AL-Mustaqbal university college

Pharmacy department , under

graduated Study, 2rd class Study

year 2021-2022

Physical pharmacy 1

Lecture1

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1- The differences between the States Of Matter, Solid, Liquid, Gas and Plasma

2- How the polarity of molecules influences those states.

3- The different types of intermolecular forces between molecules

STATES OF MATTER

They found Four States of Matter.

- Solid
- Liquid
- Gas
- Plasma

STATES OF MATTER

- Based upon particle arrangement
- Based upon energy of particles
- Based upon distance between particles

- *********Q/STATES OF the MATTER?**

Gases , Liquids and Solids

1- **In gases**, the particles in the sample are widely separated, because the attractive forces between the particles are very weak.

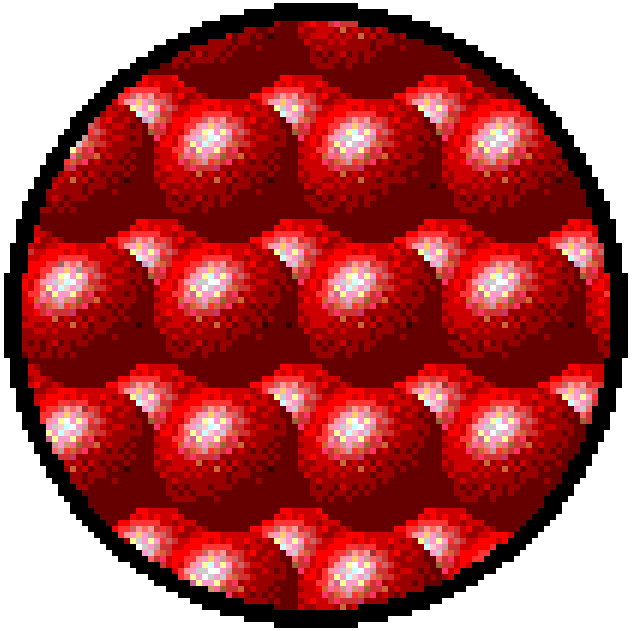
2- **In liquids**, there are strong intermolecular forces between the particles, which hold them in close contact, while still letting them slip and slide over one another.

3- **In solids**, the intermolecular forces are so strong that the particles are held rigidly in place

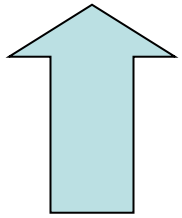
STATES OF MATTER

SOLIDS

Particles of solids are tightly packed, vibrating about a fixed position. the intermolecular forces are so strong that the particles are held rigidly in place



•**Solids have a definite shape and a definite volume.**



Heat

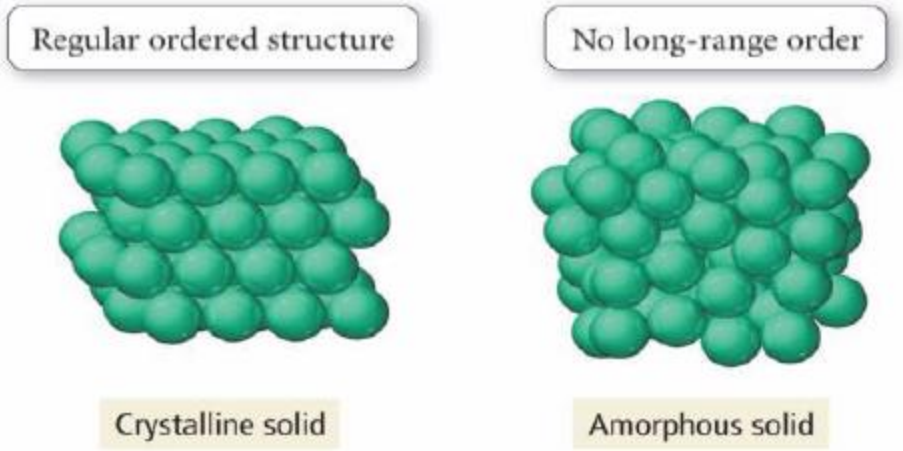
Solids

1–Have strong intermolecular forces.

2–Have high **densities** in comparison to gases.

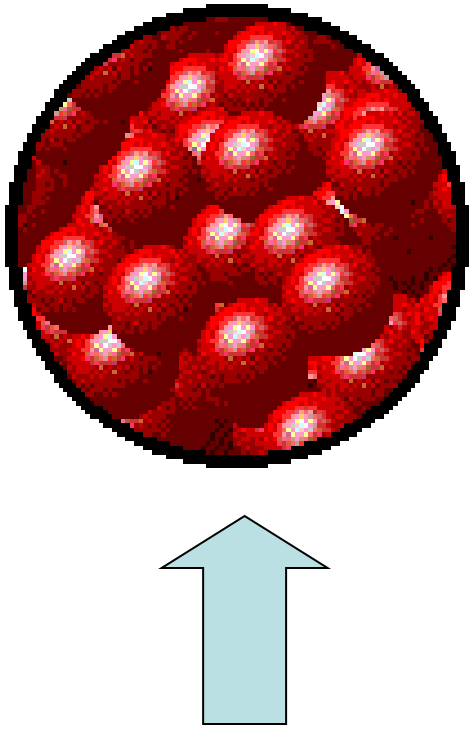
3–Rigid (have a definite shape) and incompressible (have a definite volume).

4–May be crystalline (ordered) [e.g. table salt] or amorphous (disordered) [e.g., plastics].



LIQUID

- 1- Particles of liquids are tightly packed, but are far enough apart to slide over one another.
- 2- Liquids have an **indefinite shape** and a **definite volume**. they conform to the shape of their containers (they form surfaces).
- 3- Liquids have moderate intermolecular forces
- 4- have high densities in comparison to gases.

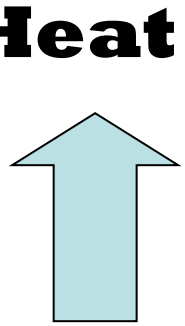


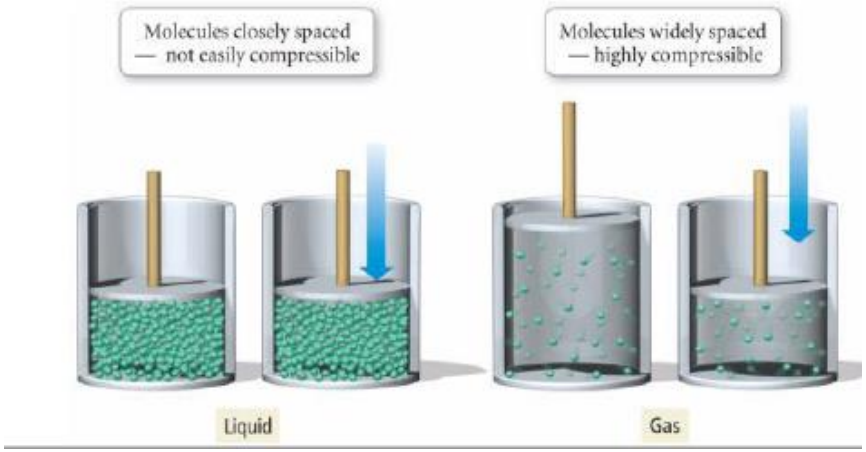
GAS

- 1- Particles of gases are very far apart and move freely.

