Previous year JEE question 6

The composition of the equilibrium mixture ($Cl_2 \rightleftharpoons 2Cl$), which is attained at 1200°C, is determined by measuring the rate of effusion through a pin–hole. It is observed that at 1.80 mmHg pressure, the mixture effuses 1.16 times as fast as krypton effuses under the same conditions. Calculate the fraction of the chlorine molecules dissociated into atoms. (Relative atomic mass of Kr = 84.) ***(1995 - 4 Marks)***

Mixture	Krypton
$r_{mix} = 1.16$	$r_{Kr} = 1$
$M_{mix} = ?$	$M_{Kr} = 84$

We know that

$$\frac{r_{mix}}{r_{Kr}} = \sqrt{\frac{M_{Kr}}{M_{min}}} \text{ or } \frac{1.16}{1} = \sqrt{\frac{84}{M_{mix}}}$$

$$\text{or } (1.16)^2 = \frac{84}{M_{mix}} \Rightarrow M_{mix} = \frac{84}{(1.16)^2} = 62.426$$

Determination of the composition of the equilibrium mixture

Let the fraction of Cl_2 molecules dissociated at equlibrium = x

	Cl_2	$\rightleftharpoons$	2Cl	Total
Initially	1		0	1
At equilibrium	$1-x$		$2x$	$1-x+2x = 1+x$

$\therefore$ Total moles at equilibrium $= 1-x+2x = 1+x$

$$\because \quad \frac{\text{Normal molecular mass}}{\text{Experimental molecular mass}} = 1+x$$

$$\therefore \quad \frac{71}{64.426} = 1+\alpha$$

$\therefore \alpha = 0.137 = \mathbf{13.7\%}.$