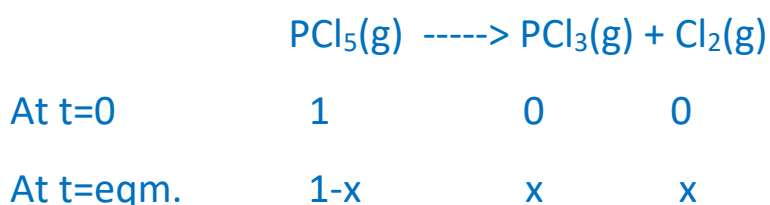


Consider the dissociation of PCl_5 into PCl_3 and Cl_2 in a container of volume 1 litre, given by the reaction $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$. Suppose at the time of equilibrium, the vapour density of the equilibrium mixture is found to be 80.25. If the equilibrium constant for the reaction is K_c then find the value of $125K_c$ to the nearest integer.

Suppose we started with 1 mole of PCl_5 and x be the degree of dissociation.



Initially, the mixture was pure PCl_5 . So the initial molecular weight of the mixture was 208.5amu (weight of PCl_5). The final molecular weight of the system is $2 \times$ vapour density, ie, $2 \times 80.25 = 160.5\text{amu}$.

Moles in the final state = $1-x+x+x = 1+x$.

Since mass remains conserved in a reaction the product of moles and molecular weight is constant.

$$\Rightarrow (1+x) \times 160.25 = 1 \times 208.5$$

$$\Rightarrow x = 0.3$$

Now since volume of container is 1 liter, concentration of each species is equal to moles/1 = moles.

So equilibrium constant $K_c = \frac{[\text{PCl}_3][\text{Cl}_2]}{[\text{PCl}_5]}$

$$\Rightarrow K_c = \frac{(x \times x)}{(1-x)}$$

$$= \frac{(0.3 \times 0.3)}{0.7}$$

$$= 0.128 \text{ mol/l}$$

So the required answer is $125 \times 0.128 = 16$.