- 2- Gases have an indefinite shape and an indefinite volume. and conform to the container shape, but fill the entire volume (i.e., they do not form surfaces).

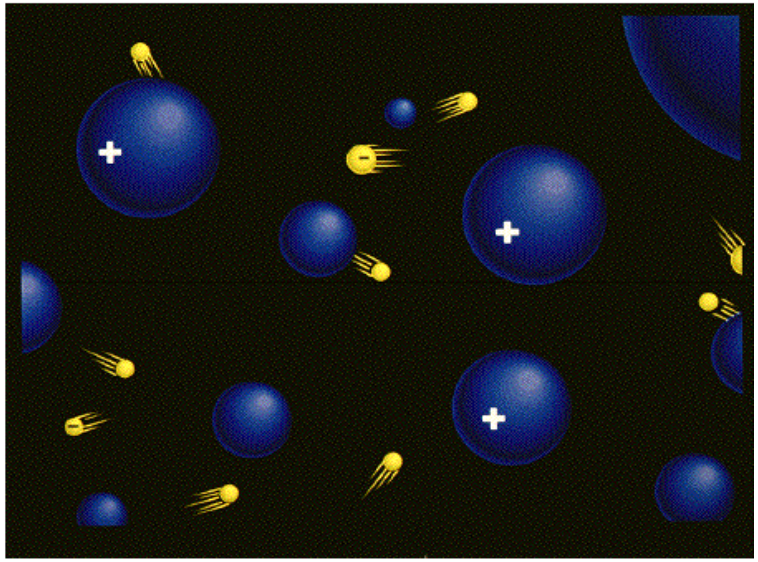
- 3- Gases have weak intermolecular forces.
- 4- have low densities.





PLASMA

- 1- A plasma is an ionized gas.
- 2- A plasma is a very good conductor of electricity and is affected by magnetic fields.
- 3- Plasmas, like gases have an indefinite shape and an indefinite volume.

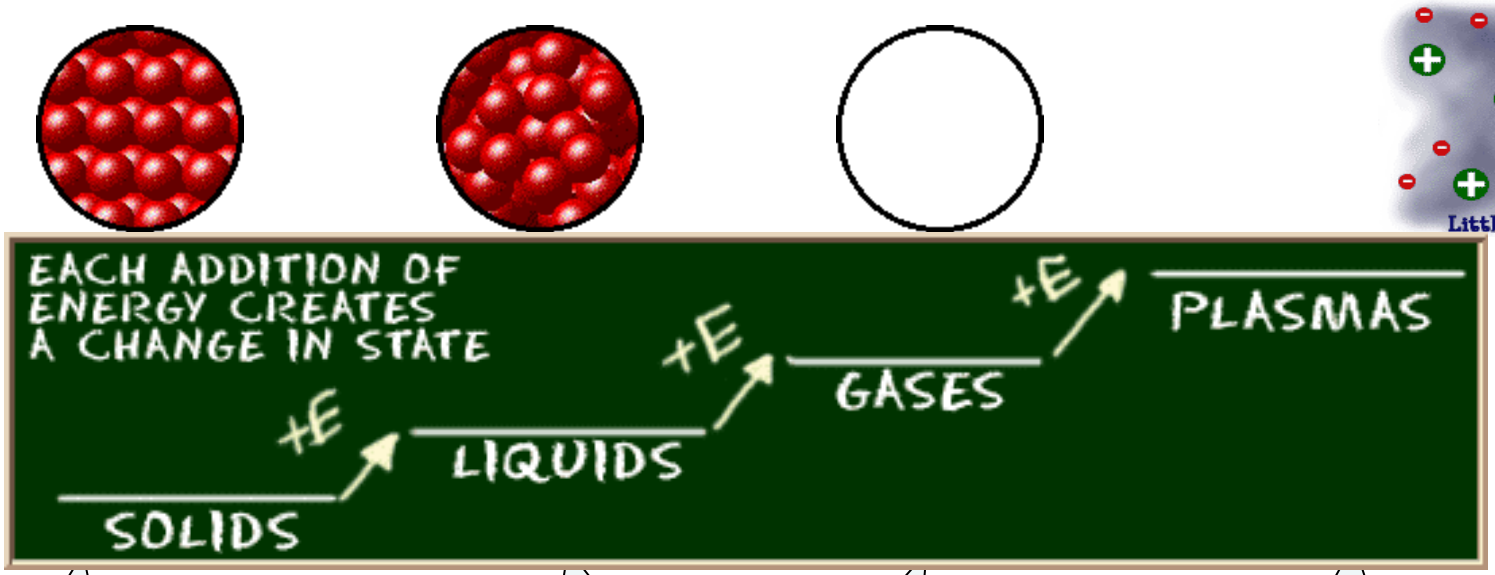


- **Plasma is the common state of matter**

Q// what happens if temperature is raises to super-high levels... between 1000˚C and 1,000,000,000˚C ?

Will every thing just be a gas?

STATES OF MATTER



SOLID

Tightly packed, in a regular pattern Vibrate, but do not move from place to place

LIQUID

Close together with no regular arrangement. Vibrate, move about, and slide past each other

GAS

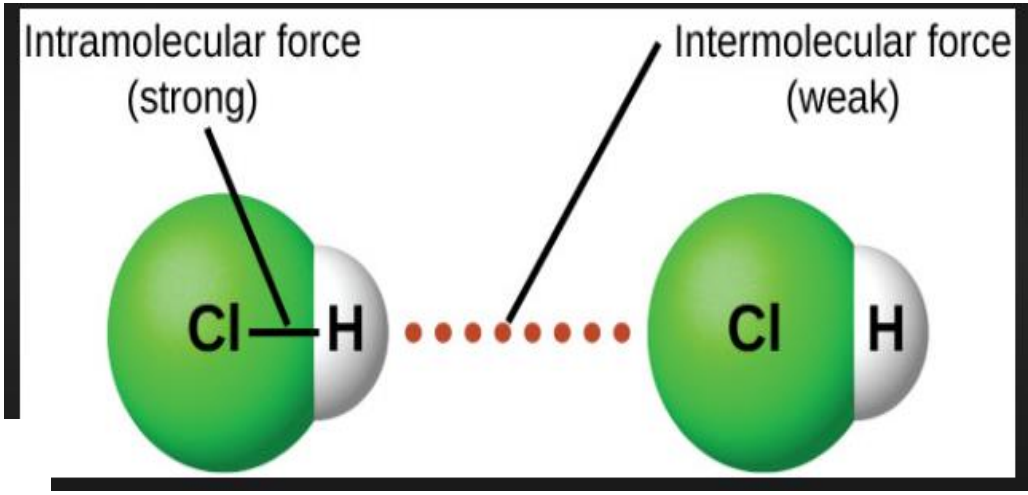
Well separated with no regular arrangement. Vibrate and move freely at high speeds

