



جامعة المستقبل
AL MUSTAQL UNIVERSITY

كلية العلوم قسم الادلة الجنائية

المحاضرة الثالثة

Periodic Table of the Element

المادة : مدخل الى الكيمياء
المرحلة : الاولى
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Periods and Groups

The periodic table is a tabular arrangement of the chemical elements, 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.



PERIODIC TABLE OF THE ELEMENTS																	
GROUP		PERIOD															
1 IA		1 0.0079															
2 IIA		2 9.0122															
3 IIIB		3 10.811															
1 H	2 Be	3 B	4 C	5 N	6 O	7 F	8 Ne	9 Al	10 Si	11 P	12 S	13 Cl	14 Ar	15 Ne	16 F	17 Cl	18 Ne
HYDROGEN	BERYLLIUM	BORON	CARBON	NITROGEN	OXYGEN	FLUORINE	NEON	ALUMINUM	SILICON	PHOSPHORUS	SULPHUR	CHLORINE	ARGON				
6.941	9.0122	10.811	12.011	14.007	15.999	17.000	18.998	20.180	26.982	28.086	30.974	32.065	35.453	39.948			
22.990	24.305																
3 Na	4 Mg	5 Al	6 Si	7 P	8 S	9 Cl	10 Ar	11 Al	12 Si	13 P	14 S	15 Cl	16 Ar	17 F	18 Ne		
SODIUM	MAGNESIUM	ALUMINUM	SILICON	PHOSPHORUS	SULPHUR	CHLORINE	ARGON										
19 39.098	20 40.078	21 44.956	22 47.867	23 50.942	24 51.996	25 54.936	26 55.845	27 56.933	28 56.693	29 63.546	30 65.39	31 69.723	32 72.64	33 74.922	34 78.96	35 79.904	36 83.80
4 K	5 Ca	6 Sc	7 Ti	8 V	9 Cr	10 Mn	11 Fe	12 Co	13 Ni	14 Cu	15 Zn	16 Ga	17 Ge	18 As	19 Se	20 Br	21 Kr
POTASSIUM	CALCIUM	SCANDIUM	TITANIUM	VANADIUM	CHROMIUM	MANGANESE	IRON	COBALT	NICKEL	COPPER	ZINC	GALLIUM	GERMANIUM	ARSENIC	SELENIUM	BROMINE	KRYPTON
37 85.468	38 87.62	39 88.906	40 91.224	41 92.906	42 95.94	43 (98)	44 101.07	45 102.91	46 106.42	47 107.87	48 112.41	49 114.82	50 116.71	51 121.76	52 127.60	53 126.90	54 131.29
5 Rb	6 Sr	7 Y	8 Zr	9 Nb	10 Mo	11 Tc	12 Ru	13 Rh	14 Pd	15 Ag	16 Cd	17 In	18 Sn	19 Sb	20 Te	21 I	22 Xe
RUBIDIUM	STRONTIUM	YTTRIUM	ZIRCONIUM	NIOBIUM	MOLYBDENUM	TECHNETIUM	RUTHENIUM	RHODIUM	PALLADIUM	SILVER	CADMIUM	INDIUM	TIN	ANTIMONY	TELLURIUM	IODINE	XENON
55 132.91	56 137.33	57-71	72 178.49	73 180.95	74 183.84	75 186.21	76 190.23	77 192.22	78 195.08	79 196.97	80 200.59	81 204.36	82 207.2	83 208.98	84 (209)	85 (210)	86 (222)
6 Cs	7 Ba	8 La-Lu	9 Hf	10 Ta	11 W	12 Re	13 Os	14 Ir	15 Pt	16 Au	17 Hg	18 Tl	19 Pb	20 Bi	21 Po	22 At	23 Rn
CAESIUM	BARIUM	Lanthanide	HAFNIUM	TANTALUM	TUNGSTEN	RHENIUM	OSMIUM	IRIDIUM	PLATINUM	GOLD	MERCURY	THALLIUM	LEAD	BISMUTH	POLONIUM	ASTATINE	RADON
87 (223)	88 (226)	89-103	104 (261)	105 (262)	106 (266)	107 (264)	108 (277)	109 (268)	110 (281)	111 (272)	112 (286)	114 (289)					
Fr	Ra	Ac-Lr	Rutherfordium	Dubnium	Seaborgium	Bohrium	Hassium	Mitnnerium	Ununnilium	Unununium	Unununium	Unununium					
		Actinide															
89 (227)	90 232.04	91 231.04	92 238.03	93 (237)	94 (244)	95 (243)	96 (247)	97 (247)	98 (251)	99 (252)	100 (257)	101 (258)	102 (259)	103 (262)			
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr			
Actinium	Thorium	Protactinium	Uranium	Neptunium	Plutonium	Americium	Curium	Berkelium	Californium	Einsteinium	Fermium	Mendelevium	Nobelium	Lawrencium			

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 Br₂).
- 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?

