



Al-Mustaqbal University

College of Science

Forensic Evidence Department



جامعة المستقبل
AL MUSTAQBAL 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 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.



PERIODIC TABLE OF THE ELEMENTS

<http://www.kjf-split.hr/periodni/en/>

GROUP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
PERIOD	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1.0079 H HYDROGEN																	4.0026 He HELIUM
2	6.941 Li LITHIUM	9.0122 Be BERYLLIUM																20.180 Ne NEON
3	22.990 Na SODIUM	24.305 Mg MAGNESIUM																39.948 Ar ARGON
4	39.098 K POTASSIUM	40.078 Ca CALCIUM	44.956 Sc SCANDIUM	47.867 Ti TITANIUM	50.942 V VANADIUM	51.996 Cr CHROMIUM	54.938 Mn MANGANESE	55.845 Fe IRON	58.933 Co COBALT	58.693 Ni NICKEL	63.546 Cu COPPER	65.39 Zn ZINC	69.723 Ga GALLIUM	72.64 Ge GERMANIUM	74.922 As ARSENIC	78.96 Se SELENIUM	79.904 Br BROMINE	83.80 Kr KRYPTON
5	85.468 Rb RUBIDIUM	87.62 Sr STRONTIUM	88.906 Y YTTRIUM	91.224 Zr ZIRCONIUM	92.906 Nb NIOBIUM	95.94 Mo MOLYBDENUM	98 Tc TECHNETIUM	101.07 Ru RUTHENIUM	102.91 Rh RHODIUM	106.42 Pd PALLADIUM	107.87 Ag SILVER	112.41 Cd CADMIUM	114.82 In INDIUM	118.71 Sn TIN	121.76 Sb ANTIMONY	127.60 Te TELLURIUM	126.90 I IODINE	131.29 Xe XENON
6	132.91 Cs CAESIUM	137.33 Ba BARIUM	173.04 La-Lu LANTHANIDE	175.07 Hf HAFNIUM	178.49 Ta TANTALUM	180.95 W TUNGSTEN	183.84 Re RHENIUM	186.21 Os OSMIUM	190.23 Ir IRIDIUM	195.08 Pt PLATINUM	196.97 Au GOLD	200.59 Hg MERCURY	204.38 Tl THALLIUM	207.2 Pb LEAD	208.98 Bi BISMUTH	(209) Po POLONIUM	(210) At ASTATINE	(222) Rn RADON
7	(223) Fr FRANCIUM	(226) Ra RADIUM	(227) Ac-Lr ACTINIDE	(227) Rf RUTHENIUM	(227) Db DUBNIUM	(227) Sg SEABORGIUM	(227) Bh BOHRNIUM	(227) Hs HASSIUM	(227) Mt MEITNERIUM	(227) Uun UNUNNIUM	(227) Uuu UNUNNIUM	(227) Uub UNBIBIUM	(227) Uuq UNUNQUADIUM	(227) Uup UNUNPENTIUM	(227) Uuh UNUNHEXIUM	(227) Uus UNUNSEPTIUM	(227) Uuo UNUNOCTIUM	(227) Uu UNUN

(1) Pure Appl. Chem., 73, No. 4, 667-683 (2001).

Relative atomic mass is shown with five significant figures. For elements having no stable nuclides, the value enclosed in brackets indicates the mass number of the longest-lived isotope of the element.

However, for such elements (Fr, Pa, and U) do have a characteristic terrestrial isotopic composition, and for these an atomic weight is tabulated.

LANTHANIDE

57 138.91 La LANTHANUM	58 140.12 Ce CERMIUM	59 140.91 Pr PRASEODYMIUM	60 144.24 Nd NEODYMIUM	61 (145) Pm PROMETHIUM	62 150.36 Sm SAMARIUM	63 151.96 Eu EUROPIUM	64 157.25 Gd GADOLINIUM	65 158.93 Tb TERBIUM	66 162.50 Dy DYSPROSIUM	67 164.93 Ho HOLMIUM	68 167.26 Er ERBIUM	69 168.93 Tm THULIUM	70 173.04 Yb YTERBIUM	71 174.97 Lu LUTETIUM
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ACTINIDE

89 (227) Ac ACTINIUM	90 232.04 Th THORIUM	91 231.04 Pa PROTACTINIUM	92 238.03 U URANIUM	93 (237) Np NEPTUNIUM	94 (244) Pu PLUTONIUM	95 (243) Am AMERICIUM	96 (247) Cm CURIUM	97 (247) Bk BERKELIUM	98 (251) Cf CALIFORNIUM	99 (252) Es EINSTEINIUM	100 (257) Fm FERMIUM	101 (258) Md MENDELEVIUM	102 (258) No NOBELIUM	103 (262) Lr LAWRENCIUM
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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.

