

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

GENERAL CHEMISTRY

Department :- Radiology Techniques

Class:1st year

Assist. Lect. :- AHMED IBRAHIM ALYASIRY

74 W Tungsten 183.84	63 E Europium 151.964	116 Lv Livermorium [293]	27 Co Cobalt 58.933195	25 Mn Manganese 54.938045	63 E Europium 151.964		
		69 Tl Thulium 168.93421	8 O Oxygen 15.9994				
6 C Carbon 12.0107	2 He Helium 4.002602	25 Mn Manganese 54.938045	53 I Iodine 126.90447	16 S Sulfur 32.065	69 Tl Thulium 168.93421	86 Rn Radon [222]	39 Y Yttrium 88.90585

The atom and molecular structure. Electronically distribution

Atom – the smallest unit of matter “indivisible”

- The atom consists of a nucleus Centre contain positively charged particles called protons (P+) and particles neutrons (n0) are called neutrons, and they turn around the nucleus negatively charged particles called electrons (e-).

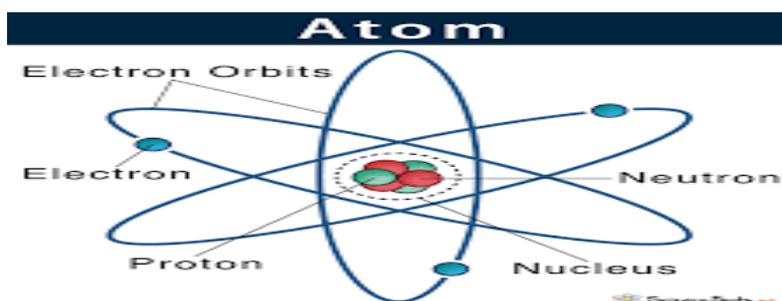


Fig 1: Structure of atom and its continent

STRUCTURE OF ATOM

Atomic Nucleus
Centre of an atom constituting positively charged particles "protons" and uncharged particles "neutrons"

Protons
Discovered by Rutherford
Contributes positive charge of the atom

Neutrons
Discovered by James Chadwick
by using scattered particle to calculate mass of the neutral particle

Extra nucleus
larger region which is composed of a cloud of negatively charged particles called an electron

Electrons
Discovered by J.J.Thomson
Revolve around centre of nucleus

Protons • Neutrons • Nucleons

Orbit
the nucleus of an atom is very small compared to the size of the atom.

Nucleus
the electrons are orbiting outside the nucleus in the electron shells.

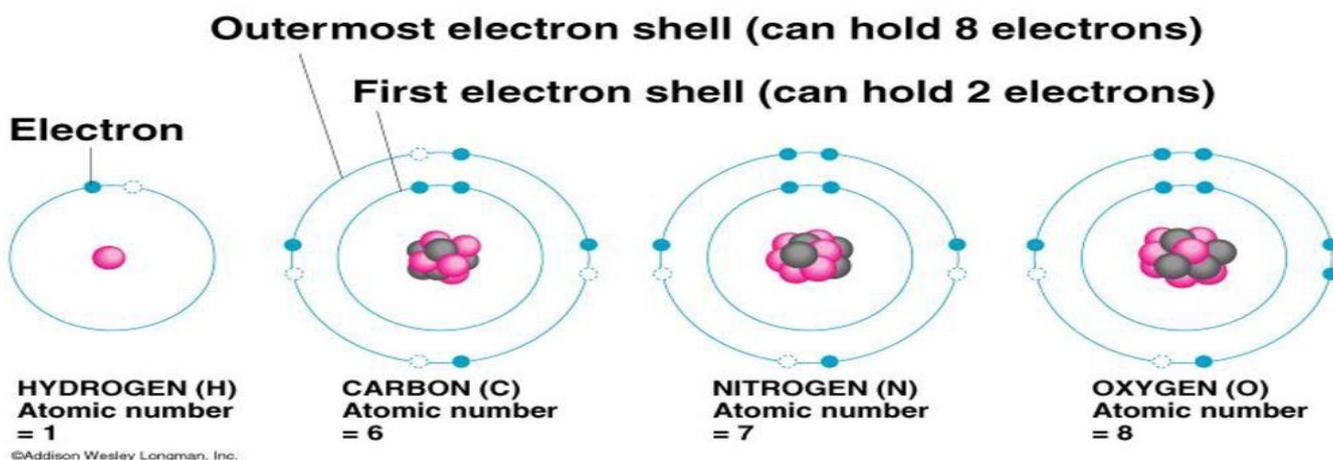
Electron
the electrons are moving in electron shells at very high speed.