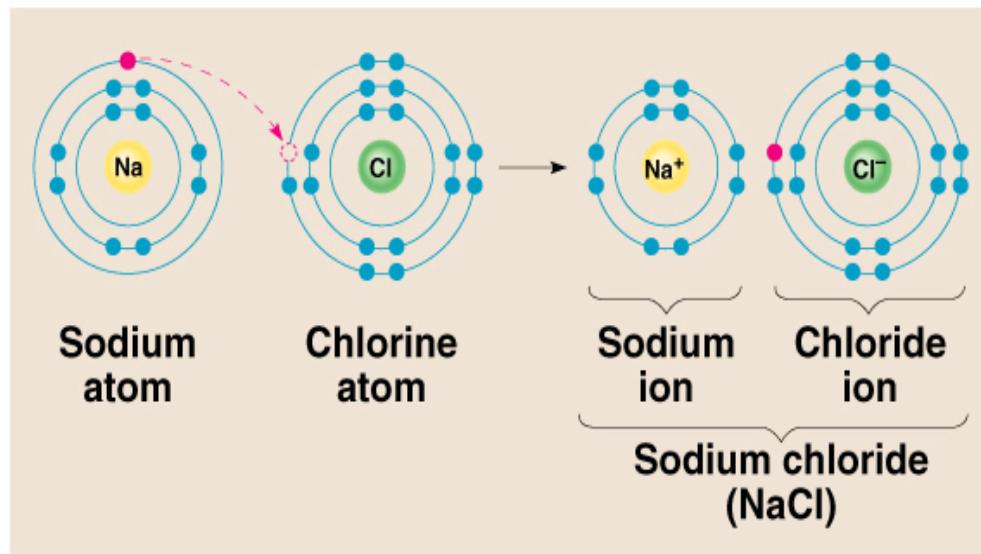
Atoms form chemical bonds to achieve a full valence shell of electrons. This may be achieved in two ways:

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

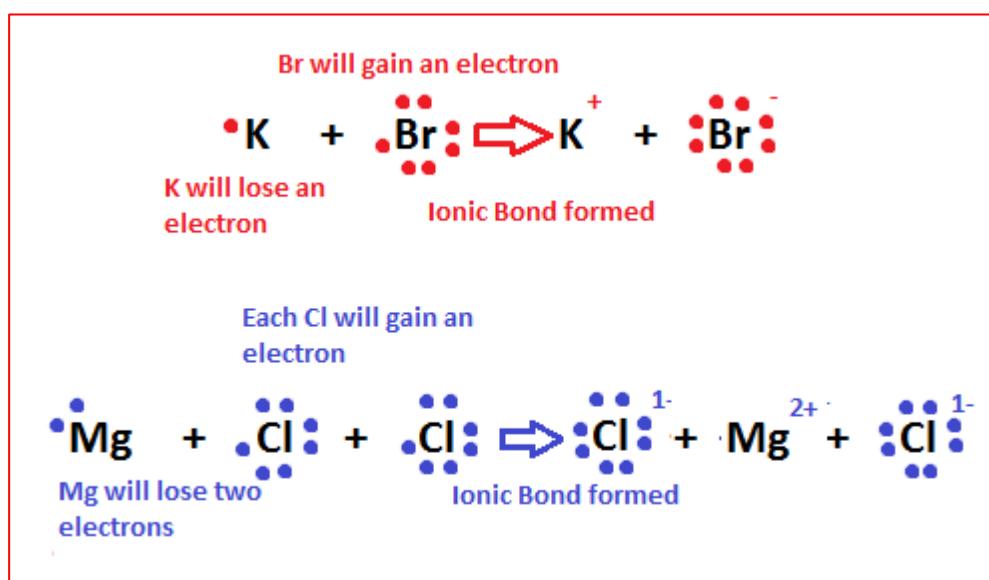


Ionic Bond

- 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).



