CHAPTER 8

ANSWER KEY

Limiting Reactant in Solution and Gas Stoichiometry Answer Key

BLM 8.1.5A

1. **(a)** $2AgNO_3(aq) + Na_2CrO_4(aq) \rightarrow Ag_2CrO_4(s) + 2NaNO_3(aq)$

$$0.0500\,\text{L AgNO}_3 \times 0.100\frac{\text{mol}}{\text{L}}\text{AgNO}_3 \times \frac{1\,\text{mol Ag}_2\text{CrO}_4}{2\,\text{mol AgNO}_3} = 0.00250\,\text{mol Ag}_2\text{CrO}_4\text{(s)}$$

$$0.0250\,\text{L Na}_2\text{CrO}_4 \times 0.150\frac{\text{mol}}{\text{L}}\text{Na}_2\text{CrO}_4 \times \frac{1\,\text{mol Ag}_2\text{CrO}_4}{1\,\text{mol Na}_2\text{CrO}_4} = 0.00375\,\text{mol Ag}_2\text{CrO}_4\text{(s)}$$

Silver nitrate is limiting.

(b) $0.00250\,\text{mol Ag}_2\text{CrO}_4 \times 331.74\frac{\text{g}}{\text{mol}}\text{Ag}_2\text{CrO}_4 = 0.829\,\text{g Ag}_2\text{CrO}_4\text{(s)}$

2. $Na_2S(s) + Pb(NO_3)_2(aq) \rightarrow 2NaNO_3(aq) + PbS(s)$

$$8.76\,\text{g Na}_2\text{S} \times \frac{\text{mol}}{78.05\,\text{g}}\text{Na}_2\text{S} \times \frac{1\,\text{mol PbS}}{1\,\text{mol Na}_2\text{S}} = 0.112\,\text{mol PbS(s)}$$

$$0.350\,\text{L Pb(NO}_3)_2 \times 0.250\frac{\text{mol}}{\text{L}}\text{Pb(NO}_3)_2 \times \frac{1\,\text{mol PbS}}{1\,\text{mol Pb(NO}_3)_2} = 0.0875\,\text{mol PbS(s)}$$

Lead(II) nitrate is limiting.

3. $Pb(NO_3)_2(aq) + 2KI(aq) \rightarrow PbI_2(s) + 2KNO_3(aq)$

$$0.0250\,\text{L Pb(NO}_3)_2 \times 0.400\frac{\text{mol}}{\text{L}}\text{Pb(NO}_3)_2 \times \frac{1\,\text{mol PbI}_2}{1\,\text{mol Pb(NO}_3)_2} = 0.0100\,\text{mol PbI}_2\text{(s)}$$

$$0.300\,\text{L KI} \times 0.220\frac{\text{mol}}{\text{L}}\text{KI} \times \frac{1\,\text{mol PbI}_2}{2\,\text{mol KI}} = 0.033\,\text{mol PbI}_2\text{(s)}$$

Lead(II) nitrate is limiting.

$$0.0100\,\text{mol PbI}_2 \times 461.00\frac{\text{g}}{\text{mol}}\text{PbI}_2 = 4.61\,\text{g PbI}_2\text{(s)}$$

The maximum mass of lead(II) iodide that can form is 4.61 g.

Limiting Reactant in Solution and Gas Stoichiometry Answer Key (continued)

4. $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$

$$PV = nRT$$

$$n = \frac{PV}{RT} \qquad n = \frac{PV}{RT}$$

$$n_{C_3H_8} = \frac{(101.325\,\text{kPa})(3.7\,\text{L})}{\left(8.314\,\frac{\text{kPa}\bullet\text{L}}{\text{mol}\bullet\text{K}}\right)(273.15\,\text{K})} \qquad n_{O_2} = \frac{(101.325\,\text{kPa})(11.2\,\text{L})}{\left(8.314\,\frac{\text{kPa}\bullet\text{L}}{\text{mol}\bullet\text{K}}\right)(273.15\,\text{K})}$$

$$n_{C_3H_8} = 0.17\,\text{mol} \qquad n_{O_2} = 0.500\,\text{mol}$$

$$0.17\,\text{mol } C_3H_8 \times \frac{3\,\text{mol } CO_2}{1\,\text{mol } C_3H_8} = 0.51\,\text{mol } CO_2(g) \qquad 0.500\,\text{mol } O_2 \times \frac{1\,\text{mol } C_3H_8}{5\,\text{mol } O_2} = 0.100\,\text{mol } C_3H_8(g)$$

Oxygen is the limiting reactant.

5. $H_2(g) + O_2(g) \rightarrow H_2O(\ell)$

$$n = \frac{PV}{RT}$$

$$n_{H_2O} = \frac{(102.5\,\text{kPa})(2.00\,\text{L})}{\left(8.314\,\frac{\text{kPa}\bullet\text{L}}{\text{mol}\bullet\text{K}}\right)(295.15\,\text{K})}$$

$$n_{H_2O} = 0.0835\,\text{mol}$$

$$0.0835\,\text{mol } H_2O \times 18.02\,\frac{\text{g}}{\text{mol}} = 1.50\,\text{g } H_2O$$

The quantity of liquid water expected is 1.50 g.