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$$\begin{split} H_2A^- + H_2O &\rightleftarrows HA^{2-} + H_3O^+ \\ HA^{2-} + H_2O &\rightleftarrows A^{3-} + H_3O^+ \\ K_{a_1} &= \frac{[H_2A^-][H_3O^+]}{[H_3A]_2} \Leftrightarrow [H_2A^-] = \frac{K_{a_1}[H_3A]_2}{[H_3O^+]} \\ K_{a_2} &= \frac{[HA^{2-}][H_3O^+]}{[H_2A^-]} \Leftrightarrow [HA^{2-}] = \frac{K_{a_2}[H_2A^-]}{[H_3O^+]} \\ K_{a_3} &= \frac{[A^3-][H_3O^+]}{[HA^{2-}]} \Leftrightarrow [A^3-] = \frac{K_{a_3}[HA^{2-}]}{[H_3O^+]} \\ [H_3A]_1 &= [H_3A]_2 + [H_2A^-] + [HA^{2-}] + [A^3-] \\ [H_3A]_1 &= [H_3A]_2 + \frac{K_{a_1}[H_3A]_2}{[H_3O^+]} + \frac{K_{a_2}[H_2A^-]}{[H_3O^+]} + \frac{K_{a_3}[HA^{2-}]}{[H_3O^+]} \\ [H_3A]_1 &= [H_3A]_2 + \frac{K_{a_1}[H_3A]_2}{[H_3O^+]} + \frac{K_{a_2}\frac{K_{a_1}[H_3A]_2}{[H_3O^+]}}{[H_3O^+]} + \frac{K_{a_3}\frac{K_{a_3}[HA^{2-}]}{[H_3O^+]}}{[H_3O^+]} \\ [H_3A]_1 &= [H_3A]_2 + \frac{K_{a_1}[H_3A]_2}{[H_3O^+]} + \frac{K_{a_2}\frac{K_{a_1}[H_3A]_2}{[H_3O^+]}}{[H_3O^+]} + \frac{K_{a_3}\frac{K_{a_4}[H_3A]_2}{[H_3O^+]}}{[H_3O^+]} \\ [H_3A]_1 &= [H_3A]_2 \left(1 + \frac{K_{a_1}}{[H_3O^+]} + \frac{K_{a_2}K_{a_1}}{[H_3O^+]^2} + \frac{K_{a_3}K_{a_2}K_{a_1}}{[H_3O^+]^3}\right) \Leftrightarrow \end{split}$$

 $H_2A + H_2O \rightleftharpoons H_2A^- + H_2O^+$ 

$$\begin{split} \left[H_{3}A\right]_{2} &= \frac{\left[H_{3}A\right]_{1}}{1 + \frac{K_{a_{1}}}{\left[H_{3}O^{+}\right]^{2}} + \frac{K_{a_{2}}K_{a_{1}}}{\left[H_{3}O^{+}\right]^{3}} + \frac{K_{a_{1}}K_{a_{2}}K_{a_{1}}}{\left[H_{3}O^{+}\right]^{3}} = \frac{\left[H_{3}A\right]_{1}}{\left[H_{3}O^{+}\right]^{3} + K_{a_{1}}\left[H_{3}O^{+}\right]^{2} + K_{a_{2}}K_{a_{1}}\left[H_{3}O^{+}\right]^{3}} \\ &= \frac{\left[H_{3}A\right]_{1}\left[H_{3}O^{+}\right]^{3}}{\left[H_{3}O^{+}\right]^{3} + K_{a_{1}}\left[H_{3}O^{+}\right]^{2} + K_{a_{2}}K_{a_{1}}\left[H_{3}O^{+}\right] + K_{a_{3}}K_{a_{2}}K_{a_{1}}} \end{split}$$

$$K_{w} = [OH^{-}][H_{3}O^{+}] \Leftrightarrow [OH^{-}] = \frac{K_{w}}{[H_{3}O^{+}]}$$

$$B + H_{2}O \rightleftharpoons HB^{+} + OH^{-}$$

$$K_{b} = \frac{[HB^{+}][OH^{-}]}{[B]_{2}} \Leftrightarrow [HB^{+}] = \frac{K_{b}[B]_{2}}{[OH^{-}]} = \frac{K_{b}[B]_{2}}{\frac{K_{w}}{[H_{3}O^{+}]}} = \frac{K_{b}[B]_{2}[H_{3}O^{+}]}{K_{w}}$$

