Svag enprotonig syra + svag enprotonig bas

$$HA + H_2O \rightleftarrows A^- + H_3O^+$$

$$K_a = \frac{[A^-][H_3O^+]}{[HA]_2} \Leftrightarrow [A^-] = \frac{K_a[HA]_2}{[H_3O^+]}$$

$$[HA]_1 = [HA]_2 + [A^-] = [HA]_2 + \frac{K_a[HA]_2}{[H_3O^+]} = [HA]_2\left(1 + \frac{K_a}{[H_3O^+]}\right) = [HA]_2\left(\frac{[H_3O^+] + K_a}{[H_3O^+]}\right) \Leftrightarrow$$

$$[HA]_2 = \frac{[HA]_1}{\left(\frac{[H_3O^+] + K_a}{[H_3O^+]}\right)} = \frac{[HA]_1[H_3O^+]}{[H_3O^+] + K_a}$$

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

$$B + H_2O \rightleftarrows HB^+ + OH^-$$

$$K_b = \frac{[HB^+][OH^-]}{[B]_2} \Leftrightarrow [HB^+] = \frac{K_b[B]_2}{[OH^-]} = \frac{K_b[B]_2}{\frac{K_w}{[H_3O^+]}} = \frac{K_b[B]_2[H_3O^+]}{K_w}$$

$$[B]_1 = [B]_2 + [HB^+] = [B]_2 + \frac{K_b[B]_2}{[OH^-]} = [B]_2\left(1 + \frac{K_b}{[OH^-]}\right) = [B]_2\left(\frac{[OH^-] + K_b}{[OH^-]}\right) \Leftrightarrow$$

$$[B]_2 = \frac{[B]_1}{\left(\frac{[OH^-] + K_b}{[OH^-]}\right)} = \frac{[B]_1[OH^-]}{[OH^-] + K_b}$$

$$[B]_2 = \frac{[B]_1 \frac{K_w}{[H_3O^+]}}{\frac{K_w}{[H_3O^+]} + K_b} = \frac{\frac{[B]_1 K_w}{[H_3O^+]}}{\frac{K_w + K_b[H_3O^+]}{[H_3O^+]}} = \frac{[B]_1 K_w}{K_w + K_b[H_3O^+]}$$

$$[HB^+] + [H_3O^+] = [OH^-] + [A^-]$$

$$\frac{K_b[B]_2[H_3O^+]}{K_w} + [H_3O^+] = \frac{K_w}{[H_3O^+]} + \frac{K_a[HA]_2}{[H_3O^+]}$$

$$\frac{K_b[B]_2[H_3O^+]^2}{K_w} + [H_3O^+]^2 = K_w + K_a[HA]_2$$

$$K_b[B]_2[H_3O^+]^2 + K_w[H_3O^+]^2 = {K_w}^2 + K_w K_a[HA]_2$$

$$K_b[H_3O^+]^2 \frac{[B]_1 K_w}{K_w + K_b[H_3O^+]} + K_w[H_3O^+]^2 = {K_w}^2 + K_w K_a \frac{[HA]_1[H_3O^+]}{[H_3O^+] + K_a}$$

$$\frac{K_w K_b[H_3O^+]^2[B]_1}{K_w + K_b[H_3O^+]} + K_w[H_3O^+]^2 = {K_w}^2 + \frac{K_w K_a[HA]_1[H_3O^+]}{[H_3O^+] + K_a}$$

$$\frac{K_b[H_3O^+]^2[B]_1}{K_w + K_b[H_3O^+]} + [H_3O^+]^2 = K_w + \frac{K_a[HA]_1[H_3O^+]}{[H_3O^+] + K_a}$$

$$K_b[H_3O^+]^2[B]_1 + K_w[H_3O^+]^2 + K_b[H_3O^+]^3 = {K_w}^2 + K_w K_b[H_3O^+] + \frac{K_w K_a[HA]_1[H_3O^+] + K_a K_b[HA]_1[H_3O^+]^2}{[H_3O^+] + K_a}$$

$$K_b[H_3O^+]^3[B]_1 + K_w[H_3O^+]^3 + K_b[H_3O^+]^4 + K_a K_b[H_3O^+]^2[B]_1 + K_a K_w[H_3O^+]^2 + K_a K_b[H_3O^+]^3$$
$$= {K_w}^2[H_3O^+] + K_w K_b[H_3O^+]^2 + K_a {K_w}^2 + K_w K_a K_b[H_3O^+] + K_w K_a[HA]_1[H_3O^+] + K_a K_b[HA]_1[H_3O^+]^2$$

$$K_b[H_3O^+]^3[B]_1 + K_w\,[H_3O^+]^3 + K_b[H_3O^+]^4 + K_aK_b[H_3O^+]^2[B]_1 + K_aK_w\,[H_3O^+]^2 + K_aK_b[H_3O^+]^3 - {K_w}^2[H_3O^+] - K_w\,K_b[H_3O^+]^2 - {K_aK_w}^2 - K_w\,K_aK_b[H_3O^+] - K_w\,K_a[HA]_1[H_3O^+] - K_aK_b[HA]_1[H_3O^+]^2 = 0$$

$$K_b[H_3O^+]^4 + [H_3O^+]^3(K_b[B]_1 + K_w\ + K_aK_b) + [H_3O^+]^2(K_aK_b\,[B]_1 + K_aK_w\ - K_w\,K_b - K_aK_b[HA]_1) - [H_3O^+]\left({K_w}^2 + K_w\,K_aK_b + K_w\,K_a[HA]_1\right) - K_a{K_w}^2 = 0$$

$$K_b[H_3O^+]^4 + [H_3O^+]^3(K_b([B]_1 + K_a) + K_w\,) + [H_3O^+]^2\left(K_aK_b\,([B]_1 - [HA]_1) + K_w\,(K_a - K_b)\right) - [H_3O^+]\left(K_w\,K_a(K_b + [HA]_1) + {K_w}^2\right) - K_a{K_w}^2 = 0$$