Neutron **Proton**

Comparison of Subatomic Particles

Particles	Location	Charge(C)	Mass(g)	Mass(amu)
Proton	Inside nucleus	1.602×10^{-19}	1.67×10^{-24}	1.00073=1
Neutron	Inside nucleus	0	1.68×10^{-24}	1.00087=1
Electron	Outside nucleus	-1.602×10^{-19}	9.11×10^{-24}	0.0006=0

- Octet Rule = atoms tend to gain, lose or share electrons so as to have 8 electrons



Octet Rule = atoms tend to gain, lose or share electrons so as to have 8 electrons

Carbon has 4 valence electrons	Needs 4 electrons
Nitrogen has 5 valence electrons	Needs 3 electrons
Oxygen has 6 valence electrons	Needs 2 electrons

Chapter 2

The Chemical Context of Life

First shell	Hydrogen ${}^1_1\text{H}$							Helium ${}^2_2\text{He}$
Second shell	Lithium ${}^3_3\text{Li}$	Beryllium ${}^4_4\text{Be}$	Boron ${}^5_5\text{B}$	Carbon ${}^6_6\text{C}$	Nitrogen ${}^7_7\text{N}$	Oxygen ${}^8_8\text{O}$	Fluorine ${}^9_9\text{F}$	Neon ${}^{10}_{10}\text{Ne}$
Third shell	Sodium ${}^{11}_{11}\text{Na}$	Magnesium ${}^{12}_{12}\text{Mg}$	Aluminum ${}^{13}_{13}\text{Al}$	Silicon ${}^{14}_{14}\text{Si}$	Phosphorus ${}^{15}_{15}\text{P}$	Sulfur ${}^{16}_{16}\text{S}$	Chlorine ${}^{17}_{17}\text{Cl}$	Argon ${}^{18}_{18}\text{Ar}$

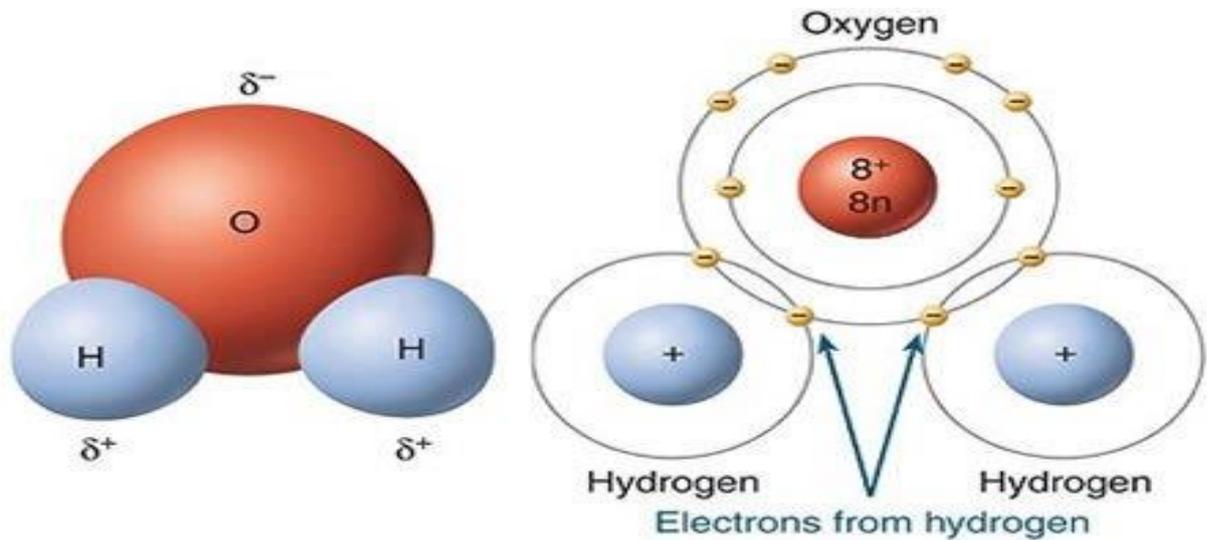
Mass number — 2
He
4.00 — Atomic number —

