DRAWING DOT STRUCTURES FOR SIMPLE MOLECULES

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.

$COCl_2$

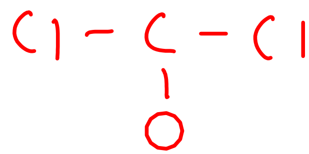
C: 1 x4

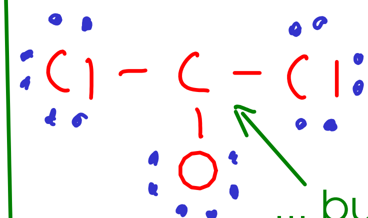
O: 1 x6

Cl: $\underline{2 \times 7 = 14}$

24 valence e^-

Pick CARBON as central atom, since it needs to gain more electrons than either oxygen or chlorine (and should form more bonds to do so!)

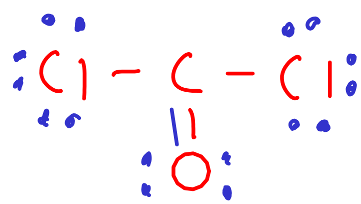




Distributing remaining electrons, stop when we reach the count from above (24).

... but CARBON only has a share in SIX valence electrons! We need to fix this, but how?

Let's make a double bond. Where to get electrons? We'll pick OXYGEN because it needed to gain two electrons in the first place ... and is likely to form more bonds to do so.



Making the double bond "fixes" this structure. All atoms have a share in eight outer electrons!

(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^-

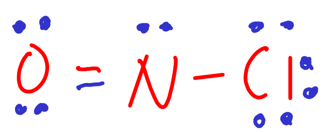
Pick NITROGEN as central atonm, since it needs to gain more electrons than the other two.

O - N - Cl

DIstribute remaining electrons...

We put the last pair of electrons onto NITROGEN because we rean out of room on the outer atoms, but even so NITROGEN only has a share in six valence electrons!

Like last example, we need to repurpose a pair of electrons to make a double bond. Which? Like last time, we'll use a pair from OXYGEN (for the same reason). Why not N? Because using its pair won't increase the amount of electrons available to N ... which is why we're looking to make a double bond!



(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.

CO_2

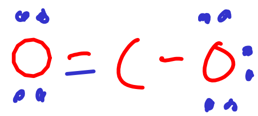
C: 1 × 4
O: 2 × 6

16 e^-

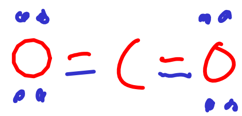
O – C – O

Choose CARBON as central atom.

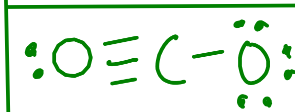
Distribute electrons ... but C only has a share in FOUR valence electrons.



... now SIX.



... a second double bond gives CARBON a complete octet.



Why not this structure?

This structure suggests that two identical oxygen atoms put into the same chemical situation will behave differently (one forming a triple bond and one forming a single). If what we know about Dalton's theory is true (all atoms of the same element are chemically identical), this should not happen!

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.

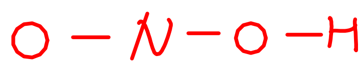
4. Check octet rule - each atom should have a share in 8 electrons (H gets 2). if not, make double or triple bonds.

HNO_2 "nitrous acid"

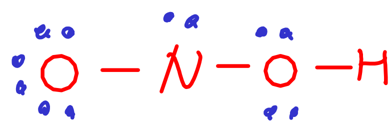
In oxyacids, the acidic hydrogen atoms are attached to OXYGEN atoms in the structure!

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

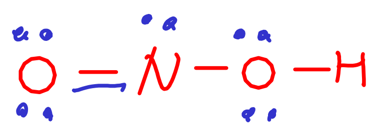
$18e^-$



All OXYACIDS have at least one H attached directly to O!



After distributing electrons, NITROGEN has a share in only six. Make a double bond! Pick the oxygen atom on the LEFT to make the bond, since the one on the right already has two bonds.



(Unlike the last example, THESE two oxygen atoms are in different environments, so they don't both make double bonds to nitrogen.)

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.

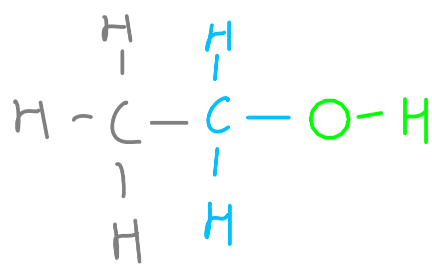
CH_3CH_2OH ETHANOL!

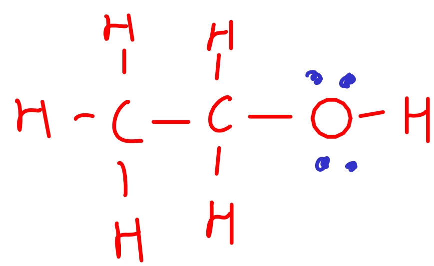
C : 4 x 2 = 8
H : 1 x 6 = 6
O : 6 x 1 = 6

20

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

CH_3 CH_2 OH





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: 1x5
H: 4x1

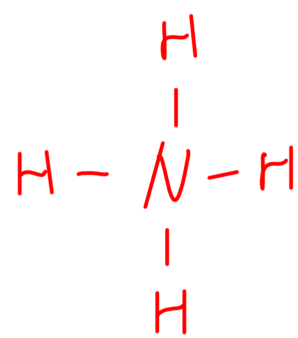
9 valence e^-

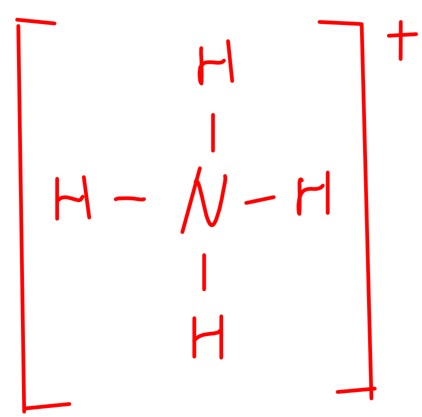
−1 e^- (+1 charge)

8 e^-

Problem: Nine electrons? So far, all our electron counts have been EVEN ... because we use electron PAIRS for bonds!

For a charged molecule, adjust the electron count to account for the charge. (Add electrons for -, subtract them for + charge)





To indicate the charge, put the structure in large brackets, then write the charge on the upper right corner, similar to how you indicate charge for other ions!