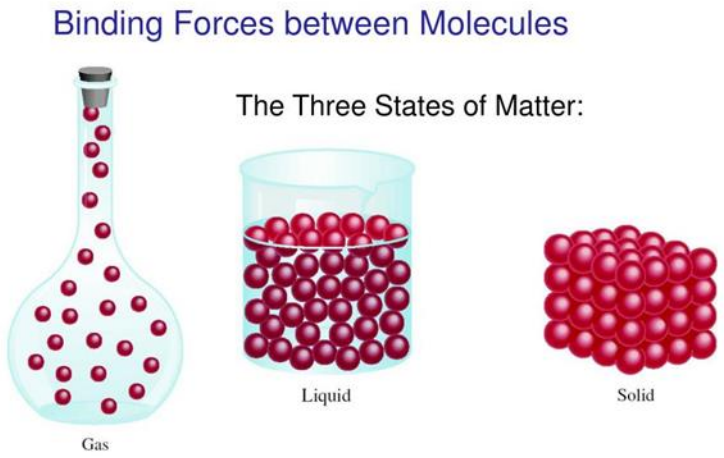
PLASMA

Has no definite volume or shape and is composed of electrical charged particles

Binding Forces Between Molecules

1- **Repulsive and attractive forces**
2- **Intramolecular forces**
3- **Intermolecular forces**
4- **Bond energy**





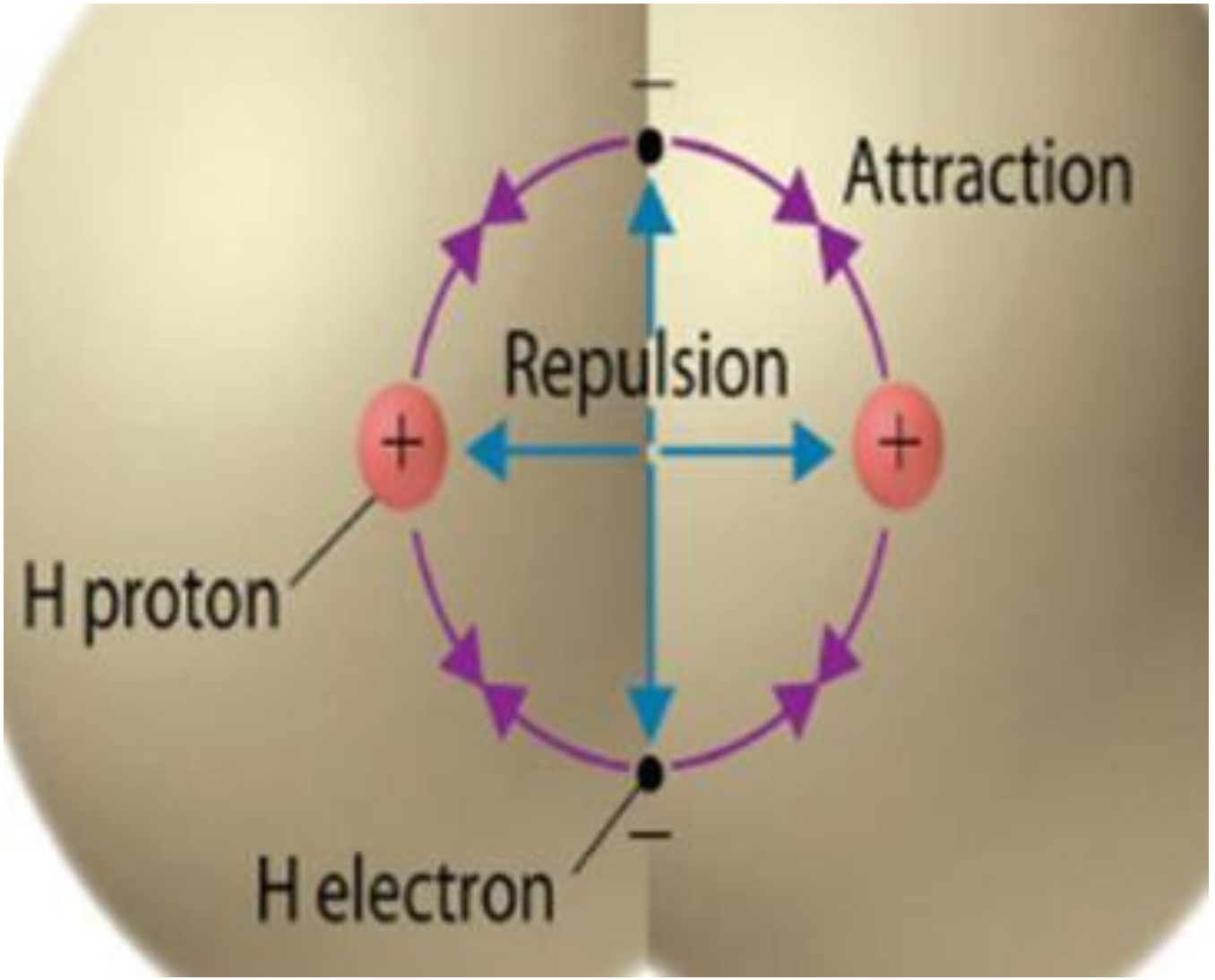
1- **Repulsive and Attractive Forces**

For molecules to exist as aggregates in **gases ,liquids ,and solids ,intermolecular forces must exist These intermolecular forces involve both attractive and repulsive forces.** These forces must be balanced in an energetically favored arrangement for the molecules to interact.

H-CL--------H_2O

intermolecular force

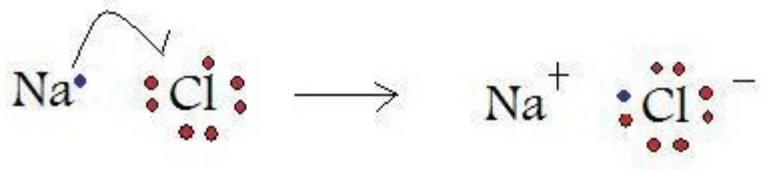
When two atoms or molecules are brought closer together, the opposite charges and binding forces in the two molecules are closer together than the similar charges and forces ,causing the molecules to attract one another.


Attraction
Repulsion
H proton
H electron

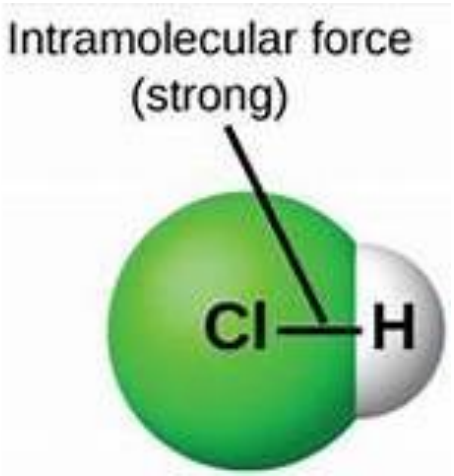
➢Intramolecular forces

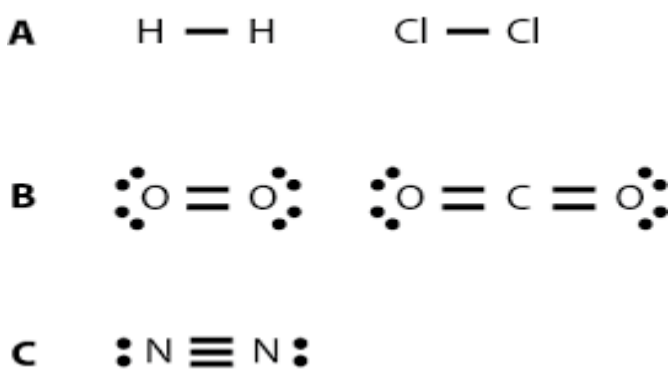
Types of intramolecular forces of attraction

1-Ionic bond: This bond is formed by the complete transfer of valence electron(s) between atoms.



