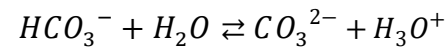
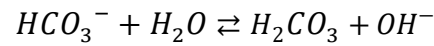
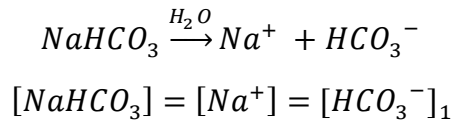


Amfolyt + stark bas



$$K_{b_1} = \frac{[H_2CO_3][OH^-]}{[HCO_3^-]_2} \Leftrightarrow [H_2CO_3] = \frac{K_{b_1}[HCO_3^-]_2}{[OH^-]}$$

$$K_{a_2} = \frac{[CO_3^{2-}][H_3O^+]}{[HCO_3^-]_2} \Leftrightarrow [CO_3^{2-}] = \frac{K_{a_2}[HCO_3^-]_2}{[H_3O^+]}$$

$$K_w = [OH^-][H_3O^+] \Leftrightarrow [OH^-] = \frac{K_w}{[H_3O^+]}$$

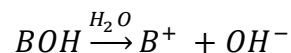
$$K_w = K_a K_b \Rightarrow K_{b_1} = \frac{K_w}{K_{a_1}}$$

$$[HCO_3^-]_1 = [HCO_3^-]_2 + [H_2CO_3] + [CO_3^{2-}]$$

$$[HCO_3^-]_1 = [HCO_3^-]_2 + \frac{K_{b_1}[HCO_3^-]_2}{[OH^-]} + \frac{K_{a_2}[HCO_3^-]_2}{[H_3O^+]} = [HCO_3^-]_2 \left(1 + \frac{K_{b_1}}{[OH^-]} + \frac{K_{a_2}}{[H_3O^+]} \right) = [HCO_3^-]_2 \left(1 + \frac{\frac{K_w}{K_{a_1}}}{\frac{K_w}{[H_3O^+]}} + \frac{K_{a_2}}{[H_3O^+]} \right)$$

$$[HCO_3^-]_1 = [HCO_3^-]_2 \left(1 + \frac{K_w [H_3O^+]}{K_{a_1} K_w} + \frac{K_{a_2}}{[H_3O^+]} \right) = [HCO_3^-]_2 \left(1 + \frac{[H_3O^+]}{K_{a_1}} + \frac{K_{a_2}}{[H_3O^+]} \right) = [HCO_3^-]_2 \left(\frac{K_{a_1}[H_3O^+] + [H_3O^+]^2 + K_{a_2}K_{a_1}}{K_{a_1}[H_3O^+]} \right)$$

$$\Leftrightarrow [HCO_3^-]_2 = \frac{[HCO_3^-]_1}{\left(\frac{K_{a_1}[H_3O^+] + [H_3O^+]^2 + K_{a_2}K_{a_1}}{K_{a_1}[H_3O^+]}\right)} = \frac{[HCO_3^-]_1 K_{a_1} [H_3O^+]}{[H_3O^+]^2 + K_{a_1}[H_3O^+] + K_{a_2}K_{a_1}}$$



$$[BOH] = [B^+]$$

$$[B^+] + [Na^+] + [H_3O^+] = [OH^-] + [HCO_3^-]_2 + 2[CO_3^{2-}]$$

$$[BOH] + [Na^+] + [H_3O^+] = \frac{K_w}{[H_3O^+]} + \frac{[HCO_3^-]_1 K_{a_1} [H_3O^+]}{[H_3O^+]^2 + K_{a_1}[H_3O^+] + K_{a_2}K_{a_1}} + 2 \frac{K_{a_2} [HCO_3^-]_2}{[H_3O^+]}$$

$$[BOH] + [Na^+] + [H_3O^+] = \frac{K_w}{[H_3O^+]} + \frac{[HCO_3^-]_1 K_{a_1} [H_3O^+]}{[H_3O^+]^2 + K_{a_1}[H_3O^+] + K_{a_2}K_{a_1}} + \frac{2K_{a_2} \frac{[HCO_3^-]_1 K_{a_1} [H_3O^+]}{[H_3O^+]^2 + K_{a_1}[H_3O^+] + K_{a_2}K_{a_1}}}{[H_3O^+]}$$

