Republic of Iraq
Ministry of Higher Education & Scientific research
Al-Mustaqbal University
Science College
Biochemistry Department

Introduction in Chemistry

For

First Year Student

Lecture 2

By

Dr. Karrar M. Obaid

2024-2025

Periodic Table of the Element

Periods and Groups

The periodic table is a tabular arrangement of the chemical element , organized on the basis of their atomic numbers , electron configurations (electron shell model) and recurring chemical properties.

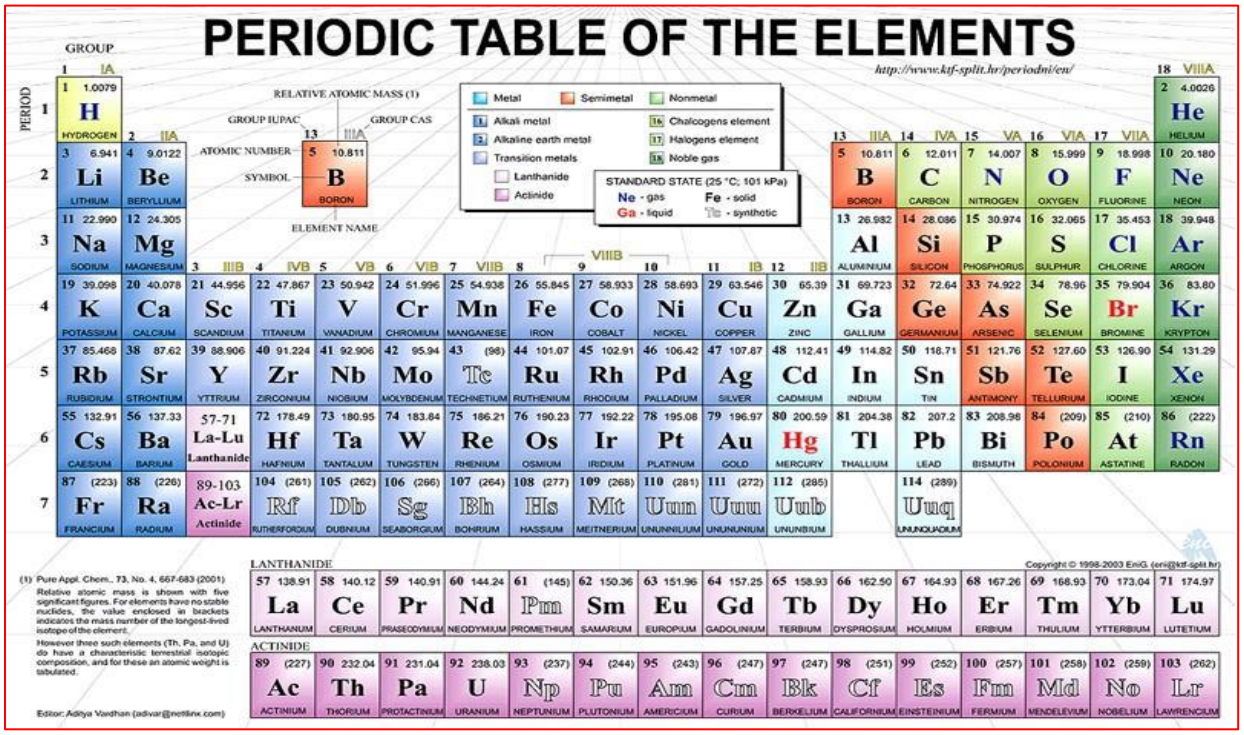
The first reasonably successful attempt was made by **Dimitri Mendeleev** in 1869. He had the idea of arranging elements in order of increasing atomic mass, and, most importantly, found that elements with similar chemical and physical properties occurred periodically. He placed these similar elements under each other in columns.

In 1914, **Henry Moseley** determined that a better arrangement was in order of increasing atomic number, giving us the periodic table we have today.

We can define the periodic table as an arrangement of elements in order of increasing **atomic number** placing those with similar chemical and physical properties in columns.