Element symbol —

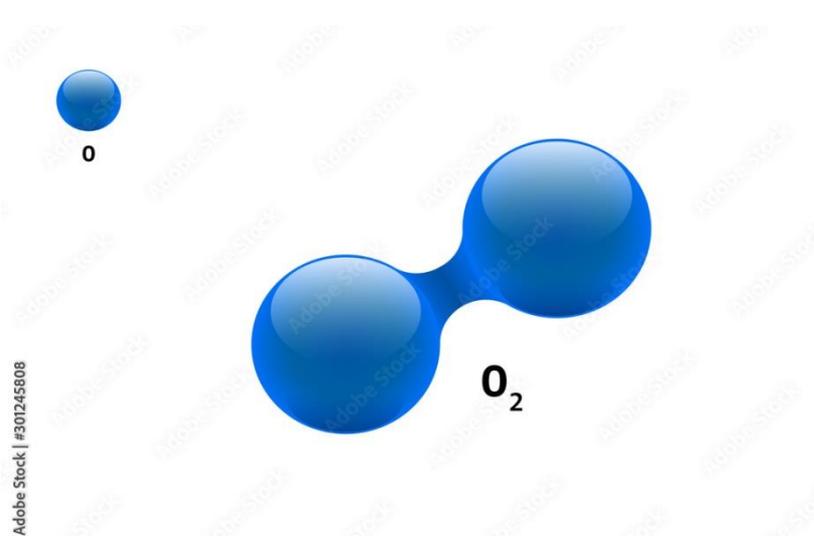
Electron distribution diagram —

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- **Element Molecule:** An element molecule is a mixture of two or more atoms of the same type.
- **Compound molecule:** It is a mixture of two or more atoms of different types.



