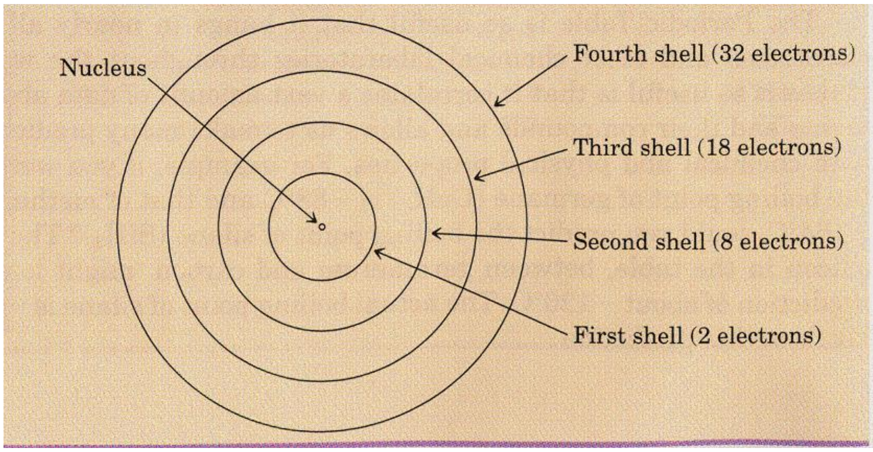
THE MODERN ATOM

- The modern model of the atom describes the electron cloud consisting of separate ***energy levels***, each containing a ***fixed number*** of electrons.



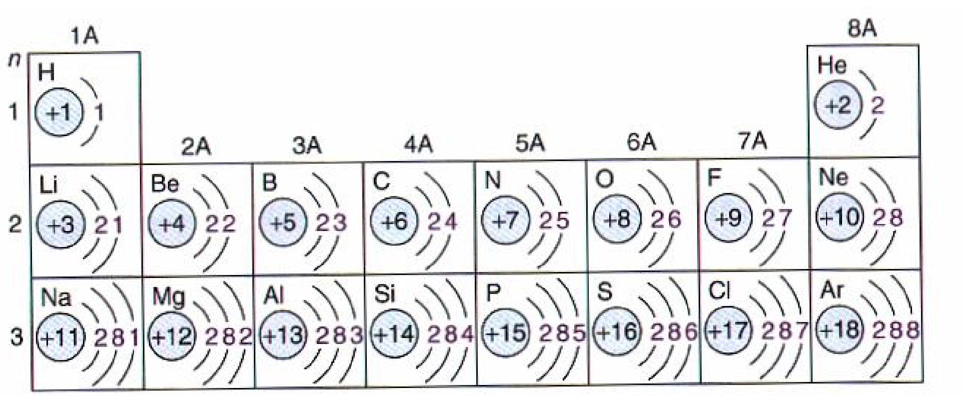
- The energy levels increase in energy based on their distance from the nucleus.
- Based on this model, electrons can move from ***lower levels to higher ones*** by ***absorbing energy*** such as heat or electricity.
- When electrons move from ***higher to lower energy levels***, they ***release energy*** in the form of light.
- The number of electrons in the outermost filled energy level are called ***valence electrons***.
- The lowest energy level can only hold a maximum of 2 electrons, while others can have 8, 18 and 32 electrons.

ELECTRON CONFIGURATION OF ATOMS

- ***Similarities*** of behavior in the periodic table is due to the similarities in the ***electron arrangement*** of the atoms. This arrangement is called ***electron configuration***.

- The elements in any group have the ***same number of valence electrons***. Therefore, they have similar ***electron configurations*** and properties.

- The number of valence electrons for the main group elements is the same as their group number.



