Practice Sheet

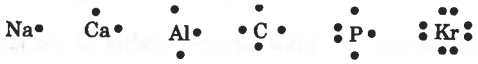
Electron Dot (Lewis) Structures

A Lewis or Electron Dot Structure is a convenient representation of the valence electrons in an atom.

An electron dot structure for an atom is simply the symbol for the element, surrounded by a number of dots equal to the number of valence electrons.

Avoid a common mistake: the dots represent valence electrons only, so make sure you use only the number of dots corresponding to the number of valence electrons.

Examples:



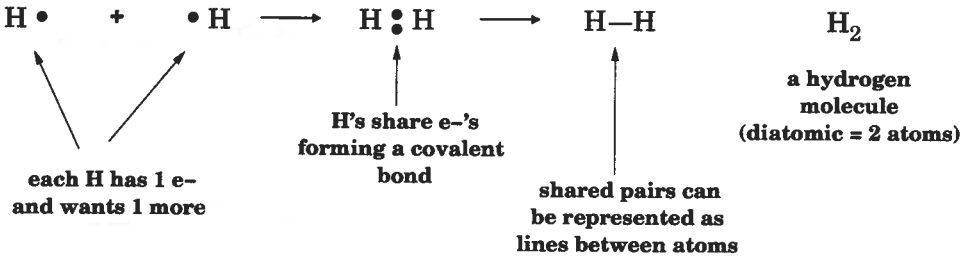
- Draw lewis dot structures for an atom of each of following elements:

1. K
2. Si
3. Ar
4. As

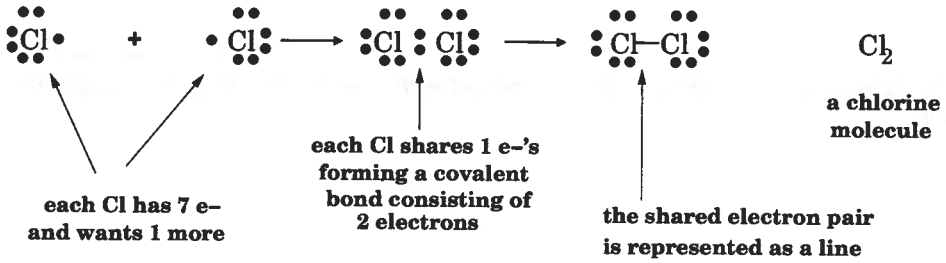
Covalent Bonds

An atom can also achieve a noble gas configuration by sharing electrons with other atoms. When two non-metals combine, they typically share electrons in covalent bonds and form what are know as covalent compounds. We can draw Lewis Electron Dot Diagrams for covalent molecules to determine what type of bonds the molecules form.

For example, consider two hydrogen atoms. Each one has one valence electron. However, both hydrogens would like to have two electrons, to obtain the same configuration as [He]. To do this, each H atom shares an electron with the other, forming a covalent bond. In H_2, each H atom has 2 electrons.

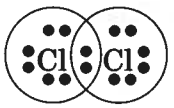


Here's another example, this time for chlorine. A Cl atom has 7 valence electrons, so it needs 1 more to achieve an octet (8 electrons).



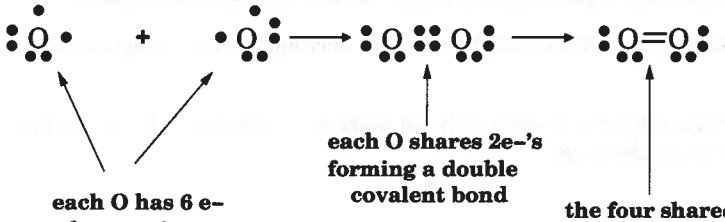
Each chlorine now has 8 electrons, because you can count the shared ones:

this Cl now has an octet of 8 electrons



this Cl atom also has an octet

Sometimes you need to share more than one pair of electrons to achieve an octet:



O_2

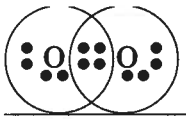
an oxygen molecule

each O has 6 e- and wants 2 more

each O shares 2e-'s forming a double covalent bond

the four shared electrons are represented as two lines between the atoms

We can check to see that each oxygen has the appropriate number of electrons:



each oxygen atom now has an octet

total # valence electrons = 12 (note the 12 dots)

For the following problems, calculate the total number of valence electrons in each of the following molecules. Then, draw lewis dot structures for each:

- Br_2 # valence e^- _____

- HCl # valence e^- _____

- HBr # valence e^- _____

- N_2 # valence e^- _____

- NO # valence e^- _____

  This one is tricky, there is no way to achieve an octet. So, get each atom as close to an octet as possible without going over.

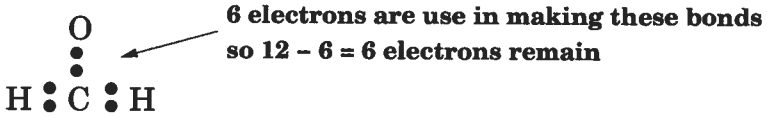
Steps for Drawing Lewis Dot Structures for Larger Molecules

1. First, determine the central atom:
   (a) Hydrogens (H) and halogens (F,Cl,Br,I) are almost always outer atoms. They only want to form one bond to get to a noble gas configuration.
   (b) If the choice is still ambiguous, the atom further to the right on the periodic table is generally an outer atom, the one further to the left is often the central atom.
   For example: COH_2
   The H's are outer atoms, leaving C and O as candidates.
   C is further to the left than O, so C is the central atom.

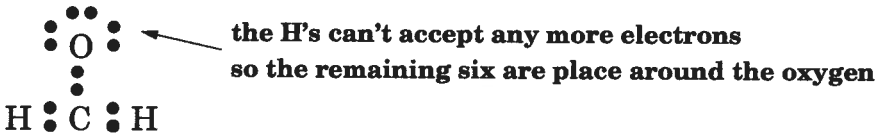
2. Arrange the outer atoms around the central atom:

3. Count up the valence electrons: C (4) + O (6) + 2H (2x1) = 12 electrons

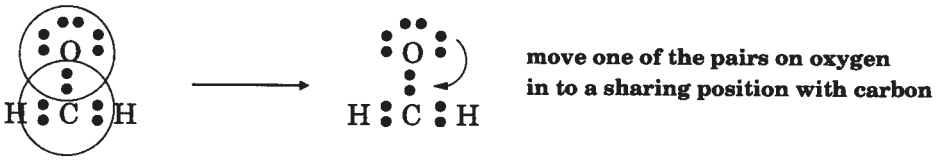
4. Draw a bond between each outer atom and the central atom. Count the electrons you have used in these bonds and subtract them from your total valence electrons.



5. Use the remaining electrons to fill octets around the outer atoms. Put any remaining ones on the central atom.



6. If all the atoms don't have an octet, move a non-bonding electron pair from 1 atom into a sharing position.



the H's have 2 electrons
O has an octet, but C does not

or

both C and O have octets
and H has 2 electrons

Try drawing lewis dot structures for these molecules:

- SiH_4 # valence e^- _____

- CCl_4 # valence e^- _____

- PCl_3 # valence e^- _____

- NCl_3 # valence e^- _____

- CS_2 # valence e^- _____

- CH_2Cl_2 # valence e^- _____