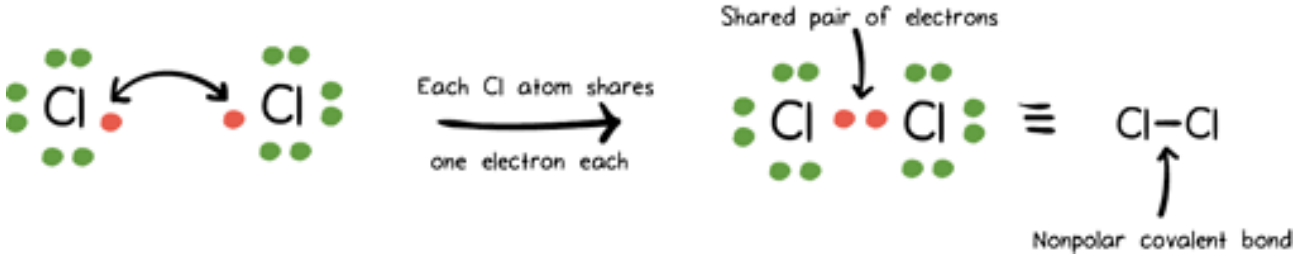
2-Covalent bond: **This bond is formed between atoms that have similar electro negativities**—the affinity or desire for electrons. they share electrons in order to achieve octet configuration and become more stable ; (three type single ,double &triple bond)



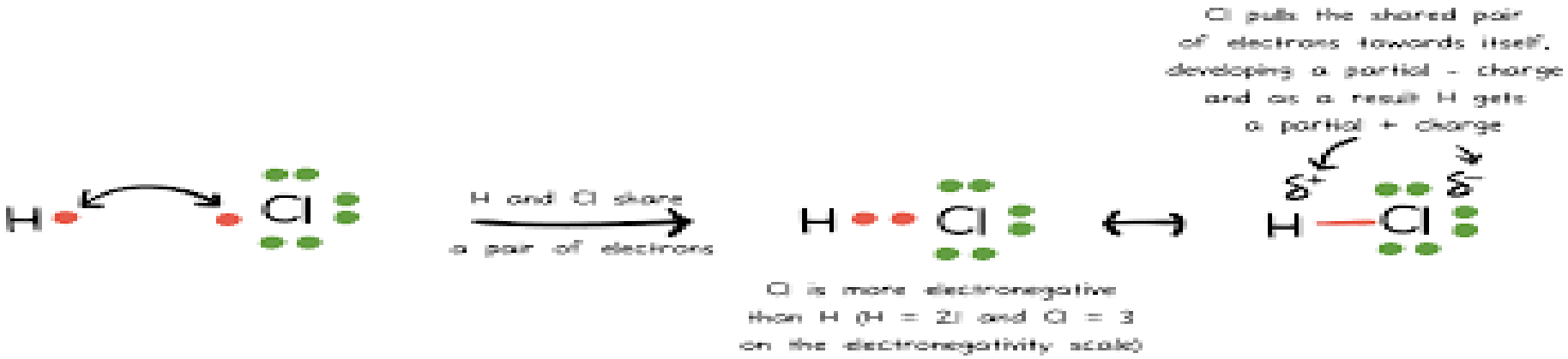


Covalent bond

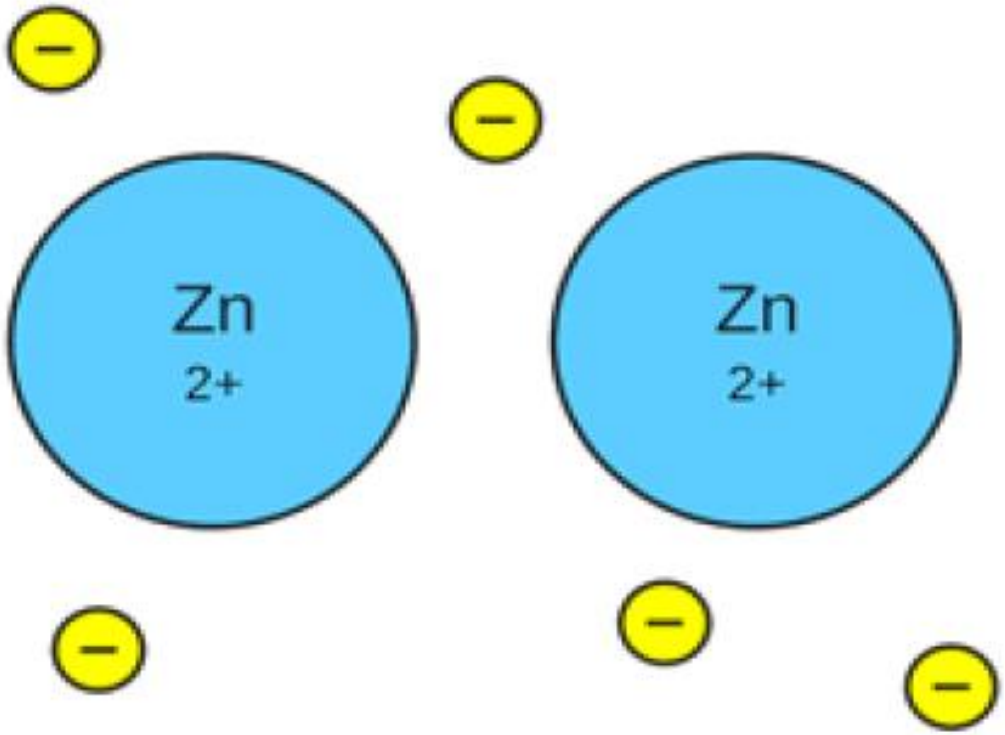
A nonpolar covalent bond is formed between **same atoms or atoms with very similar electronegativities**



A polar covalent bond is formed when **atoms of slightly different electronegativities share electrons**.



3-Metallic bonding: This type of covalent bonding specifically occurs between atoms of metals



➢ Intermolecular forces

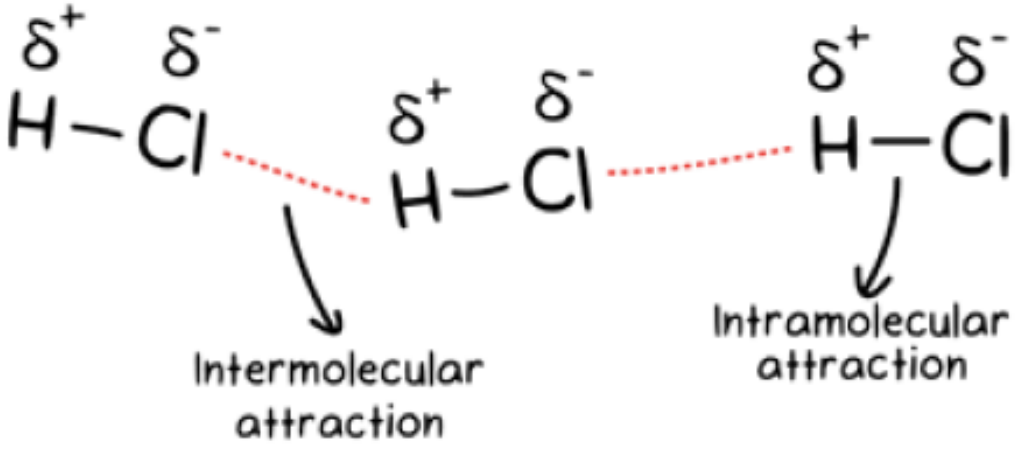
Intermolecular forces occur between molecules . It can be divided in to:

1.Vanderwaals forces

2.Ion–dipole interaction

3.Ion–induced dipole interaction

4.Hydrogen bonds



Intermolecular forces

1-VanderWaals Forces

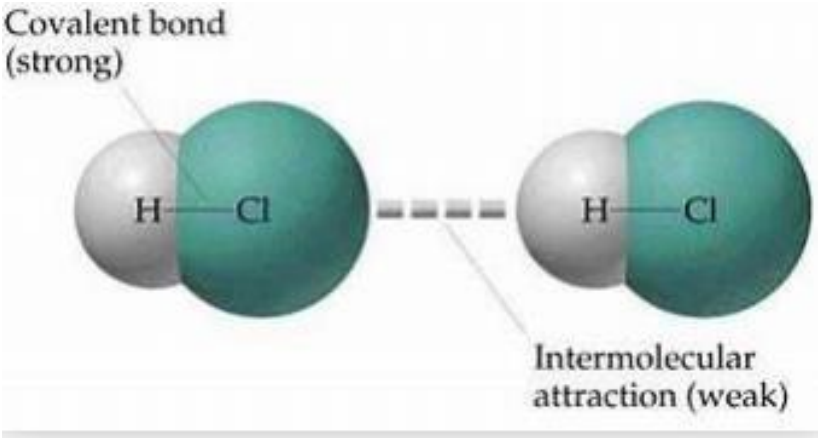
VanderWaal interactions are weak forces that involve the dispersion of charge across a molecule called adipole.

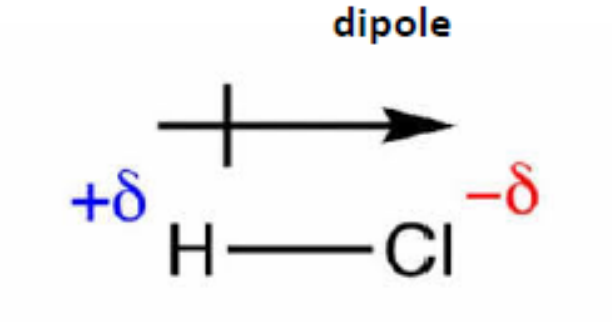
VanderWaal interactions can be classified into:

A. Dipole–dipole interaction ,orientation effect ,or **Keesom force**

B. Dipole-induced dipole interaction ,induction effect ,or **Debye force**

C. Induced dipole induced dipole interaction ,dispersion effect ,or **London force**



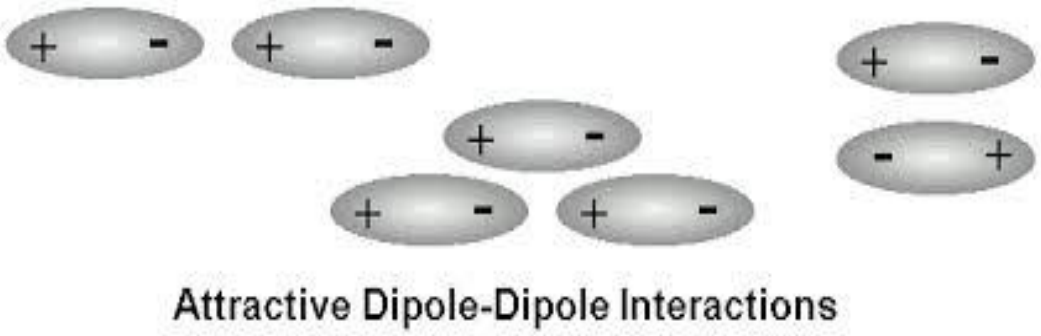


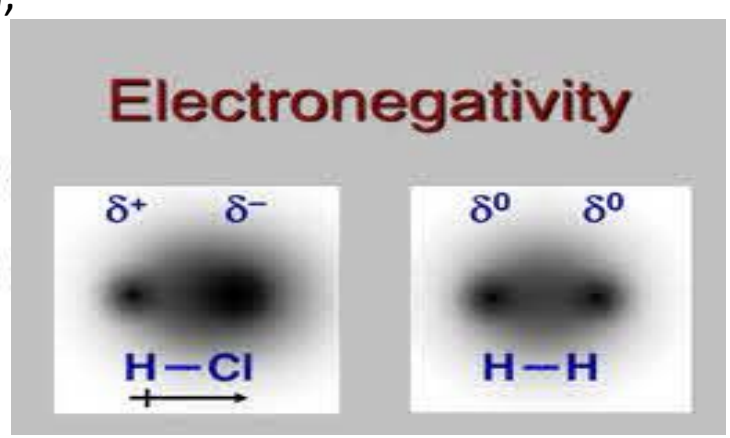
Keesom forces

Keesom forces occur between polar molecules in which the permanent dipoles interact with one an other(**dipole-dipole interactions)or(orientation effect**).

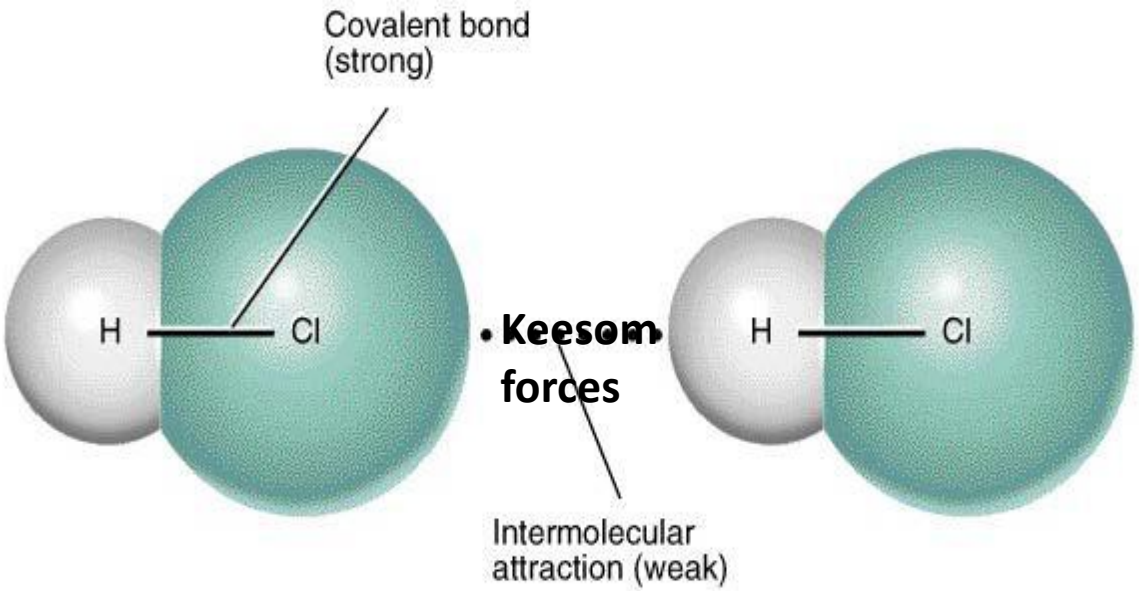
Polar molecules have polar covalent bonds which are unevenly distributed in space due to the difference in the electronegativity of the atoms forming the bond .e.g. HCl.