$$[B]_{1} = [B]_{2} + [HB^{+}] = [B]_{2} + \frac{K_{b}[B]_{2}}{[OH^{-}]} = [B]_{2} \left(1 + \frac{K_{b}}{[OH^{-}]}\right) = [B]_{2} \left(\frac{[OH^{-}] + K_{b}}{[OH^{-}]}\right) \Leftrightarrow$$

$$[B]_{2} = \frac{[B]_{1}}{\left(\frac{[OH^{-}] + K_{b}}{[OH^{-}]}\right)} = \frac{[B]_{1}[OH^{-}]}{[OH^{-}] + K_{b}}$$

$$[B]_{2} = \frac{[B]_{1}\frac{K_{w}}{[H_{3}O^{+}]}}{\frac{K_{w}}{[H_{3}O^{+}]} + K_{b}} = \frac{\frac{[B]_{1}K_{w}}{[H_{3}O^{+}]}}{\frac{K_{w} + K_{b}[H_{3}O^{+}]}{[H_{3}O^{+}]}} = \frac{[B]_{1}K_{w}}{K_{w} + K_{b}[H_{3}O^{+}]}$$

$$[HB^+] + [H_3O^+] = [OH^-] + [H_2A^-]_2 + 2[HA^{2-}] + 3[A^{3-}]$$

$$\frac{K_{b}[B]_{2}[H_{3}O^{+}]}{K_{w}} + [H_{3}O^{+}] = \frac{K_{w}}{[H_{3}O^{+}]} + \frac{K_{a_{1}}[H_{3}A]}{[H_{3}O^{+}]} + 2\frac{K_{a_{2}}[H_{2}A^{-}]}{[H_{3}O^{+}]} + 3\frac{K_{a_{3}}[HA^{2-}]}{[H_{3}O^{+}]}$$

$$\frac{K_{b}[H_{3}O^{+}] \frac{[B]_{1}K_{w}}{K_{w} + K_{b}[H_{3}O^{+}]} + [H_{3}O^{+}] = \frac{K_{w}}{[H_{3}O^{+}]} + \frac{K_{a_{1}}[H_{3}A]_{2}}{[H_{3}O^{+}]} + 2\frac{K_{a_{2}}[H_{2}A^{-}]}{[H_{3}O^{+}]} + 3\frac{K_{a_{3}}[HA^{2-}]}{[H_{3}O^{+}]}$$

$$\frac{K_{b}[H_{3}O^{+}][B]_{1}}{K_{w} + K_{b}[H_{3}O^{+}]} + [H_{3}O^{+}] = \frac{K_{w}}{[H_{3}O^{+}]} + \frac{K_{a_{1}}[H_{3}A]_{2}}{[H_{3}O^{+}]} + \frac{2K_{a_{2}}\frac{K_{a_{1}}[H_{3}A]_{2}}{[H_{3}O^{+}]}}{[H_{3}O^{+}]} + \frac{3K_{a_{3}}\frac{K_{a_{2}}[H_{2}A^{-}]}{[H_{3}O^{+}]}}{[H_{3}O^{+}]}$$

$$\frac{K_{b}[H_{3}O^{+}][B]_{1}}{K_{w} + K_{b}[H_{3}O^{+}]} + [H_{3}O^{+}] = \frac{K_{w}}{[H_{3}O^{+}]} + \frac{K_{a_{1}}[H_{3}A]_{2}}{[H_{3}O^{+}]} + \frac{2K_{a_{2}}K_{a_{1}}[H_{3}A]_{2}}{[H_{3}O^{+}]^{2}} + \frac{3K_{a_{3}}\frac{K_{a_{1}}[H_{3}A]_{2}}{[H_{3}O^{+}]}}{[H_{3}O^{+}]}$$

$$\frac{K_{b}[H_{3}O^{+}][B]_{1}}{K_{w} + K_{b}[H_{2}O^{+}]} + [H_{3}O^{+}] = \frac{K_{w}}{[H_{2}O^{+}]} + \frac{K_{a_{1}}[H_{3}A]_{2}}{[H_{2}O^{+}]} + \frac{2K_{a_{2}}K_{a_{1}}[H_{3}A]_{2}}{[H_{2}O^{+}]^{2}} + \frac{3K_{a_{3}}K_{a_{2}}K_{a_{1}}[H_{3}A]_{2}}{[H_{2}O^{+}]^{3}}$$

