**Science 10 (4.1) Atomic Theory and Bonding**

(Refer to pp. 166 – 183 of BC Science 10)

**VOCAB REVIEW**

**What is an atom? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Pure substances**: are made of only \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or only one type of molecule (a group of atoms bonded together).

* Classified as either:

Elements – made up of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Example:

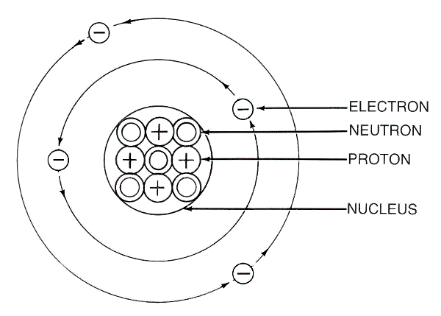
Atoms can join together to form \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Example:

Compounds – made up of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Example

**ATOMIC STRUCTURE**

The **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is the centre of an atom.

Subatomic particles:

**protons**: \_\_\_\_\_ charge; found in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**neutrons**: \_\_\_\_\_ charge: found in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**electrons**: \_\_\_\_\_ charge; found in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

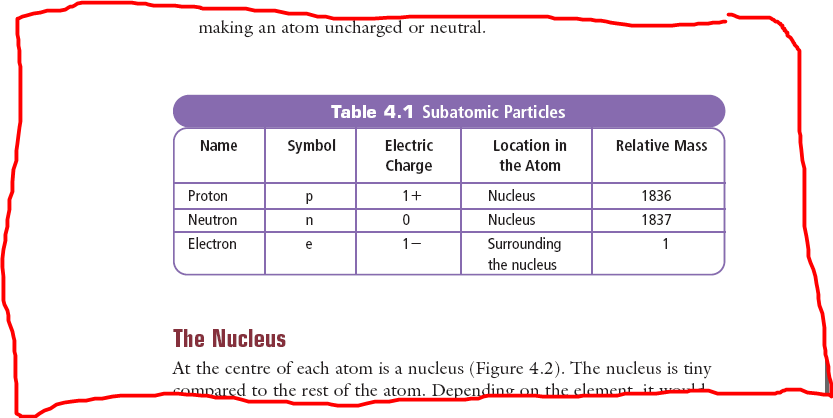
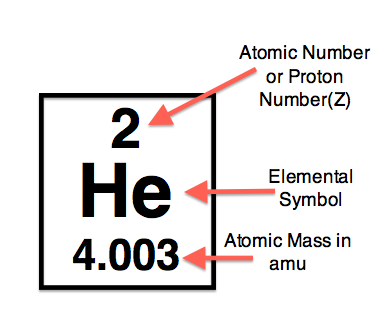
most of the mass of an atom: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

most of the volume of an atom: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

nuclear charge is determined by: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Atomic number is determined by: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

atoms are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, meaning they have the same number of \_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.



**Organization of the Periodic Table**

In the periodic table, elements are listed in order by the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

There are 3 main types of elements:

\_\_\_\_\_\_\_\_\_\_\_: located on the \_\_\_\_\_\_\_\_\_

\_\_\_\_\_-\_\_\_\_\_\_\_\_\_: located on the \_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_: form a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the middle

Rows (across) are called: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Columns (verticle) are called: \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Families of the Periodic Table**

All elements in a family:

* Have similar \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Bond with other elements \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Have same number \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Family Names:

Group 1 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ex.

Group 2 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ex.

Group 17 =\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ex.

Group 18 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ex.