Compound molecule H₂O



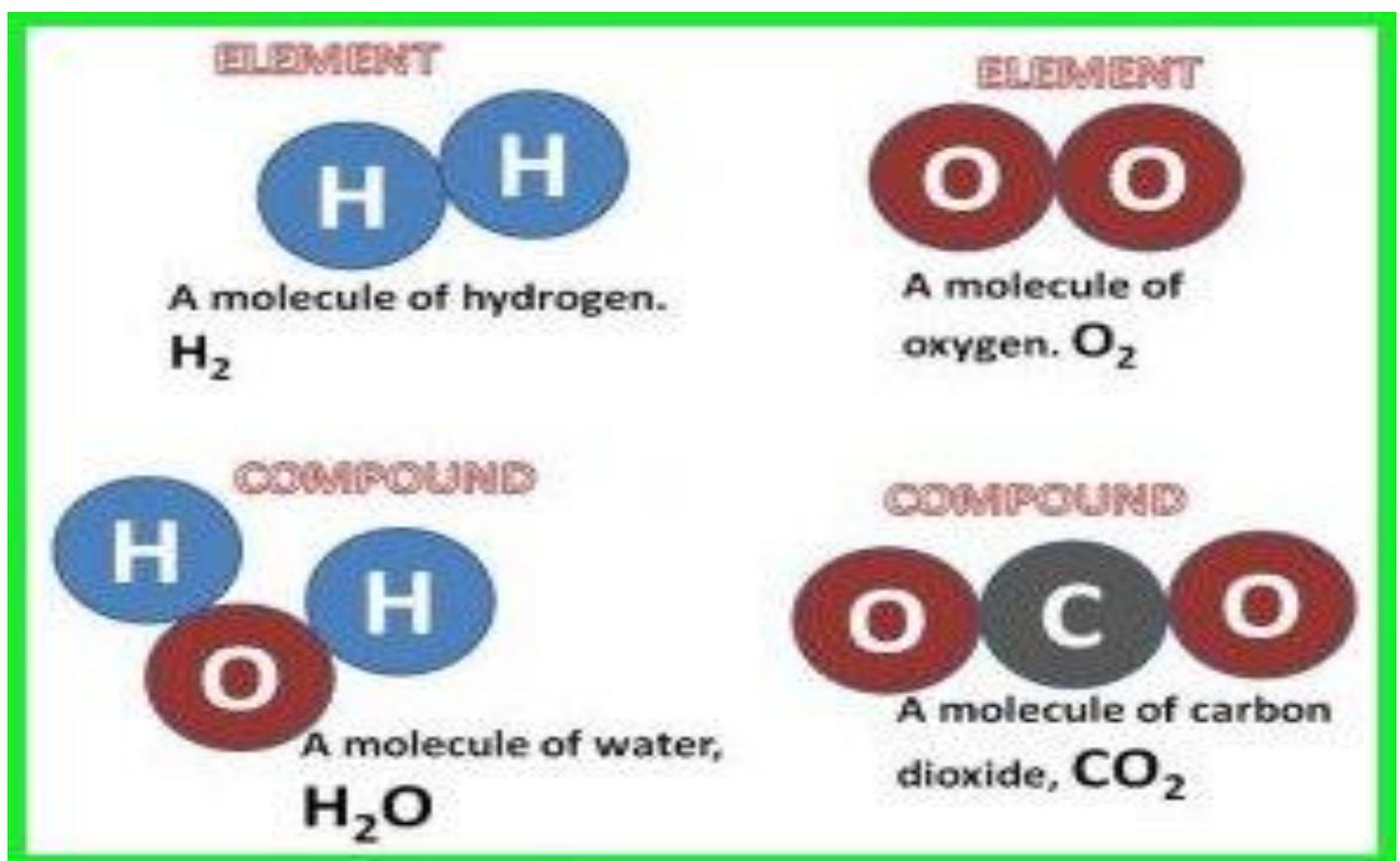
Element Molecule O₂

Elements, Atoms, Molecules & Compounds

- **Elements** → Substances that can't be broken down any further.
- **Molecule**: Two or more atoms joined together chemically:
- **Compound** : Molecule containing at least two different Elements.

Examples of molecules: Carbon dioxide (CO_2) and methane (CH_4), molecular hydrogen (H_2), molecular oxygen (O_2) and molecular nitrogen (N_2).

- Examples of compounds: Only molecules containing two or more elements, such as carbon dioxide (CO_2) and methane (CH_4).
- Q: Explain why all compounds are molecules but not all molecules are compounds.



Chemical Bonding

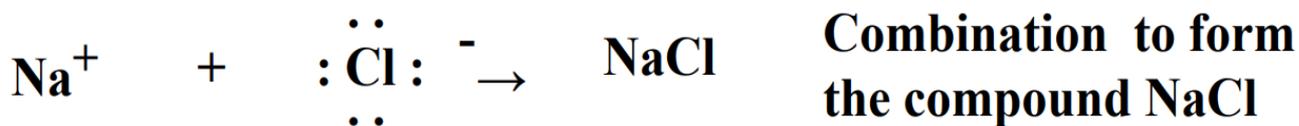
- Bonding is the force of attraction that holds atoms together in an element (N₂) or compound (CO₂ or NaCl).
- The distances between bonded atoms are less than those between non-bonded atoms.
- The forces between bonded atoms are greater than those between non-bonded atoms.
- All atoms are trying to achieve a stable octet
- Types of chemical bonds:
 - 1- Ionic bond
 - 2- Covalent bond
 - 3- van der Waals forces
 - 4- Hydrogen bond

Types of Chemical Bonds

1- Ionic Bonds

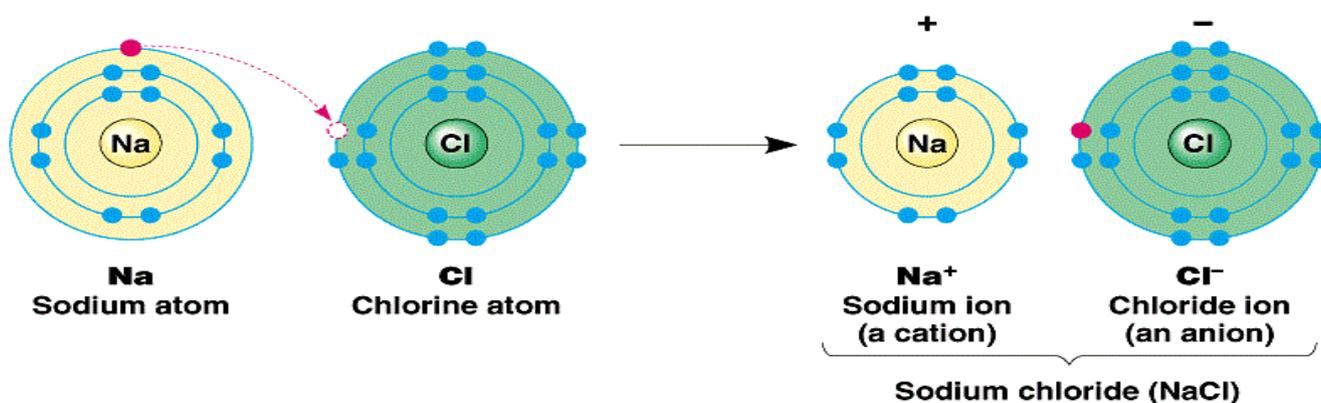
Ionic substances are formed when an atom that loses electrons easily reacts with an atom that gains electrons easily.

