Lesson #4: Lewis Dot Diagrams and Covalent Bonds.

***Orally**: Recall that there are two types of chemical bonds that we will cover in this course. Last day we looked at the ionic bond. Today we will focus on covalent bonds.*

Covalent Bond: Non-metals share electrons because the attraction for electrons is similar.

***Orally**: While metal – metal covalent bonds occur also, they are not covered in this course.*

Question: How can I tell when a compound is Ionic or Covalent?

For the purpose of this course, covalent compounds contain all nonmetals and Ionic compounds contain a metal-nonmetal combination (with the exception of the ammonium ion NH_4^{+1})

Covalent Lewis Dots:

Step #1: Determine the total number of valence electrons in the molecule.

Step #2: Put the single atom in the center and spread the remaining atoms around it.

Step #3: Place a pair of electrons between atoms that are bonding (i.e., connected together).

Step #4: Complete the outer shell/valence shell of electrons for all the atoms. Most elements that we deal with will fill with 8e-. This is referred to as an octet of electrons.

Note: Since Hydrogen only fills the first shell of a Bohr diagram, it will fill with 2e- instead of 8e-.

Exercises:

1. Draw a Lewis dot structure for methane (CH_4)

Step #1: Valence e- calculation

1C x 4 valence e- = 4e-

<u>4H x 1 valence e- = 4e-</u>

Total e- = 8e-

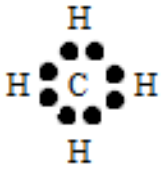
Step #2: Arrange the atoms with the single atom in the middle

H

H C H

H

Step #3: Place an e- pair between boning atoms.



Step #4: Complete all outer shells with e-.

Since Hydrogen fills with 2e-, the diagram is complete.

Question: How can I be certain I've got the correct diagram?

1) Make sure your diagram contains the same number of e- that you calculated in step #1
2) Make sure that all outer/valence shells are full of e-

Note: Every unpaired electron in the separate atoms becomes paired when bonded.

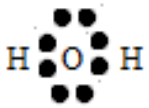
2. Draw Lewis dot diagram for H_2O

2H x 1e- = 2e-

1O x 6e- = 6e-

Total e- = 8e-

H O H

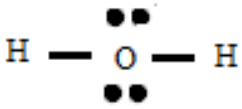


Bonding electrons are located between atoms in a molecule. There are two bonding pairs for water.

Lone pairs of electrons are not involved in bonding. There are two lone pairs on the oxygen atom in the water molecule.

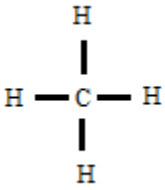
Structural diagrams are often used in covalent molecules. A dash is used to represent bonding pairs of electrons. The lone pairs are still shown as dots.

e.g., Water is shown as:



Question: What does the structural diagram of CH_4 look like?

Answer:



Recall that a molecule is a collection of 2 or more atoms that are bonded. The type of bond associated with molecules is the covalent bond. Ionic bonds always result in crystal formation. Crystals of a particular compound can be of indeterminate size (i.e, they can be big or small) and they can grow to a bigger size.

It is also important to note that while ionic crystals always result from transferring e- from metal to non-metal, the covalent molecules above form from the sharing of electrons between non-metals.

Video: Compares ionic vs covalent bonds.
https://www.youtube.com/watch?v=PKA4CZwbZWU

Practice:

Label the following substances as ionic or covalent:

1. CH_3OH Covalent (C)
2. $Ca(OH)_2$ Ionic (I)
3. PO_4^{-3} C
4. KBr I
5. N_2O_4 C
6. SCN^- C
7. NaSCN I
8. Na_2CO_3 I
9. $(NH_4)_2SO_4$ I
10. H_2O C

Worksheet (Covalent Lewis Dots)