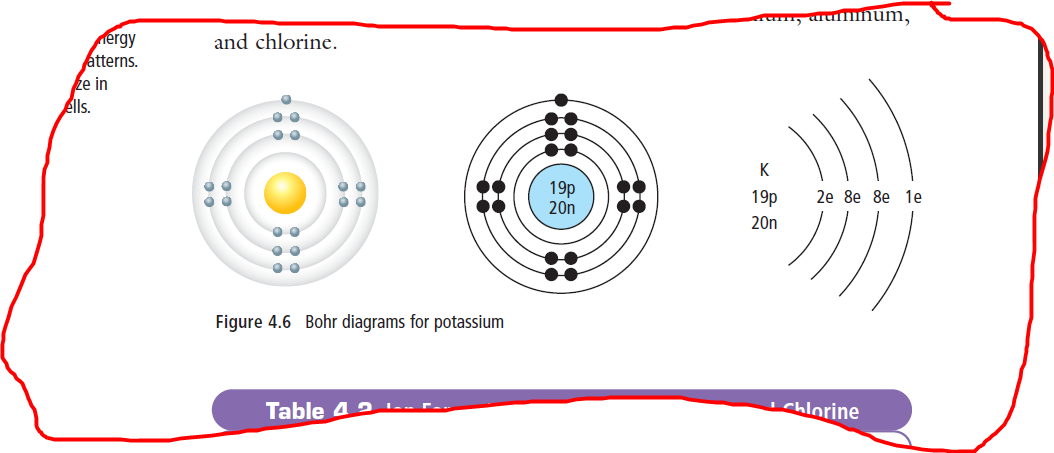
Groups 3 – 12 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ex.

**Bohr Diagrams**

* Show the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_of subatomic particles in atoms and ions.
* Electrons arranged in energy levels called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* First shell contains \_\_\_\_\_\_\_ electrons,

then \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

* Outermost shell is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is when the valence shell has 8 electrons.



* Rows determine the number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Group number determines the number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

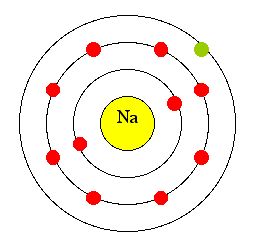
**Ions**

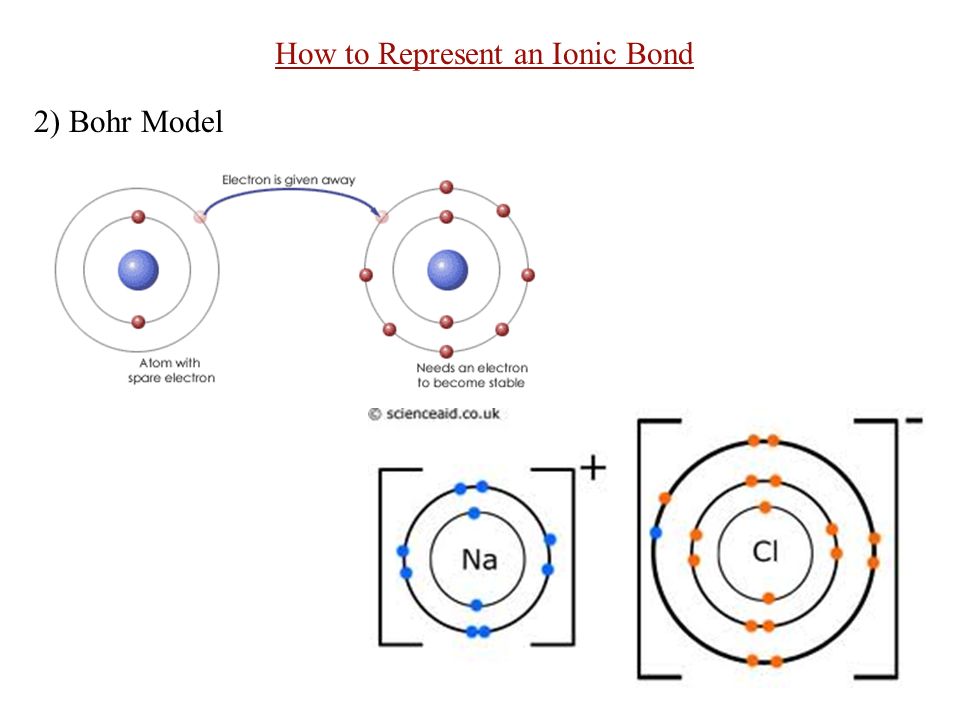
It is more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to achieve a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ shell (like the noble gases). To do this, atoms will either \_\_\_\_\_\_ or \_\_\_\_\_\_\_\_ electrons to become **ions** (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ particles).

