SELF-IONIZATION OF WATER

Properties of Water

Amphoteric (Amphiprotic) Acid/Base Nature

In the Bronsted-Lowry theory, water can function as both an acid and a base, whereas in the Lewis concept, it is considered solely as a base.

$$\text{In pure water } [H^+] = [OH^-] \quad \text{so it is neutral.}$$

Molar Concentration / Molarity of Water

$$\text{Molarity} = \text{No. of moles/liter} = \frac{1000\text{g/ litre}}{18\ \text{g/mole}}$$

$$= 55.55 \text{ mole/liter} = 55.55 \text{ M (density} = 1 \text{ g/cc)}$$

Ionic Product of Water

According to Arrhenius concept

$$H_2O \longrightarrow H^+ + OH^-$$

so, ionic product of water,

$$k_w = [H^+]\,[OH^-] = 10^{-14} \text{ at } 25° \text{ (exp.)}$$

The water dissociation process is endothermic, which means that as the temperature rises, K_{eq} also increases. This higher temperature leads to an increase in K_w.

It's important to note that the ionic product of water remains constant, independent of the dissolved substances, as it is an equilibrium constant solely influenced by temperature.

Degree of Dissociation of Water

$$H_2O \longrightarrow H^+ + OH^-$$

$$\Rightarrow \quad \alpha = \frac{\text{no.of moles dissociated}}{\text{Total no.of moles initially taken}}$$

$$= \frac{10^{-7}}{55.55} = 18 \times 10^{-10} \text{ or } 1.8 \times 10^{-7}\ \%$$

Absolute Dissociation Constant of Water

$$H_2O \longrightarrow H^+ + OH^- \quad K_a = K_b = \frac{[H^+][OH^-]}{[H_2O]} = \frac{10^{-7} \times 10^{-7}}{55.55} = 1.8 \times 10^{-16}$$

$$\text{So,} \quad pK_a = pK_b = -\log(1.8 \times 10^{-16}) = 16 - \log 1.8 = 15.74$$