

Unit 3 and 4 review... Ksp, Ka, Kb

1) Does a precipitate form when 0.050 L of 0.50 M $\text{Ca}(\text{NO}_3)_2$ is mixed with 0.100 L of 0.12 M NaF?

$$\text{Moles of } \text{Ca}^{2+} \rightarrow 0.50 \text{ M} \times 0.050 \text{ L} = 0.025 \text{ moles } \text{Ca}^{2+}$$

$$[\text{Ca}^{2+}] = \frac{0.025 \text{ moles } \text{Ca}^{2+}}{0.050 \text{ L} + 0.100 \text{ L}} = [0.16666] \text{ M } \text{Ca}^{2+}$$

$$\text{Moles of } \text{F}^- \rightarrow 0.12 \text{ M} \times 0.100 \text{ L} = 0.012 \text{ moles } \text{F}^-$$

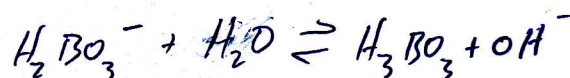
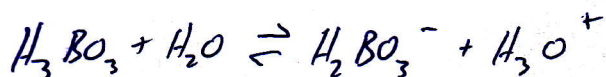
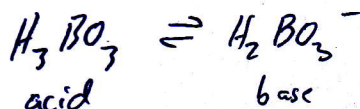
$$[\text{F}^-] = \frac{0.012 \text{ moles } \text{F}^-}{0.050 \text{ L} + 0.100 \text{ L}} = [0.080] \text{ M } \text{F}^-$$

$$\begin{aligned} Q &= [\text{Ca}^{2+}][\text{F}^-]^2 \\ &= [0.16666][0.080]^2 \\ &= 0.0011 \end{aligned}$$

$$Q \gg K_{sp} \quad 0.0011 \quad 3.2 \times 10^{-11}$$

so CaF_2 will precipitate out until $Q = K_{sp}$

2) Use the Boric acid and its conjugate base to prove that $K_a \times K_b = K_w$.



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

$$K_b = \frac{[\text{H}_3\text{BO}_3][\text{OH}^-]}{[\text{H}_2\text{BO}_3^-]}$$

$$\overset{K_a \times K_b}{\frac{[\cancel{\text{H}_2\text{BO}_3^-}][\text{H}_3\text{O}^+]}{[\cancel{\text{H}_3\text{BO}_3]}} \times \frac{[\cancel{\text{H}_3\text{BO}_3}][\text{OH}^-]}{[\cancel{\text{H}_2\text{BO}_3^-}]}$$

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

