Solutions/Answers to NCERT/CBSE CHEMISTRY Class 11(Class XI)textbook

CHAPTER SEVEN

EQUILIBRIUM

7.72 What is the minimum volume of water required to dissolve 1g of calcium sulphate at 298 K? (For calcium sulphate, K sp is 9.1 × 10−6).

Solution:

Let the solubility of $CaSO_4$ be s.

$$CaSO_4 \rightleftharpoons Ca^{2+} + SO_4^{2-}$$

At equilibrium: s s

We have, $K_{sp} = s \times s = s^2$

$\Rightarrow 9.1\times10^{-6} = s^2$

Solving, $s = 3\times10^{-3}$ M

So $3\times10^{-3}\times136 g$ is dissolved in 1 l.

Minimum volume of water required for dissolution of 1 g $CaSO_4 = \dfrac{1}{3\times10^{-3}\times136} = 2.46$ L

.70 The ionization constant of benzoic acid is 6.46 × 10−5 and K for silver benzoate sp is 2.5 × 10−13. How many times is silver benzoate more

Let the solubility of silver benzoate in water be s.

The reaction is:

$$C_6H_5COOAg \rightleftarrows C_6H_5COO^{-1} + Ag^+$$

At eqbm.: s s

We have, $K_{SP} = [C_6H_5COO^{-1}][Ag^+]$

$$\Rightarrow 2.5\times10^{-13} = s^2$$

Solving ,s=5.0×10^{-7} M

Now in case of buffer of given pH,

3.19=-log[H^+]

$$\Rightarrow [H^+] = 10^{-3.19} = \text{Antilog}(\bar{4}.81) = 6.457\times10^{-4}$$

Reaction for dissociation of benzoic acid is:

$$C_6H_5COOH \rightleftarrows C_6H_5COO^{-1} + H^+$$

Concentration of hydrogen ions can be assumed to be constant as the solution is a buffer.

Assume solubility in buffer solution to be s'.

We have,

$$K_a = \frac{[C_6H_5COO^{-1}][H^+]}{[C_6H_5COOH]} = 6.46\times10^{-5}$$

$$\Rightarrow \frac{[C_6H_5COOH]}{[C_6H_5COO^{-1}]} = \frac{6.457\times10^{-4}}{6.46\times10^{-5}} \approx 10$$

Now:

$[Ag]^+ = s' = [C_6H_5COO^{-1}] + [C_6H_5COOH]$(*These* values are to be substituted from above).

$$\Rightarrow s' = 11[C_6H_5COO^{-1}]$$

$$\Rightarrow [C_6H_5COO^{-1}] = \frac{s'}{11}$$

$$C_6H_5COOAg \rightleftarrows C_6H_5COO^{-1} + Ag^+$$

At eqbm.: $\frac{s'}{11}$ s'

$$\text{Now}, k_{SP} = [C_6H_5COO^{-1}][Ag^+] = \frac{s'^2}{11} = 1.66\times10^{-6}$$

$$\text{Now ratio of solubilities} = \frac{s'}{s} = \frac{1.66\times10^{-6}}{5.0\times10^{-7}} = 3.32$$

Thus,silver benzoate is 3.32 times more soluble in a buffer of pH 3.19 compared to its solubility in pure water.