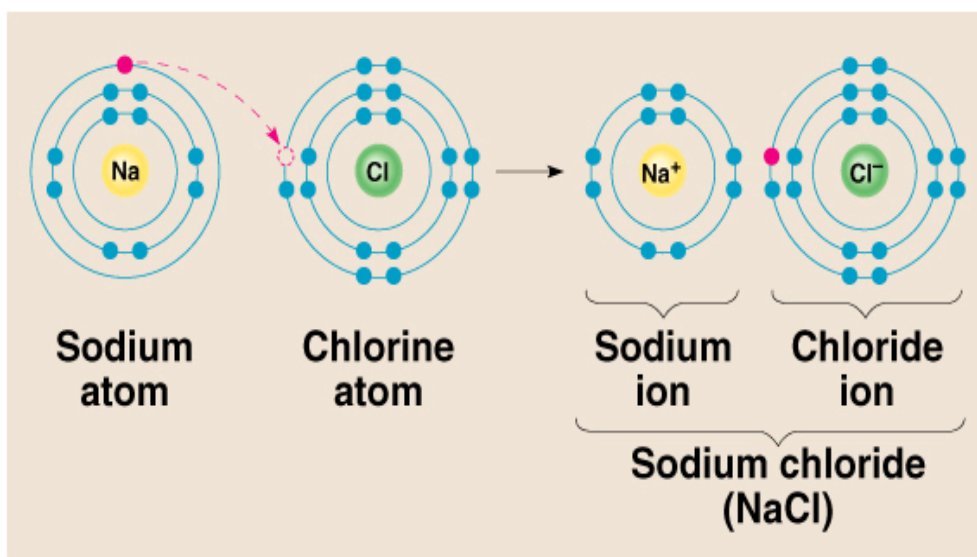
What are atoms and compounds always trying to achieve?

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

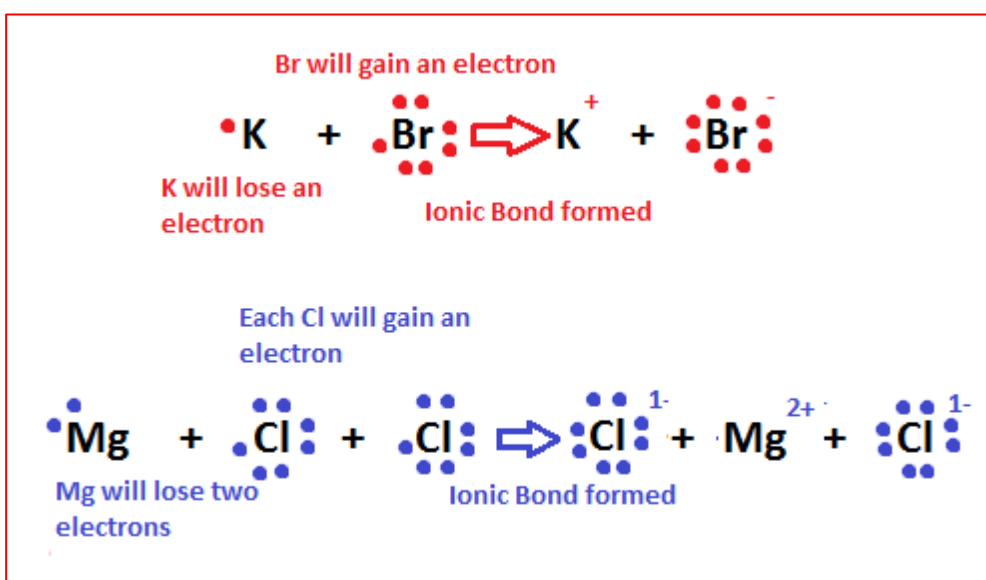
- 1- An exchange** of electrons between metal and non-metal atoms.
- 2- Sharing of** electrons between non-metal atoms.

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).