The nucleus of the chlorine atom pulls the electron pair involved in the chlorine hydrogen bond closer to itself and creates a permanent partial positive charge on the hydrogen and a permanent partial negative charge on the chlorine(**Permanent dipole**),





The Partial opposite charges (permanent dipoles) attract one another(**dipole-dipole interactions**)

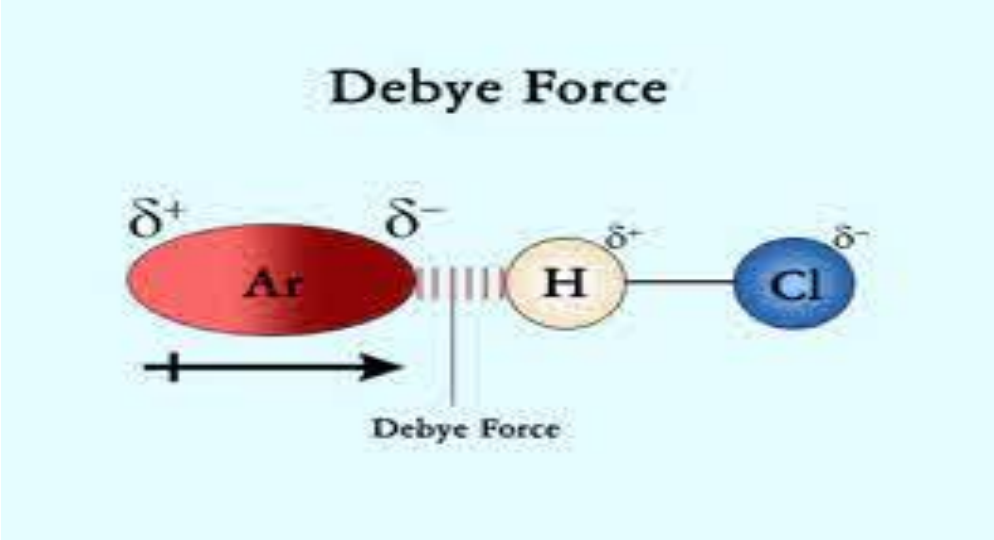


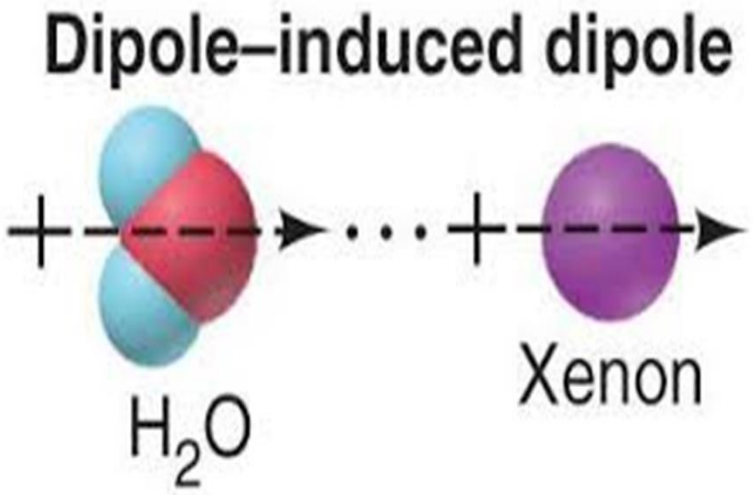
The dipole-dipole forces increases as the polarity of the molecule increases .Keesom forces are much weaker than ionic bonds because the charges involved in bonding are partial

Debye forces

Debye forces occur between a polar and a non polar molecule in which the permanent dipole in the polar molecule Induce an electric dipole in the non polar one(**dipole-induced dipole interactions**)or(**induction effect**).e.g. water and oxygen

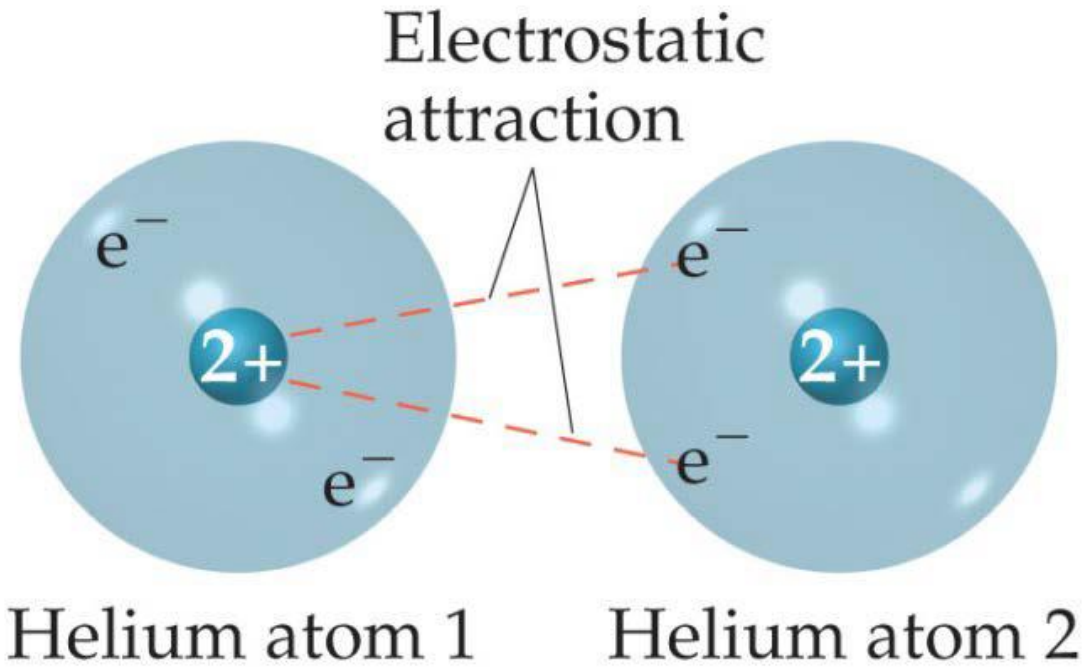
The strength of Debye forces increases with the ease of distortion of the electron cloud of the nonpolar molecule(i.e. polarizability of the molecule)
Debye forces is weaker than Keesom forces because the dipole in the nonpolar molecule is temporary(induced)and forms only when the two molecules is extremely close to each other