**BOHR MODEL OF AN ION**

Remember, an ion is an atom that has gained a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (by either losing or gaining one or more electrons)

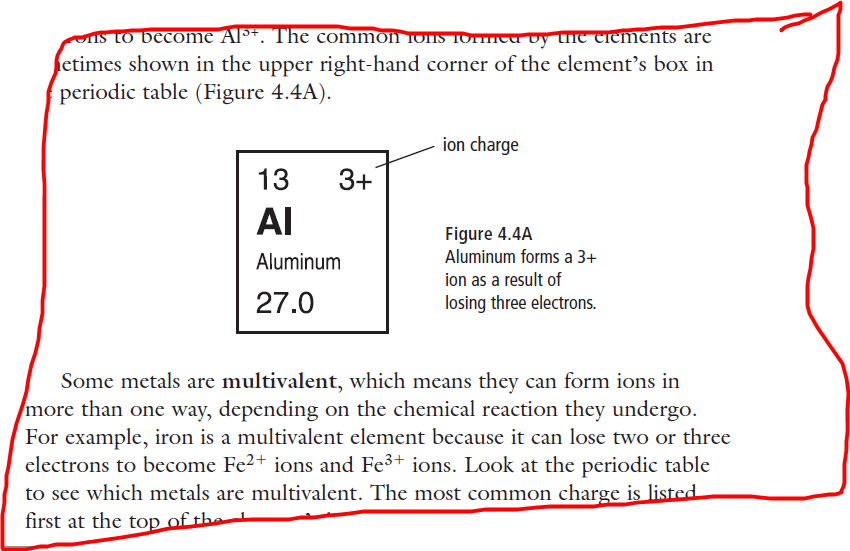
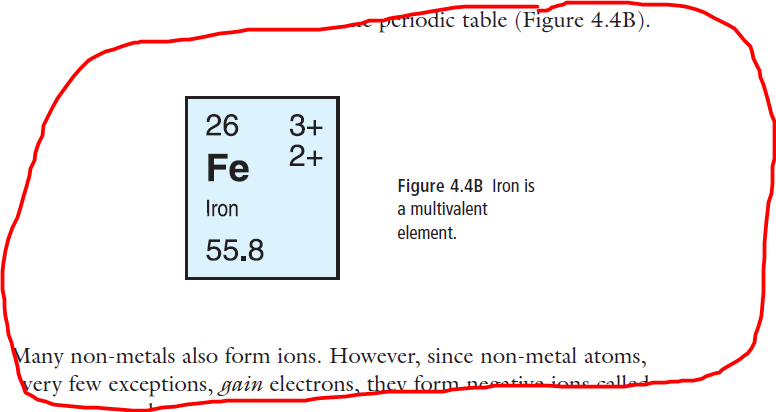
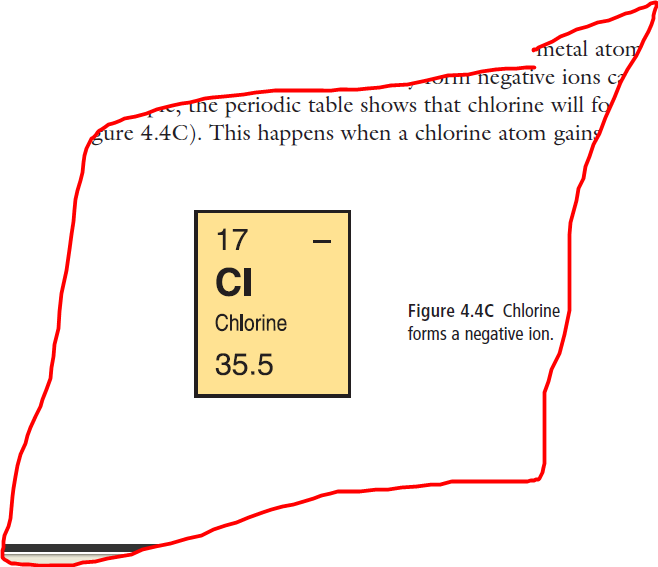
* The Bohr model indicates the charge with a “\_\_\_ or \_\_\_\_” and \_\_\_\_\_\_\_\_\_\_\_\_\_.
* Ex. Sodium ion has lost it’s outer most electron (-) to become more stable (like the noble gases) and now has a positive charge, indicated by the + and brackets.

