

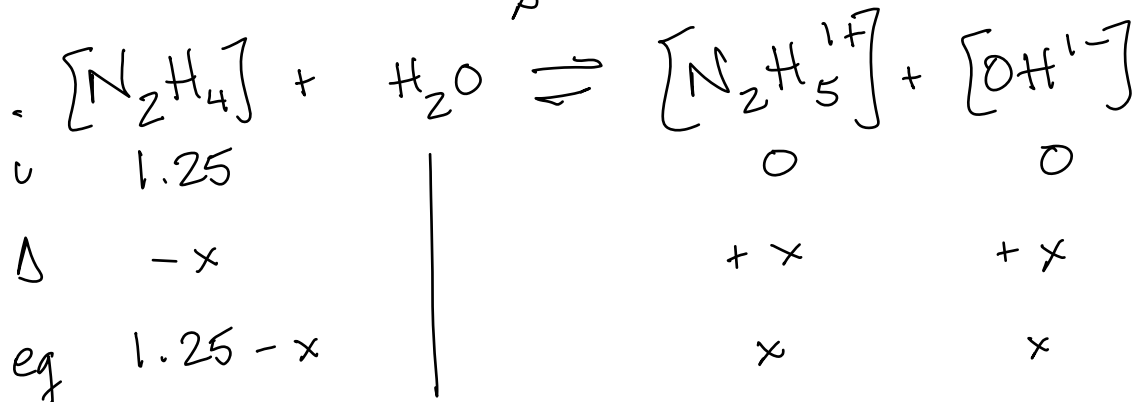
Clements—Chemistry I (H)
More Ka and Kb Practice... w/my work!!

14. Hydrazine, H_2NNH_2 , has a K_b of 9.50×10^{-7} . If you have 10.0 g of N_2H_4 in enough H_2O to make 250 mL of solution, what is the pH?

15. If you have a 1.00 M solution of iodic acid, HIO_3 , whose pH is 0.474, what is the K_a ?

16. A 2.00 M solution of boric acid, H_3BO_3 , has what equilibrium concentrations of H_3BO_3 , $\text{H}_2\text{BO}_3^{2-}$, BO_3^{3-} , H^+ , OH^- , and pH? $K_{a1} = 5.81 \times 10^{-10}$, $K_{a2} = 1.80 \times 10^{-13}$, $K_{a3} = 1.60 \times 10^{-14}$

$$14. \quad 10 \text{ g } \text{N}_2\text{H}_4 \times \frac{1 \text{ mol}}{32.06 \text{ g}} \times \frac{1}{0.250 \text{ L}} = 1.25 \text{ M}$$



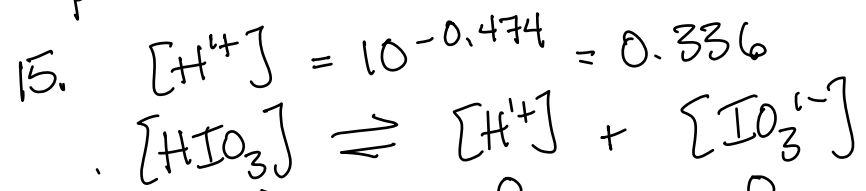
$$K_b = \frac{[\text{N}_2\text{H}_5^+][\text{OH}^-]}{[\text{N}_2\text{H}_4]} = 9.5 \times 10^{-7} = \frac{[x][x]}{[1.25 - x]}$$

$$x = 0.00109$$

5% test: $\frac{0.00109}{1.25} \times 100 = 0.0872\% \dots$ good assumption

$$[\text{OH}^-] = 0.00109 \dots p\text{OH} = -\log [0.00109] = 2.96$$

$$\text{pH} = 14 - 2.96 = 11.0$$



$$K_a = \frac{[\text{H}^+][\text{IO}_3^-]}{[\text{HIO}_3]} = \frac{[0.336][0.336]}{[0.664]} = 0.170$$



