Similarly $$pOH = -\log\,[OH^-]$$

Note : * As per thermodynamics pH has no unit, pH is difined as

$$pH = -\log\, a_{H^+}$$

Where, a_{H^+} is the hydrogen ion activity. The H^+ activity is obtained by multiplying $[H^+]$ by a suitable activity coefficient (γ) based on thermodynamic measurements. They approach 1.0 for very dilute solutions but get smaller as concentration increases.

* for concentrate solution pH values greater than 14 are possible for concentrated strong base and negative pH values are possible for concentrated strong acids.

* pH of very dilute ($\sim 10^{-8}$M or Lower) acids (or bases) is nearly 7 (not simply–log[acid] etc. due to ionization of water.

* At 25°C, if pH = 7, then solution is neutral, pH > 7 then solution is basic.

Ionisation Constants

* For dissociation of weak acids (eg. HCN), $HCN + H_2O \rightleftharpoons H_3O^+ + CN^-$ the equilibrium constant expression is written as $K_a = \dfrac{[H_3O^+][CN^-]}{[HCN]}$

* For the Polyprotic acids (e.g. H_3PO_4), sucessive ionisation constants are denoted by K_{a_1}, K_{a_2}, K_{a_3} etc. For H_3PO_4,

$$K_{a_1} = \frac{[H_3O^+][H_2PO_4^-]}{[H_3PO_4]} \quad ; \quad K_{a_2} = \frac{[H_3O^+][HPO_4^{2-}]}{[H_2PO_4^-]} \quad ; \quad K_{a_3} = \frac{[H_3O^+][PO_4^{3-}]}{[HPO_4^{2-}]}$$

Similarly, K_b denotes basic dissociation constant for a base.

Also, $pK_b = -\log_{10}K_b$, $pK_b = -\log_{10}K_b$

pH CALCULATION :-

Case (i)

A weak acid in water :

(a) if $\alpha = \sqrt{\dfrac{K_a}{C}}$ is < 0.05, then $[H^+] \approx \sqrt{K_aC}$.

(b) **General Expression :** $[H^+] = 0.5(-K_a + \sqrt{K_a^2 + 4K_aC})$

Similarly for a weak base, substitute $[OH^-]$ and K_b instead of $[H^+]$ and K_a respectively in these expressions.

Case (ii)

(a) **A weak acid and a strong acid :** $[H^+]$ is entirely due to dissociation of strong acid may be both depend on conditions.

(b) **A weak base and a strong base :** $[OH^-]$ is entirely due to dissociation of strong base may be both depend on conditions.

Neglect the contribution of weak acid/base if α is negligiable.

Case (iii)

Two (or more) weak acids

If acids dissociate to a negligible extent, $[H^+] = \sqrt{K_aC_1 + K_{a_2}C_2}$