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Day - I (HL) Gaseous State.

Topics - Deviation of gas from Ideality.
(Ideal & Real Gases)

Ideal gas: — A gas which obeys Boyle's law, Charles law etc under all condition of Temp & Press is known as ideal gas / Perfect gas.

OR

The gas obeys gas equation ($PV = nRT$) under all condition of Temp & Press.

But in actual practice no any gas is ideal because it does not obeys gas law eqn under given set of condition.

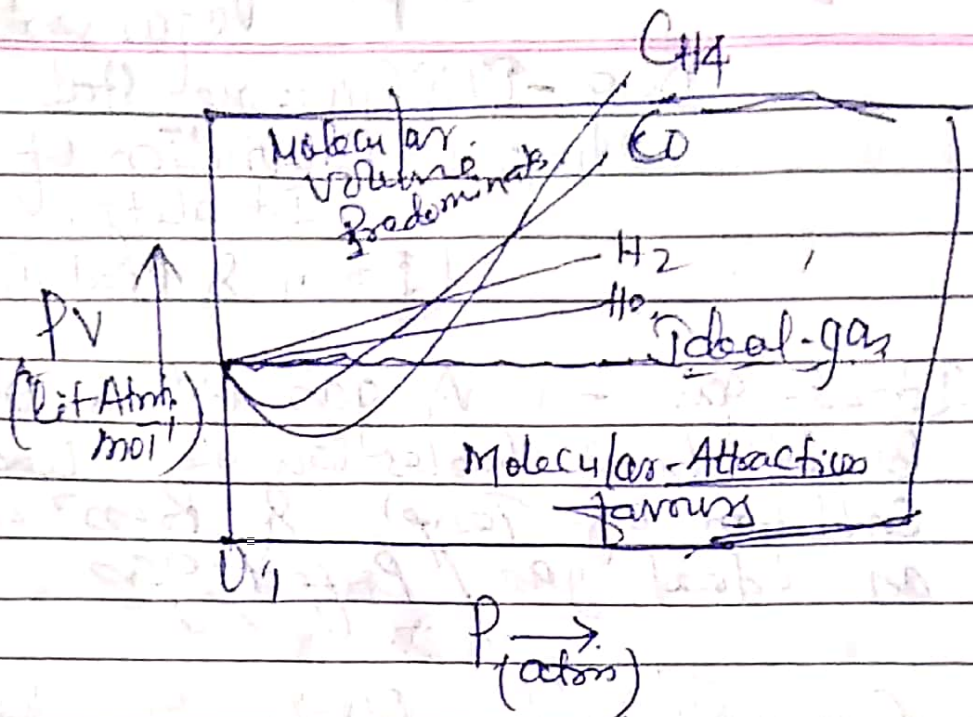
It obeys the gas laws fairly well at low press & high Temp only.

Real gas: - A real gas or imperfect gas is one which obeys gas laws fairly well under all conditions.

All gases are real gases. They show more & more deviation from the gas laws as we by increasing press & decreasing Temp.

Deviation of Real gases from ideal behaviour

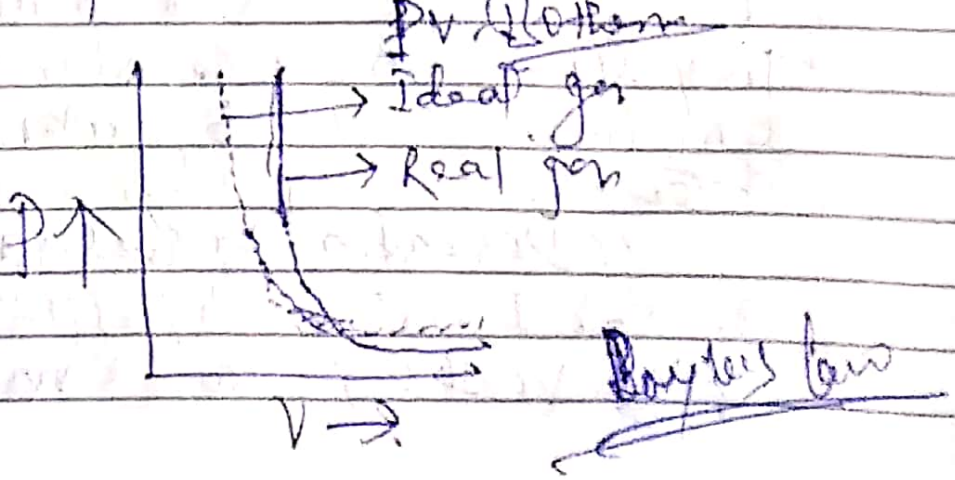
It can be shown by plotting a graph of PV Versus P at constant Temp.



