Intermolecular forces of attraction

Intermolecular forces are the attractive and repulsive forces between the molecules of a substance.

Forces also exist between the molecules themselves and these are collectively referred to as Intermolecular forces. Intermolecular forces are the responsible for the condensed matter.

The particles making up by solid or liquid are held together by Intermolecular forces.

Types of Intermolecular forces.

An Intermolecular force is an attractive force that arises between the positive component of one substance and the negative component of the other substance, the boiling point of the substance is proportional to the strength of the Intermolecular forces.

Higher the boiling point higher is the strength of the Intermolecular forces.

Types of Intermolecular forces

Ion-Ion Interaction

Say for Na^{+} Cl^{-}

positive charge and Negative charge attracted together and exerts by the electrostatic force.

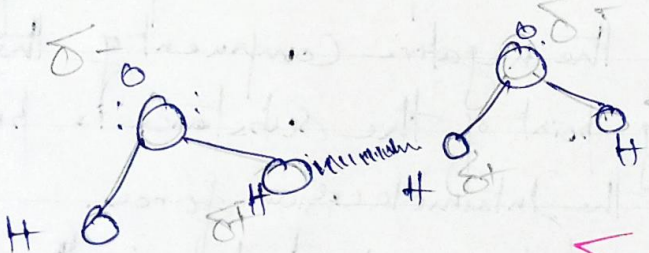
$$F = \frac{k\, q_1 q_2}{r^2}$$

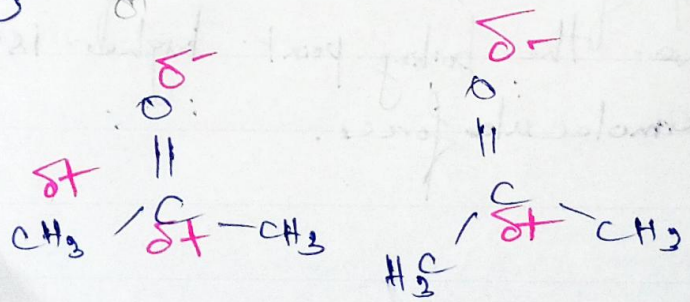
Ca^{2+} ... O^{2-} Magnitude of the charge is greater

the Ionic Interaction between the Ca and O is greater than Na and Cl. because the charge is greater

So the charge Increase the electrostatic ↑

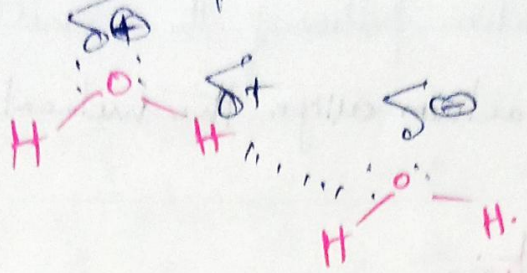
. Size Increase then the electrostatic ↓



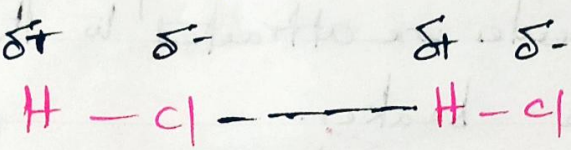


this is a dipole moment. partial positive and partial Negative

Intermolecular forces depend on the electronegativity



It is stronger dipole - dipole Interaction
It is strongerest dipole Interaction
Hydrogen Interacting with the other partial character



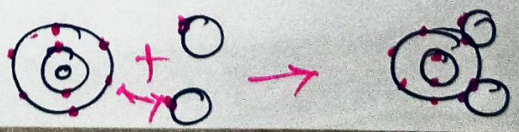
---- Intermolecular force
— Interatomic Bonds.

Dipole - Dipole Interaction

Dipole-Dipole Interactions are the strongest forces among polar molecules.

Polar molecules have permanent dipoles that are formed due to the difference in the electronegativity of the atom that are associated with the covalent Bond

[Covalent Bond:- Type of chemical Bond wherein two or more atom share one or more electron pair]

$H_2O \rightarrow$ 

the partial positive charge of the one atom is attracted to the partially Negative portion of the another molecule.

