[illegible]

[illegible] : Physical Chemistry [illegible]

[illegible] : Chemical Equilibrium

[illegible]

Calculation of Degree of Dissociation :-

Degree of Dissociation = [illegible]

(i) By determining equilibrium concentrations :

The equilibrium constant (K) for the [illegible] [illegible] using equilibrium concentrations. [illegible]

[illegible] degree of dissociation [illegible]

Solution :

[illegible]

[illegible] equilibrium [illegible]

Concentration at equilibrium :

[illegible]

Substituting the values in the equilibrium constant expression :

[illegible]

[illegible] calculation of degree of dissociation.

[illegible]

[illegible]

[illegible] degree of [illegible]

[illegible]

At [illegible]

At equilibrium [illegible]

Substituting [illegible] in the [illegible]

[illegible]

[illegible]

[illegible]

Thus the degree of dissociation of [illegible]

is [illegible]

(b) By density measurement:

This method is used for the determination of the degree of dissociation of gases in which [illegible]

[illegible]

[illegible]

[illegible] the degree of dissociation [illegible]

[illegible] density of the [illegible] gas [illegible] dissociated gas at equilibrium.

[illegible] the degree of dissociation is [illegible]

[illegible]

At [illegible]

At equilibrium [illegible]

Then the [illegible] at equilibrium

[illegible]

The density of [illegible]

[illegible]

of mass for a given volume.

Thus, the ratio of density d_1 of the undissociated gas to the density d_2 of the dissociated gas at equilibrium is given as

$$\frac{d_1}{d_2} = \frac{1+\alpha}{1}$$

or, $d_1 = d_2 + \alpha d_2$

or, $\alpha = \frac{d_1 - d_2}{d_2}$

Substituting the values of d_1 and d_2, the value of α, the degree of dissociation can be calculated.

Problem: When PCl_5 is heated in gaseous state, it dissociates into PCl_3 and Cl_2. The density of the gas mixture at [illegible] is [illegible]. Find the degree of dissociation of PCl_5 at [illegible].

Solution: [illegible] $\alpha = \frac{d_1 - d_2}{d_2}$

The density d_1 of undissociated PCl_5 would be

[illegible]

Observed density d_2 = [illegible]

∴ α = [illegible]

Thus, the degree of dissociation of PCl_5 at [illegible] is [illegible]

(ii) By molecular mass determination:

At constant temperature and pressure, molecular masses are proportional to the gas densities. Thus, we can substitute molecular masses for the densities in the expression

$$\alpha = \frac{d_1 - d_2}{d_2}$$

which gives $\alpha = \frac{M_1 - M_2}{M_2}$

where M_1 is the molecular mass of the undissociated gas and M_2 is the average molecular mass of the gas at equilibrium.

Problem: [illegible] of nitrogen tetroxide gas [illegible]

[illegible] pressure of 1 atm. [illegible] partially [illegible]
at equilibrium [illegible] at [illegible] °C [illegible]
[illegible] degree of dissociation [illegible]
[illegible]

[illegible]

[illegible] partially [illegible]
[illegible] by using the
general gas equation [illegible]

[illegible]

[illegible]

Hence the degree of dissociation of [illegible] at [illegible] °C
= [illegible]

Types of Chemical Equilibria :-

[illegible] equilibrium [illegible]
[illegible]
(i) Homogeneous Equilibria :- [illegible]
[illegible] phase [illegible] equilibrium [illegible]
[illegible] reactants and products [illegible] same phase.
The equilibrium [illegible] in a gaseous [illegible]
[illegible] equilibrium [illegible]
in the [illegible]
[illegible] e.g.

[illegible]

[illegible]

[illegible]

(ii) Heterogeneous Equilibria :- [illegible]
[illegible] phase [illegible] equilibrium [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Case I: [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

at equilibrium are [illegible]

[illegible]

The equilibrium constant [illegible] given by

$$K_p = [illegible]$$

[illegible]

The equilibrium constant in terms of [illegible] can be obtained as given below:

The [illegible] of [illegible] at equilibrium [illegible]

[illegible]

[illegible]

[illegible] given by:

[illegible]

Therefore

[illegible]

[illegible]