The basic structure of the periodic table is its division into rows and columns, or periods and groups. A **period** consists of the elements in any one horizontal row of the periodic table. A **group** consists of the elements in any one column of the periodic table. The first period of elements consists of only hydrogen (H) and helium (He). The second period has 8 elements, beginning with lithium (Li) and ending with neon (Ne). There is then another period of 8 elements, and this is followed by a period having 18 elements, beginning with potassium (K) and ending with krypton (Kr). The fifth period also has 18 elements. The sixth period actually consists of 32 elements, but in order for the row to fit on a page, part of it

appears at the bottom of the table. Otherwise the table would have to be expanded, with the additional elements placed after barium (Ba, atomic number 56). The seventh period, though not complete, also has some of its elements placed as a row at the bottom of the table.



The groups are usually numbered. The numbering frequently seen in North America labels the groups with numerals and A's and B's. In Europe a similar convention has been used, but some columns have the A's and B's interchanged. To eliminate this confusion, the International Union of Pure and Applied Chemistry (IUPAC) suggested a convention in which the columns are numbered 1 to 18.

1. **Metals**

- solids at room temperature (except Hg).
- metallic luster.
- malleable and ductile.

- good conductors of heat and electricity

2. **Non-metals**

- gases or solids at room temperature (except Br_2).
- variety of color and appearance.
- brittle solids.
- insulators (poor conductors.

3. **Metalloids (semimetal)**

- intermediate in properties between metals and non-metals.
- solids at room temperature.
- many have more than one structure (one metallic, the other non-metallic).
- some are semi-conductors.

Main Group Elements (Vertical Groups)

- Group 1(IA) - Alkali Metals
- Group 2(IIA) - Alkaline Earth Metals
- Group 13(IIIA) - Boron Family
- Group 14(IVA) - Carbon Family
- Group 15(VA) - Nitrogen Family
- Group 16(VIA) - Oxygen Family (Chalcogens)
- Group 17(VIIA) - Halogens
- Group 18(VIIIA) - Noble Gases

Other Groups (Vertical and Horizontal Groups)

- Group 3-12(IB-8B) - Transition Metals
- Period 6 Group - Lanthanides (Rare Earth Elements)

- Period 7 Group - Actinides

Chemical bonds

A chemical bond is an attraction between atoms.

What are atoms and compounds always trying to achieve?

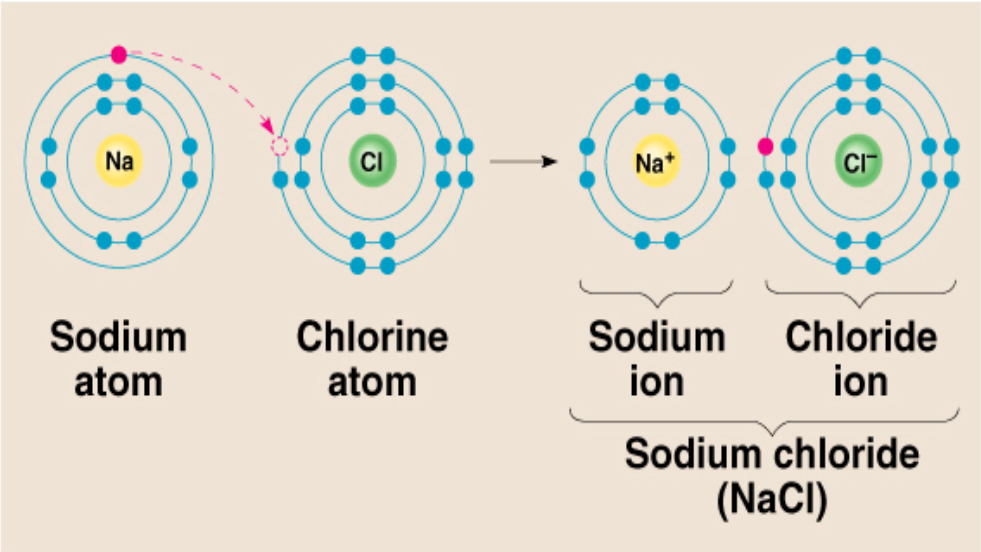
Atoms form chemical bonds to achieve a fill valence shell of electrons. This may be achieved in two ways:

1- An exchange of electrons between metal and non-metal atoms.

2- Sharing of electrons between non-metal atoms.