- forms ionic compounds
- transfer of valence e^-
- Always formed between two ions by the transfer of electrons (metal cations and non-metals anions)



- The oppositely charged ions stick like magnets [METALS]+ Gained e^- [NON-METALS]- Lost e^-

for example the sodium atom needs one ion of chloride because the last orbit needs one electron to reach a stable state



Ion = an atom or group of atoms which have lost or gained one or more electrons, making them negatively or positively charged.

Q: What are positively charged ions (+) called?

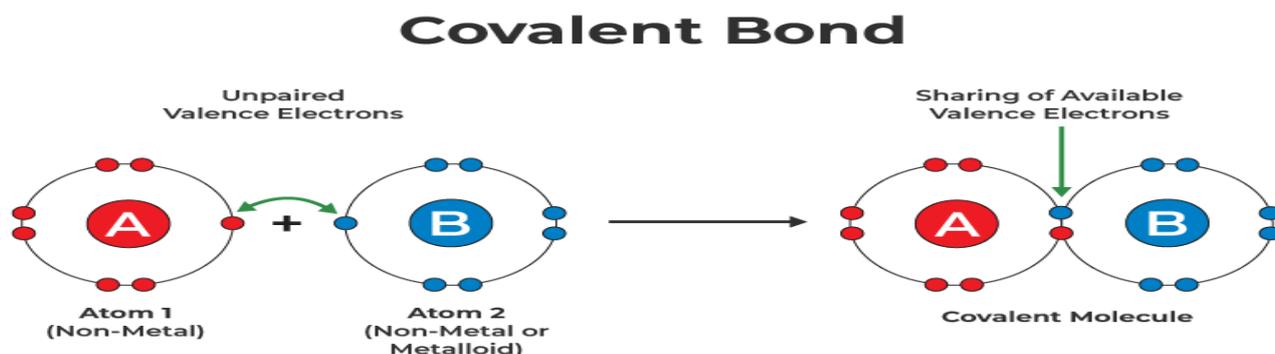
Q: What are negatively charged ions (-) called?

- The properties of ionic bonds:

- 1- Medium hard.
- 2 - High melting point due to the strong electrostatic attraction between the positive and negative ions.
- 3 - Low electrical conduction and thermal conductivity.
- 4- Soluble in water.

