

- Q 1 (ii) Explain the following terms
 (a) Mean free path (b) Collision frequency (c) Potentiometric titration.
 (iii) What is Maxwell's distribution of molecular velocities? Write the effect of temperature on velocity distribution.

(Only For B.B.A. Bihar University)

Ans. (i) (a) **Mean free path :-**

— It is generally denoted by λ

— It is the average distance covered by a molecule between the two successive collisions.

— It is directly proportional to the absolute temperature and thus by increasing the temperature, it also increases.

— It is inversely proportional to the pressure and this is the reason that when pressure increases then its value decreases.

$$\text{— Mean free path, } \lambda = \frac{V}{\sqrt{2} \pi \sigma^2 N}$$

Where $\left\{ \begin{array}{l} V = \text{average velocity} \end{array} \right.$

$\left\{ \begin{array}{l} \sigma = \text{molecular diameter} \end{array} \right.$

$\left\{ \begin{array}{l} N = \text{number of molecules} \end{array} \right.$

(b) **Collision frequency :-**

— It is the number of collisions performed by the gaseous molecules per second, which can be expressed by the following equation —

$$N_c = \frac{1}{\sqrt{2}} \pi V \sigma^2 N^2$$

Where $V = \text{average molecular velocity}$

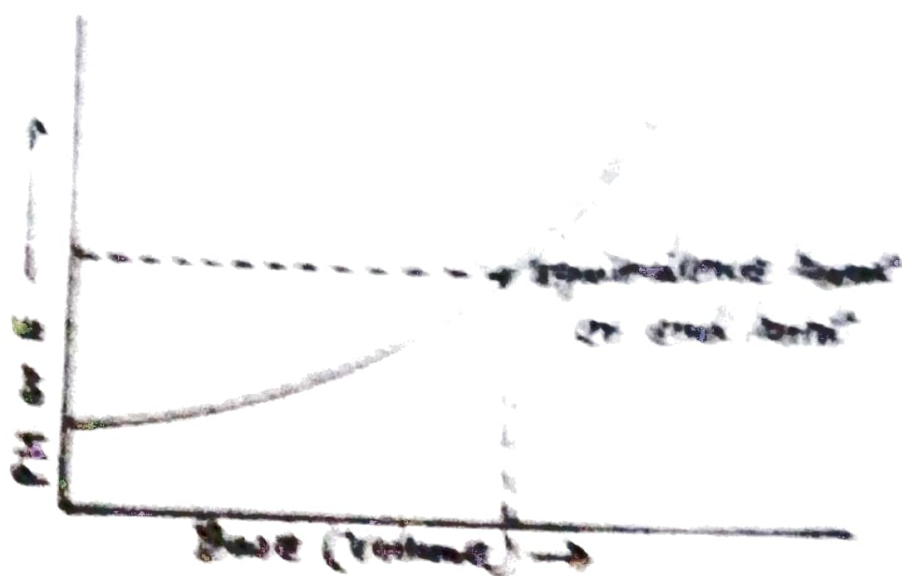
$\sigma = \text{molecular diameter}$

(c) **Potentiometric titration :-**

— The principle of the potentiometric titration is based upon the emf measurement at its successive stages. Let us take an example of an acid-base titration then in this case, first of all we measure its emf at its

successive stages and then we draw a plot against the volume of the base and on the basis of the such type of the plotted graph, end point can be known.

This potentiometric titration is a technique in which end point can be known on the basis of the emf measurement.



— This graph shows the variation of pH against the volume of the base added during the titration. Let us take the example of HCl as an acid and NaOH as a base then in this case, it is seen that initially the pH of the solution increases slowly, then, after it becomes very fast and continuous while it achieves the end point. Thus we see the sharp increase in pH in this case.

— During the titration, the variation of the pH is determined stoichiometrically and on the basis of the calculations, this result can be known.

Advantages —

W.r.t. the ordinary titration it has the following advantages —

— In this titration, indicator is not required.

— The titration of the polybasic acid can also be done by this method.

— The oxidation-reduction titration can also be done successfully by

potentiometrically method.

The estimation of the several substances within the same solution

can also be performed using this method.