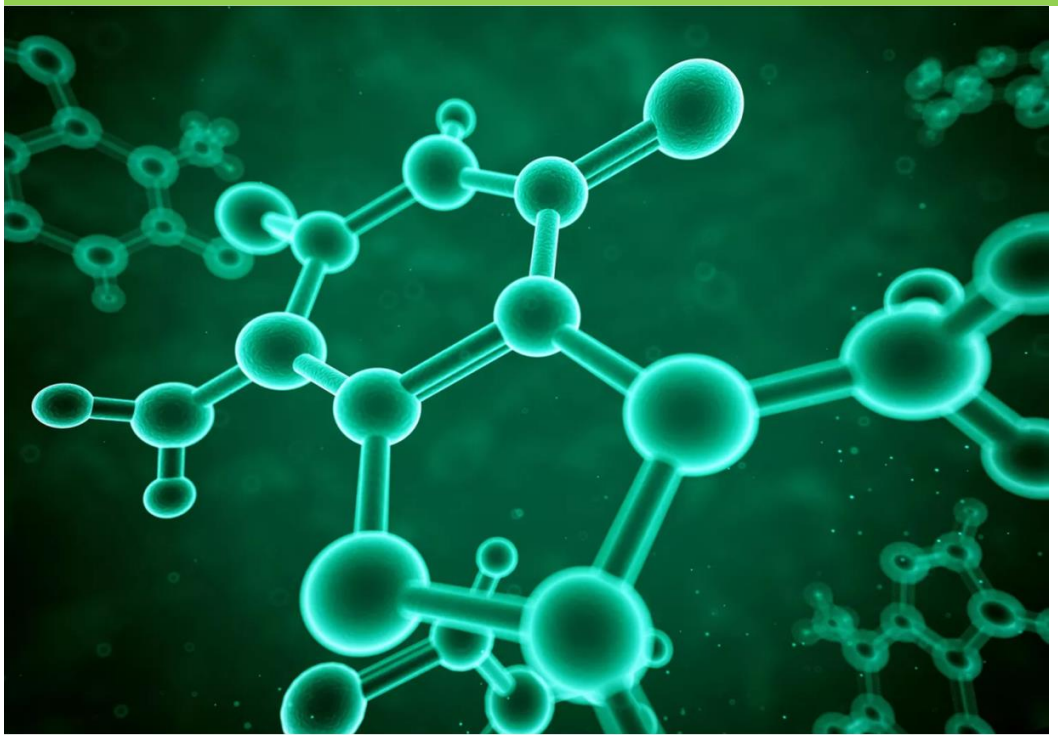
Analytical Chemistry



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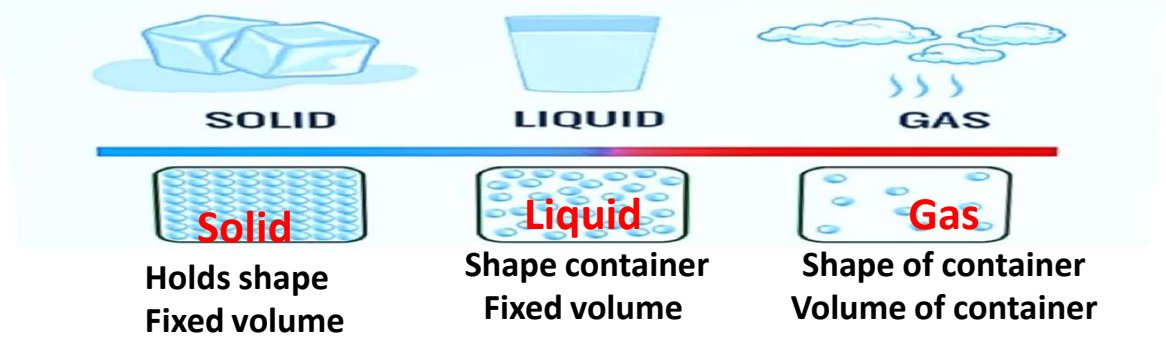
Introduction to chemistry

Matter

- matter is any thing which has mass and volume.
- examples of matter : sand (a solid), Water (a liquid), Air (a mixture of gases).

- Solid have shape and volume. Liquid have volume but adopt the shap their container. Gases occupy the shape and volume of their containar.



Substance

- A substance is a form of matter that has constant chemical composition and characteristics properties.

