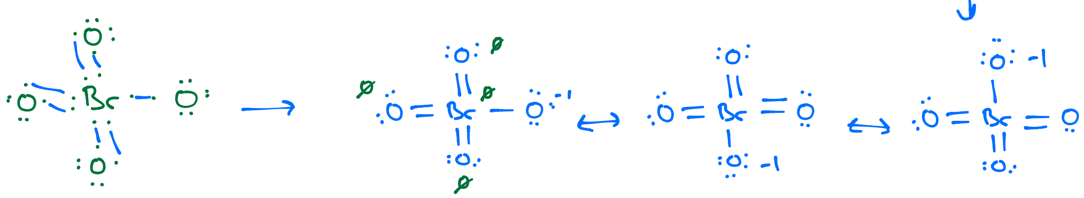
BrO_3^-



Minimize F.C.!



BrO_4^-



General approach to drawing Lewis structures:

1. Draw each atom with correct number of VE
2. Connect the dots
3. Add / subtract e- for anions/cations
4. Check formal charge
5. Can any atom expand the octet to minimize F.C.? If so, do it.

Formal charge = VE - Electrons owned

← 2(LP) + number of bonds

It's generally true that the least electronegative atom is going to be central.

Your book says "put unique atom in the center"

Always show Lone Pairs!