$$[BOH] + [Na^+] + [H_3O^+] = \frac{K_w}{[H_3O^+]} + \frac{[HCO_3^-]_1 K_{a_1} [H_3O^+]}{[H_3O^+]^2 + K_{a_1}[H_3O^+] + K_{a_2}K_{a_1}} + \frac{2K_{a_2} K_{a_1} [HCO_3^-]_1}{[H_3O^+]^2 + K_{a_1}[H_3O^+] + K_{a_2}K_{a_1}}$$

$$[BOH] + [Na^+] + [H_3O^+] = \frac{K_w}{[H_3O^+]} + \frac{[HCO_3^-]_1 K_{a_1} [H_3O^+] + 2K_{a_2} K_{a_1} [HCO_3^-]_1}{[H_3O^+]^2 + K_{a_1}[H_3O^+] + K_{a_2}K_{a_1}}$$

$$[BOH][H_3O^+] + [Na^+][H_3O^+] + [H_3O^+]^2 = K_w + \frac{[HCO_3^-]_1 K_{a_1} [H_3O^+]^2 + 2K_{a_2} K_{a_1} [HCO_3^-]_1 [H_3O^+] }{[H_3O^+]^2 + K_{a_1}[H_3O^+] + K_{a_2}K_{a_1}}$$

$$\begin{aligned}
& [BOH][H_3O^+]^3 + [Na^+][H_3O^+]^3 + [H_3O^+]^4 + [BOH][H_3O^+]^2K_{a_1} + [Na^+][H_3O^+]^2K_{a_1} + K_{a_1}[H_3O^+]^3 + [BOH][H_3O^+]K_{a_2}K_{a_1} \\
& + [Na^+][H_3O^+]K_{a_2}K_{a_1} + [H_3O^+]^2K_{a_2}K_{a_1} \\
& = K_w[H_3O^+]^2 + K_wK_{a_1}[H_3O^+] + K_wK_{a_2}K_{a_1} + [HCO_3^-]_1K_{a_1}[H_3O^+]^2 + 2K_{a_2}K_{a_1}[HCO_3^-]_1[H_3O^+]
\end{aligned}$$

$$\begin{aligned}
& [BOH][H_3O^+]^3 + [Na^+][H_3O^+]^3 + [H_3O^+]^4 + [BOH][H_3O^+]^2K_{a_1} + [Na^+][H_3O^+]^2K_{a_1} + K_{a_1}[H_3O^+]^3 + [BOH][H_3O^+]K_{a_2}K_{a_1} \\
& + [Na^+][H_3O^+]K_{a_2}K_{a_1} + [H_3O^+]^2K_{a_2}K_{a_1} - K_w[H_3O^+]^2 - K_wK_{a_1}[H_3O^+] - K_wK_{a_2}K_{a_1} - [HCO_3^-]_1K_{a_1}[H_3O^+]^2 \\
& - 2K_{a_2}K_{a_1}[HCO_3^-]_1[H_3O^+] = 0
\end{aligned}$$

$$\begin{aligned}
& [H_3O^+]^4 + [H_3O^+]^3([BOH] + [NaHCO_3] + K_{a_1}) + [H_3O^+]^2([BOH]K_{a_1} + [NaHCO_3]K_{a_1} + K_{a_2}K_{a_1} - K_w - [NaHCO_3]K_{a_1}) \\
& + [H_3O^+]([BOH]K_{a_2}K_{a_1} + [NaHCO_3]K_{a_2}K_{a_1} - K_wK_{a_1} - 2K_{a_2}K_{a_1}[NaHCO_3]) - K_wK_{a_2}K_{a_1} = 0
\end{aligned}$$

$$\begin{aligned}
& [H_3O^+]^4 + [H_3O^+]^3([BOH] + [NaHCO_3] + K_{a_1}) + [H_3O^+]^2(K_{a_1}([BOH] + [NaHCO_3] + K_{a_2} - [NaHCO_3]) - K_w) \\
& + [H_3O^+](K_{a_1}(K_{a_2}[BOH] + K_{a_2}[NaHCO_3] - K_w - 2K_{a_2}[NaHCO_3])) - K_wK_{a_2}K_{a_1} = 0
\end{aligned}$$

$$\begin{aligned}
& [H_3O^+]^4 + [H_3O^+]^3([BOH] + [NaHCO_3] + K_{a_1}) + [H_3O^+]^2(K_{a_1}([BOH] + K_{a_2}) - K_w) + [H_3O^+](K_{a_1}(K_{a_2}[BOH] - K_w - K_{a_2}[NaHCO_3])) \\
& - K_wK_{a_2}K_{a_1} = 0
\end{aligned}$$