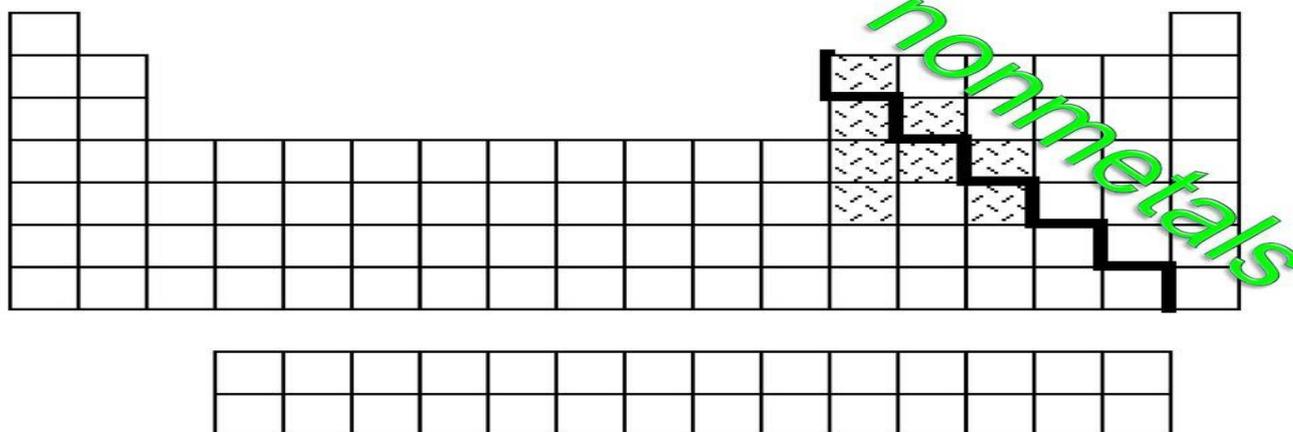
2- Covalent Bonding

Pairs of e- are shared between 2 nonmetal atoms to acquire the electron configuration of a noble gas.



Covalent Bonding

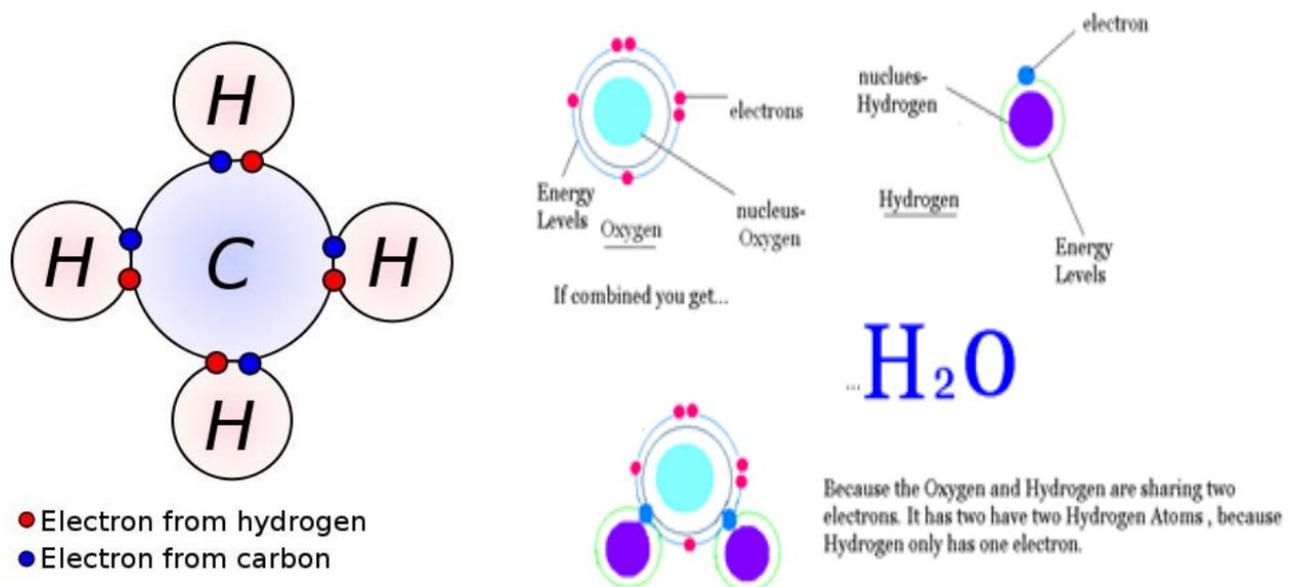
- Occurs between nonmetal atoms which need to gain electrons to get a stable octet of electrons or a filled outer shell.