Sodium Atom: Sodium Ion:



**Practice: Draw the bohr model of aluminum atom and ion**

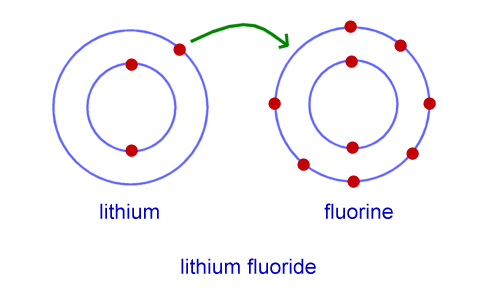
**Periodic Table and Ion Formation**

* + Elements on the left of the periodic table (metals) tend to \_\_\_\_\_\_\_\_ electrons and become \_\_\_\_\_\_\_\_\_\_ ions (called \_\_\_\_\_\_\_\_\_\_\_)
    - Some metals (\_\_\_\_\_\_\_\_\_\_\_\_\_\_) lose electrons in different ways
    - Ex. Iron, Fe, loses either 2 (fe2+) or 3 (fe3+) electrons
  + Elements on the right of the Periodic Tabel (Non-metals) tend to \_\_\_\_\_\_\_\_ electrons and become \_\_\_\_\_\_\_\_\_\_\_ ions (called \_\_\_\_\_\_\_\_)

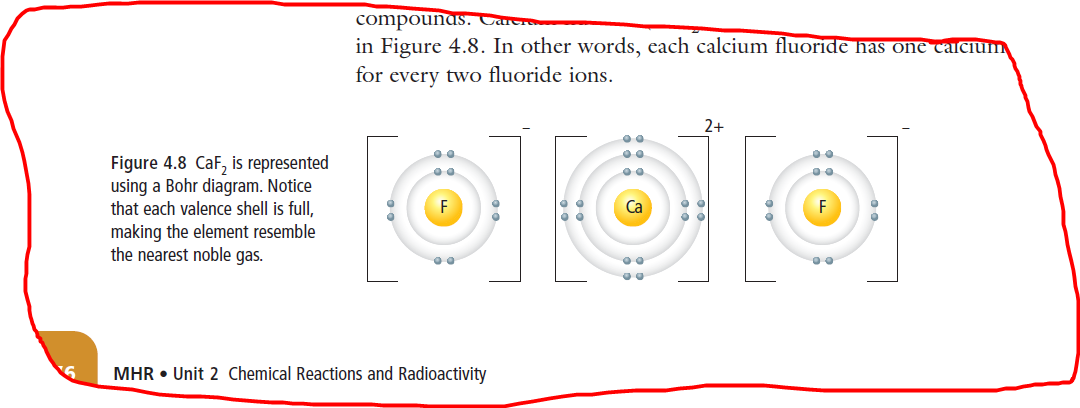
**FORMING COMPOUNDS**

* When two atoms get close together, their \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ interact.
  + If the valence electrons can combine to form a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bond (to become more stable), a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is formed.
  + Each atom in the compound attempts to have the \_\_\_\_\_\_\_\_\_\_\_\_ number of valence electrons as the nearest \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