$$\begin{split} \frac{K_{b}[H_{3}O^{+}][B]_{1}}{K_{w} + K_{b}[H_{3}O^{+}]} + [H_{3}O^{+}] \\ &= \frac{K_{w}}{[H_{3}O^{+}]} + \frac{K_{a_{1}} \frac{[H_{3}A]_{1}[H_{3}O^{+}]^{3}}{[H_{3}O^{+}]^{2} + K_{a_{2}}K_{a_{1}}[H_{3}O^{+}] + K_{a_{3}}K_{a_{2}}K_{a_{1}}}}{[H_{3}O^{+}]^{3}} \\ &+ 2 \frac{K_{a_{2}} \frac{K_{a_{1}} \frac{[H_{3}O^{+}]^{3} + K_{a_{1}}[H_{3}O^{+}]^{2} + K_{a_{2}}K_{a_{1}}[H_{3}O^{+}] + K_{a_{3}}K_{a_{2}}K_{a_{1}}}}{[H_{3}O^{+}]}}{[H_{3}O^{+}]} \\ &+ 3 \frac{K_{a_{3}} \frac{K_{a_{1}} \frac{[H_{3}O^{+}]^{3} + K_{a_{1}}[H_{3}O^{+}]^{2} + K_{a_{2}}K_{a_{1}}[H_{3}O^{+}] + K_{a_{3}}K_{a_{2}}K_{a_{1}}}}{[H_{3}O^{+}]}}{[H_{3}O^{+}]} \\ &+ 3 \frac{K_{a_{3}} \frac{K_{a_{1}} \frac{[H_{3}O^{+}]^{3} + K_{a_{1}}[H_{3}O^{+}]^{2} + K_{a_{2}}K_{a_{1}}[H_{3}O^{+}] + K_{a_{3}}K_{a_{2}}K_{a_{1}}}}{[H_{3}O^{+}]}} \\ &+ 3 \frac{K_{a_{1}} \frac{[H_{3}O^{+}]^{3} + K_{a_{1}}[H_{3}O^{+}]^{2} + K_{a_{2}}K_{a_{1}}[H_{3}O^{+}] + K_{a_{3}}K_{a_{2}}K_{a_{1}}}}{[H_{3}O^{+}]}} \\ &+ 3 \frac{K_{a_{3}} \frac{K_{a_{1}} \frac{[H_{3}O^{+}]^{3} + K_{a_{1}}[H_{3}O^{+}]^{2} + K_{a_{2}}K_{a_{1}}[H_{3}O^{+}] + K_{a_{3}}K_{a_{2}}K_{a_{1}}}}{[H_{3}O^{+}]}} \\ &+ 3 \frac{K_{a_{3}} \frac{K_{a_{1}} \frac{[H_{3}O^{+}]^{3} + K_{a_{1}}[H_{3}O^{+}]^{2} + K_{a_{2}}K_{a_{1}}[H_{3}O^{+}]^{2} + K_{a_{3}}K_{a_{2}}K_{a_{1}}}}{[H_{3}O^{+}]^{3}}} \\ &+ 3 \frac{K_{a_{3}} \frac{K_{a_{1}} \frac{[H_{3}O^{+}]^{3} + K_{a_{1}}[H_{3}O^{+}]^{2} + K_{a_{2}}K_{a_{1}}[H_{3}O^{+}]^{3}}{[H_{3}O^{+}]}} \\ &+ 3 \frac{K_{a_{1}} \frac{K_{a_{1}} \frac{[H_{3}O^{+}]^{3} + K_{a_{1}}[H_{3}O^{+}]^{3} + K_{a_{1}}[H_{3}O^{+}]^{3}}{[H_{3}O^{+}]^{3}}} \\ &+ 3 \frac{K_{a_{1}} \frac{K_{a_{1}} \frac{[H_{3}O^{+}]^{3} + K_{a_{1}}[H_{3}O^{+}]^{3}}{[H_{3}O^{+}]^{3}}}}{[H_{3}O^{+}]^{3}} \\ &+ 3 \frac{K_{a_{1}} \frac{K_{a_{1}} \frac{[H_{3}O^{+}]^{3} + K_{a_{1}}[H_{3}O^{+}]^{3}}{[H_{3}O^{+}]^{3}}}} \\ &+ 3 \frac{K_{a_{1}} \frac{K_{a_{1}} \frac{[H_{3}O^{+}]^{3}}{[H_{3}O^{+}]^{3}}}}{[H_{3}O^{+}]^{3}}} \\ &+ 3 \frac{K_{a_{1}} \frac{K_{a_{1}} \frac{[H_{3}O^{+}]^{3}}{[H_{3}O^{+}]^{3}}}}{[H_{3}O^{+}]^{3}}} \\ &+ 3 \frac{K_{a_{1}} \frac{K_{a_{1}} \frac{[H_{3}O^{+}]^{3}}{[H_{3}O^{+}]^{3}}}}{[H_{3}O^{+}]^{3}}} \\ &+ 3 \frac{K_{a_{1}} \frac{K_{a_{1}} \frac{[H_{3}O^{+}]^{3}}{[H_{3}O^{+}]^{3}}}}{[H_{3}O^{+}]$$