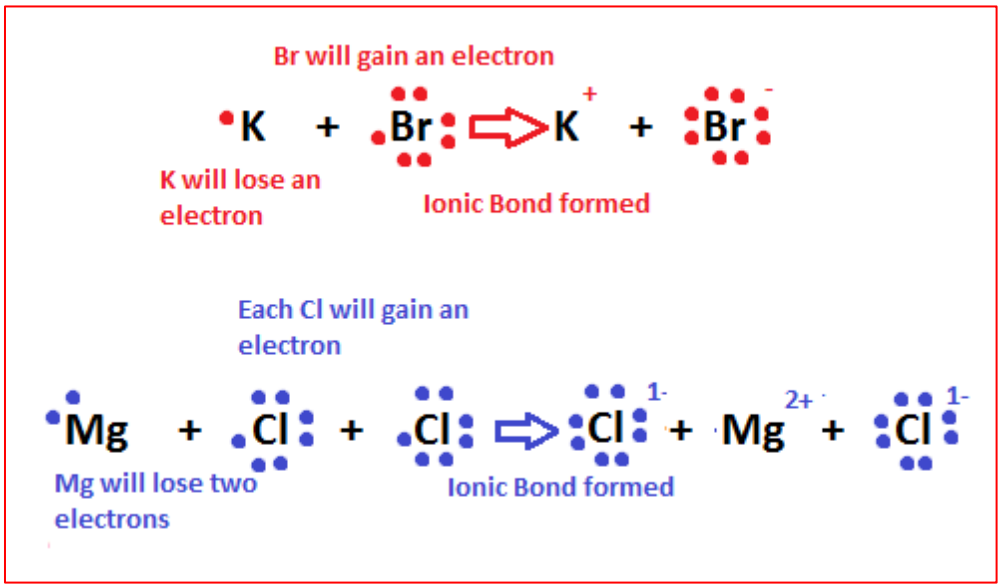
Ionic Bond

- An ionic bond is the electrostatic attraction between oppositely charged ions.
- Ionic bonds involve electron transfer (one atom loses electrons and another gain them).
- The atom that loses electrons becomes a cation (a positive ion).
- The atom that gains electrons becomes an anion (a negative ion).



• An ionic bond usually occurs between a metal and a nonmetal.

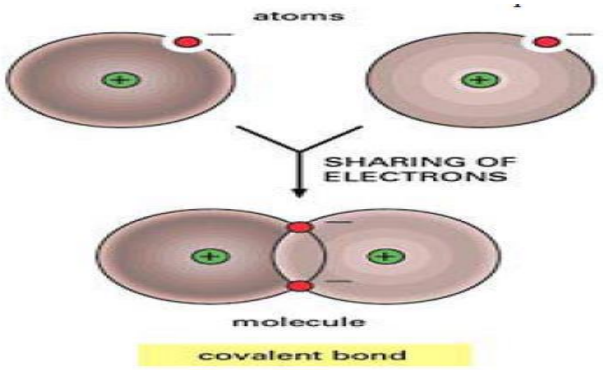
• Ionic bonds are found in ionic compounds ex. NaCl, Al_2O_3, KBr, $MgCl_2$.



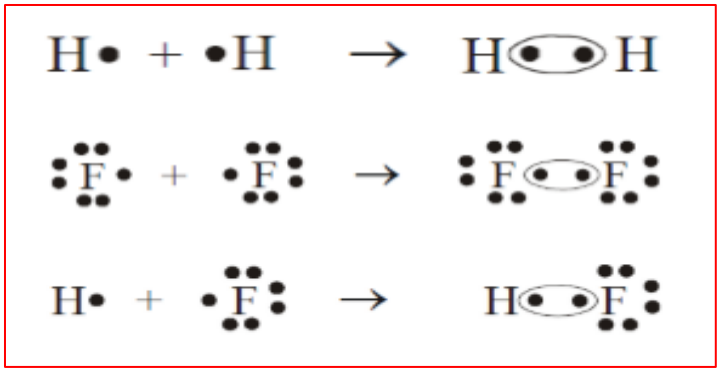
Covalent Bond

• It is a strong bond formed between two atoms by sharing two valence electrons, one from each atom.

• A covalent bond usually occurs between two **non-metals** atoms.