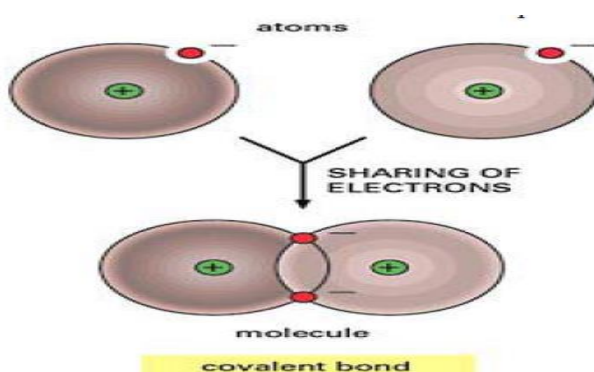
- An ionic bond usually occurs between a metal and a nonmetal.
- Ionic bonds are found in ionic compounds ex. NaCl, Al₂O₃, KBr, MgCl₂.



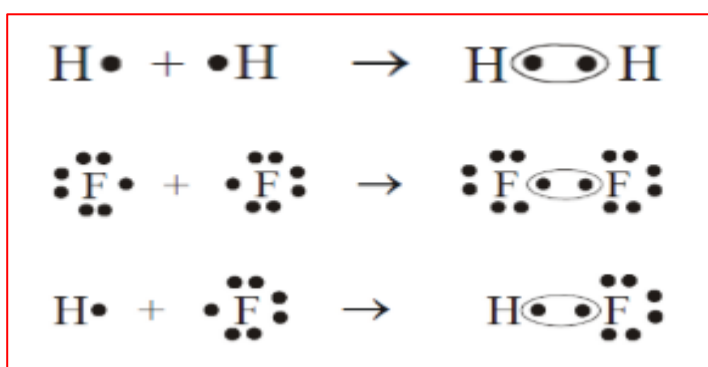


Covalent Bond

- 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.

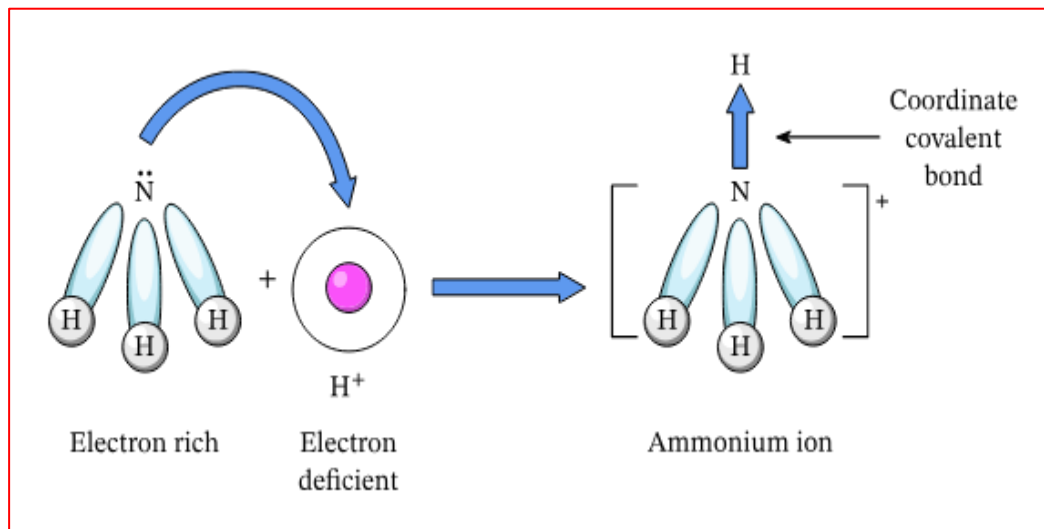


Covalent bonds are found in molecular elements(ex H_2 , F_2 , Cl_2 , O_3). And molecular compounds (ex H_2O , CO_2 , C_3H_8 , HF).

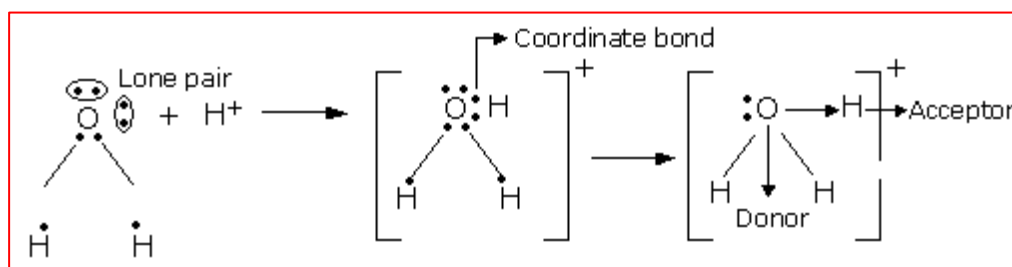


Coordinate bond

- 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.