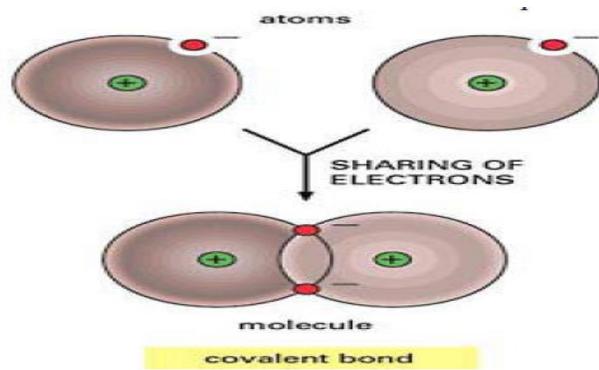
- An ionic bond usually occurs between a metal and a nonmetal.
- Ionic bonds are found in ionic compounds ex. NaCl , Al_2O_3 , KBr , MgCl_2 .



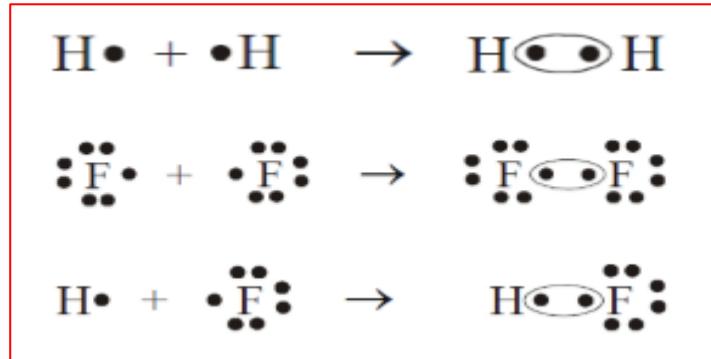


Covalent Bond

- 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.

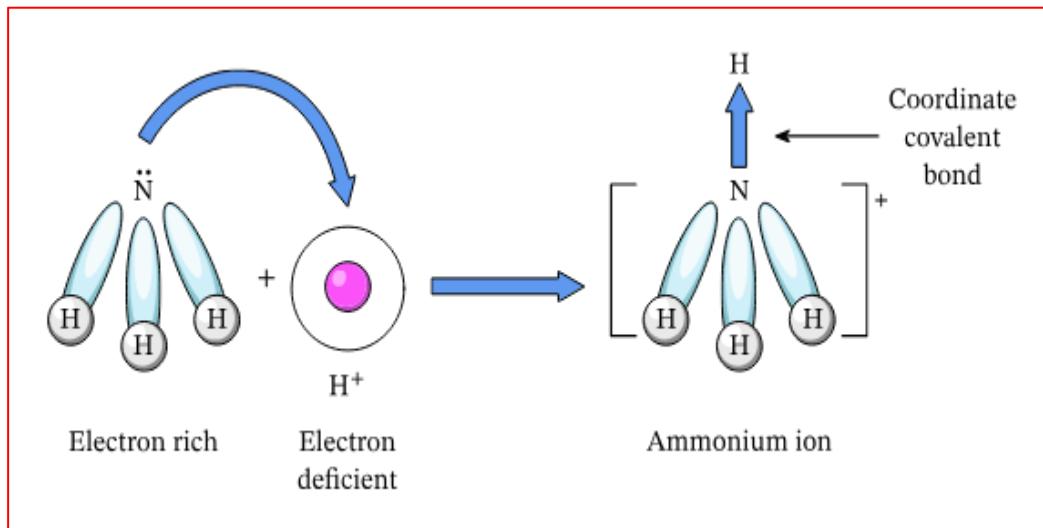


Covalent bonds are found in molecular elements(ex **H₂**, **F₂**, **Cl₂**, **O₃**). And molecular compounds (ex **H₂O**, **CO₂**, **C₃H₈**, **HF**).

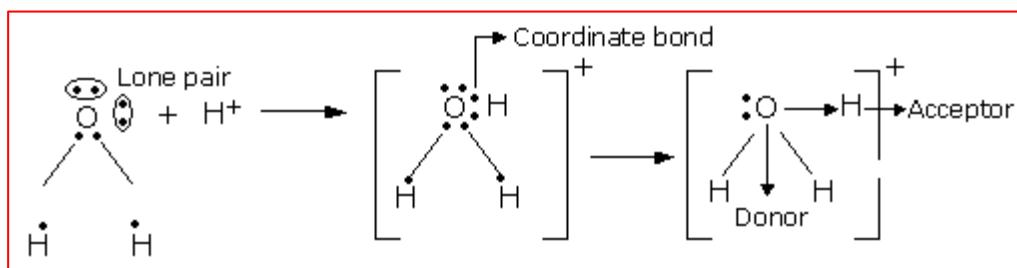


Coordinate bond

- 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.

