Langat Singh College, Muzaffarpur
NAAC Grade 'A'
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Mean Free Path Lec -01

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Mean free path : The mean free path is average distance that a molecule travels between successive collisions .

If λ_1 ,λ_2 , λ_3 ……. λ_n are the values of successive free paths , then the total time in which they are travelled = $\lambda_1 + \lambda_2 + \lambda_3 + \ldots + \lambda_n = vt$

Where v is the mean speed of a molecule and n is the number of collisions suffered or free path traversed in time t .

If λ is the mean free path then

$$\lambda = \lambda_1 + \lambda_2 + \lambda_3 + \dots + \lambda_n / n = vt/n = S/n$$

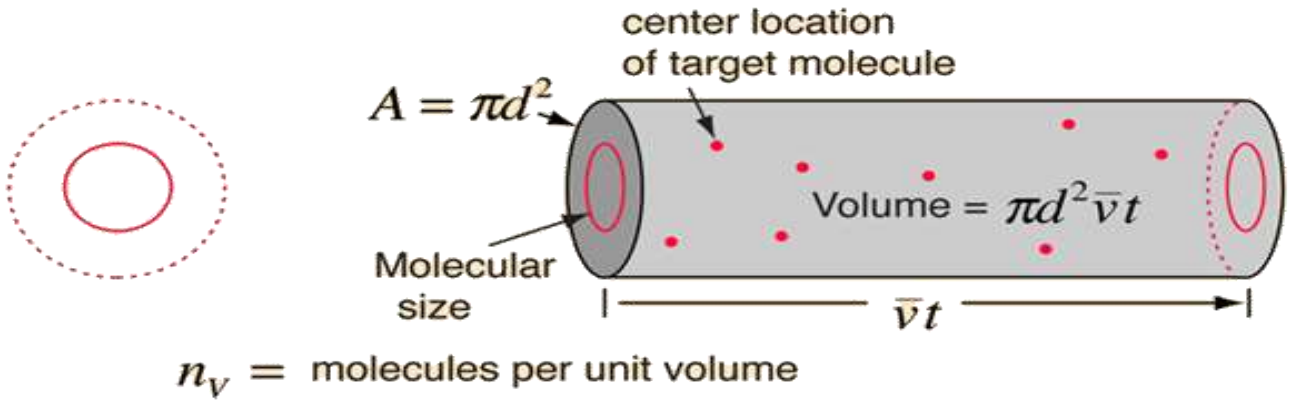
Where s is the total distance travelled in n collisions

Expression of mean free path : Let us assume that except one all other molecules are at rest

Then ,

$$\lambda = v / \pi d^2 vn = 1/ \pi d^2 n$$

Where d = diameter of molecules .whose centres are at a distance d from its centre .



Clausius expression for mean free path :

According to Clausius consideration , all the molecules were moving with a constant speed in all possible direction obtained an expression

$$\lambda = 3/ 4\pi d^2 n \qquad (1)$$

Maxwell's expression : According to Maxwell consideration all the molecules are moving in all possible directions and with all possible velocities as a result of Maxwell velocity distribution law of velocities . The mean free path averaged over molecules of all velocities is given by by

$$\lambda = 1/ \pi d^2 n (c/r) \qquad (2)$$

Where c = average velocity of molecule

r = mean relative velocity of all molecules w.r.t all others .