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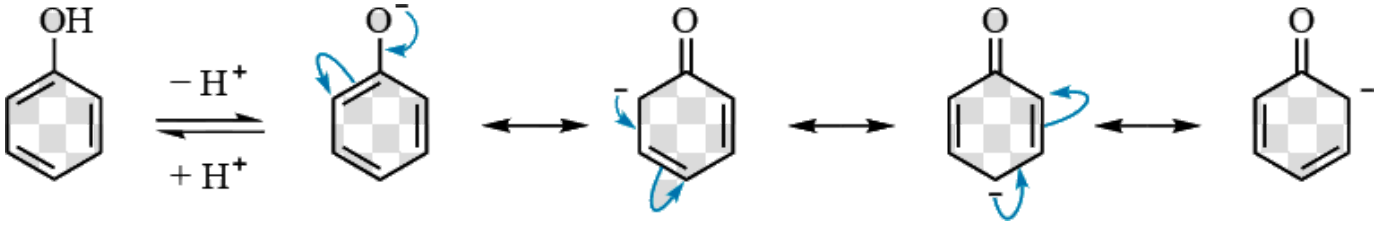
Chemistry Class 11 NCERT Solutions: Chapter 7 Equilibrium Part 14

Chemistry Class 11 NCERT Solutions Chapter 7 Equilibrium Part 14

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

	C_6H_5OH	+	H_2O	↔	$C_6H_5O^-$	+	H_3O^+
Initialconcentration	0.05				0		0
Atequilibrium	$0.05 - x$				x		x

$$K_a = \frac{[C_6H_5O^-][H_3O^+]}{[C_6H_5OH]}$$

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

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

$$\therefore x = \sqrt{1 \times 10^{-10} \times 0.05}$$

$$= \sqrt{5 \times 10^{-12}}$$

$$= 2.2 \times 10^{-6}\text{M} = [H_3O^+]$$

Since $[H_3O^+] = [C_6H_5O^-]$,

$$[C_6H_5O^-] = 2.2 \times 10^{-6}\text{M}$$

Now, let α be the degree of ionization of phenol in the presence of 0.01 M C_6H_5ONa.

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	C_6H_5ONa	$\rightarrow$	$C_6H_5O^-$	+	Na^+
Concentration					0.01

Also,

	C_6H_5OH	+	H_2O	$\leftrightarrow$	$C_6H_5O^-$	+	H_3O^+
Concentration	$0.05 - 0.05\alpha$				0.05α		0.05α

$[C_6H_5OH] = 0.05 - 0.05\alpha \,; 0.05\ M$

$[C_6H_5O^-] = 0.01 + 0.05\alpha \,; 0.01\ M$

$[H_3O^+] = 0.05\alpha$

$$K_a = \frac{[C_6H_5O^-]\,[H_3O^+]}{[C_6H_5OH]}$$

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

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

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