- There are two kinds of substances __ Elements and Compounds. Element is a pure chemical substance consisting of one type of atom. Compound is a pure chemical substance consisting of two or more different chemical elements.

➢ Physical properties

The properties related to the state (gas ,liquid or solid)or appearance of a sample are called physical properties. Some commonly known physical properties are density , state at room temperature, color, hardness, melting point and boiling point.

➢ Chemical properties

A chemical properties is a change in which at least one substance changes its compositions and its set of properties. Examples : flammability , rust resistance ,reactivity.

Classification of matter (substance)

- Therefore, matter is classified according to several different schemes. Matter may be chemical classified as ,
- **Organic or Inorganic**.
- **Acids, bases or salts** .
- **Pure substance or a Mixture**.

Pure substance

Matter that has a **constant composition** and **fixed properties**.

Mixture

A physical blend of matter that can theoretically be physically separated into two or more components.

❖Homogeneous matter

Matter that has a same properties throughout the sample.

❖Solution

Homogeneous mixture of two or more pure substance .

❖Heterogeneous

Matter with properties that are not the same throughout the sample.

❖Atoms

Atom are the basic unit of chemistry. They consist of 3 smaller things:

- Protons – these are positively charged (+)
- Electron – these are negatively charged (-)
- Neutrons – these have no charged

❖ Ion

An ion is a particle (an atom or group of atom) carrying negative or positive charge.

- **Positive Ion (cation)** – occurs when an atom loses an electron. It has more proton than electrons.
- **Negative Ion (anion)** – occurs when an atom gains an electron. It will have more electron than proton.

❖ Molecule

A molecule is comprised of two or more **chemically bonded atoms**. The atoms may be of the same type element or they may be different.

- **Molecular formulas** – refer to the **actual** number of the different atoms which comprise a single molecule of a compound.
- **Empirical formulas** – refer to the **smallest whole number ratios** of atoms in a particular compound.

molecular formula and empirical formula

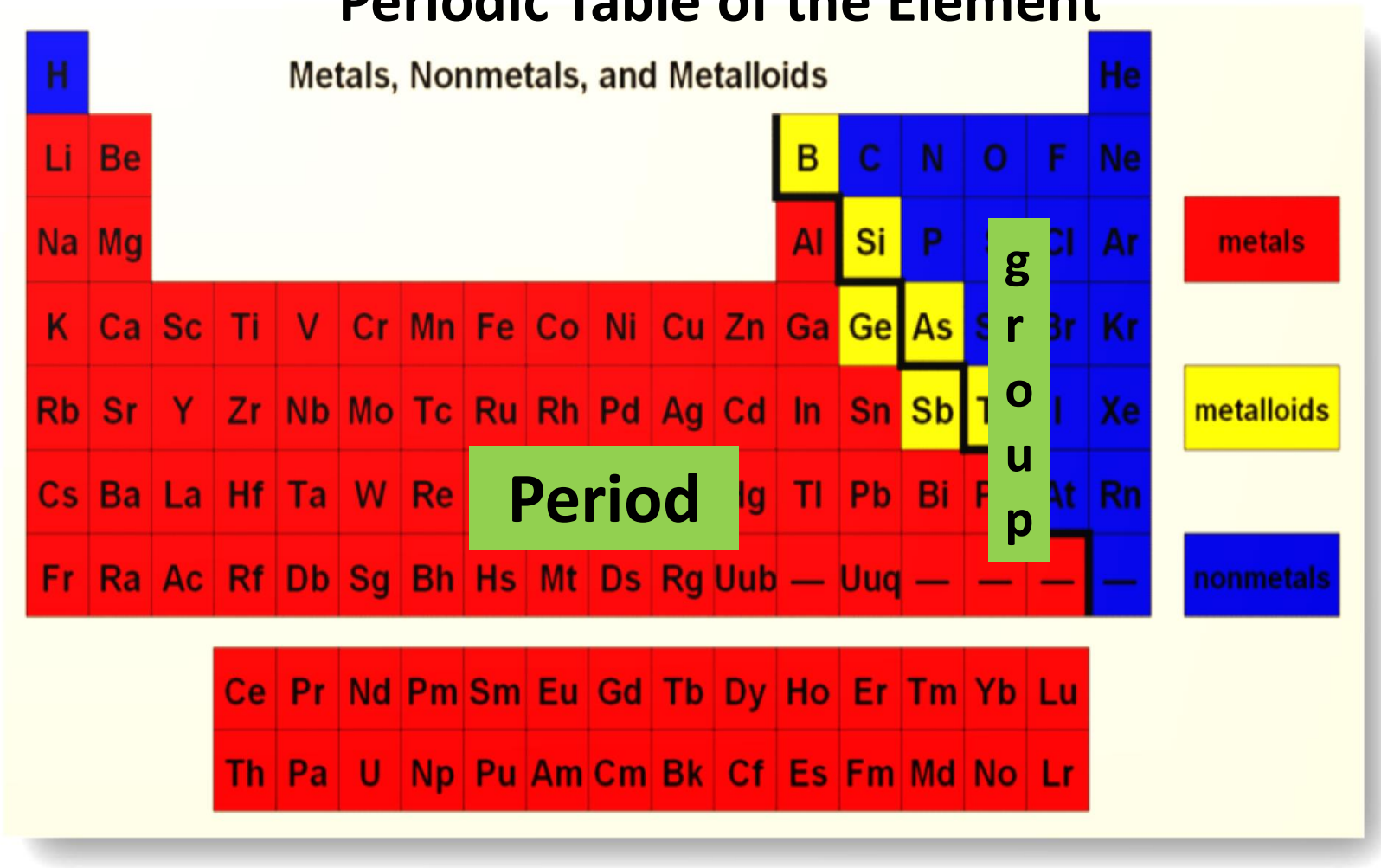
Element	Molecular Formula	Empirical Formula
Water	H_2O	H_2O
Glucose	$C_6H_{12}O_6$	CH_2O
Hydrogen Peroxide	H_2O_2	HO
Butane	C_4H_{10}	C_2H_5
Benzene	C_6H_6	CH