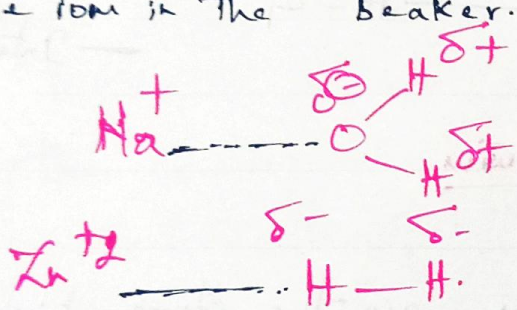
* These types of interaction allign the molecule to increase the attraction.

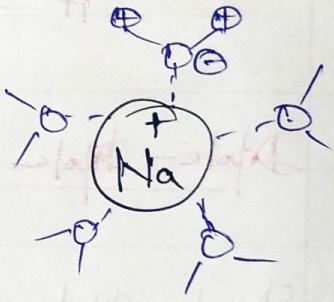
2) Ion-Dipole Interaction

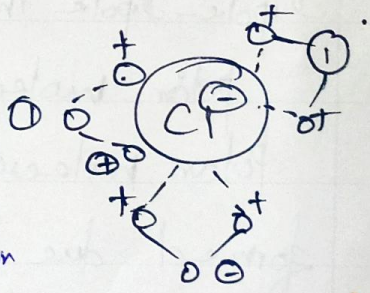
These type of Interaction are similar to dipole-dipole interaction expect for the fact that they are between ion and polar molecules

Example NaCl dissolved in a beaker of water.

the polar H_2O molecules are attracted to the sodium and chloride ion in the beaker.







The strength of this Interaction depends upon

a) the magnitude of the dipole moment
b) Size of the polar molecule
c) the size and charge of the Ion.

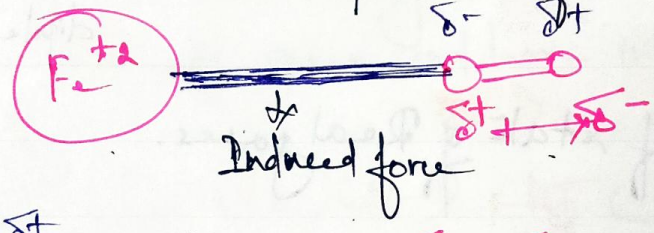
Ion-Induced Dipole Interaction:

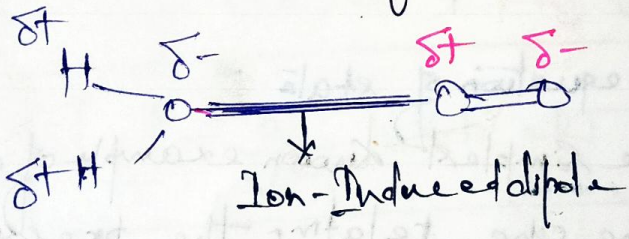
In this type of interaction, a non-polar molecule is polarised by an ion placed nearit.

When one of the ions is near the polar molecule it has the capability of polarising it. The non polar molecule becomes the induced dipole because of the presence of the Ion.

The interaction between the non polar molecule and the ion are known as the Ion induced dipole Interaction.

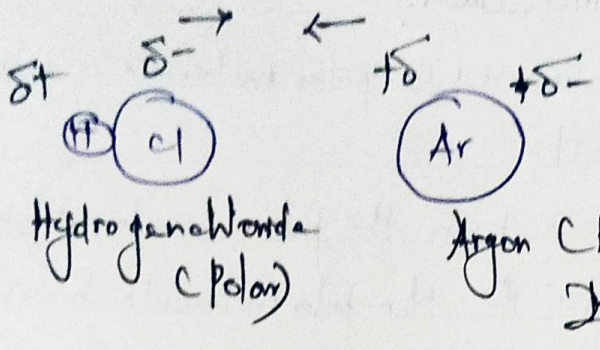
The strength of the Intermolecular forces depends upon the ease with which the polarisation of Non-polar molecule happens.