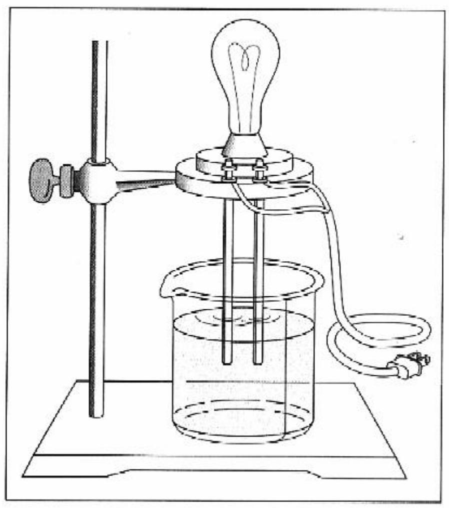
Electron Configuration of Main-group Elements in Periods 1-3

CHEMICAL BONDING

- Most ***matter*** in nature is found in form of ***compounds***: 2 or more elements held ***together*** through a ***chemical bond***.

- Elements combine together (***bond***) to ***fill their outer energy levels*** and achieve a ***stable structure (low energy)***. ***Noble*** gases are ***unreactive*** since their ***energy levels are complete***.

- The nature and type of the ***chemical bond*** is directly responsible for many physical and chemical ***properties*** of a substance: (e.g. melting point, conductivity)



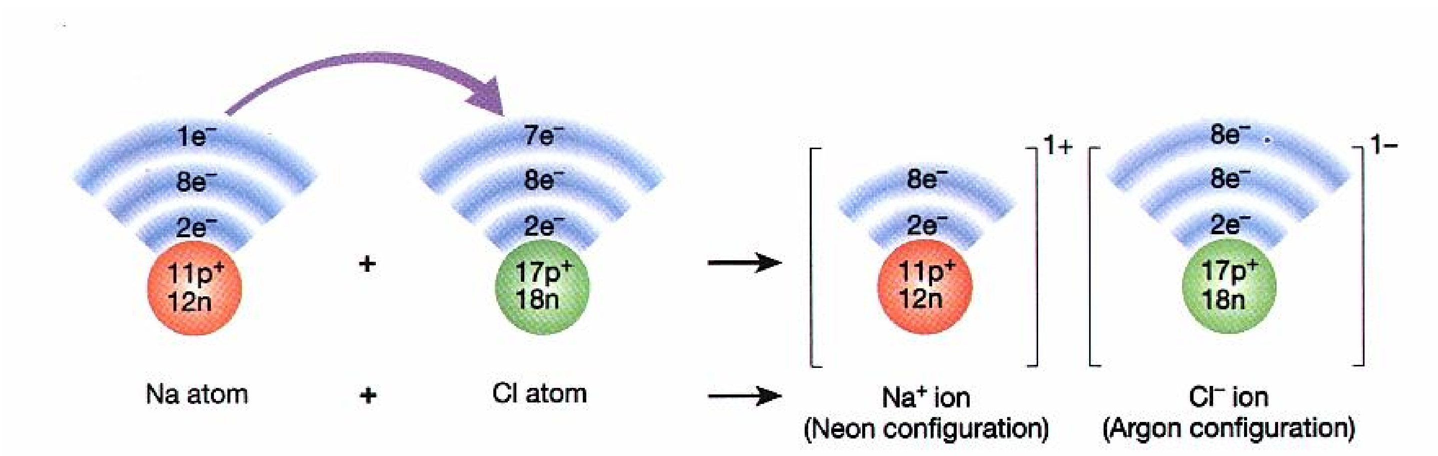
When the ***conductivity*** apparatus is placed in ***salt*** solution, the bulb ***will light***. But when it is placed in ***sugar*** solution, the bulb ***does not light***.

This ***difference in conductivity*** between salt and sugar is due to the ***different types of bonds*** between their atoms.