Periodic Table of the Element

- The periodic table is a tubular arrangement of the chemical elements ,organized on the basis of their **atomic numbers** , **electron configuration** and **chemical properties**.

- The basic structure of the periodic table is its division into rows and groups. A **period** consists of elements in any one horizontal row of the periodic table. A **group** consist of the element in any one column of the periodic table.

Periodic Table of the Element



❖Metals

- ❑ Solids at room temperature (except HG).
- ❑ Metallic luster.
- ❑ Malleable and ductile .
- ❑ Good conductors of heat and electricity.

❖ Non-metals

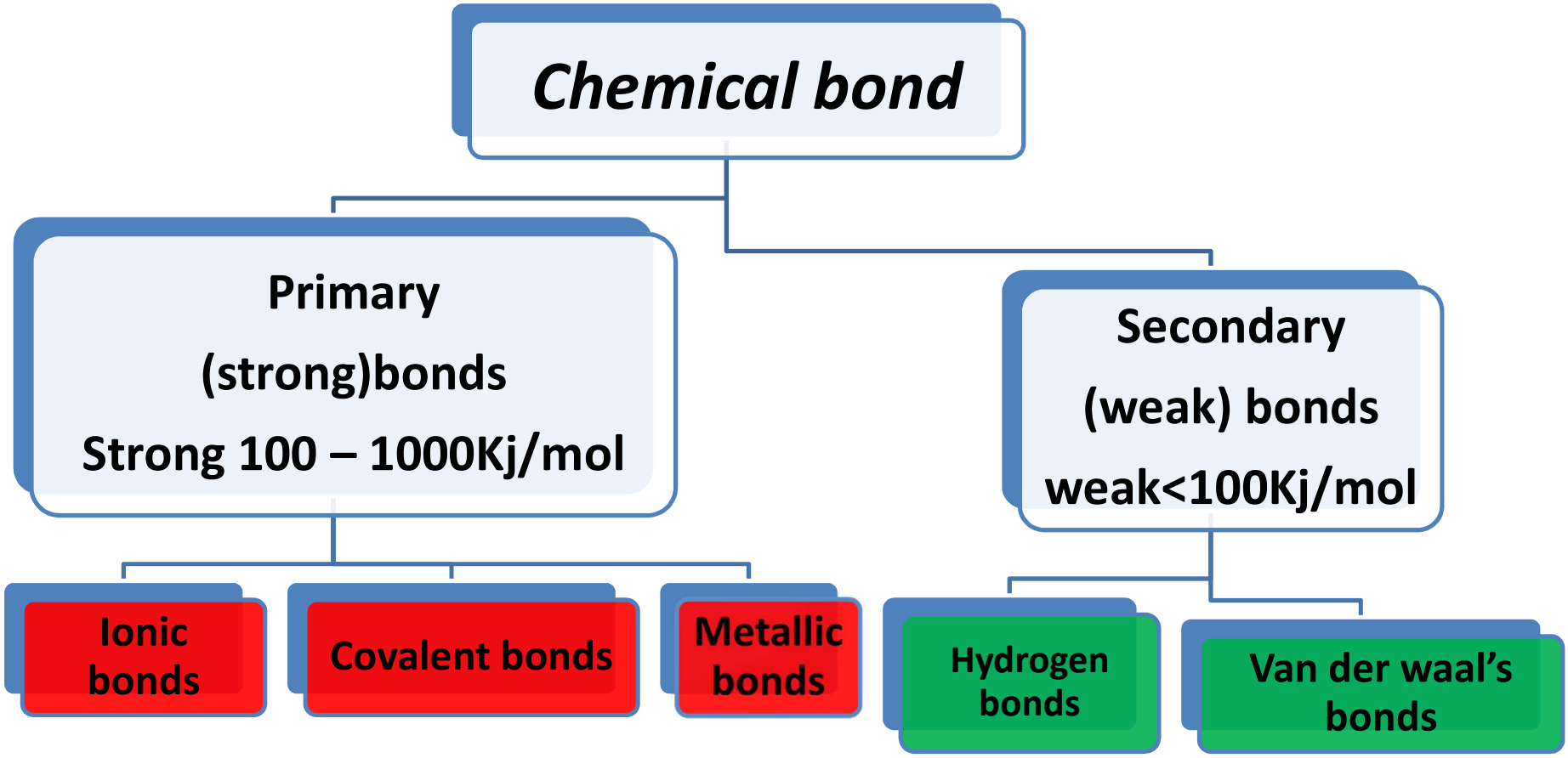
- ❑ Gases or solids at room temperature (except br2).
- ❑ Variety of color and appearance
- ❑ Brittle solids
- ❑ Insulators (poor conductors)

