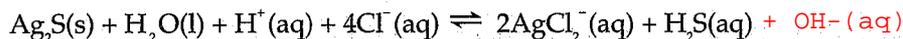
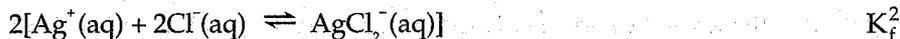
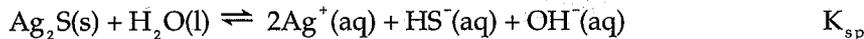


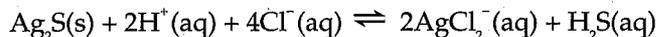
17 Additional Aspects of Aqueous Equilibria

Solutions to Exercises

17.68 According Appendix D.3, K_{sp} for $\text{Ag}_2\text{S}(s)$ is of the type



~~Add $\text{H}^+(\text{aq})$ to each side to obtain the overall reaction.~~ really need to add in water equil. above

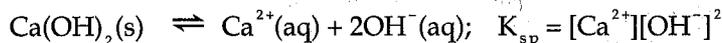


$$K = \frac{K_{sp} \times K_f^2}{K_{a1} K_w} = \frac{(6 \times 10^{-51})(1.1 \times 10^5)^2}{(9.5 \times 10^{-8})(1.0 \times 10^{-14})} = 7.64 \times 10^{-34} = 8 \times 10^{-34} = 7.64 \times 10^{-20}$$

Precipitation and Separation of Ions (Section 17.6)

17.69 *Analyze/Plan.* Follow the logic in Sample Exercise 17.16. Precipitation conditions: will Q (see Chapter 15) exceed K_{sp} for the compound? *Solve.*

(a) In base, Ca^{2+} can form $\text{Ca}(\text{OH})_2(s)$.



$$Q = [\text{Ca}^{2+}][\text{OH}^-]^2; [\text{Ca}^{2+}] = 0.050 \text{ M}; \text{pOH} = 14 - 8.0 = 6.0; [\text{OH}^-] = 1.0 \times 10^{-6} \text{ M}$$

$$Q = (0.050)(1.0 \times 10^{-6})^2 = 5.0 \times 10^{-14}; K_{sp} = 6.5 \times 10^{-6} \text{ (Appendix D.3)}$$

$Q < K_{sp}$, no $\text{Ca}(\text{OH})_2$ precipitates.

(b) $\text{Ag}_2\text{SO}_4(s) \rightleftharpoons 2\text{Ag}^+(\text{aq}) + \text{SO}_4^{2-}(\text{aq}); \quad K_{sp} = [\text{Ag}^+]^2[\text{SO}_4^{2-}]$

$$[\text{Ag}^+] = \frac{0.050 \text{ M} \times 100 \text{ mL}}{110 \text{ mL}} = 4.545 \times 10^{-2} = 4.5 \times 10^{-2} \text{ M}$$

$$[\text{SO}_4^{2-}] = \frac{0.050 \text{ M} \times 10 \text{ mL}}{110 \text{ mL}} = 4.545 \times 10^{-3} = 4.5 \times 10^{-3} \text{ M}$$

$$Q = (4.545 \times 10^{-2})^2 (4.545 \times 10^{-3}) = 9.4 \times 10^{-6}; K_{sp} = 1.5 \times 10^{-5}$$

$Q < K_{sp}$, no Ag_2SO_4 precipitates.

17.70 (a) $\text{Co}(\text{OH})_2(s) \rightleftharpoons \text{Co}^{2+}(\text{aq}) + 2\text{OH}^-(\text{aq}); \quad K_{sp} = [\text{Co}^{2+}][\text{OH}^-]^2 = 1.3 \times 10^{-15}$

$$\text{pH} = 8.5; \text{pOH} = 14 - 8.5 = 5.5; [\text{OH}^-] = 10^{-5.5} = 3.16 \times 10^{-6} = 3 \times 10^{-6} \text{ M}$$

$$Q = (0.020)(3.16 \times 10^{-6})^2 = 2 \times 10^{-13}; Q > K_{sp}, \text{Co}(\text{OH})_2 \text{ will precipitate.}$$

(b) $\text{AgIO}_3(s) \rightleftharpoons \text{Ag}^+(\text{aq}) + \text{IO}_3^-(\text{aq}); \quad K_{sp} = [\text{Ag}^+][\text{IO}_3^-] = 3.1 \times 10^{-8}$

$$[\text{Ag}^+] = \frac{0.010 \text{ M Ag}^+ \times 0.020 \text{ L}}{0.030 \text{ L}} = 6.667 \times 10^{-3} = 6.7 \times 10^{-3} \text{ M}$$