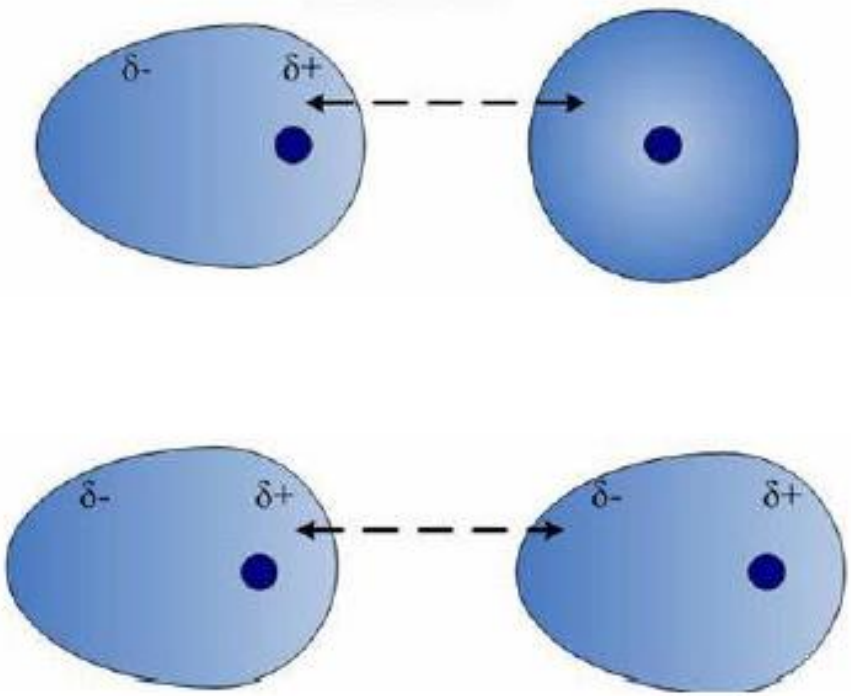


London forces

London forces occur between two nonpolar(neutral)molecules in which molecules can induce polarity on each other(**induced dipole-induced dipole interactions**)or(**dispersion effect**).e.g. Helium

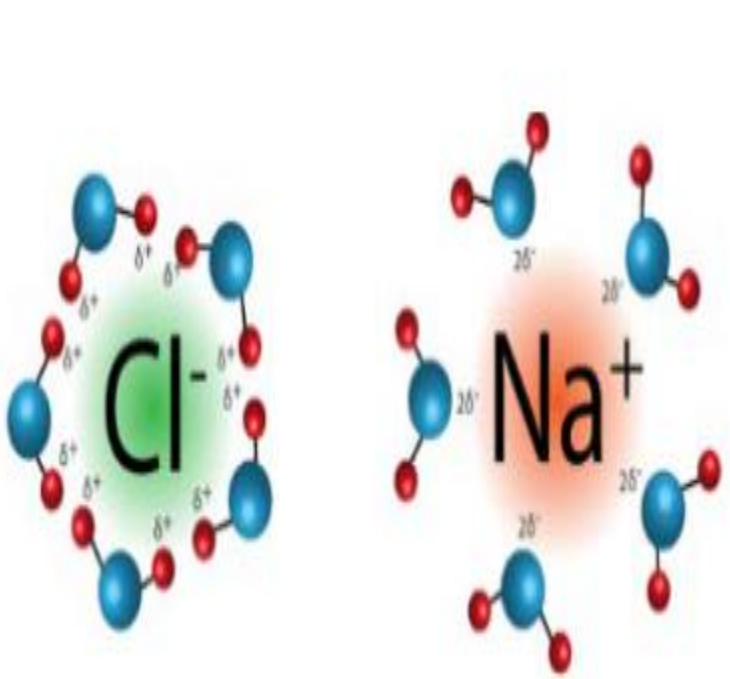


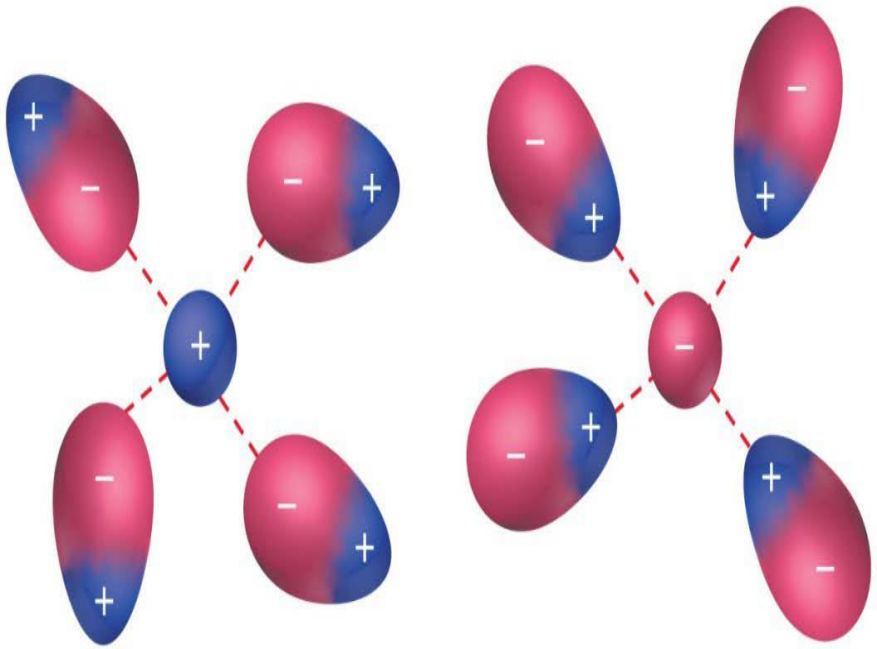
Two Helium atoms are nonpolar and posses no dipoles .The average distribution of electrons around each nucleus is spherically symmetrical



2- Ion-dipole interaction

An **ion-dipole interaction** is the result of an electrostatic **interaction** between a charged **ion** and a molecule that has a **dipole**. It is an attractive force that is commonly found in solutions, especially **ionic** compounds dissolved in polar liquids.



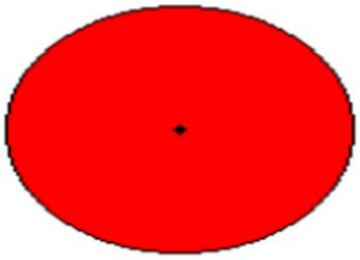


Cation–dipole attractions

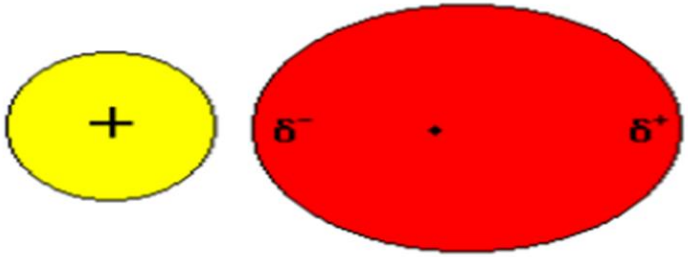
Anion–dipole attractions

3-Ion-induced dipole interaction

Ion Induced dipole forces occur between a charged ion and a nonpolar molecule.



Spherical atom with no dipole.
The dot indicates the location
of the nucleus.

