Average velocity (Cav): →

As the name emplies average velocity means the verage of velocity. This term is used because the velocity of gaseous molecules are defferent due to difference in their kinetic energy.

suppose c_1, c_2, c_3 & c_n are the velocity of the molecules and the no of molecules are N. then Average velocity can be calculated as follows:-

$$C_{av} = \frac{c_1 + c_2 + c_3 + \cdots c_n}{N}$$

But it is not possible to find out the velocity of each and every molecule separately, so we calculate the average velocity of one mole of gas at a given temperature as follows:-

$$C_{av} = \sqrt{\frac{8RT}{\pi M}}$$

Where: Cav = Average velocity
T = Temperature
R = Universal gas constant
M = Mol. mass of gas., π = 22/7. (fixed)

Most Probable velocity. (Cmp): →

As we know velocity of all the molecules of gases are not same rather they are diffrent, the velocity possessed by maximum no. of molecules of the gas at a perticular temperature is called most probable velocity (Cmp). Mathematically most probable velocity can be calculated as follows.

$$C_{mp} = \sqrt{\frac{2RT}{M}}$$

Where R = Universal gas Constant
T = Temperature.
M = molecular mass of the gas.

~~Deviation of real gas from ideal behaviour:~~ →

Relation between three types of molecular velocities - -

Most Probable vt $(C_{mp}) = \sqrt{\frac{2RT}{M}}$

Average Vel. $(C_{av}) = \sqrt{\frac{8RT}{\pi M}}$

~~Root~~

Root mean square velocity $(C) = \sqrt{\frac{3RT}{M}}$

Ratio of all three are: $C_{mp} : C_{av} : C = \sqrt{\frac{2RT}{M}} : \sqrt{\frac{8RT}{\pi M}} : \sqrt{\frac{3RT}{M}}$

$= 1.414 \quad 1.595 \quad 1.732$

$= 1 : 1.128 : 1.224$

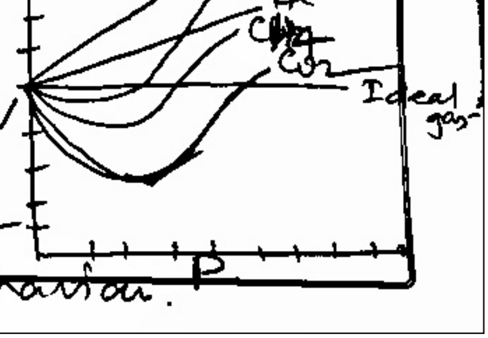
~~Teacher's Signature~~ : ____________

Deviation of real gas from ideal behaviour:-

As we know ideal gas follow the ideal gas equation i.e $PV = nRT$, at low pressure and high temperature real gas also behave as ideal gas. When pressure is high and temperature is low real gas deviate from ideal behaviour.

<u>Reason</u>: At high temperature and low pressure volume of gas becomes more so the molecule get aparted to each other hence force of attraction becomes negligible among themself and due to large volume the volume of one molecule becomes negligible with respect to the entire volume of the gas, so as to the concept of kinetic theory of gas it is ideal gas. Just reverse when temperature becomes low and pressure becomes high volume becomes low (due to contraction) so the distance of molecule is more nor neither the volume of one molecule becomes negligible with respect to entire volume of the gas.

By Boyle's law $P \propto \frac{1}{V}$ or $PV = const$ for ideal gas but real gas do not show like this.



In graph it is clear that PV is parallel to P for ideal gas, but He, H_2 shows +ve deviation & CH_4 & CO_2 shows negative deviation from ideal behaviour.

Compressibility factor (Z) :- Compressibility factor is such a term which explain the deviation better.

$$PV = Z \cdot nRT$$

$$\text{So } Z = \frac{PV}{nRT}$$

If the value of $Z = 1$, ($\because PV = nRT$)
It shows ideal nature of gas.

but if $Z \neq 1$, ($\because PV \neq nRT$)
It means it do not show ideal behaviour rather it shows nature of real gas.

Z can be more than one or can be less than one.

If $Z > 1$ (It shows +ve deviation)
$Z > 1$ for He & H_2.

If $Z < 1$ (It shows −ve deviation)
i.e CH_4, CO_2 etc

Greater is the value of Z greater will be the deviation of real gas from ideal behaviour.

For the same gas at a particular pressure, deviation depends on temperature.