B.Sc. (Honours) Part-I

Paper-IA

Topic: Ionic Product of Water

UG

Subject-Chemistry

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Ionic Product of Water

Water is a weak electrolyte and undergoes selfionistion to a small extent.

"The product of concentrations of H^+ and OH^- ions in water at a particular temperature is known as ionic

product of water." It is designated as K_w.

Ionic Product of Water

The ion product of water

Hydrogen ion (H^+) is key=It indicates the acidity @ basicity of the solution

Equilibrium constant for the auto ionization of water

$$H_2O\ (l) \rightleftharpoons H^+(aq) + OH^-(aq)$$

$$K_c = \frac{[H^+]\ [OH^-]}{[H_2O]}$$

Since, the degree of dissociation of water is extremely small, the concentration of water can be

considered constant

$$K_c\ [H_2O] = \mathbf{Kw = [H^+][OH^-]}$$

$$Kw = (1.0 \times 10^{-7}\ moldm^{-3})\ (1.0x10^{-7}\ moldm^{-3}) = 1.0x10^{-14}\ mol^2\ dm^{-6}$$

The ionic product of water can be expressed in terms of pKw, where

$$\mathbf{pK_w = -\log K_w} = -\log(1.0 \times 10^{-14}) = 14$$

From the expression:

$$\mathbf{K_w = [H^+][OH^-]}$$

The value of K_w increases with the increase of temperature, i.e., the concentration H^+ and OH^- ions increases with increase in temperature.

The Equilibrium Constant for this Reaction, K_w, is called the Ionic Product for Water

Another expression can be derived by taking the (-log) of the K_w expression

$$\mathbf{pK_w = P^{OH} + p^H}$$

Thus if P^{OH} of the solution is known, its P^H value can be calculated from the above relationship

Measurement of Acidity and basicity

pH of the solution

The P^H of solution is defined as negative logarithm of the hydrogen ion concentration (in mol/L)

$$p^H = -\log [H^+]$$

Neutral if, $[H^+] = [OH^-]; pH = 7$

Acidic if, $[H^+] > [OH^-]; pH < 7$

Basic if, $[H^+] < [OH^-]$; $pH > 7$

The P^{OH} of solution is defined as negative logarithm of the hydroxyl ion concentration (in mol/L)

$$p^{OH} = -\log[OH^-]$$