❖ Metalloids (semi – metals)

- ❑ Intermediate in properties between metals an non- metals.
- ❑ Solid at room temperature.
- ❑ Many have more than one structure (one structure ,the other non structure)
- ❑ Some are semi- conductors

The chemical bond

A chemical bond is a strong force of attraction ,which holds atoms together in molecules.



Classification of chemical Bonds

There are two major bond classification :

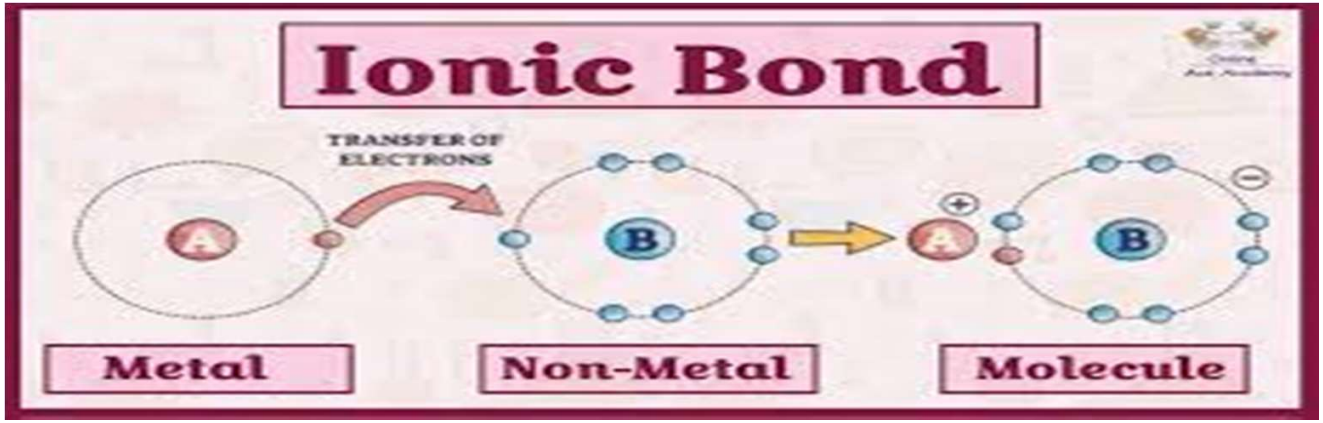
- **primary bond (strong 100 – 1000Kj / mol)**

The three types of primary bonding reflect these ways in which atoms can group together by **gaining** or **losing** or **sharing** electrons, so they get inert gas electron configuration.