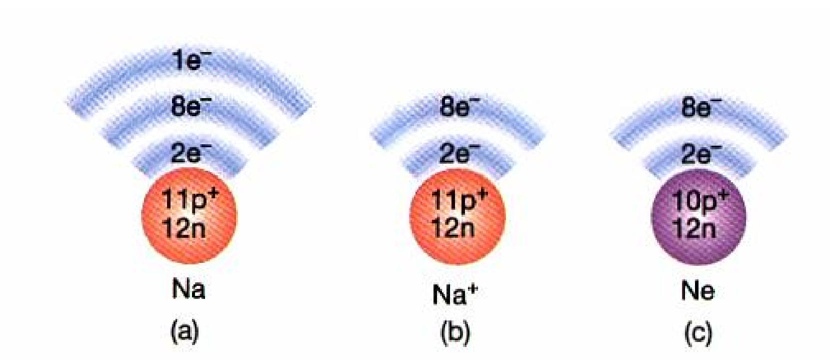
- Two common ***types*** of bonding are present: ***ionic, & covalent.***

IONIC BOND

- ***Ionic bonds*** occur when electrons are ***transferred*** between two atoms.



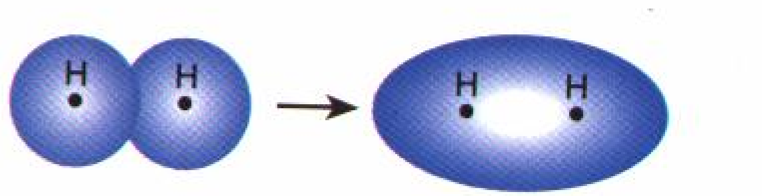
- ***Ionic bonds*** occur between ***metals*** and ***non-metals***.
- Atoms that lose electrons (***metals***) form positive ions (***cations***).
- Atoms that gain electrons (***non-metals***) form negative ions (***anions***).
- The ***smallest*** particles of ***ionic compounds*** are ***ions*** (not atoms).



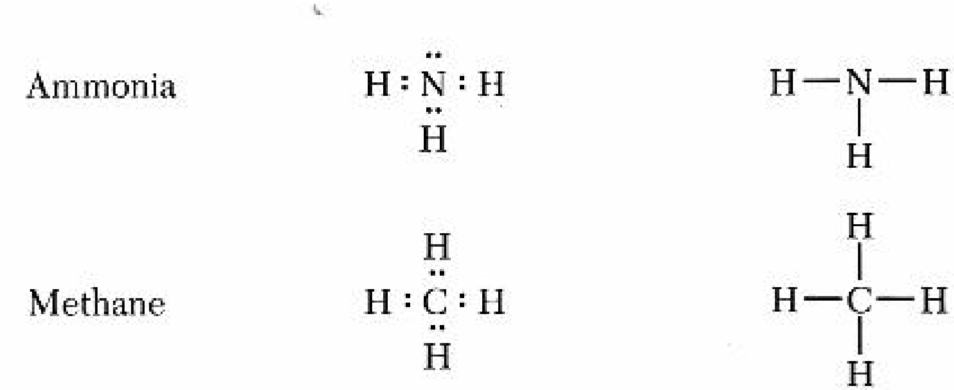
Comparison between sodium atom (a), sodium ion (b) and neon aotm (c)

COVALENT BOND

- ***Covalent*** bonds occur when electrons are ***shared*** between two atoms.



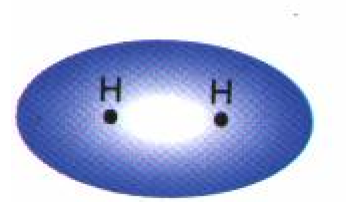
- ***Covalent bonds*** occur between ***two non-metals***.
- The ***smallest*** particle of a ***covalent*** compound is a ***molecule***.
- Covalent structures are best represented with ***electron-dot symbols*** or ***Lewis structures***.
- Structures must satisfy ***octet rule*** (8 electrons around the central atom). Hydrogen is one of the few exceptions and forms a doublet (2 electrons).



