$$K_{(equilibrium)} = \frac{\text{Concentration of products}}{\text{concentration of reactants}}$$

$$K_a = \frac{[H_3O^+] \text{ or } [H^+] * [\text{conjugate base}]}{[\text{Acid}]}$$

$$K_b \quad \frac{[OH^-] * [\text{conjugate acid}]}{[\text{base}]}$$

$$pK_a = -\log K_a \Rightarrow K_a = 10^{-pK_a}$$

$$\text{Molarity (M)} = \frac{\text{number of moles (n)}}{\text{Volume of the solution (V) "in liter"}}$$

↳ Unit of (M) is mol/liter

$$n = \frac{\text{mass (m) "in grams"}}{\text{molecular weight (MW)}}$$

$$\text{grams} = M * V * MW$$

1 mol $[H^+]$ = 1 equivalent

1 mol $[OH^-]$ = 1 equivalent

gram equivalent (g-Eq) for any ion $= \frac{\text{Molar mass}}{\text{ionic charge}}$

$$\text{Normality (N)} = \underline{\underline{n}} * M \text{ (molarity)}$$

number of protons donated by the acid or number of protons accepted by base or the number of OH a base can donate

For neutralization:- "Titration"

$$\frac{\text{number of equivalent (الحمض)}}{\text{number of equivalent (القاعدة)}} = \text{number of moles that required}$$

$$\text{Normality (N)} = \frac{\text{Equivalent of acid or base}}{\text{liters of Solution}}$$

For acid: equivalent = For base: equivalent

$N * V$ = $N * V$

$n * M * V$ = $n * M * V$

1 liter of water is 1 Kg in mass = 1000 g of water

So, $M = \frac{n}{V} = \frac{m}{MW \cdot V} = \frac{1000}{18 * 1} = 55.5\ M$

So, $K_{eq} = \frac{[H^+][OH^-]}{[H_2O]} = \frac{[1 * 10^{-7}][1 * 10^{-7}]}{55.5} = 18 * 10^{-16}$

$K_w = K_{eq} * [H_2O] = [OH^-][H^+] = 10^{-14}\ M^2$

Also $K_w = K_a * K_b$

$pH = -\log [H^+] \Rightarrow [H^+] \text{ or } [H_3O^+] = 10^{-pH}$

If $HA \rightleftharpoons H^+ + A^-$, $[H^+] = [A^-]$ "conjugate base"

$$K_a = \frac{[H^+]^2}{[\text{acid}]}$$

(نفس الشئ بالنسبة للقاعدة)

If $Ba(OH_2) \rightleftharpoons Ba + \underline{\underline{2}}\ OH^-$,

$[OH^-] = 2 * [Ba(OH)_2]$ (نفس الشئ بالنسبة لـ OH^-)

$pK_b = -\log K_b \Rightarrow K_b = 10^{-pK_b}$

$$pH = pK_a + \log \frac{[\text{conjugate base}]}{[\text{Acid}]}$$

$$[H_3O^+] = K_a \frac{[\text{acid}]}{[\text{Salt}]}$$ ⇐ (تذكر)