DRAWING DOT STRUCTURES FOR SIMPLE MOLECULES

$COCl_2$

C : 1 x 4

O : 1 x 6

Cl : 2 x 7 = 14

24 valence e⁻

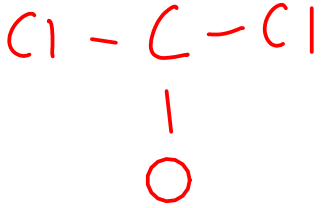
1. Count valence electrons

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

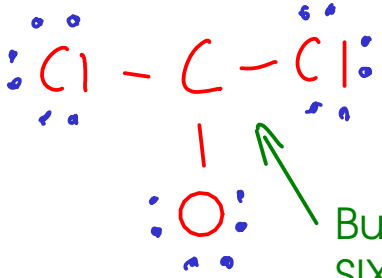
3. Distribute remaining valence electrons around structure, outer atoms first. Follow octet rule until you run out of electrons.

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

Pick CARBON for the central atom, since it needs to gain more electrons than either oxygen or chlorine.



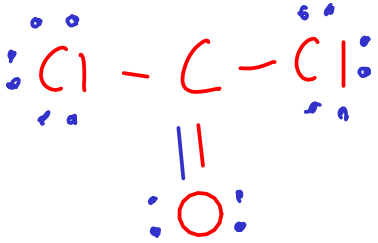
Draw skeletal structure...



Distribute remaining electrons, stop when you reach the number you counted earlier (24, here)

But the CARBON atom has a share in only SIX outer shell electrons. We need to fix this ... how? Try a double bond.

Pick OXYGEN to supply the electrons for the bond. Oxygen needed two electrons more initially, and the normal way to gain two more electrons is to share two.



Adding a double bond between oxygen and carbon "fixes" this structure!

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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.

NOCl

N : 1 x 5
O : 1 x 6
Cl : 1 x 7
18 e⁻

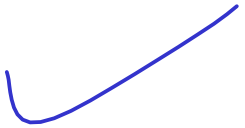
Pick NITROGEN as central atom, since it needs to gain more electrons than the other two!

O – N – Cl


Distribute ...

The last two electrons go on NITROGEN, since both outer atoms are "full". Even so, nitrogen still has a share in only six valence electrons!

Make a double bond! Which electrons to use? We can't use N (doesn't help N get MORE electrons), so we'll use OXYGEN for the same reasons as the previous example.

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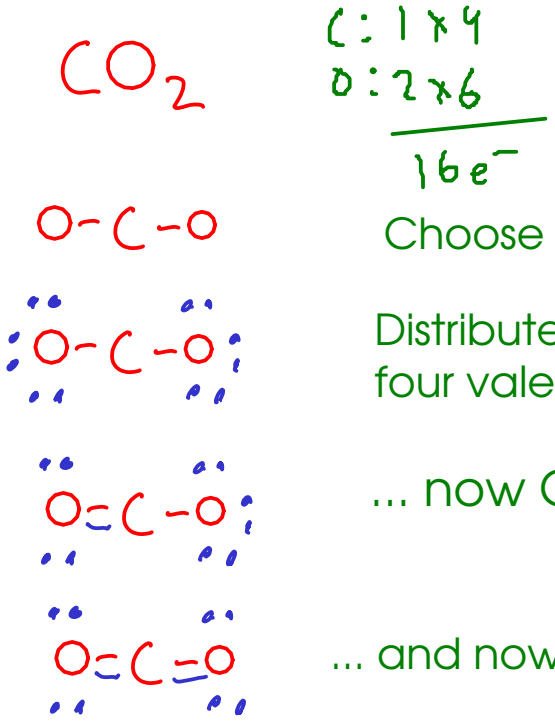

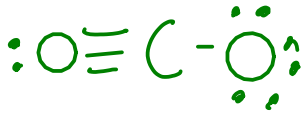
... why not this structure?

This structure has two identical atoms (O) bonding in two different ways when they're in the SAME chemical situation (both bonding to C and nothing else). If atoms of the same element really ARE chemically identical, this should not happen!