$$\begin{split} \frac{K_b[H_3O^+][B]_1}{K_w + K_b[H_3O^+]} + [H_3O^+] \\ &= \frac{K_w}{[H_3O^+]^3 + K_{a_1}[H_3O^+]^2 + K_{a_2}K_{a_1}[H_3O^+]^2} + \frac{2K_{a_2}K_{a_1}[H_3A]_1[H_3O^+]}{[H_3O^+]^3 + K_{a_1}[H_3O^+]^2 + K_{a_2}K_{a_1}[H_3O^+] + K_{a_3}K_{a_2}K_{a_1}} \\ &+ \frac{3K_{a_3}K_{a_2}K_{a_1}[H_3A]_1}{[H_3O^+]^3 + K_{a_1}[H_3O^+]^2 + K_{a_2}K_{a_1}[H_3O^+] + K_{a_3}K_{a_2}K_{a_1}} \\ &\frac{K_b[H_3O^+][B]_1}{K_w + K_b[H_3O^+]} + [H_3O^+] = \frac{K_w}{[H_3O^+]^4} + \frac{K_{a_1}[H_3A]_1[H_3O^+]^2 + 2K_{a_2}K_{a_1}[H_3A]_1[H_3O^+] + 3K_{a_3}K_{a_2}K_{a_1}[H_3A]_1}{[H_3O^+]^3 + K_{a_1}[H_3O^+]^2 + K_{a_2}K_{a_1}[H_3O^+] + K_{a_3}K_{a_2}K_{a_1}} \\ &\frac{K_b[H_3O^+]^2[B]_1}{K_w + K_b[H_3O^+]} + [H_3O^+]^2 = K_w + \frac{K_{a_1}[H_3A]_1[H_3O^+]^3 + 2K_{a_2}K_{a_1}[H_3A]_1[H_3O^+]^2 + 3K_{a_3}K_{a_2}K_{a_1}[H_3A]_1[H_3O^+]}{[H_3O^+]^3 + K_{a_1}[H_3O^+]^2 + K_{a_2}K_{a_1}[H_3O^+] + K_{a_3}K_{a_2}K_{a_1}} \end{split}$$

