Section 18.3

1. a. $Ca(OH)_2(s) \rightleftharpoons Ca^{2+}(aq) + 2OH^-(aq)$

   $K_{sp} = [Ca^{2+}] \times [OH^-]^2$

   b. $Ag_2CO_3(s) \rightleftharpoons 2Ag^+(aq) + CO_3^{2-}(aq)$

   $K_{sp} = [Ag^+]^2 \times [CO_3^{2-}]$

2. $Ag_2CO_3(s) \rightleftharpoons 2Ag^+(aq) + CO_3^{2-}(aq)$

   $K_{sp} = [Ag^+]^2 \times [CO_3^{2-}]$

   Let $x = [CO_3^{2-}]$; $2x = Ag^+$

   $K_{sp} = (2x)^2(x) = 8.1 \times 10^{-12}$

   $4x^3 = 8.1 \times 10^{-12}$

   $x^3 = 2.0 \times 10^{-12}$

   $x = 1.3 \times 10^{-4} M = [CO_3^{2-}]$

   $[Ag^+] = 2x = 2.6 \times 10^{-4} M$

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3. $Fe(OH)_2(s) \rightleftharpoons Fe^{2+}(aq) + 2OH^-(aq)$

   $K_{sp} = [Fe^{2+}] \times [OH^-]^2$

   $[Fe^{2+}] = 0.5[OH^-] = 6.0 \times 10^{-6}$

   $K_{sp} = (6.0 \times 10^{-6})(1.2 \times 10^{-5})^2$

   $K_{sp} = 8.6 \times 10^{-16}$

4. $SrCO_3 \rightleftharpoons Sr^{2+}(aq) + CO_3^{2-}(aq)$

   $K_{sp} = [Sr^{2+}] \times [CO_3^{2-}]$

   Let $x = [Sr^{2+}] = [CO_3^{2-}]$

   $K_{sp} = x^2 = 9.3 \times 10^{-10}$

   $x = [Sr^{2+}] = 3.0 \times 10^{-5} M$

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5. $K_{sp} = [Ag^+]^2 \times [CO_3^{2-}]$

Let $[Ag^+] = 2x$; $[CO_3^{2-}] = x + 0.20$

assume $x << 0.20$ mol; $[CO_3^{2-}] = 0.20$

$K_{sp} = (2x)^2(0.20) = 8.1 \times 10^{-12}$

$x^2 = 1.0 \times 10^{-11}$

$x = 3.2 \times 10^{-6} M = [CO_3^{2-}]$

$[Ag^+] = 6.4 \times 10^{-6} M$

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6. $K_{sp}(PbSO_4) = 6.3 \times 10^{-7} = [Pb^{2+}] \times [SO_4^{2-}]$

$$[SO_4^{2-}] = 0.0050M = \frac{400.0 \text{ mL}}{1000.0 \text{ mL}} = 0.0020M$$

$$[Pb^{2+}] = 0.0020M = \frac{600.0 \text{ mL}}{1000.0 \text{ mL}} = 0.0012M$$

$[Pb^{2+}] \times [SO_4^{2-}] = (0.0012)(0.0020)$

$= 2.4 \times 10^{-6}$

Because this product exceeds the K_{sp} value, precipitation will occur.

7. $K_{sp}(CaCO_3) = 4.5 \times 10^{-9} = [Ca^{2+}] \times [CO_3^{2-}]$

The total volume is 1000 mL, so

$[Ca^{2+}] = 0.0021$ mol/L $= 0.0021M$

$[CO_3^{2-}] = 0.0013$ mol/L $= 0.0013M$

$[Ca^{2+}] \times [CO_3^{2-}] = (0.0021)(0.0013)$

$= 2.7 \times 10^{-6}$

Because this product exceeds the K_{sp} value, precipitation will occur.

8. NaCl has no ion in common with $Mg(OH)_2$.

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