Chapter 15 – Problems 6, 28, 34

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6. (a) $AgCl$
   i. $AgCl \rightleftharpoons Ag^+ + Cl^-$
   ii. $K_{sp} = \left[Ag^+\right]\left[Cl^-\right]$
   (b) $Al_2(CO_3)_3$
   i. $Al_2(CO_3)_3 \rightleftharpoons 2\,Al^{3+} + {CO_3}^{2-}$
   ii. $K_{sp} = \left[Al^{3+}\right]^2\left[3\,{CO_3}^{2-}\right]^3$
   (c) MnS_2
   i. $MnS_2 \rightleftharpoons Mn^{2+} + 2\,S^-$
   ii. $K_{sp} = \left[Mn^{4+}\right]\left[2\,S^{2-}\right]^2$
   (d) $Mg(OH)_2$
   i. $Mg(OH)_2 \rightleftharpoons Mg^{2+} + 2\,OH^-$
   ii. $K_{sp} = \left[Mg^{2+}\right]\left[OH^-\right]^2$

28. (a)

$$\begin{aligned} [OH^-] &= 10^{9.62-14} \\ &= 4.17 \cdot 10^{-5}[M] \\ \left[Cd^{2+}\right]\left[OH^-\right]^2 &= 2.5 \cdot 10^{-14} \\ [Cd^{2+}] &= \frac{2.5 \cdot 10^{-14}}{\left(4.17 \cdot 10^{-5}\right)^2} \\ &= 1.4 \cdot 10^{-5}[M] \end{aligned} \tag{1}$$

(b)

$$\begin{aligned} .0013 \cdot x^2 &= 2.5 \cdot 10^{-14} \\ x &= 4.4 \cdot 10^{-6}[M] \\ 14 + \log_{10}\left(4.4 \cdot 10^{-6}\right) & \\ pH &= 8.64 \end{aligned} \tag{2}$$

(c)

$$\frac{4.4 \cdot 10^{-6}}{4.17 \cdot 10^{-5}} = .105$$
$$.105 \cdot 100\% = 10.5\% \tag{3}$$

34. (a)

$$K_{sp}\mathrm{PbSO_4} = 1.8 \cdot 10^{-8}$$
$$[\mathrm{Pb^{2+}}] = 9 \cdot 10^{-7}[\mathrm{M}]$$
$$K_{sp}\mathrm{Pb(OH)_2} = 2.8 \cdot 10^{-16}$$
$$[\mathrm{Pb^{2+}}] = 7 \cdot 10^{-13}[\mathrm{M}] \tag{4}$$
$$7 \cdot 10^{-13} < 9 \cdot 10^{-7}$$
$$\text{So } \mathrm{Pb(OH)_2} \text{ precipitates first}$$

(b)

$$[\mathrm{OH^-}]^2 \left(9 \cdot 10^{-7}\right) = 2.8 \cdot 10^{-16}$$
$$[\mathrm{OH^-}] = 1.76 \cdot 10^{-5}[\mathrm{M}] \tag{5}$$
$$14 + \log_{10}\left(1.76 \cdot 10^{-5}\right)$$
$$\mathrm{pH} = 9.25$$