

RAVNOTEŽJA
KISLINSKO BAZIČNI SISTEMI:

Pufri:

šibka kislina in njena konjugirana baza:



$$K_a = \frac{[H_3O^+][A^-]}{[HA]}$$



$$K_b = \frac{[HA][OH^-]}{[A^-]}$$

$K_a \gg K_b$ raztopina je kislina

$$C_{HA} + C_{NaA} = [HA] + [A^-] \quad (I)$$

Naboji:

$$[Na^+] + [H_3O^+] = [A^-] + [OH^-] \quad [Na^+] = C_{NaA}$$

$$[A^-] = C_{NaA} + [H_3O^+] - [OH^-] \quad (II)$$

I-II

$$[HA] = C_{HA} - [H_3O^+] + [OH^-]$$

$$K_a = \frac{[H_3O^+](C_{NaA} + [H_3O^+] - [OH^-])}{C_{HA} - [H_3O^+] + [OH^-]}$$

Kisla raztopina: $[H_3O^+] \gg \gg [OH^-]$

$$K_a = \frac{[H_3O^+] \cdot C_{NaA}}{C_{HA}}$$

$$-\log[H_3O^+] = -\log K_a - \log \frac{C_{HA}}{C_{NaA}}$$

Henderson-Hasselbach-ova enačba:

$$pH = p_{Ka} + \log \frac{C_{NaA}}{C_{HA}}$$

Amfiprotične soli

Amfiprotične soli imajo lahko kisle ali bazične lastnosti)

Izračun pH - primer NaHA:

Koncentracija soli: c_{NaHa}



$$K_{a2} = \frac{[\text{H}_3\text{O}^+][\text{A}^{2-}]}{[\text{HA}^-]} \quad K_{b2} = \frac{K_w}{K_{a1}} = \frac{[\text{H}_2\text{A}][\text{OH}^-]}{[\text{HA}^-]}$$

$$c_{\text{NaHa}} = [\text{HA}^-] + [\text{H}_2\text{A}] + [\text{A}^{2-}] \quad (\text{mase})$$

$$[\text{Na}^+] + [\text{H}_3\text{O}^+] + [\text{HA}^-] + 2[\text{A}^{2-}] + [\text{OH}^-] \quad (\text{naboji})$$

$$c_{\text{NaHa}} + [\text{H}_3\text{O}^+] = [\text{HA}^-] + 2[\text{A}^{2-}] + [\text{OH}^-]$$

$$K_w = [\text{OH}^-][\text{H}_3\text{O}^+]$$

Naboji-mase:

$$[\text{H}_3\text{O}^+] = [\text{A}^{2-}] + [\text{OH}^-] - [\text{H}_2\text{A}]$$

$$[H_3O^+] = [A^{2-}] + [OH^-] - [H_2A]$$

$$[H_2A] = \frac{[H_3O^+][HA^-]}{K_{a1}} \quad [A^{2-}] = \frac{K_{a2}[HA^-]}{[H_3O^+]}$$

$$[H_3O^+] = \frac{K_{a2}[HA^-]}{[H_3O^+]} + \frac{K_w}{[H_3O^+]} - \frac{[H_3O^+][HA]}{K_{a1}}$$

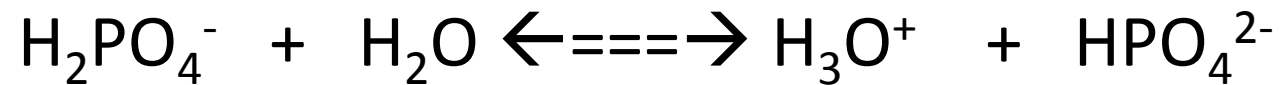
$$[H_3O^+]^2 = K_{a2}[HA^-] + K_w - \frac{[H_3O^+]^2[HA]}{K_{a1}}$$

$$[H_3O^+]^2 \left(\frac{[HA]}{K_{a1}} + 1 \right) = K_{a2}[HA^-] + K_w$$

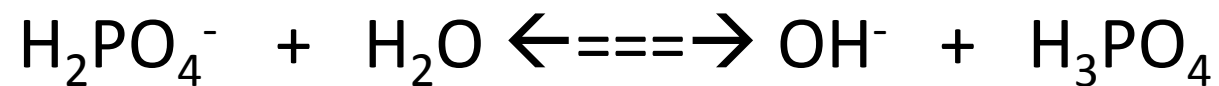
$$[H_3O^+] = \sqrt{\frac{K_{a2}[HA^-] + K_w}{1 + \frac{[HA^-]}{K_{a1}}}}$$