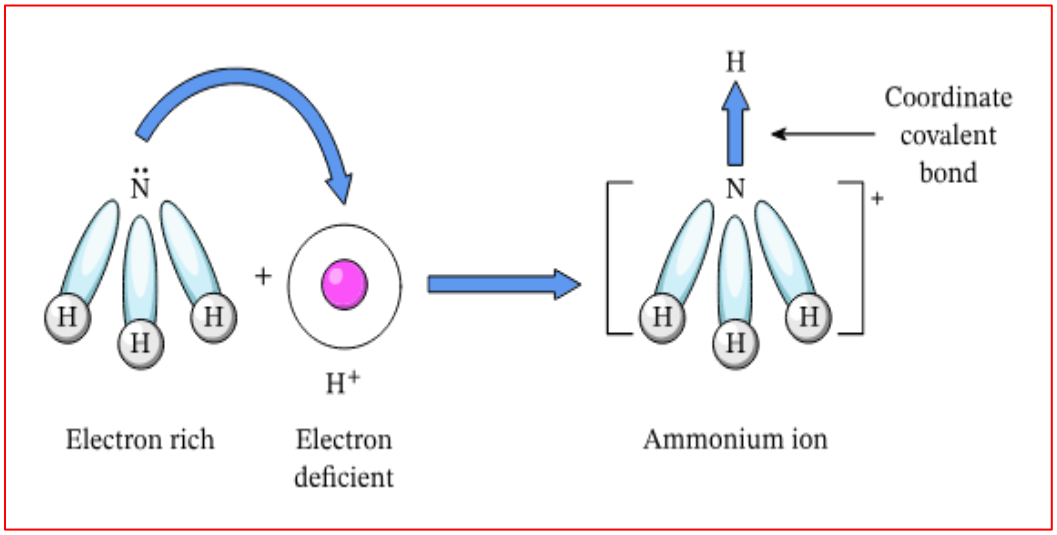


Covalent bonds are found in molecular elements(ex **H_2, F_2, Cl_2, O_3**). And molecular compounds (ex **H_2O, CO_2, C_3H_8, HF**).

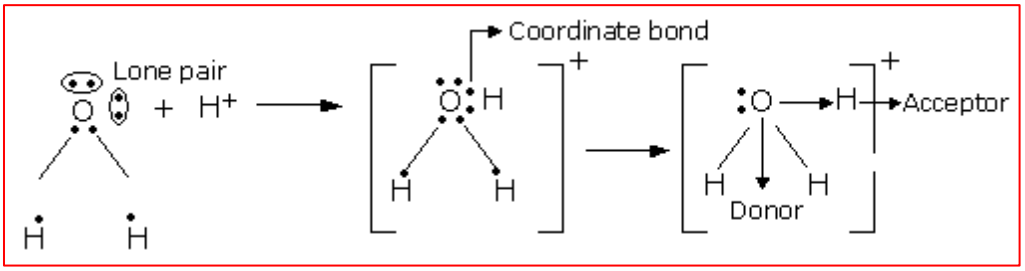


Coordinate bond

• It's a type of **covalent** bond that formed when one atom **donates both of the shared electrons** to the other atom to make the bond.