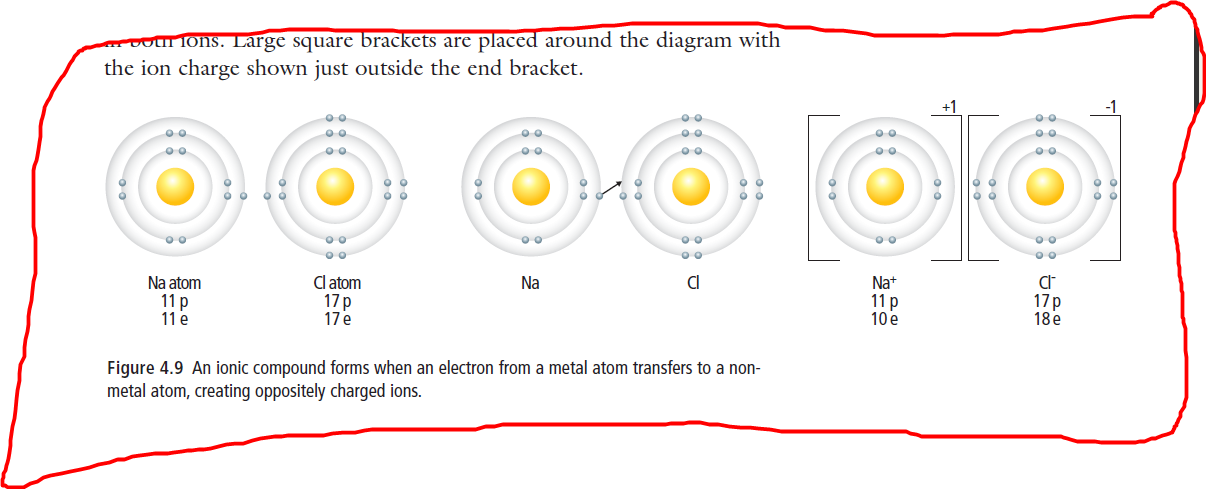
**There are two types of Bonds that form:**

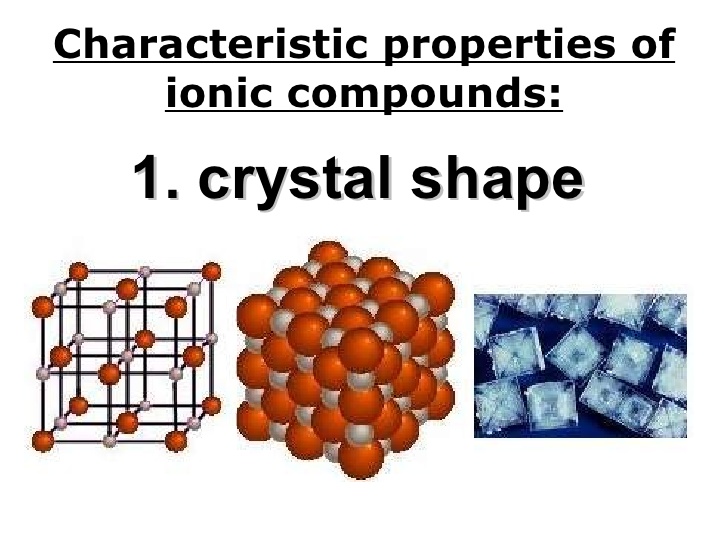
**IONIC BONDS**

* form when electrons are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from cations (+) to anions (-).
* involves a \_\_\_\_\_\_\_\_\_\_\_\_\_ (+) and a \_\_\_\_\_\_\_\_\_\_\_\_\_ (-)
* The Bohr model indicates the charge with a “\_\_\_ or \_\_\_\_” and **\_\_\_\_\_\_\_\_\_\_\_\_**.



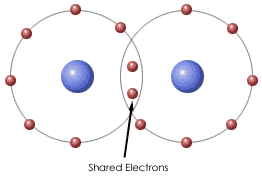
* Above: Bohr diagram of CaF2
* Notice that each balance shell is full, making the element resemble the nearest noble gas



****

**IONIC COMPOUNDS**

* Ionic substances form structured **\_\_\_\_\_\_\_\_\_\_\_\_** containing **\_\_\_\_\_\_\_\_\_\_\_\_\_\_** charged ions.
* They have high \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and boiling points, and
* conduct \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ when melted or dissolved in water.