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\frac{K_{b}[H_{3}O^{+}]^{5}[B]_{1}+K_{b}K_{a_{1}}[H_{3}O^{+}]^{4}[B]_{1}+K_{b}K_{a_{2}}K_{a_{1}}[H_{3}O^{+}]^{3}[B]_{1}+K_{b}K_{a_{3}}K_{a_{2}}K_{a_{1}}[H_{3}O^{+}]^{2}[B]_{1}}{K_{w}+K_{b}[H_{3}O^{+}]}+[H_{3}O^{+}]^{5}+K_{a_{1}}[H_{3}O^{+}]^{4}+K_{a_{2}}K_{a_{1}}[H_{3}O^{+}]^{3}
                                    + K_{a_3} K_{a_2} K_{a_4} [H_3 O^+]^2
                                     =K_{w}[H_{3}O^{+}]^{3}+K_{w}K_{a_{1}}[H_{3}O^{+}]^{2}+K_{w}K_{a_{2}}K_{a_{1}}[H_{3}O^{+}]+K_{w}K_{a_{2}}K_{a_{1}}K_{a_{1}}+K_{a_{1}}[H_{3}A]_{1}[H_{3}O^{+}]^{3}+2K_{a_{1}}K_{a_{1}}[H_{3}A]_{1}[H_{3}O^{+}]^{2}
                                     +3K_{a_2}K_{a_3}K_{a_4}[H_3A]_1[H_3O^+]
K_{b}[H_{3}O^{+}]^{5}[B]_{1} + K_{b}K_{a_{1}}[H_{3}O^{+}]^{4}[B]_{1} + K_{b}K_{a_{2}}K_{a_{1}}[H_{3}O^{+}]^{3}[B]_{1} + K_{b}K_{a_{2}}K_{a_{3}}K_{a_{1}}[H_{3}O^{+}]^{2}[B]_{1} + K_{w}[H_{3}O^{+}]^{5} + K_{w}K_{a_{1}}[H_{3}O^{+}]^{4}
                                  + K_{w} K_{a_{2}} K_{a_{1}} [H_{3}O^{+}]^{3} + K_{w} K_{a_{2}} K_{a_{1}} [H_{3}O^{+}]^{2} + K_{b} [H_{3}O^{+}]^{6} + K_{b} K_{a_{1}} [H_{3}O^{+}]^{5} + K_{b} K_{a_{2}} K_{a_{1}} [H_{3}O^{+}]^{4} + K_{b} K_{a_{2}} K_{a_{1}} [H_{3}O^{+}]^{3}
                                   = K_w^2 [H_3 O^+]^3 + K_w^2 K_{a_1} [H_3 O^+]^2 + K_w^2 K_{a_2} K_{a_1} [H_3 O^+] + K_w^2 K_{a_2} K_{a_2} K_{a_3} K_{a_4} + K_w K_{a_1} [H_3 A]_1 [H_3 O^+]^3
                                   + \ 2 K_w K_{a_2} K_{a_1} [H_3 A]_1 [H_3 O^+]^2 + 3 K_w K_{a_3} K_{a_2} K_{a_1} [H_3 A]_1 [H_3 O^+] + K_w K_b [H_3 O^+]^4 + K_w K_{a_1} K_b [H_3 O^+]^3 + K_w K_b K_{a_2} K_{a_1} [H_3 O^+]^2
                                   + K_w K_b K_{a_2} K_{a_3} K_{a_1} [H_3 O^+] + K_b K_{a_1} [H_3 A]_1 [H_3 O^+]^4 + 2 K_b K_{a_2} K_{a_1} [H_3 A]_1 [H_3 O^+]^3 + 3 K_b K_{a_2} K_{a_3} K_{a_4} [H_3 A]_1 [H_3 O^+]^2
K_{b}[H_{3}O^{+}]^{5}[B]_{1} + K_{b}K_{a_{1}}[H_{3}O^{+}]^{4}[B]_{1} + K_{b}K_{a_{2}}K_{a_{1}}[H_{3}O^{+}]^{3}[B]_{1} + K_{b}K_{a_{3}}K_{a_{2}}K_{a_{1}}[H_{3}O^{+}]^{2}[B]_{1} + K_{w}\left[H_{3}O^{+}\right]^{5} + K_{w}\left[H_{3}O^{+}\right]^{4}[B]_{1} + K_{b}K_{a_{1}}[H_{3}O^{+}]^{4}[B]_{1} + K_{b}K_{a_{2}}K_{a_{1}}[H_{3}O^{+}]^{3}[B]_{1} + K_{b}K_{a_{2}}K_{a_{3}}[H_{3}O^{+}]^{4}[B]_{1} + K_{b}K_{a_{1}}[H_{3}O^{+}]^{4}[B]_{1} + K_{b}K_{a_{2}}K_{a_{3}}[H_{3}O^{+}]^{3}[B]_{1} + K_{b}K_{a_{3}}K_{a_{3}}K_{a_{3}}[H_{3}O^{+}]^{2}[B]_{1} + K_{b}K_{a_{3}}[H_{3}O^{+}]^{4}[B]_{1} + K_