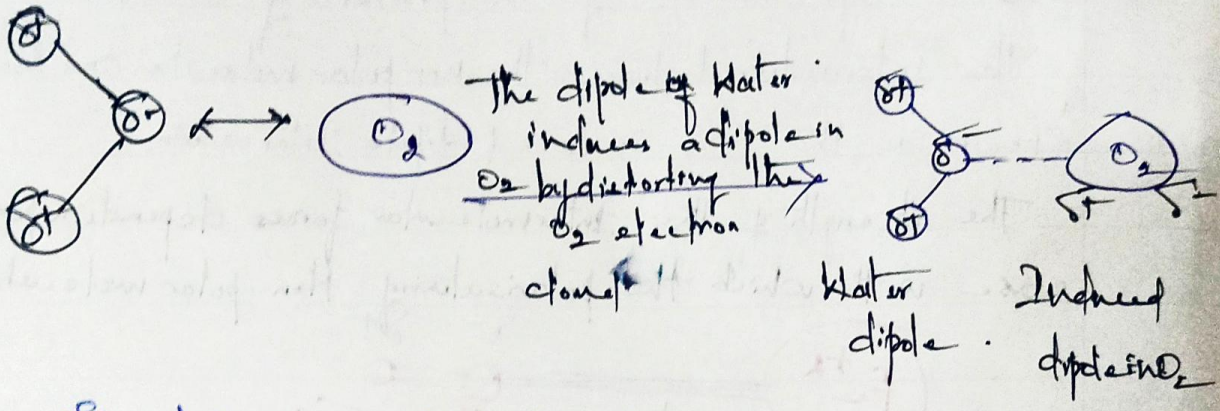




Dipole-Induced Dipole Interaction:

These interactions are similar to the Ion-induced dipole Interactions. However the differentiating factor is that Non polar molecules are transformed into the Induced dipoles due to the presence of polar molecule nearby.





Equation of state of Real gases.

What is the equation of state.

It is the simplest known example of an equation of a state is the one relating the pressure P, the volume V and the absolute temperature T of one of mole of a perfect gas. That is.

$$PV = RT$$

R is the universal gas constant.

Ideal gas obeys the gaseous laws, while the real gas doesn't obey the gas laws.

Ideal gas obeys $PV = nRT$

Real gas obeys $P + \left[\frac{(n^2 a)}{V^2}\right](V - nb) = nRT$

Ideal gas No Intermolecular forces of attraction.

Ideal gas has elastic collisions of molecules.

Equation for Real gases Real gases are Non-ideal gases where molecules occupy space and have interaction.

$$(P - aV^2)(V - b) = RT \quad \text{(or)}$$

$$\boxed{\left(P - \frac{a}{V^2}\right)(V - b) = RT}$$

P, V, T are the pressure volume and Temperature respectively and R is the Universal gas constant.

Modified Vander Waals equation

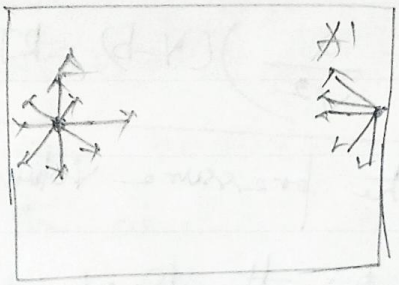
In 1873, Vander Waals modified the perfect gas equation $PV = RT$ by applying the correction for.

a) Correction for the force of attraction (i.e) pressure Correction

b) Correction for the volume.

Correction for pressure

Let us consider the molecule 'A' of the gas flow inside the container as shown in figure



the molecule 'A' is attracted by other molecules in all direction and its Net force gets Zero

But when the molecule strikes on the wall A'

its pull backward by the other molecules. Its velocity and momentum with which it strikes the wall would be less than the momentum with which it strikes in the absence of the wall.

So for a given mole of a gas.

$$P \propto \frac{1}{V}$$

The correction factor for pressure is mentioned as p.

$$P \propto p^2$$

$$\therefore P \propto \frac{1}{V^2} \qquad p = \frac{a}{V^2}$$

Here a is the constant and V is the volume of the gas.

Therefore the corrected pressure is

$$\boxed{P + p = P + \frac{a}{V^2}}$$