1. Ionic Bonds

- **Happened between metal and non metal**

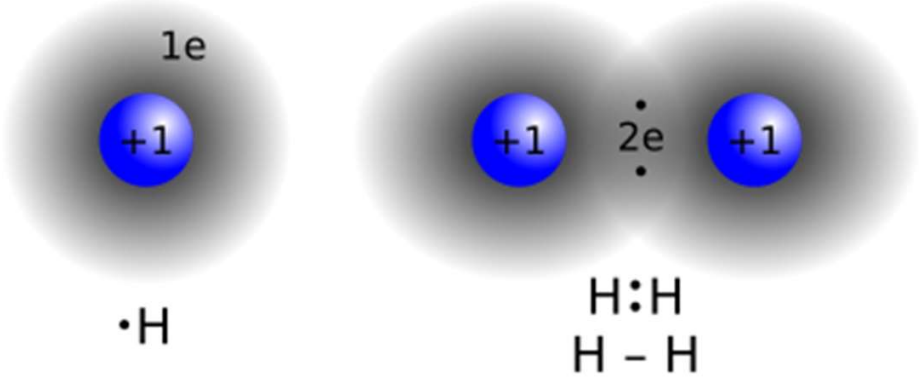
Atoms near the left or right sides of the periodic table can loose or gain 1 (or 2) electrons to from charged “ions” for example, a Sodium atom can loose one electron to have valence electrons and become a positively charged ” cation ” . A chlorine atom can gain one electron to have 8 valence electrons and become a negatively charged “ anion”