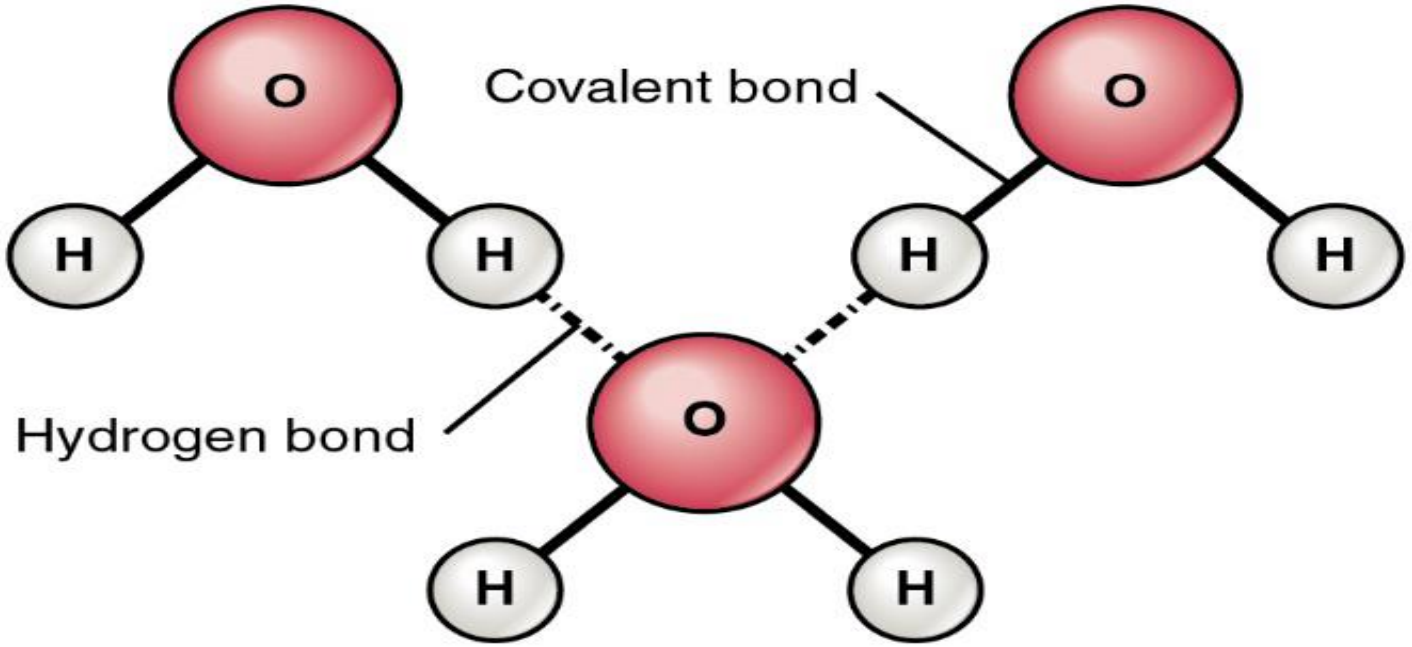


Upon approach of a charged ion,
electrons in the atom respond and
the atom develops a dipole.

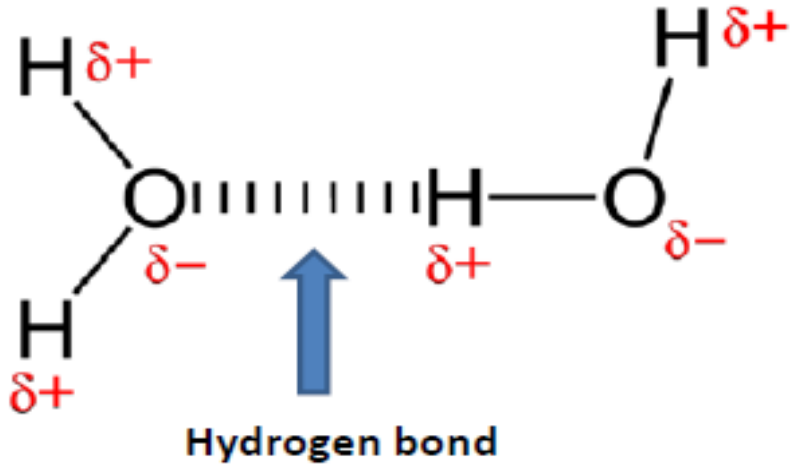
4-Hydrogen bond

Hydrogen bond is a strong type of dipole-dipole interaction that occurs between a molecule containing a hydrogen atom and a strongly electronegative atom such as fluorine ,oxygen ,or nitrogen

In order to create the bond ,the hydrogen atom must be covalently attached to another electronegative atom



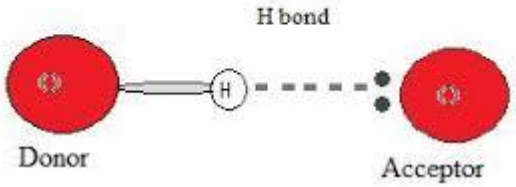
In a **water molecule** ,the hydrogen has single electron is pulled by the covalently attached oxygen atom ,creating a naked nucleus on the side of the hydrogen atom facing away(partial positive charge).



Hydrogen bonds are responsible for many unusual physical properties of water including

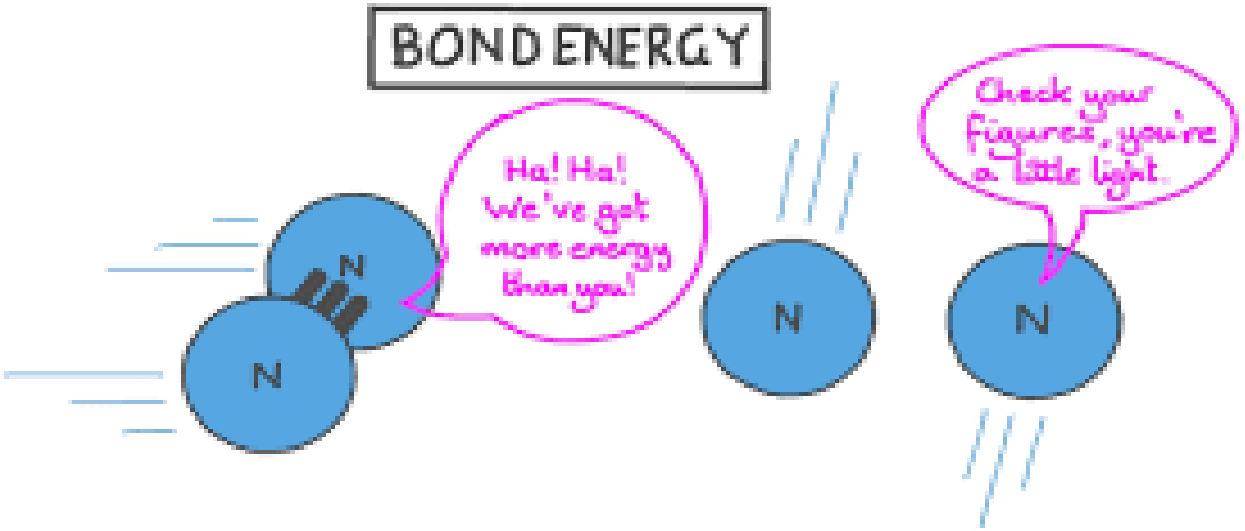
- ✓ **it's abnormally low vapor pressure ,**
- ✓ **high boiling point ,and the**
- ✓ **greater volume of ice water.**

Hydrogen bonding is stronger than all VanderWaals intermolecular forces (they are given their own classification) ,but are still weaker than ionic and covalent bonds



➢ Bond energy

Bond energy is a measure of bond strength.
It is the heat required to break one mole of molecules in to their individual atoms.



Thank you *for* your attention