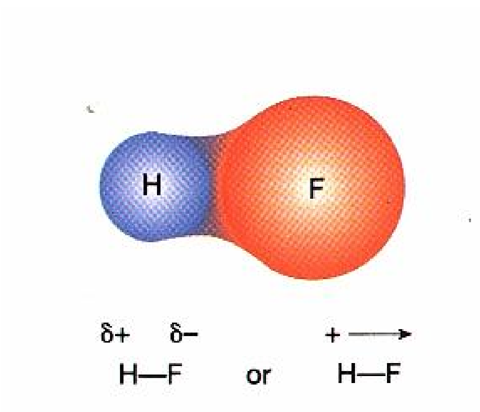
POLAR & NONPOLAR BONDS

- Two types of ***covalent*** bonds exist: ***polar and nonpolar***.

- ***Nonpolar*** covalent bonds occur between ***similar atoms***. In these bonds the ***electron pair*** is shared ***equally*** between the two protons.



- ***Polar*** covalent bonds occur between ***different*** atoms. In these bonds the ***electron pair*** is shared ***unequally*** between the two protons. As a result there is a ***charge separation*** in the molecule, and ***partial charges*** on each atom.



<u>Examples:</u>
Identify each of the following substances as ionic, polar or non-polar covalent:

1. PCl_3

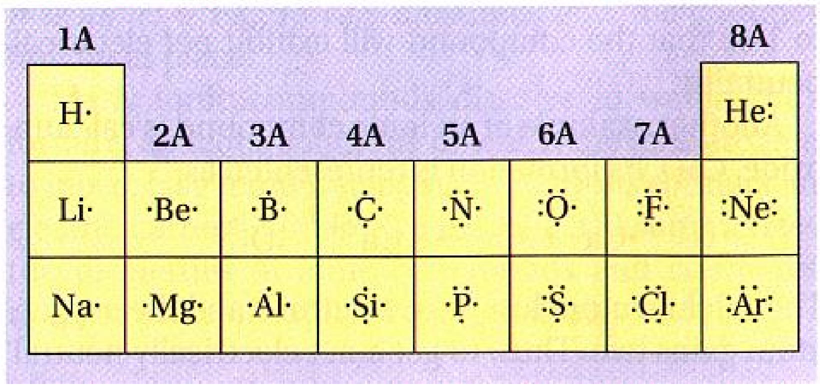
2. MgF_2

3. O_2

4. SO_2

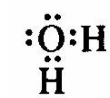
LEWIS STRUCTURES

- ***Lewis structures*** use Lewis symbols to show ***valence electrons*** in ***molecules*** and ***ions*** of compounds.

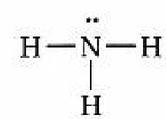


Lewis symbols for the first 3 periods of Representive Elements

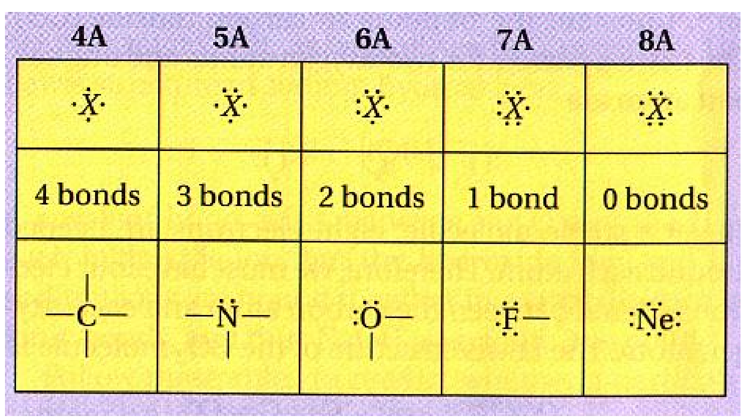
- In a Lewis structure, a ***shared electron pair*** is indicated by ***two dots*** between the atoms, or by a ***dash*** connecting them.



- ***Unshared*** pairs of valence electrons (called ***lone pairs***) are shown as belonging to individual atoms or ions.

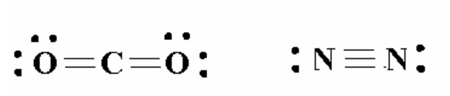


- Writing correct Lewis structures for covalent compounds requires an understanding of the ***number of bonds*** normally ***formed by common nonmetals***.