Covalent Bonds

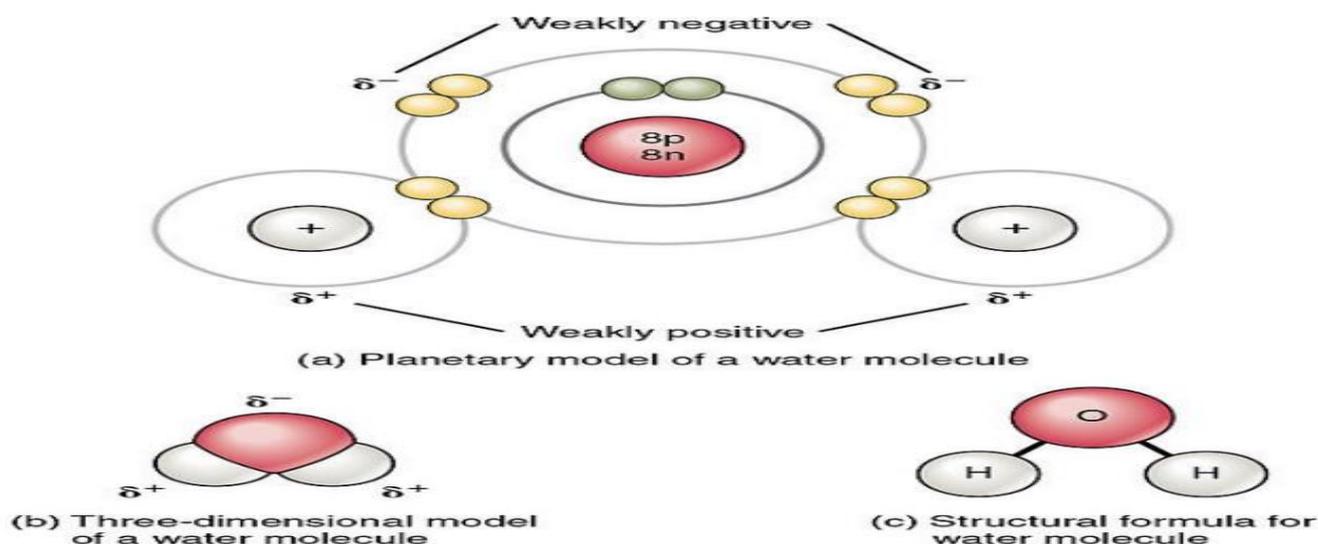
Involves the sharing of a pair of electrons between atoms. One covalent bond = 1 pair of shared electrons Covalent Compounds can make single (2 electrons), double (4 electrons) or even triple bonds

- (6 electrons) depending on the number of electrons they share.
- This bond is always stronger than the
- hydrogen bond

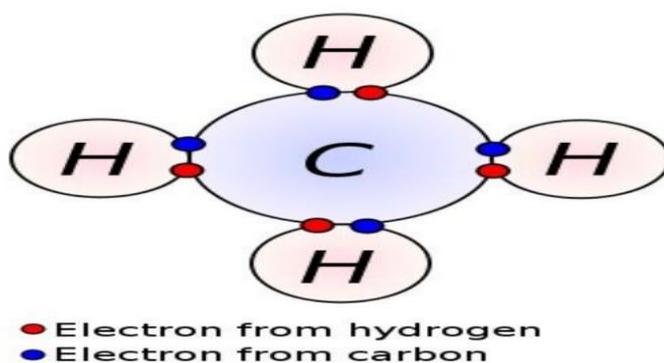


Polar vs. Non-Polar Covalent Bonds

- Polar molecules unequally share electrons between atoms, so have a slight positive charge at one end and a slight negative charge at the other. H_2O

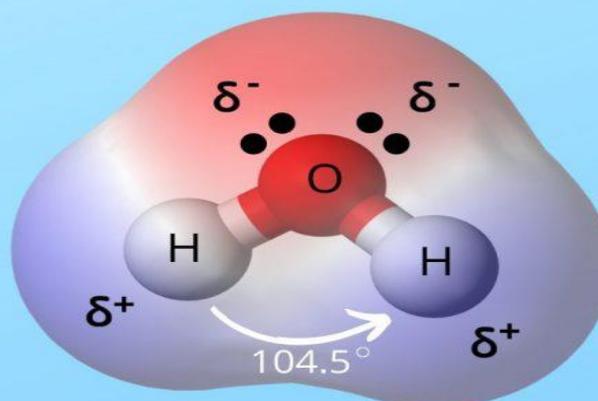


Non-polar molecules have electrons equally shared between their atoms. H_2 or Cl_2



Why Water Is a Polar Molecule

- Water is polar because oxygen and hydrogen have different electronegativity values.
- Oxygen has two lone electron pairs that repel each other and the electrons bonded to the hydrogen atoms.
- This gives the water molecule a bent shape.
- The oxygen side has a partial negative charge; the hydrogen side has a partial positive charge.