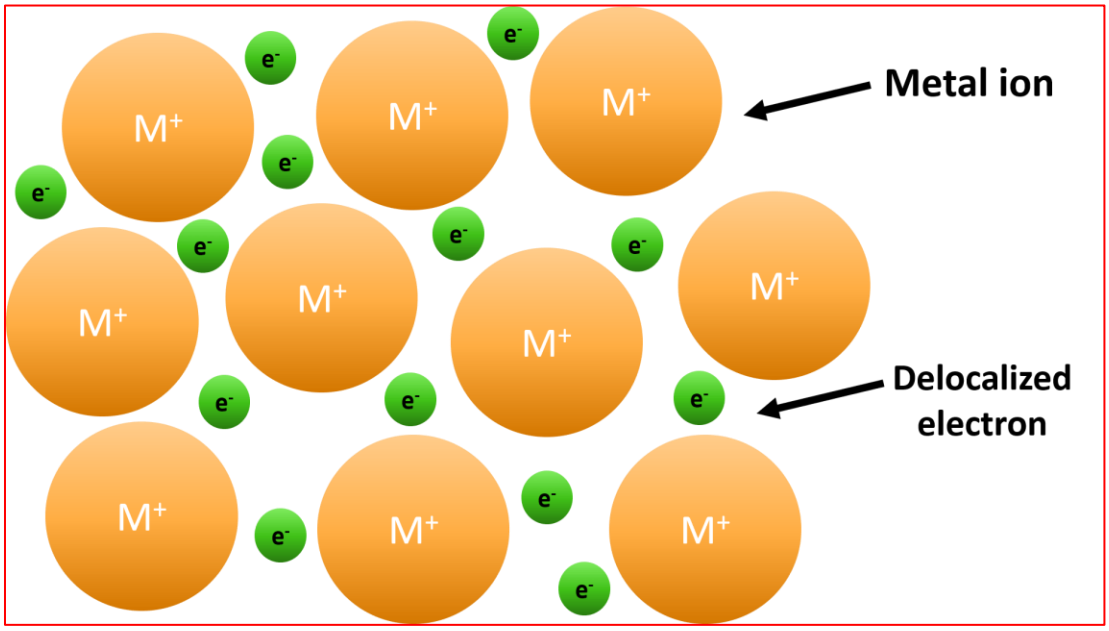


This is different from a covalent bond because both electrons **come from one atom or molecule** but are **shared as in a typical covalent** bond.



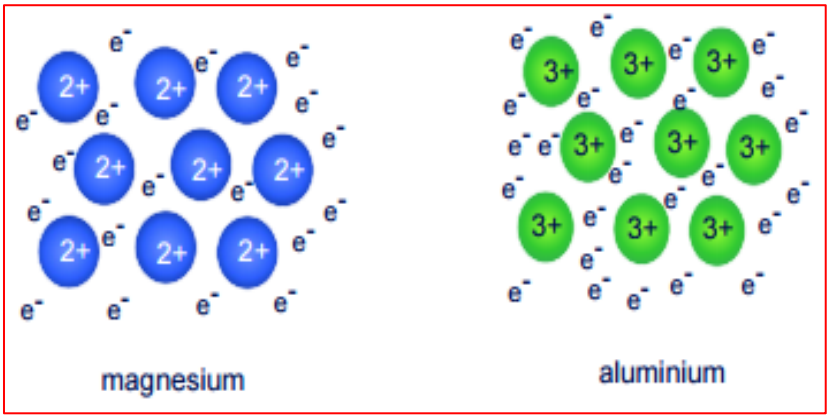
Metallic bond

Is the type of bonding found in metallic crystals, that formed by the **attraction** between the **metal positive ion and delocalized electrons.**



- The free movement of electrons make metals good conductors of heat and electricity.

• Aluminum more conduct electricity more than magnesium because it has more electrons delocalized.