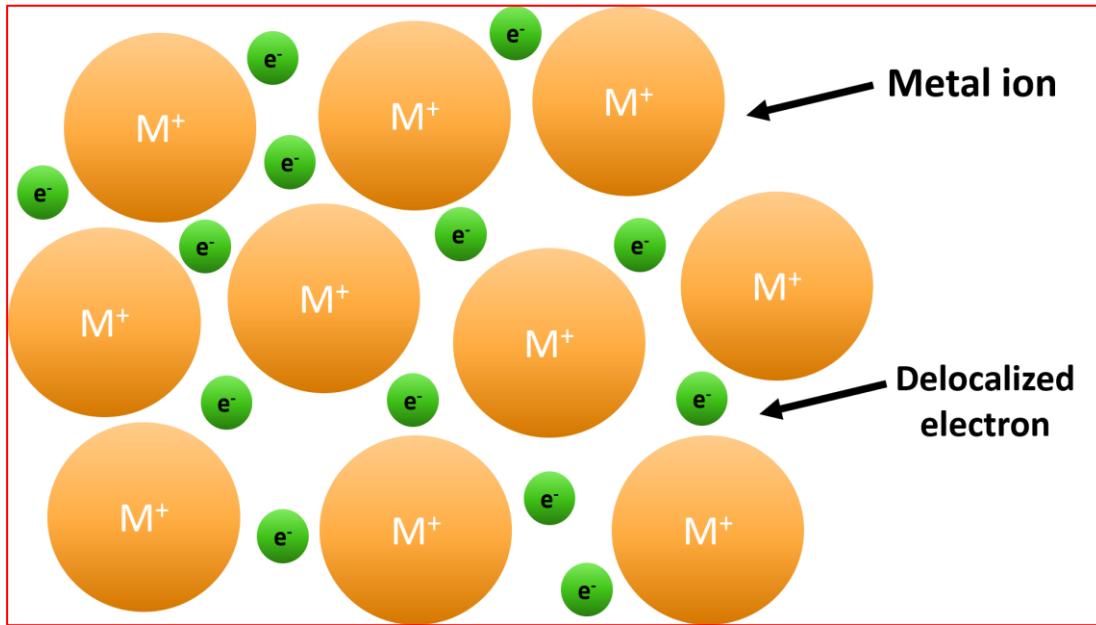


This is different from a covalent bond because both electrons **come from one atom or molecule** but are **shared as in a typical covalent bond**.