Properties of covalent bonds:

- 1- Insoluble in general.
- 2- Chemically Stable.
- 3- Very high melting and boiling point.
- 4- The electrical conduction department

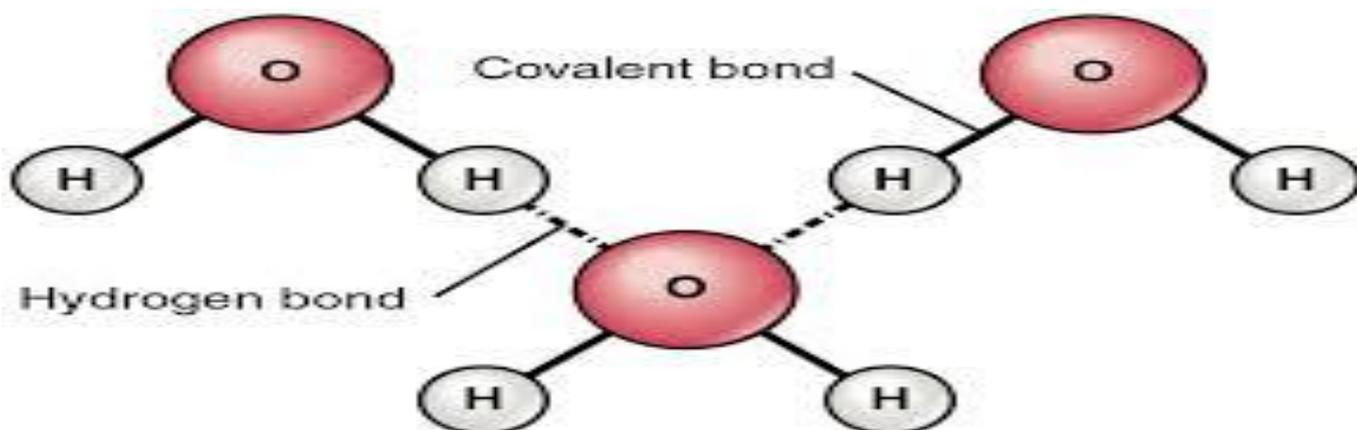
3-Hydrogen Bonds

Hydrogen Bonds:

When an atom of hydrogen is attracted to another electronegative atom in addition to the one it is covalently bonded to. In some covalent bonds electrons are shared unequally by the hydrogen and the atom that the hydrogen is bound to. When the electrons in a covalent bond are not equally shared, the molecule is polar.

See the polar, covalent bonds of each individual water molecule below.

See the hydrogen bond attractions between the hydrogen's and the oxygen's of nearby, but separate water molecule below

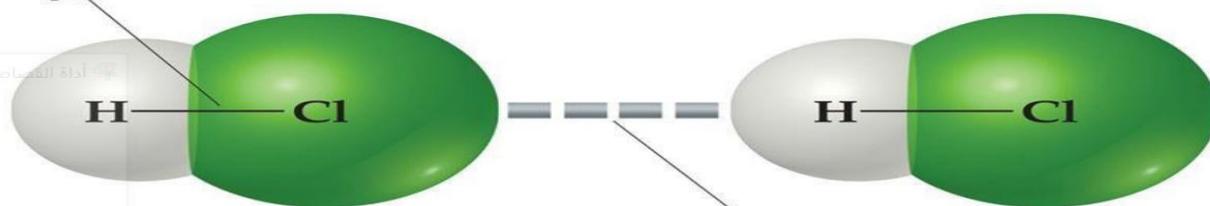


4-Van der Waals forces:

are the forces of mutual effects between the molecules of a single substance that are electrically neutral with each other, and result from the attraction of the nuclei of atoms in a particular molecule with the valence electrons in a neighboring molecule .

Names of Intermolecular Forces

Covalent bond
(strong)



Intermolecular
attraction (weak)

These intermolecular forces as a group are referred to as van der Waals forces.

No.	Vocabulary	Meaning
1	General Chemistry	الكيمياء العامة
2	Atom	الذرة
3	Structure	التركيب
4	Chemical bond	الاصرة الكيميائية
5	Electrons	الالكترونات
6	Proton	بروتونات
7	Neutron	نيوترونات
8	Nucleus	النواة
9	elements	عناصر
10	compound	مركب
11	ionic	ايونية
12	covalent	تساهمية
13	Van der Waals forces	قوى فندر فالز