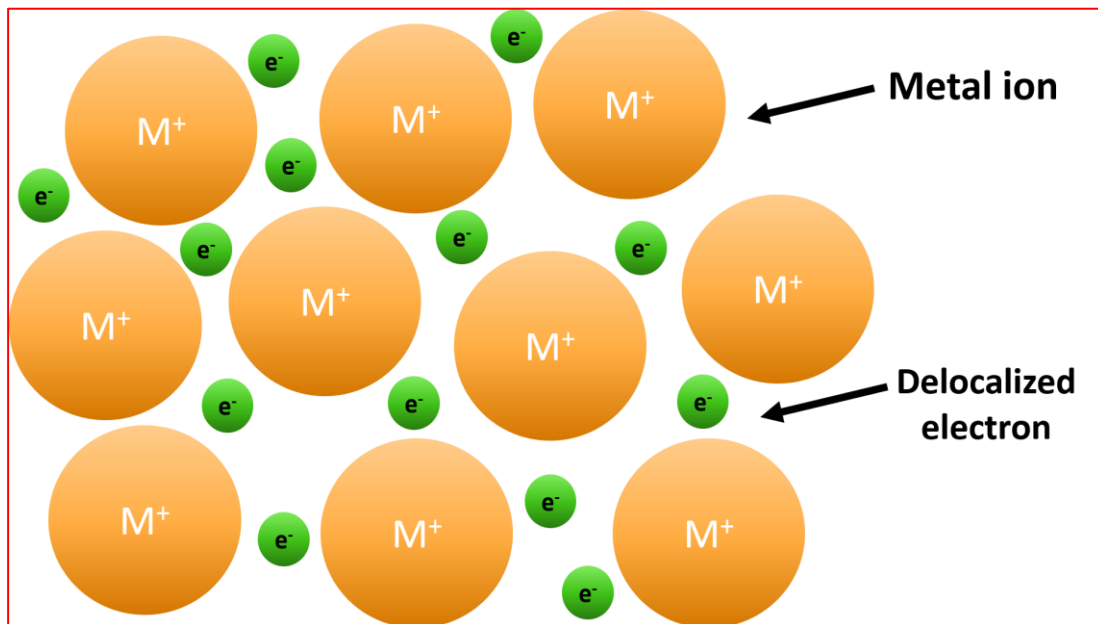


This is different from a covalent bond because both electrons **come from one atom or molecule** but are **shared as in a typical covalent bond**.