According to Boyle's law PV = Constant at constant temperature (at const. Temp) that means by increasing the value of P, V always remain constant by increasing the P value at const. Temp. But it was observed that for some gases its PV value decrease for some extent & again increases by increasing pressure.

But for some gases PV value regularly increase by increasing pressure.

By Plotting graph of P vs V also clearly shows the deviation behaviour of gases.



By observing graph, we conclude that theoretical value calculated (for ideal gas) must be different from experimental value (for real gas).

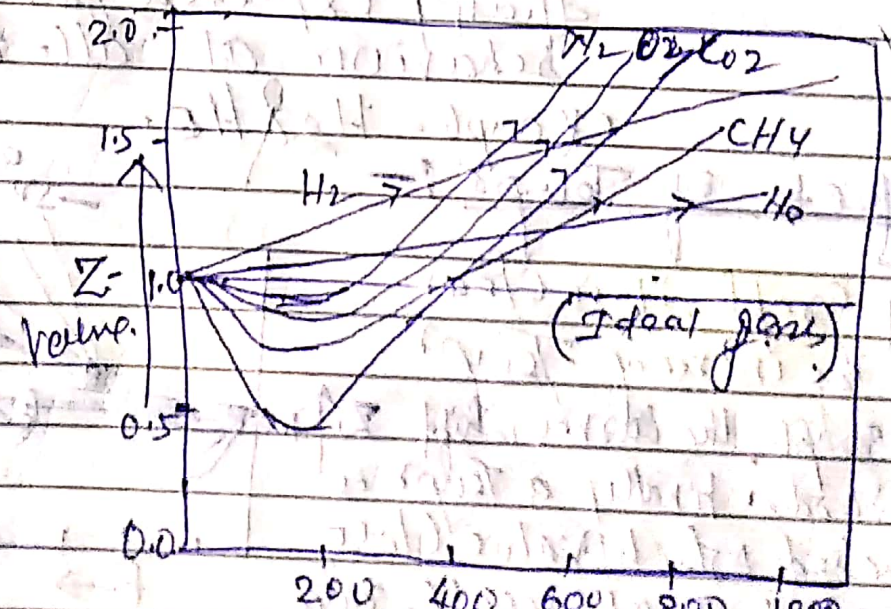
However it is observed that both the value nearly approach to each other at low pressure.

Deviation of Real gases from gas laws interms of Compressibility factor (Z).

Deviation of gases can also observe interms of compressibility factor (Z)

$$Z = \frac{PV(\text{observed})}{PV(\text{ideal})}$$

or, $$Z = \frac{PV}{nRT}$$



From Graph

(a) $Z = 1$ (for ideal gas)

Thus $\frac{PV}{nRT} = 1$

$\Rightarrow PV = nRT$

But for real gases $Z \neq 1$

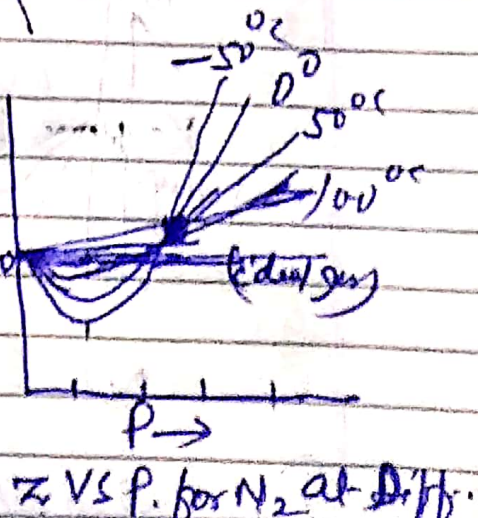
The value of Z either increases / decreases from one.

(b) $Z < 1$, it is negative deviation. In this case molecular attraction forces it is more easily liquifiable gas. The gas becomes more compressible than expected from ideal behaviour.
Example - CO_2, CH_4, N_2, O_2 etc

(c) $Z > 1$ it is Positive deviation.
these gases are less compressible than expected from ideal behaviour at all pressure.
Example - H_2 & He.

Effects of Temp :-

From graph, it is clear that by increasing Temp the graph, the curves shift upwards. Finally a Temp is reached which value close to ideal at appreciable range of Pressure called Boyle's Temp.



Z vs P for N_2 at Diff. Temp.