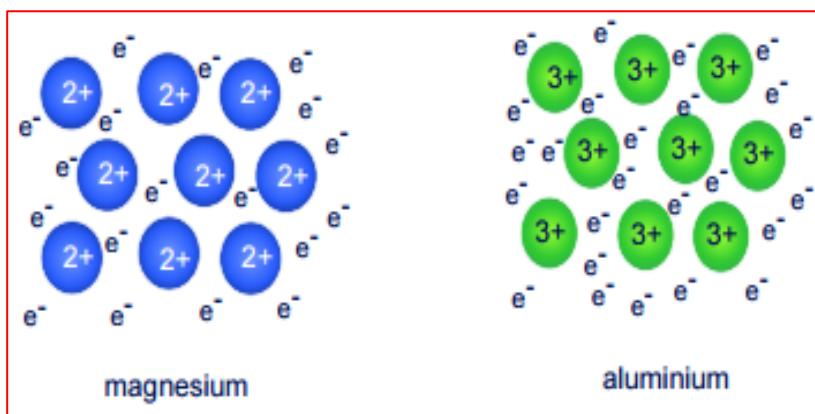


Metallic bond

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

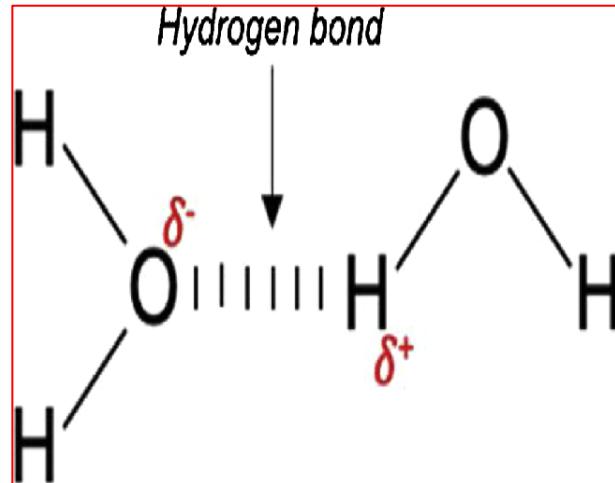
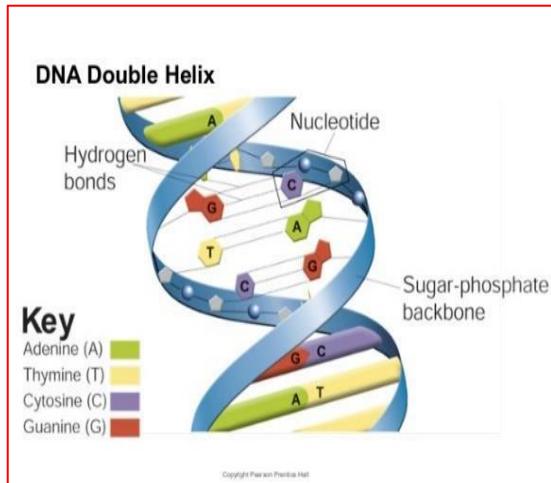


- The free movement of electrons make metals good conductors of heat and electricity.
- Aluminum more conduct electricity more than magnesium because it has more electrons delocalized.



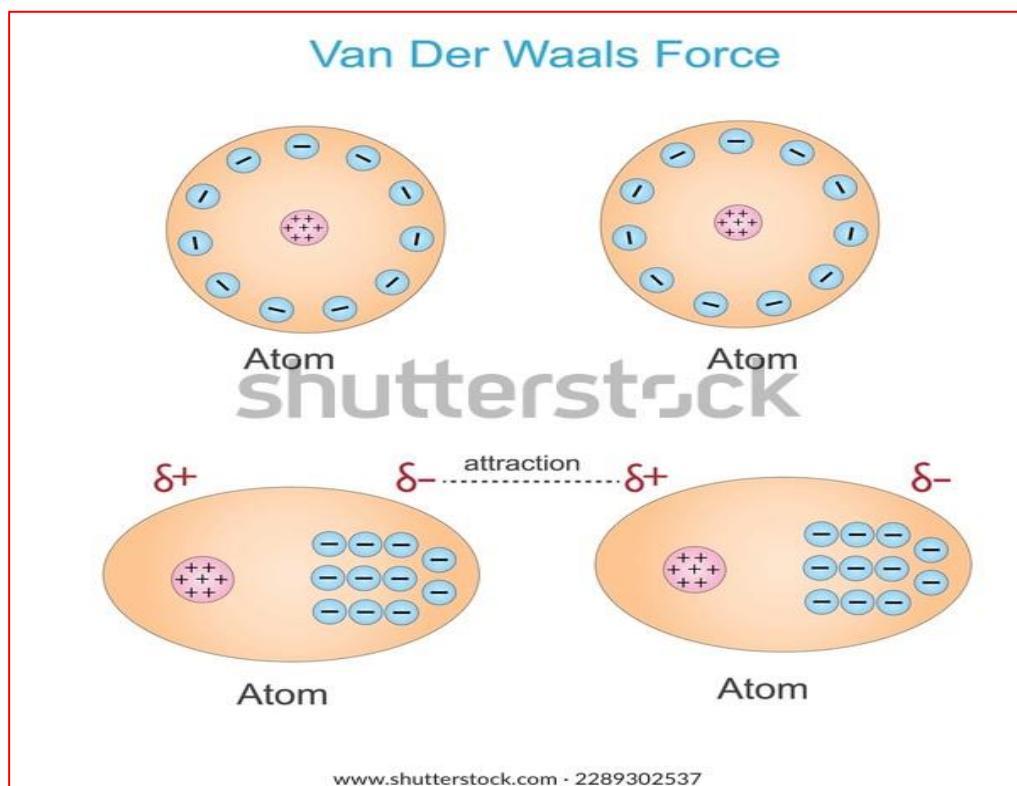
Hydrogen bond

- 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 ($2-4 \text{ kJmol}^{-1}$), 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.