# Chapter 4 Problem Set 1

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1. Write the molecular, complete ionic, and net equations for the following:

   (a) $BaCl_2$ and $Na_2SO_4$ (1)

$$BaCl_2(aq) + Na_2SO_4(aq) \longrightarrow 2\,NaCl(aq) + BaSO_4(s)$$

$$Ba^{2+}(aq) + 2\,Cl^-(aq) + 2\,Na^+(aq) + {SO_4}^{2-}(aq) \longrightarrow 2\,Cl^-(aq) + 2\,Na^+(aq) + BaSO_4(s) \quad (1)$$

$$Ba^{2+}(aq) + {SO_4}^{2-}(aq) \longrightarrow BaSO_4(s)$$

   (b) KOH and $Fe(NO_3)_3$ (2)

$$3\,KOH\,(aq) + Fe(NO_3)_3(aq) \longrightarrow 3\,KNO_3(aq) + Fe(OH)_3(s)$$

$$3\,K^+(aq) + 3\,OH^-(aq) + 3\,{NO_3}^-(aq) + Fe^{3+}(aq) \longrightarrow 3\,K^+(aq) + 3\,{NO_3}^-(aq) + Fe(OH)_3(s) \quad (2)$$

$$3\,OH^-(aq) + Fe^{3+}(aq) \longrightarrow Fe(OH)_3(s)$$

   (c) $Ca(C_2H_3O_2)_2$ and $K_2SO_4$ (3)

$$Ca(C_2H_3O_2)_2(aq) + K_2SO_4(aq) \longrightarrow 2\,KC_2H_3O_2(aq) + CaSO_4(s)$$

$$Ca^{2+}(aq) + 2\,{C_2H_3O_2}^-(aq) + 2\,K^+(aq) + {SO_4}^{2-}(aq) \longrightarrow 2\,{C_2H_3O_2}^-(aq) + 2\,K^+(aq) + CaSO_4(s) \quad (3)$$

$$Ca^{2+}(aq) + {SO_4}^{2-}(aq) \longrightarrow CaSO_4(s)$$

(d) $FeCl_3$ and NaOH (4)

$$\begin{aligned}
&3\,NaOH\,(aq) + FeCl_3(aq) \longrightarrow Fe(OH)_3(s) + 3\,NaCl\,(aq) \\
&Fe^{3+}(aq) + 3\,Cl^-(aq) + 3\,Na^+(aq) + 3\,OH^-(aq) \longrightarrow \\
&\qquad 3\,Cl^-(aq) + 3\,Na^+(aq) + Fe(OH)_3(s) \\
&Fe^{3+}(aq) + 3\,OH^-(aq) \longrightarrow Fe(OH)_3(s)
\end{aligned} \tag{4}$$

2. What volume of .25[M] $AgNO_3$ is required to react with:

(a) 82[mL] of .08[M] $Na_2S$ (5)

$$\begin{aligned}
82[\text{mL}] &= .082[\text{L}] \\
2\,AgNO_3(aq) + Na_2S\,(aq) &\longrightarrow AgS\,(s) + 2\,NaNO_3(aq) \\
.082 \cdot .08 = .00656[\text{mol}_{Na_2S}] &\rightarrow .01312[\text{mol}_{AgNO_3}] \\
\frac{.01312}{.25} &= .052[\text{L}_{AgNO_3}]
\end{aligned} \tag{5}$$

(b) 15[mL] of .44[M] $K_2CrO_4$ (6)

$$\begin{aligned}
15[\text{mL}] &= .015[\text{L}] \\
2\,AgNO_3(aq) + K_2CrO_4(aq) &\longrightarrow Ag_2CrO_4(s) + 2\,KNO_3(aq) \\
.015 \cdot .44 = .0066[\text{mol}_{K_2CrO_4}] &\rightarrow .0132[\text{mol}_{AgNO_3}] \\
\frac{.0132}{.25} &= .053[\text{L}_{AgNO_3}]
\end{aligned} \tag{6}$$

3. Write a net equation for the following:

(a) $HNO_3$ and $Ba(OH)_2$ (7)

$$H^+(aq) + OH^-(aq) \longrightarrow H_2O\,(l) \tag{7}$$

(b) LiOH and HB (8)

$$HB\,(aq) + OH^-(aq) \longrightarrow H_2O\,(l) + B^-(aq) \tag{8}$$

(c) $HClO_4$ and $NH_3$ (weak base) (9)

$$H^+(aq) + NH_3(aq) \longrightarrow NH_4{}^+(aq) \tag{9}$$

(d) $CH_3NH_2$ (weak base) and HBr (10)

$$H^+(aq) + CH_3NH_2(aq) \longrightarrow CH_3NH_3{}^+(aq) \tag{10}$$

(e) HF and KOH (11)

$$HF\,(aq) + OH^-(aq) \longrightarrow H_2O\,(l) + F^-(aq) \tag{11}$$

(f) $Mg(OH)_2$ and $H_2SO_4$ (12)

$$H^+(aq) + OH^-(aq) \longrightarrow H_2O\,(l) \tag{12}$$

(g) $HClO_4$ and CsOH (13)

$$H^+(aq) + OH^-(aq) \longrightarrow H_2O\,(l) \tag{13}$$