**COVALENT BONDS**

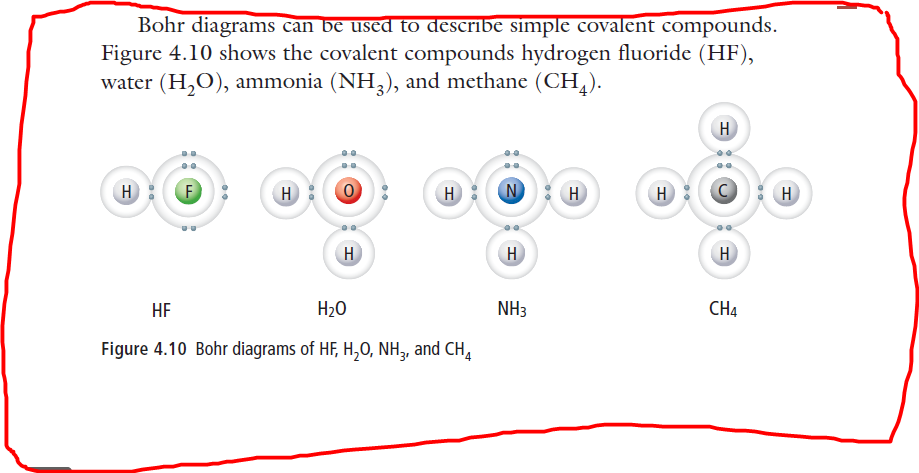
* form when electrons are \_\_\_\_\_\_\_\_\_\_\_\_\_between two \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Electrons \_\_\_\_\_\_ with their atom, but \_\_\_\_\_\_\_\_\_\_\_\_\_\_ with other shells.
* A covalent bond, is also called a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_bond.
* A **molecule** is an electrically \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ group of two or more atoms held together by chemical bonds.
* Molecules are distinguished from ions by their lack of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* The pair of electrons involved in the bond is called a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.**

**COVALENT COMPOUNDS**

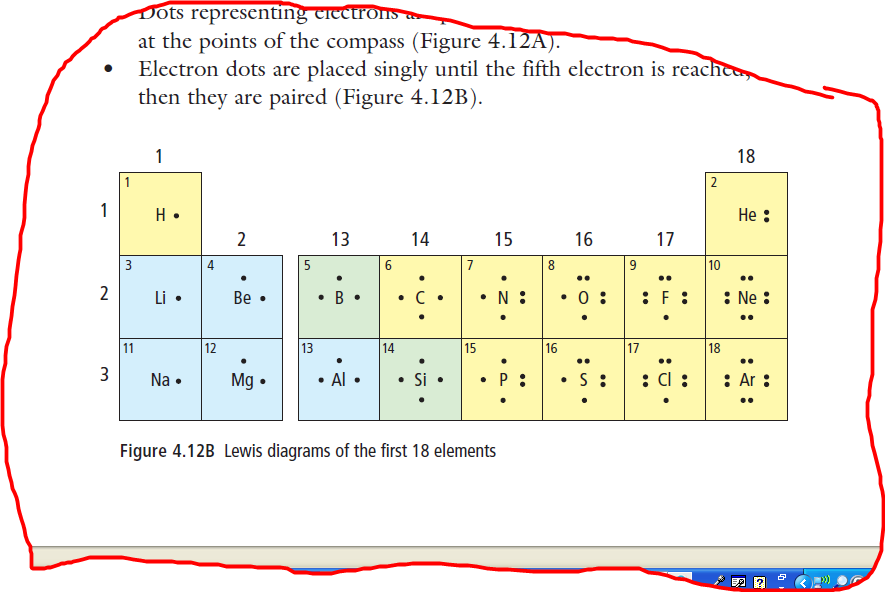
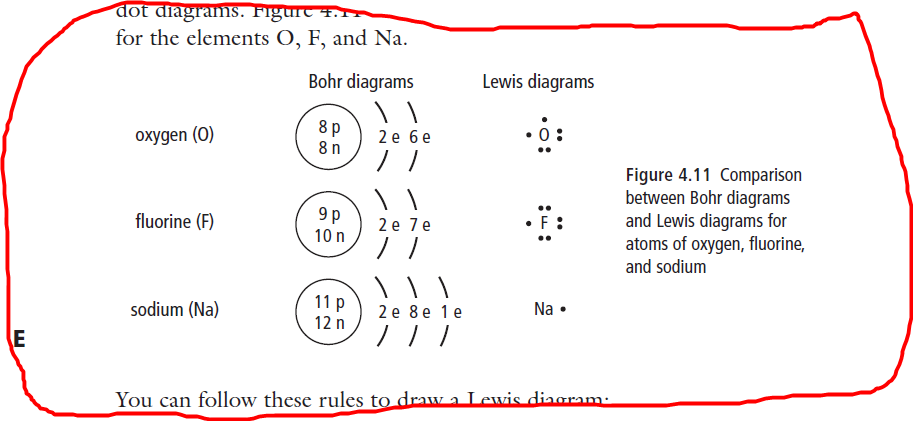
* Involve \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_only.
* Have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ melting points than ionic compounds (due to weaker bonds).
* Do not \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ when solid or dissolved (no ions).