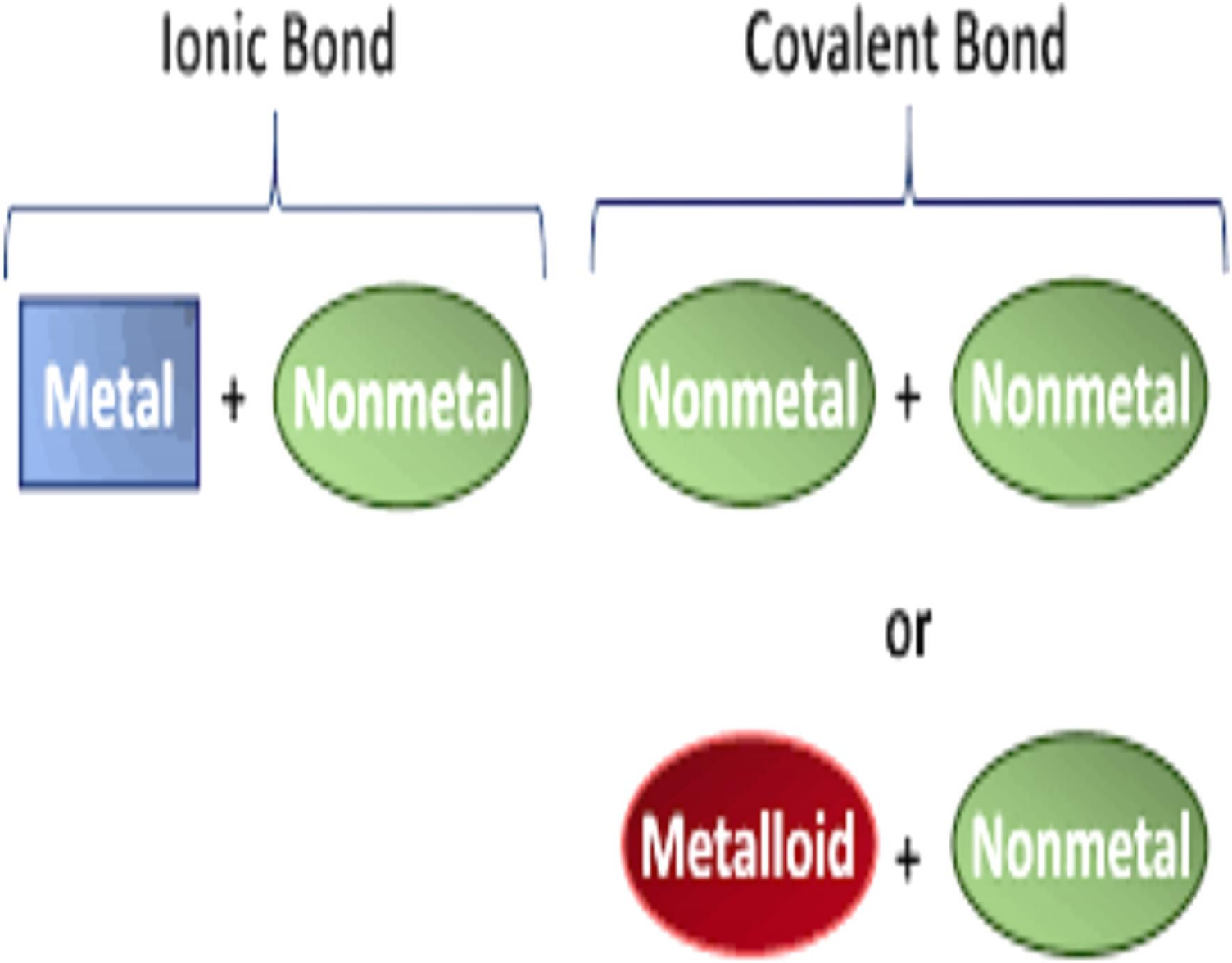
2. Covalent Bonds

- **Happened between non metal and non metal**

In Covalent bonding atoms **share** electrons.
For example H2 molecule. Since each hydrogen has only one electron , when two hydrogen get together the can share their electrons.



Pure hydrogen excits as H2 molecules


Ionic Bond
Covalent Bond
Metal
+
Nonmetal
Nonmetal
+
Nonmetal
or
Metalloid
+
Nonmetal

3. **Metallic bond**

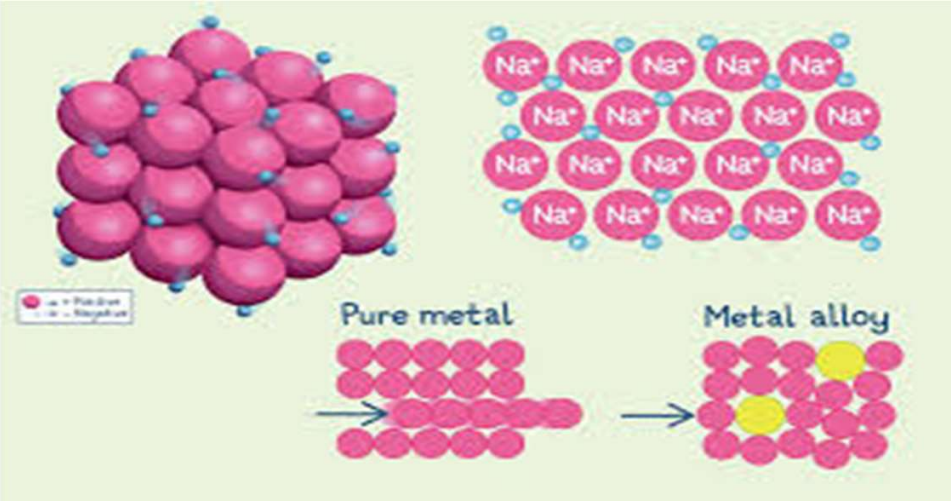
➢ Happened between metal and metal

The atoms are ionized , losing some electrons from the valence bands the charged nuclei in place.

Metallic bonding occurs between the positive atom cores and the " nearly free" electrons.

In metallic bonding :

- There are no charge requirements.
- There are no directional requirement.
- There are long range effects.



➢Secondary Bonds (Weak <100 Kj / mol)

No electron transferred or shared. Secondary or weak bonds are formed when there is effectively a partial and / or momentary charge.

1. Hydrogen bonding

Hydrogen bonding is the most common type of bonding between permanent dipoles. The situation that leads to hydrogen bonding arises with a normal bond between a hydrogen atom and a neighbor. Since any other atom will bind the electron from the hydrogen atom more tightly , the electron will spend more time with the other atom. This creates a permanent dipole(a partially exposed proton) that can interact with other dipoles nearby.

2. Van der waal's bonds

The dipoles involved in van der Waals binding come from fluctuations in the symmetry of the electron distribution surrounding the nucleus of an atom. Momentary electric dipoles are set up and give rise to weak, very short range, non directional attractive forces between molecules or atoms. Example : Ni atom