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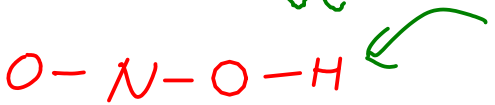
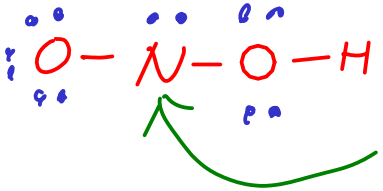
HNO_2 "nitrous acid"

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

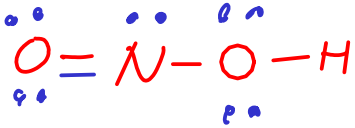
H: 1 x 1
N: 1 x 5
O: 2 x 6
18 e⁻



SInce this is an oxyacid, we know at least one H is directly attached to an O.



The NITROGEN has a share in only six valence electrons.



Pick the oxygen atom on the left to supply additional electrons, since the one on the right already has two bonds!

A DOT STRUCTURE FOR A LARGER MOLECULE

CH_3CH_2OH ETHANOL!

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

1. Count valence electrons

2. Pick central atom and draw skeletal structure
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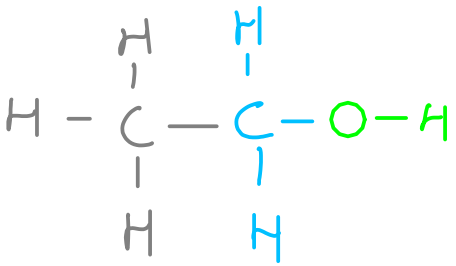
   - skeletal structure has all atoms connected to center with single bonds

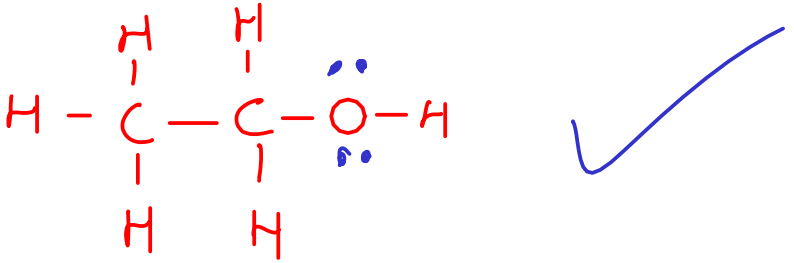
3. Distribute remaining valence electrons around structure, outer atoms first. Follow octet rule until you run out of electrons.

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

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

$CH_3 \quad CH_2 \quad OH$





A DOT STRUCTURE FOR A POLYATOMIC ION

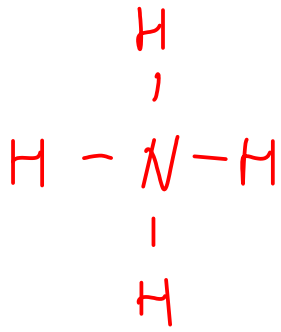
NH_4^+

1. Count valence electrons

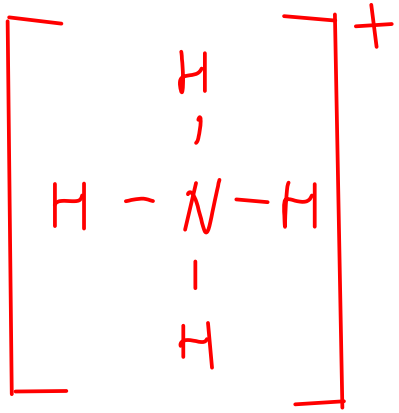
N: 1 x 5
H: 4 x 1
9 valence e⁻
−1 e⁻ (+1 charge)
8 e⁻

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

Since ammonium ion is charged, we need to adjust the electron count to get the right charge. + charge means take away electrons, - charge means to add them!



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.

To indicate the charge of the ion, draw big brackets around the structure and put the charge in the upper right.