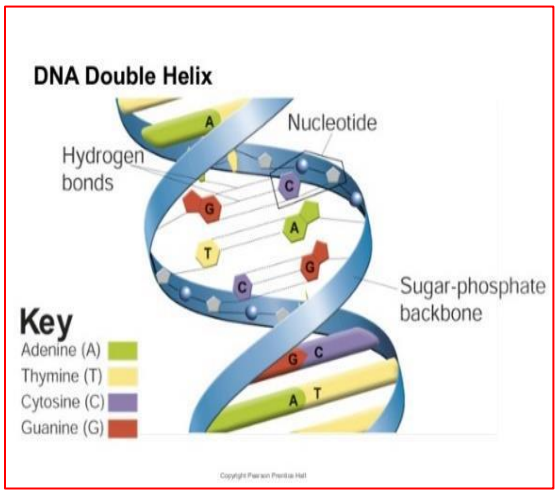


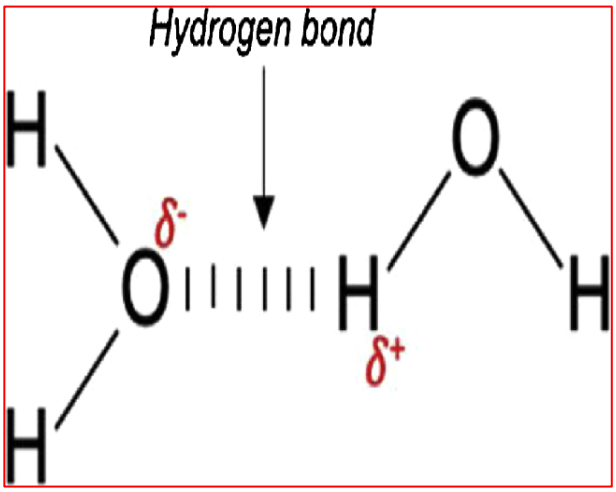
Hydrogen bond

• A chemical bond that hydrogen atom of one molecule is attracted to an electronegative atom, especially **nitrogen (N), oxygen (O) or fluorine (F)** atom, usually of another molecule.

• It is a **weak** attraction, where it's **weaker** than **covalent, ionic and metallic** bonds.

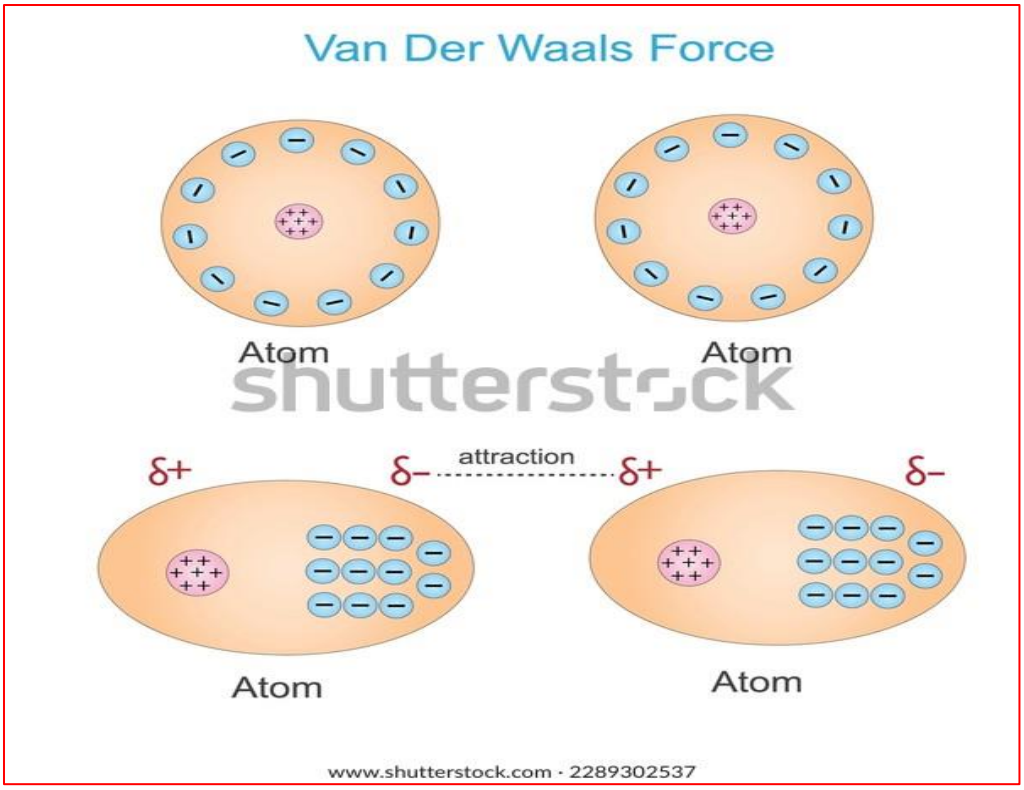
• Is very important, where **this type of bond occurs in both inorganic molecules (such as water) and organic molecules (such as DNA).**





Van der Waals Bonds

The dipoles involved in Van der Waals bonding come from fluctuations in the symmetry of the electron distribution surrounding the nucleus of an atom. Very weak interactions (2-4 $kJmol^{-1}$), very short-range, non-directional attractive forces between molecules or atoms. Example: Ni atom



Type of Van der Waals Bonds

1- dipole-dipole interactions

2-ion -dipole interactions.

3- London dispersion forces.

4-induced dipole-induced interaction.

Factors affecting Van der Waals interactions

1- the distance between the atoms.

2- the nature of the atoms involved.

3- the environment around the atoms.