08/03/19

Unit - 3

Intermolecular forces:

* **Vanderwalls forces:**

It is Now fully established that forces of attraction exist b/w non polar molecules as well. these intermolecular forces are known as Coheresive forces or ~~wa~~ vanderwall forces.

these forces originate from three main types of interactions, namily

1) dipole - dipole interaction:

In the case for polar molecules which though Neutral, have permanent dipoles, the vanderwalls forces are mainly due to ~~is~~ Electrical inraction b/w the dipoles known as dipole dipole intraction.
for Ex: Gases such as amonia, sulphur dioxide HF, HCl, etc. have Parmanent dipoles as a result of which there is appriciable dipole-dipole interaction b/w the molecules of these gases

The magnitude of this type of interaction depends upon the dipole moment of the molecules concerned. the greater the dipole moment the greater the dipole dipole intraction. Because of the attractive intraction, these gases can be easily liquified.

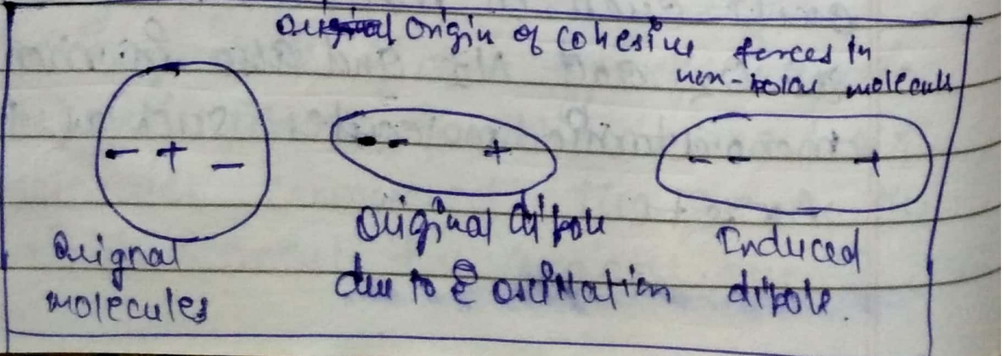
(2) **dipole induced dipole intraction:**
A polar molecules may some times polarised a neutral molecules. which lies in the vicinity and thereby induced dipolarity in that molecules. just as a magnet induces magnetic dipolarity in the neutral piece of iron lying close by. the induced dipole then intract with the dipole moment of the first molecules and there by the two molecules are attracted together

- The magnitude of this intraction would evidently, depend upon the magnitude of the dipole moment of the polar molecules and polarisiablity of the neutral molecules.

(3) **Induced dipole-Induced dipole Intraction:**
or
London forces; dispersive forces:
As we know, the vanderwaals forces exist even in non polar molecules such as O_2 and N_2 and also in non polar monoatomic molecules such as He, Ne, Ar etc

this attraction is evident from the condensation of these gases into liquids at sufficiently high pressure and low temp. this could not be understood for several years.

In 1930, F. London provided a satisfactory explanation for the existance of forces of attraction b/w non-polar molecules based on quantum mechanics. acc. to this view, electrons of Neutral molecules keep on oscillating w.r.t the nuclei of atoms. As a result of this, at a given instant, positive charges may be concentrated in one region and negative charge in another region of the same molecule. therefore a non polar molecules may become momentrely self polarised. this polarised molecules may include a dipole moment in nebouring molecules with anti-Parallel orientation.



(4) Ion dipole forces:-

We know that ions great tendency to attract polar molecules. the positive ion attract the negative pole and negative ion attract the +ve pole of the polar molecules. Such an interaction is known as ion dipole interaction and the forces causing these interaction are known as ion dipole forces.

* The Critical phenominam:-

Critical constants of a Gas:-

the most charactstic properties of gases is that their molecules lie far apart from one another and are in continuous rapid motion. Each molecules therefore leads almost an independent existance. this particularly so when temp. is high and pressure is low. however as the temp. of gases are decrease the K.E of gases is decreases, the volume of occupy by the gases decreases.

at a sufficiently at a low temp, some of slow moving molecules can not resist the force of attraction and they come closer and closer and ultimately the gas changes into the liquid state

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Therefore liquification of gases results from decrease of temperature.

Increase of pressure has also the effect of bringing the gaseous molecules closer and closer to one another (due to decrease in volume). this is an additional helpful factor in converting the gas into factor - thus increase of pressure and ↓es of pressure both tend to liquification of gases. For instance, sulphur dioxide can be liquified at -8°c if the pressure is 1atm. but it can be liquified even at a high temp. of 20°c if the pressure is increase to 3.24 atm. the effect of temp. however is more important then that of the pressure because for each gas there is certain temp. above which it can not be liquified, no mettar how high pressure may be applied. This temp. is known as critical temp. Therefore the critical temp of the gas may be defined as that temp above which it can not be liquified how so ever high the pressure may be.