                                   +K_{w}K_{a_{2}}K_{a_{4}}[H_{3}O^{+}]^{3}+K_{w}K_{a_{2}}K_{a_{4}}[H_{3}O^{+}]^{2}+K_{b}[H_{3}O^{+}]^{6}+K_{b}K_{a_{4}}[H_{3}O^{+}]^{5}+K_{b}K_{a_{2}}K_{a_{4}}[H_{3}O^{+}]^{4}+K_{b}K_{a_{2}}K_{a_{4}}[H_{3}O^{+}]^{3}
                                   -K_{w}^{2}[H_{3}O^{+}]^{3}-K_{w}^{2}K_{a_{1}}[H_{3}O^{+}]^{2}-K_{w}^{2}K_{a_{2}}K_{a_{1}}[H_{3}O^{+}]-K_{w}^{2}K_{a_{2}}K_{a_{3}}K_{a_{4}}-K_{w}K_{a_{4}}[H_{3}A]_{1}[H_{3}O^{+}]^{3}
                                   -2K_wK_{a_2}K_{a_1}[H_3A]_1[H_3O^+]^2-3K_wK_{a_3}K_{a_2}K_{a_1}[H_3A]_1[H_3O^+]-K_wK_b[H_3O^+]^4-K_wK_{a_1}K_b[H_3O^+]^3-K_wK_bK_{a_2}K_{a_1}[H_3O^+]^2
                                   -K_{w}K_{b}K_{a_{3}}K_{a_{2}}K_{a_{1}}[H_{3}O^{+}] - K_{b}K_{a_{1}}[H_{3}A]_{1}[H_{3}O^{+}]^{4} - 2K_{b}K_{a_{2}}K_{a_{1}}[H_{3}A]_{1}[H_{3}O^{+}]^{3} - 3K_{b}K_{a_{3}}K_{a_{2}}K_{a_{1}}[H_{3}A]_{1}[H_{3}O^{+}]^{2} = 0
     K_b[H_3O^+]^6 + [H_3O^+]^5(K_b[B]_1 + K_w + K_bK_{a_s}) + [H_3O^+]^4(K_bK_{a_s}[B]_1 + K_wK_{a_s} + K_bK_{a_s}K_{a_s} - K_wK_b - K_bK_{a_s}[H_3A]_1)
                                        +[H_3O^+]^3(K_bK_{a_2}K_{a_4}[B]_1+K_wK_{a_2}K_{a_4}+K_bK_{a_2}K_{a_3}K_{a_4}-K_w^2-K_wK_{a_4}[H_3A]_1-K_wK_{a_4}K_b-2K_bK_{a_2}K_{a_4}[H_3A]_1)
                                        + [H_3O^+]^2 (K_b K_{a_3} K_{a_2} K_{a_1} [B]_1 + K_w K_{a_3} K_{a_2} K_{a_1} - K_w^2 K_{a_1} - 2K_w K_{a_2} K_{a_1} [H_3A]_1 - K_w K_b K_{a_2} K_{a_1} - 3K_b K_{a_3} K_{a_2} K_{a_1} [H_3A]_1)
                                        -[H_3O^+](K_w^2K_{a_2}K_{a_3} + 3K_wK_{a_2}K_{a_3}K_{a_4}[H_3A]_1 + K_wK_bK_{a_2}K_{a_2}K_{a_3}K_{a_4}) - K_w^2K_{a_2}K_{a_3}K_{a_4} = 0
                                     K_b[H_3O^+]^6 + [H_3O^+]^5 (K_b([B]_1 + K_{a_1}) + K_w) + [H_3O^+]^4 (K_bK_{a_1}([B]_1 - [H_3A]_1 + K_{a_2}) + K_w(K_{a_1} - K_b))
                                                                       + [H_3O^+]^3 (K_{a_2}K_{a_1}(K_b[B]_1 + K_w + K_bK_{a_2} - 2K_b[H_3A]_1) - K_w(K_w + K_{a_1}[H_3A]_1 + K_{a_1}K_b)
                                                                       + [H_3O^+]^2 (K_{a_2}K_{a_1}(K_bK_{a_3}[B]_1 + K_wK_{a_3} - 2K_w[H_3A]_1 - K_wK_b - 3K_bK_{a_2}[H_3A]_1) - K_w^2K_{a_4})
                                                                       -[H_3O^+](K_wK_{a_2}K_{a_1}(K_w+3K_{a_2}[H_3A]_1+K_bK_{a_2}))-K_w^2K_{a_2}K_{a_2}K_{a_3}=0
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