**BOHR DIAGRAM OF COVALENT BONDS**

* Because a covalent bond means electrons are \_\_\_\_\_\_\_\_\_\_\_\_, valence electrons \_\_\_\_\_\_\_\_\_\_\_\_\_ (spending time orbiting both elements)
* indicated by shell from each element in the bond \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

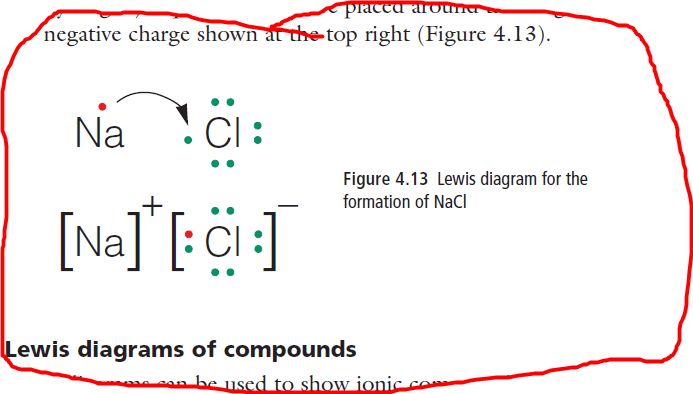


**Lewis Diagrams**

* Invented by an American chemist Gilbert Lewis (1875 – 1946)
*  Demonstrates chemical bonding by only showing an atom’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons and chemical \_\_\_\_\_\_\_\_\_\_\_\_\_.

Rules to draw a Lewis diagram:

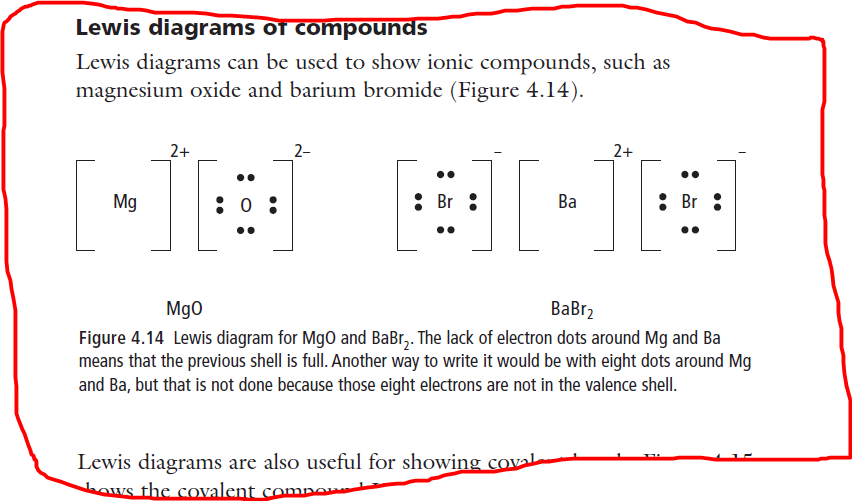
* + - * 1. Dots that represent the \_\_\_\_\_\_\_\_\_\_\_ electrons are placed around the element \_\_\_\_\_\_\_\_\_\_\_\_\_\_ at the points of a compass.
        2. Dots are placed \_\_\_\_\_\_\_\_\_\_\_\_ until the \_\_\_\_\_\_\_\_\_\_ electron, then they are \_\_\_\_\_\_\_\_\_\_\_\_.

