

Quadrant II – Transcript and Related Materials

Programme : Bachelor of Science

Subject : Chemistry

Paper Code : CHC102

Paper Title : Physical Chemistry and Organic Chemistry.

Unit : Ionic Equilibria

Module Name: Ionization constant and Ionic Product of water

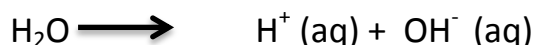
Module No :03

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NOTES:

Ionization constant and Ionic Product of water

The dissociation of water is given by the following reaction,



On applying law of mass action

$$K = \frac{[\text{H}^+][\text{OH}^-]}{[\text{H}_2\text{O}]}$$

K is called ionisation constant

$$K [\text{H}_2\text{O}] = [\text{H}^+][\text{OH}^-]$$

$$K_w = [\text{H}^+][\text{OH}^-] \dots\dots\dots 1$$

K [H₂O] may be written as another constant, K_w

[H₂O] is a constant quantity because the concentration of water does not change. It is very large compared to H⁺ and OH⁻ ions hence can be regarded as practically constant.

K_w is called the ionic product of water.

Conductivity measurements show that in pure water

$$[H^+] = 1 \times 10^{-7} \text{ mole/litre at } 25^\circ\text{C}$$

Also in pure water: [H⁺] = [OH⁻]

Therefore equation 1 may be written as;

$$K_w = [1 \times 10^{-7}] [1 \times 10^{-7}]$$

$$K_w = 1 \times 10^{-14} \quad \text{at } 25^\circ\text{C} \dots\dots\dots 2$$

Taking equation 1

$$K_w = [H^+] [OH^-]$$

And taking log on both side

$$\log K_w = \log [H^+] [OH^-]$$

Change the sign on both sides

$$-\log K_w = -\log [H^+] [OH^-]$$

$$-\log K_w = -\log [1 \times 10^{-7}] [1 \times 10^{-7}]$$

$$-\log K_w = -\log 10^{-14}$$

$$pK_w = 14$$

$$pK_w = pH + pOH$$

$$= 14$$

pK_w is an important quantity for aqueous solutions

For neutral solution pH is 7

$$pH = -\log [1 \times 10^{-7}]$$

= 7

In acidic solution $[H^+] > 10^{-7}$; therefore pH is less than 7

In alkaline solution $[OH^-] > [H^+]$;

therefore $[OH^-] > 10^{-7}$ and $[H^+] < 10^{-7}$

Hence their pH is greater than 7

Thus pH value of the solution is 7, if it is neutral

If pH value is less than 7, the solution is acidic,

If it is more than 7, the solution is alkaline

A pH scale ranges from 0 to 14