$$[H_3O^+] = \sqrt{\frac{K_{a2}c_{NaHA} + K_w}{1 + \frac{c_{NaHA}}{K_{a1}}}}$$

$$[H_3O^+] \approx \sqrt{K_{a1} \cdot K_{a2}}$$



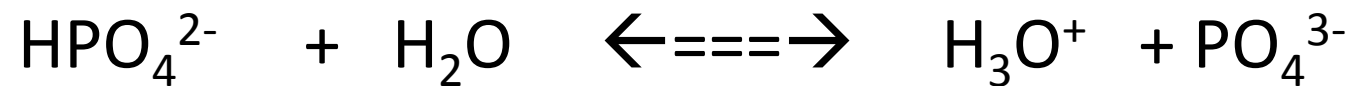
$$K_{a2} = 6,32 \times 10^{-8}$$



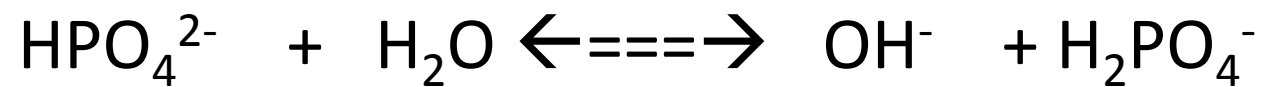
$$K_{b3} = K_w / K_{a1} = 1,41 \times 10^{-12}$$

$K_{a2} \gg K_{b3}$ Raztopina je kislá, zato jo titriramo z bazo!

HPO_4^{2-} :



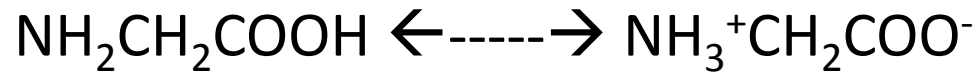
$$K_{a3} = 4,5 \times 10^{-13}$$



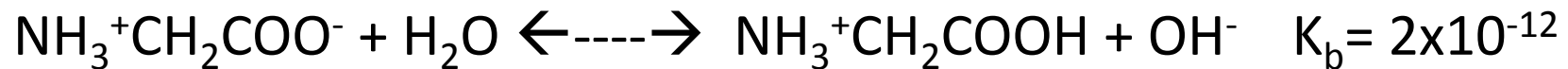
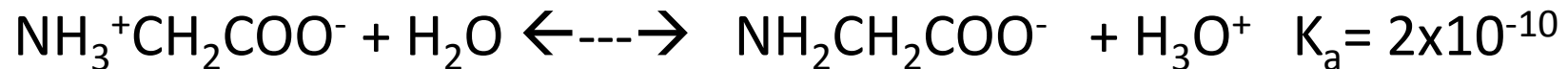
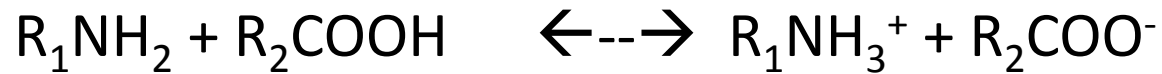
$$K_{b2} = K_w / K_{a2} = 1,58 \times 10^{-7}$$

$K_{b2} \gg K_{a3}$ Raztopina je bazična. Titriramo jo s kislino!

Amino kisline:



Podobna reakcija kot med kislino in aminom



$$K_a = \frac{[\text{H}_3\text{O}^+][\text{NH}_2\text{CH}_2\text{COO}^-]}{[\text{NH}_3^+\text{CH}_2\text{COO}^-]}$$

$$K_b = \frac{[\text{OH}^-][\text{NH}_3^+\text{CH}_2\text{COO}^-]}{[\text{NH}_3^+\text{CH}_2\text{COOH}]}$$

Izoelektrična točka: $[\text{NH}_2\text{CH}_2\text{COO}^-] = [\text{NH}_3^+\text{CH}_2\text{COOH}]$

$$\frac{K_a}{K_b} = \frac{[\text{H}_3\text{O}^+][\text{NH}_2\text{CH}_2\text{COO}^-]}{[\text{OH}^-][\text{NH}_3^+\text{CH}_2\text{COOH}]} = \frac{[\text{H}_3\text{O}^+]}{[\text{OH}^-]}$$

$$[\text{H}_3\text{O}^+] = \sqrt{\frac{K_a K_w}{K_b}}$$