Deviation of Roult's law :—

The vapour pressure of a dilute solution is directly Proportional to the mole fraction of the Solvent.

Thus, $P \propto x_1$

or, $P = K \cdot x_1$

$= K \times \frac{n_1}{n_1 + n_2}$ —— (I)

Where x_1 is the mole fraction the Solvent.

n_1 = no. of moles of Solvent.

n_2 = " " " " Solute.

K = Proportionality Constant.

In the Case of Pure Solvent, if $n_2 = 0$

So, $P^\circ = K \times \frac{n_1}{n_1}$

because $n_2 = 0$.

So, $K = P^\circ$ —— (II)

Hence, from eq (I) and (II), we get

$P = P^\circ \times \frac{n_1}{n_1 + n_2}$

or, $\frac{P}{P^\circ} = \frac{n_1}{n_1 + n_2}$ —— (III)

or, $1 - P/P^\circ = 1 - \frac{n_1}{n_1 + n_2}$

or, $\frac{P^\circ - P}{P^\circ} = \frac{n_1 + n_2 - n_1}{n_1 + n_2}$

Henry's law (1805):→ The mass of gas dissolved in given volume of liquid is directely proportional to Pressure of the gas at constant Temperature in equilibrium with solution.

$$\text{mass of gas} \propto P_{gas}$$

Suppose m be the mass of gas dissolved per unit volume of a solvent and P is the pressure of the gas in equilibrium with the solution, then

$$m \propto P_{gas} \Rightarrow \boxed{m = K_H \cdot P_g}$$ where K_H is known as Henry's law constant. K_H-value depends upon the nature of the gas, solvent, Temp(T) and pressure(P)

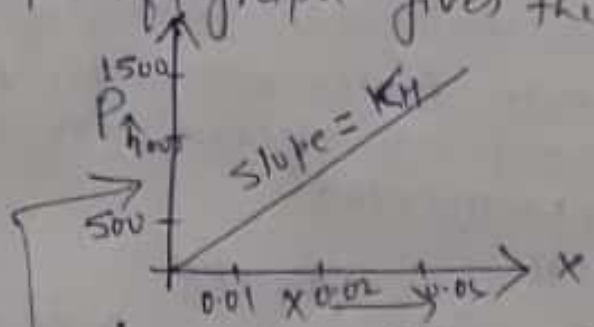
$$\text{Solubility of gas} \propto \frac{1}{K_H}$$. It means

$K_H \propto$ Temp $\propto \frac{1}{\text{solubility}}$ i.e Solubility $\propto$ pressure $\propto \frac{1}{K_H}$

$$\boxed{\text{Solubility} \propto P \propto \frac{1}{K_H} \propto \frac{1}{T}}$$

unit of K_H = Pressure unit
i.e unit of K_H = Torr or K.bar

Graphical representation of Henry's law:→ When a graph is plotted b/w Pressure and mole fraction then a straight line is obtained. the slope of graph gives the value of K_H.



Henry's law in terms of Dalton's law of partial pressure

At a given Temp. mole fraction of a gas is directely proportional to Pressure of the gas i.e Pressure of gas is directely proportional to mole fraction of the gas.

$$P_{gas} \propto X_{gas} \Rightarrow \boxed{P_g = K_H \cdot X_g}$$