$$i \quad \quad \quad 2 \quad \quad \quad 0 \quad \quad \quad 0$$

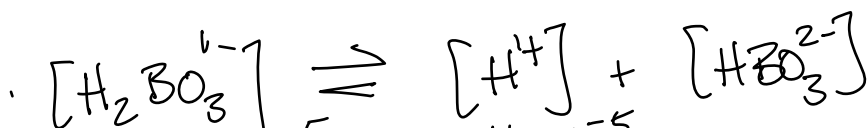
$$\Delta \quad -x \quad \quad \quad +x \quad \quad \quad +x$$

$$eq \quad 2-x \quad \quad \quad x \quad \quad \quad x$$

$$K_{a1} = \frac{\text{[H}^+][\text{H}_2\text{BO}_3^{1-}]}{\text{[H}_3\text{BO}_3]} = 5.81 \times 10^{-10} = \frac{[x][x]}{[2-x]}$$

$$x = 3.41 \times 10^{-5} = \text{[H}^+] = \text{[H}_2\text{BO}_3^{1-}]$$

$$5\% \text{ test: } \frac{3.41 \times 10^{-5}}{2} \times 100 = 0.00170\% \dots \text{ good assumption}$$



$$i \quad \quad \quad 3.41 \times 10^{-5} \quad \quad \quad 3.41 \times 10^{-5} \quad \quad \quad 0$$

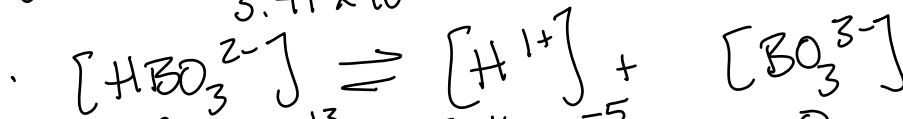
$$\Delta \quad -x \quad \quad \quad +x \quad \quad \quad +x$$

$$eq \quad 3.41 \times 10^{-5} - x \quad \quad \quad 3.41 \times 10^{-5} + x \quad \quad \quad x$$

$$K_{a2} = \frac{\text{[H}^+][\text{HBO}_3^{2-}]}{\text{[H}_2\text{BO}_3^{1-}]} = 1.8 \times 10^{-13} = \frac{[3.41 \times 10^{-5} + x][x]}{[3.41 \times 10^{-5} - x]}$$

$$x = 1.80 \times 10^{-13} = \text{[HBO}_3^{2-}]$$

$$5\% \text{ test: } \frac{1.80 \times 10^{-13}}{3.41 \times 10^{-5}} \times 100 = 5.23 \times 10^{-7}\% \dots \text{ good}$$



$$i \quad \quad \quad 1.80 \times 10^{-13} \quad \quad \quad 3.41 \times 10^{-5} \quad \quad \quad 0$$

$$\Delta \quad -x \quad \quad \quad +x \quad \quad \quad +x$$

$$eq \quad 1.80 \times 10^{-13} - x \quad \quad \quad 3.41 \times 10^{-5} + x \quad \quad \quad x$$

$$K_{a3} = \frac{\text{[H}^+][\text{BO}_3^{3-}]}{\text{[HBO}_3^{2-}]} = 1.6 \times 10^{-14} = \frac{[3.41 \times 10^{-5} + x][x]}{[1.8 \times 10^{-13} - x]}$$

$$x = 8.45 \times 10^{-23} \quad \text{" good!"}$$

$$\begin{aligned} \text{[H}_3\text{BO}_3]_{eq} &= 2.00 \\ \text{[H}_2\text{BO}_3^{1-}]_{eq} &= 3.41 \times 10^{-5} \\ \text{[HBO}_3^{2-}]_{eq} &= 1.80 \times 10^{-13} \end{aligned}$$

$$\begin{aligned} \text{[BO}_3^{3-}]_{eq} &= 8.45 \times 10^{-23} \\ \text{[H}^+]_{eq} &= 3.41 \times 10^{-5} \\ \text{[OH}^-]_{eq} &= 2.93 \times 10^{-10} \end{aligned}$$

$$\text{pH} = 4.47$$