



III. Long Answer Type Questions

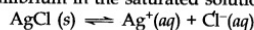
Question 1. (i) Point out the differences between ionic product and solubility product.

(ii) The solubility of AgCl in water at 298 K is 1.06×10^{-5} mole per litre. Calculate its solubility product at this temperature.

Answer: (i)

Ionic Product	Solubility Product
(a) It is applicable to all types of solutions. (b) Its value changes with the change in concentration of the ions.	(a) It is applicable to the saturated solutions. (b) It has a definite value for an electrolyte at a constant temperature.

(ii) The solubility equilibrium in the saturated solution is



The solubility of AgCl is 1.06×10^{-5} mole per litre.

$$[\text{Ag}^+(\text{aq})] = 1.06 \times 10^{-5} \text{ mol L}^{-1}$$

$$[\text{Cl}^-(\text{aq})] = 1.06 \times 10^{-5} \text{ mol L}^{-1}$$

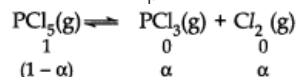
$$K_{sp} = [\text{Ag}^+(\text{aq})] [\text{Cl}^-(\text{aq})]$$

$$= (1.06 \times 10^{-5} \text{ mol L}^{-1}) \times (1.06 \times 10^{-5} \text{ mol L}^{-1})$$

$$= 1.12 \times 10^{-2} \text{ mol}^2 \text{ L}^{-2}$$

Question 2. At certain temperature and under a pressure of 4 atm, PCl_5 is 10% dissociated. Calculate the pressure at which PCl_5 will be 20% dissociated at temperature remaining constant.

Answer: Calculation of K_p



$$\begin{aligned} \text{Total no. of moles in the equilibrium mixture} &= 1 - \alpha + \alpha + \alpha \\ &= (1 + \alpha) \text{ mol.} \end{aligned}$$

Let the total pressure of equilibrium mixture = p atm

Partial pressure of PCl_5

$$p_{\text{PCl}_5} = \frac{1-\alpha}{1+\alpha} \times p \text{ atm}$$

$$\text{Partial pressure of } \text{PCl}_3 = \frac{\alpha}{1+\alpha} \times p \text{ atm}$$

Partial pressure of Cl_2

$$p_{\text{Cl}_2} = \frac{\alpha}{(1+\alpha)} \times p \text{ atm}$$

$$K_p = \frac{p_{\text{PCl}_3} \times p_{\text{Cl}_2}}{p_{\text{PCl}_5}}$$

$$= \frac{\left(\frac{\alpha}{1+\alpha} p \text{ atm} \right) \times \left(\frac{\alpha}{1+\alpha} p \text{ atm} \right)}{\frac{1-\alpha}{1+\alpha} p \text{ atm}} = \frac{\alpha^2 p}{1-\alpha^2} \text{ atm}$$

$$P = 4 \text{ atm and } \alpha = 10\% = \frac{10}{100} = 0.1$$

$$K_p = \frac{(0.1) \times (0.1) \times (4 \text{ atm})}{1 - (0.1)^2}$$

$$= \frac{0.04}{0.99} = 0.04 \text{ atm.}$$

Calculation of P under new condition

$$\alpha = 0.2, K_p = 0.04 \text{ atm '}$$

$$\begin{aligned}
 K_p &= \frac{\alpha^2 p}{1 - \alpha^2} \text{ or } p = \frac{K_p (1 - \alpha^2)}{\alpha^2} \\
 &= \frac{(0.04 \text{ atm}) [(1 - (0.2)^2)]}{(0.2)^2} = \frac{0.04 \text{ atm} \times 0.96}{0.04} \\
 &= \mathbf{0.96 \text{ atm.}}
 \end{aligned}$$

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