For instance the critical temp. of CO_2 is 31.1°C this means that it is not Possible to liquified CO_2 at above 31.1°C ~~on~~ by any means.

at the critical temp ~~pressure~~ ~~temp~~; a certain Pressure is needed to liquify the gas this pressure is called critical Pressure. for instant at 31.1°C CO_2 is liquified under a pressure of 72.9 atm. therefore the critical Pressure of this gas 72.9 atm.

The critical temp of oxygen is −118°C and that of Hydrogen is −240°C these gases therefor can not be liquified ordinary temp. their critical Pressure are 49.7 atm and 12.8 atm. respectively.

The volume occupied by 1 mole of a gas at its critical temp and critical Pressure is known as critical volume

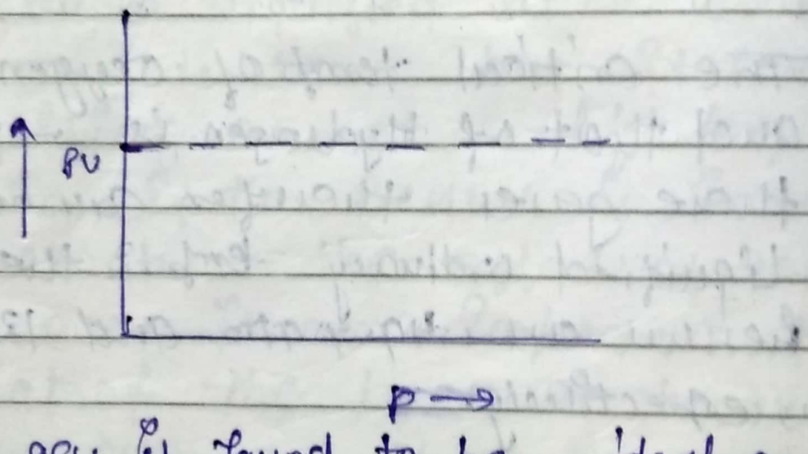
for Ex- critical volume of CO_2, Oxygen and Hydrogen are 940.0, 78.2, 61.5 ml/mole respectively

* Ideal and non-ideal gases:

A gas obeys gas laws completely is known as ideal gas or perfect gas

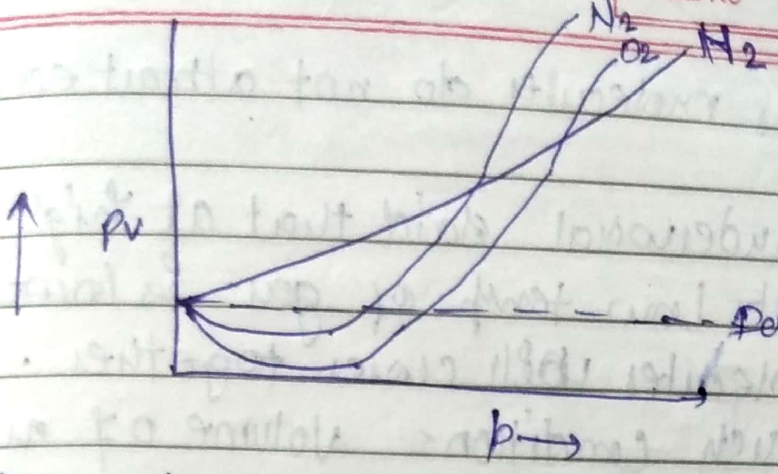
A gas which does not obes gas laws completely, is known as non-ideal gas or real gas.

when a graph obeys boyles law completely then following type of graph is obtained.



no gas is found to be ideal gas, all known gases are real gases and they show more or less deviations from gas laws.

The deviations by real gases from ideal behaviour may be shown as



from above curves, it is clear that real gas shows larger deviations at high Pressure and low temperature.

therefore a real gas will show lesser deviation at low pressure and high temp. It means that a real gas behaves almost ideal gas at low Pressure and high temp

* Cause of deviation and vanderwalls eq^n: (V.I.)

Real gases show larger deviation at high pressure and low temp. from ideal gas eq^n ($PV = nRT$), the region of these deviation explained by Vanderwaals. He said that gas laws are based on Postulates of Kinetic theory of gases and two Postulates are wrong

(1) gas molecules are so small that their volume may be neglected in comparision of total volume of gas

(ii) gas molecules do not attract each other

Vanderwaal said that at high Pressure at Low temp. of gas is lower and molecules will closer together. In such conditions volume of molecules and attraction forces b/w them can not be neglected. If we neglect these facts, the gas will show Larger deviation.

In order to explain the behaviour of real gases, Vanderwaals Proposed following two correction in ideal gas equation (PV = nRT)

(1) Volume Correction
(2) Pressure Correction