1. Count valence electrons

2. Pick central atom and draw skeletal structure

   - central atom is usually the one that needs to gain the most electrons!

   - skeletal structure has all atoms connected to center with single bonds

3. Distribute remaining valence electrons around structure, outer atoms first. Follow octet rule until you run out of electrons.

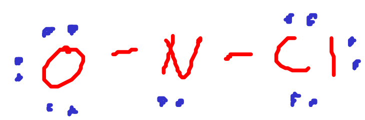
4. Check octet rule - each atom should have a share in 8 electrons (H gets 2). if not, make double or triple bonds.

NOCl

N: 1 x 5
O: 1 x 6
Cl: 1 x 7

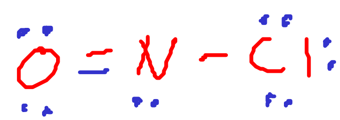
18 e^-

Pick NITROGEN as central atom, since it needs 3 more electrons (more than O or Cl)



We ran out of outer atoms before running out of electrons, so the last pair of electrons is put on the central NITROGEN.

... but NITROGEN has a share in only six valence electrons.



Changing one of oxygen's lone pairs to a bonding pair with nitrogen gives the nitrogen a share in eight valence electrons.

Why oxygen? Oxygen needed to gain two electrons. Since the way an atom typically gains an electron in sharing is by sharing one of its own, oxygen was likely to form two bonds. (Compare to chlorine, which only needs one!)

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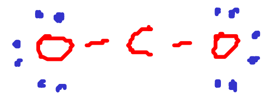
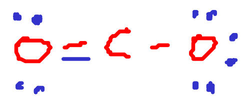
CO_2

C: 1 x 4
O: 2 x 6
16 e⁻

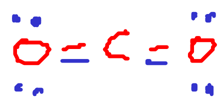
Choose CARBON as central atom.



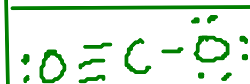
... but CARBON has a share in only four outer shell electrons!



... now SIX



Adding a second double bond gives carbon a share in eight outer shell electrons.



Why not this one? This structure has two oxygen atoms in the same environment (both bonded to only C), yet bonding differently. They should bond the same way!

The triple bond/single bond strucure suggests that there are two different bond lengths in carbon dioxide. If the bond lengths are measured using x-ray diffraction, we find that there is only one bond length in carbon dioxide - both carbon-oxygen bonds are the same length! This suggests the O=C=O structure is correct!

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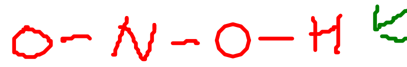
4. Check octet rule - each atom should have a share in 8 electrons (H gets 2). if not, make double or triple bonds.

HNO_2 "nitrous acid"

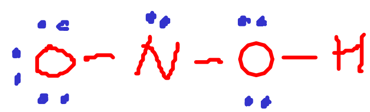
In oxyacids, the acidic hydrogen atoms are attached to OXYGEN atoms in the structure!

H: 1 x 1
N: 1 x 5
O: 2 x 6

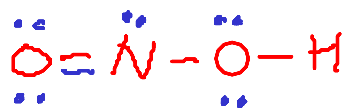
18 e^-



This is an OXYACID, so we know at least one H must be attached to an OXYGEN atom!



... but the nitrogen atom has a share in only SIX valence electrons! We need a double bond.



Adding a double bond with the oxygen atom on the left gives N enough valence electrons.

Unlike the last example, this molecule has oxygen atoms in DIFFERENT environments (one bonds to only N, the other to both N and H), so we're not surprised to see them bond differently.

A DOT STRUCTURE FOR A LARGER MOLECULE

(1) Count valence electrons

(2) Pick central atom and draw skeletal structure

- central atom is usually the one that needs to gain the most electrons!
- skeletal structure has all atoms connected to center with single bonds

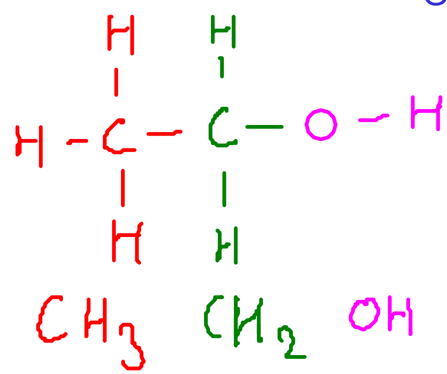
(3) Distribute remaining valence electrons around structure, outer atoms first. Follow octet rule until you run out of electrons.

(4) Check octet rule - each atom should have a share in 8 electrons (H gets 2). if not, make double or triple bonds.

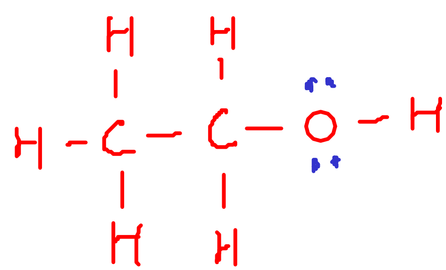
CH_3CH_2OH ETHANOL!

C : 4 x 2 = 8
H : 1 x 6 = 6
O : 6 x 1 = 6
| 20

This formula gives us a hint to the structure of ethanol. Ethanol has THREE central atoms chained together.



This skeleton uses 16 of the 20 valence electrons, so we need to distribute the other four.



A DOT STRUCTURE FOR A POLYATOMIC ION

(1) Count valence electrons

(2) Pick central atom and draw skeletal structure

- central atom is usually the one that needs to gain the most electrons!
- skeletal structure has all atoms connected to center with single bonds

(3) Distribute remaining valence electrons around structure, outer atoms first. Follow octet rule until you run out of electrons.

(4) Check octet rule - each atom should have a share in 8 electrons (H gets 2). if not, make double or triple bonds.

NH_4^+

N: 1 x 5

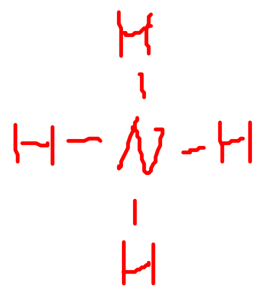
H: 4 x 1

$9e^-$

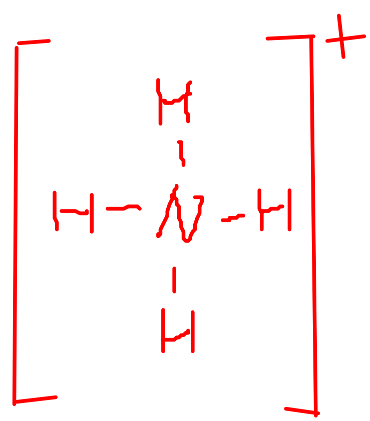
$-1e^-$

$8e^-$

Ammonium ion has a +1 charge, so it must have lost a single electron!



After adjusting the total number of electrons to account for the charge, we choose NITROGEN as central atom!



To indicate the charge of the ion, draw brackets around the structure, then indicate the charge in the upper right. (Same place as we usually put charge!)