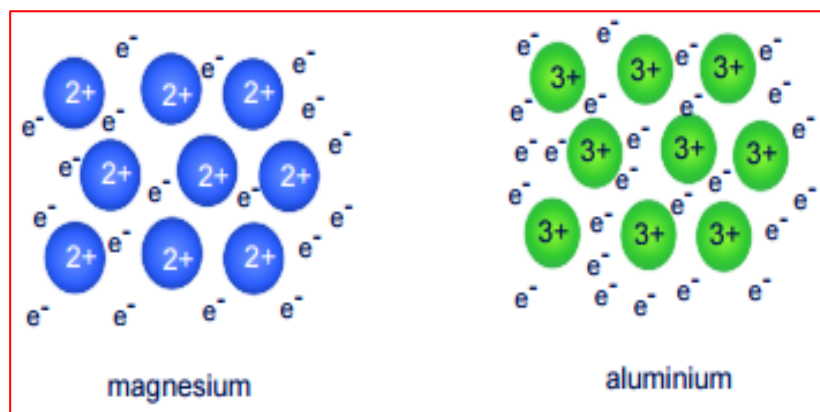


Metallic bond

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

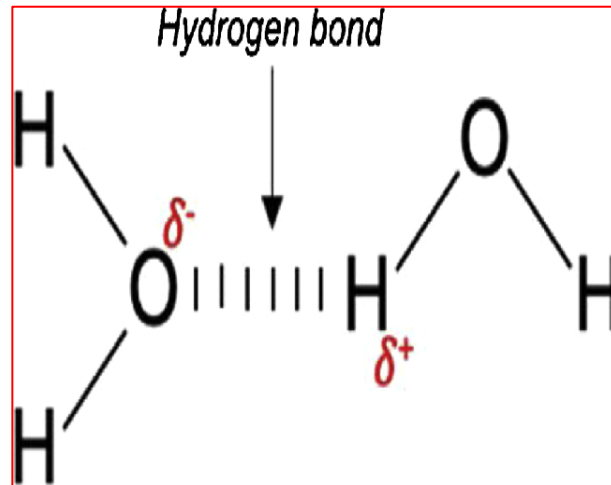
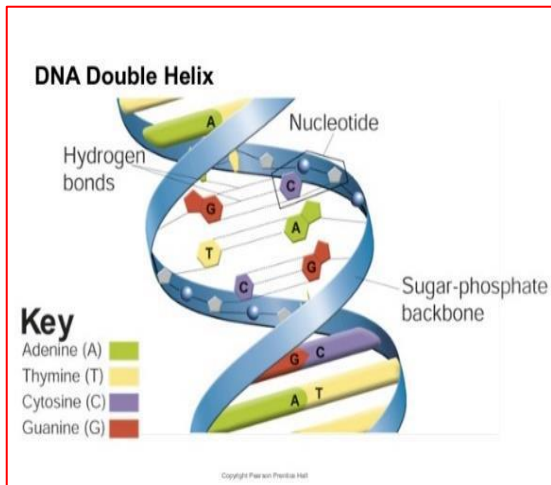


- The free movement of electrons make metals good conductors of heat and electricity.
- Aluminum more conduct electricity more than magnesium because it has more electrons delocalized.



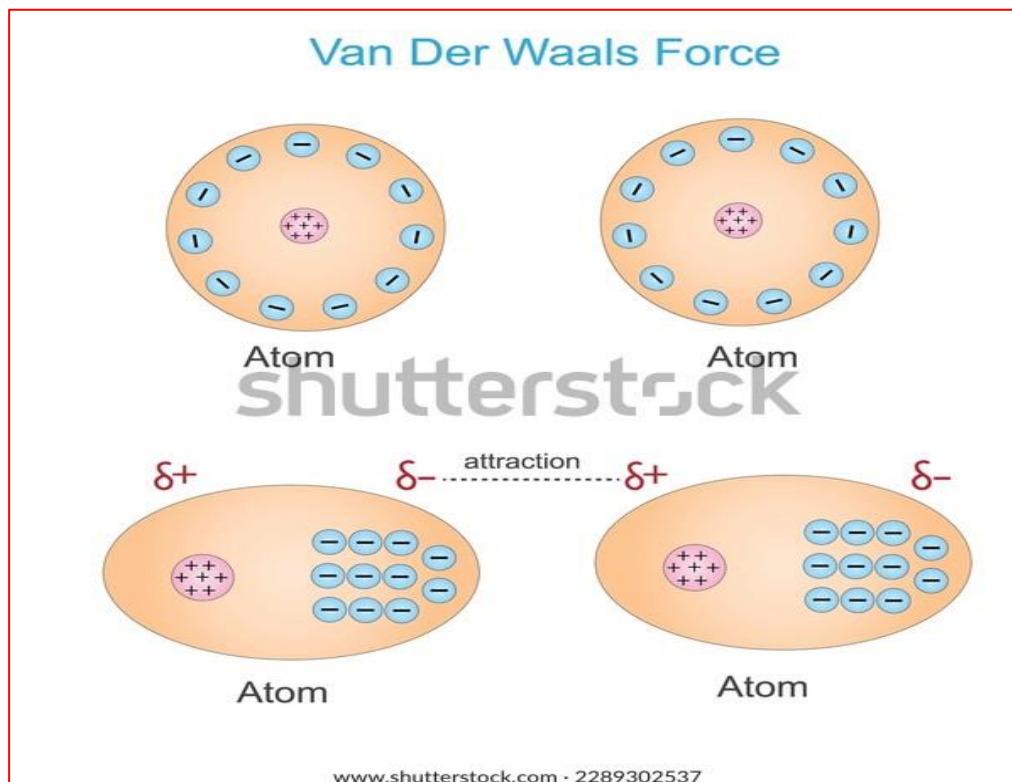
Hydrogen bond

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