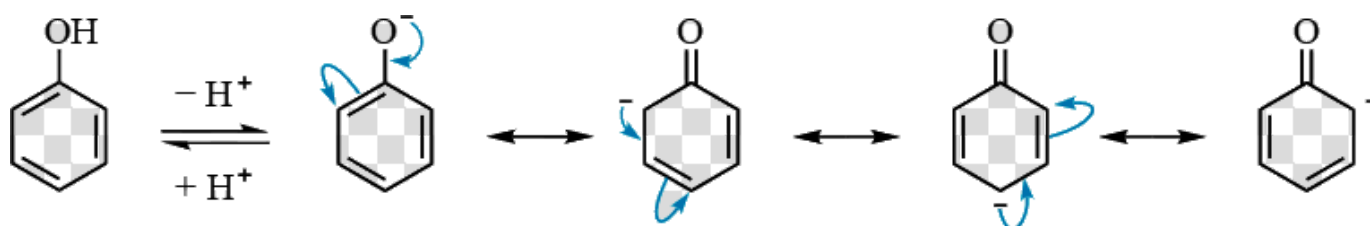




Chemistry Class 11 NCERT Solutions: Chapter 7 Equilibrium Part 14

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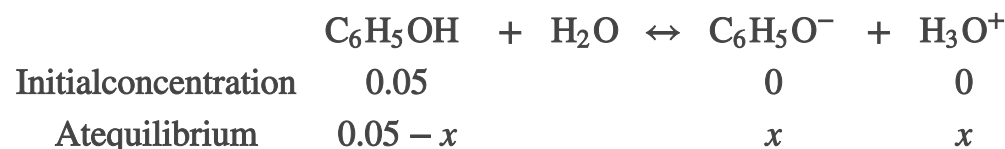
Q: 44. The ionization constant of phenol is 1.0×10^{-10} . What is the concentration of phenolate ion in 0.05 M solution of phenol? What will be its degree of ionization if the solution is also 0.01M in sodium phenolate?



Structure of Phenol-Phenolate Equilibrium.

Answer:

Ionization of phenol



$$K_a = \frac{[\text{C}_6\text{H}_5\text{O}^-][\text{H}_3\text{O}^+]}{[\text{C}_6\text{H}_5\text{OH}]}$$

$$K_a = \frac{x \times x}{0.05 - x}$$

As the value of the ionization constant is very less, x will be very small. Thus, we can ignore x in the denominator

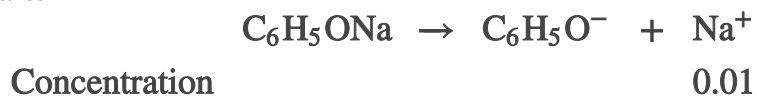
$$\begin{aligned} \therefore x &= \sqrt{1 \times 10^{-10} \times 0.05} \\ &= \sqrt{5 \times 10^{-12}} \\ &= 2.2 \times 10^{-6} \text{ M} = [\text{H}_3\text{O}^+] \end{aligned}$$

Since $[\text{H}_3\text{O}^+] = [\text{C}_6\text{H}_5\text{O}^-]$,

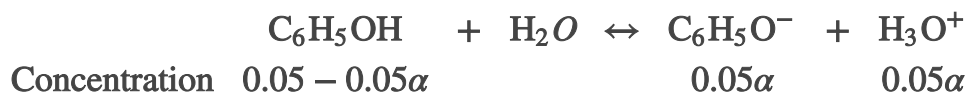
$$[\text{C}_6\text{H}_5\text{O}^-] = 2.2 \times 10^{-6} \text{ M}$$

Now, let α be the degree of ionization of phenol in the presence of 0.01 M $\text{C}_6\text{H}_5\text{ONa}$.

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Also,



$$[\text{C}_6\text{H}_5\text{OH}] = 0.05 - 0.05\alpha ; 0.05 \text{ M}$$

$$[\text{C}_6\text{H}_5\text{O}^-] = 0.01 + 0.05\alpha ; 0.01 \text{ M}$$

$$[\text{H}_3\text{O}^+] = 0.05\alpha$$

$$K_a = \frac{[\text{C}_6\text{H}_5\text{O}^-] [\text{H}_3\text{O}^+]}{[\text{C}_6\text{H}_5\text{OH}]}$$

$$K_a = \frac{(0.01)(0.05\alpha)}{0.05}$$

$$1.0 \times 10^{-10} = .01\alpha$$

$$\alpha = 1 \times 10^{-8}$$