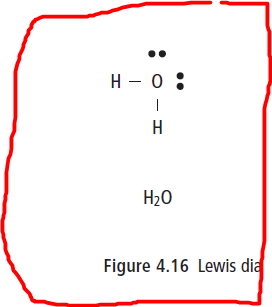
**Lewis diagrams of ions**

1. For positive ions, one electron dot is \_\_\_\_\_\_\_\_\_\_\_\_\_\_ for each positive charge.

Because only valence electrons are shown in Lewis diagrams, the positive ion usually not have any valence electrons left to show.

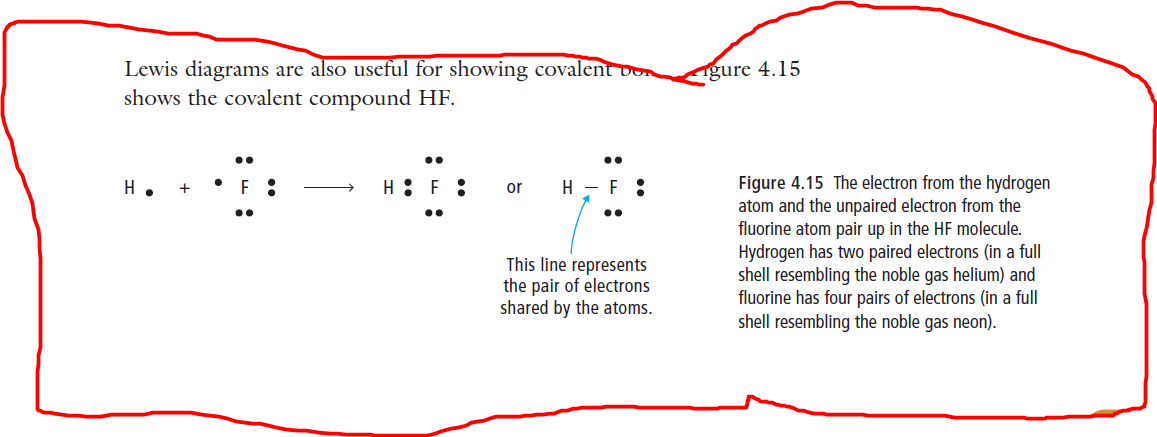
1. For negative ions, one electron dot \_\_\_\_\_\_\_\_\_\_\_\_\_\_ for each negative charge.
   * Usually means the symbol is surrounded by all \_\_\_\_\_ dots.
2. Place \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ around element and indicate proper \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Lewis Diagrams of Ionic Compounds**

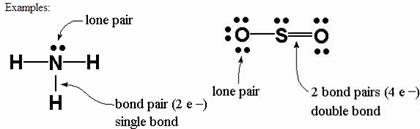


**Lewis Diagrams of a Covalent Compounds**

* The shared pairs of electrons are usually drawn as a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_.



* Valence electrons involved in the bonding are called a \_\_\_\_\_\_\_\_\_\_\_\_\_pair.
* Valence electrons NOT involved in the bond are called \_\_\_\_\_\_\_\_\_\_\_\_ pairs.

****

**Lewis Diagrams of Diatomic Molecules**

**Diatomic molecules** are **molecules** composed of only \_\_\_\_\_\_\_\_\_\_\_\_\_ atoms, making them \_\_\_\_\_\_\_ stable than the individual atoms.