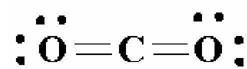
LEWIS STRUCTURES

- When an element has ***2, 3, or 4 unpaired valence electrons***, its atoms sometimes ***share more than one*** of them with another atom. Thus ***double and triple bonds*** are possible.



Evaluating Lewis Structures:
When evaluating Lewis structures, 2 items should be checked:

1. Structure contains the correct number of electrons. (Add valence electrons for each atom in the structure)

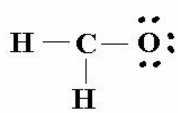


2. Each atom should obey the Octet Rule (8 electrons). Hydrogen is an exception (doublet).

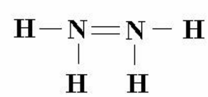
Examples:

1. Determine if each of the following Lewis structures are correct or incorrect. If incorrect, rewrite the correct structure.

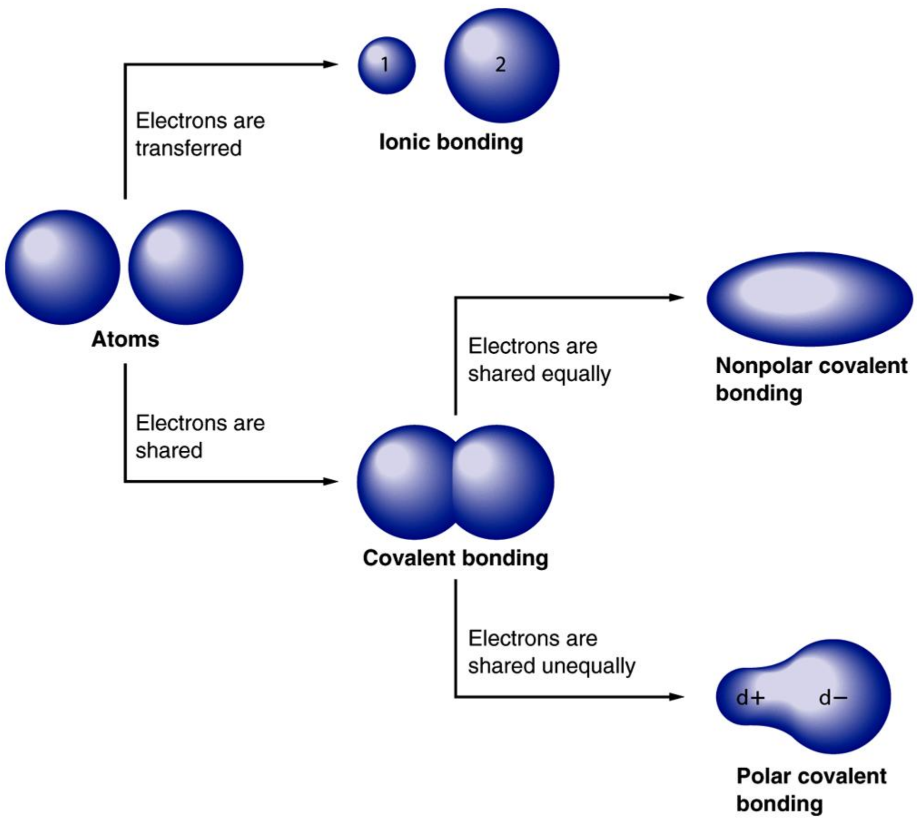
H_2CO



N_2H_4



SUMMARY OF BONDING



COMPARISON OF PROPERTIES OF IONIC & COVALENT COMPOUNDS

	Ionic	***Covalent***
Structural Unit	Ions	Atoms or Molecules
Attractive Force	Strong	Moderate to Strong
Melting point	High	Generally low
Boiling point	High	Generally low
Solubility in Water	High	Low or None
Hardness	Hard & brittle	Soft to very hard
Electrical Conductivity	Low (solid) High (sol'n)	None
Examples	AgBr NaCl	H_2 H_2O