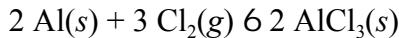


### Solution to Extra Problem 3.1 Using the “Set” Method



$$\text{mol Al} = (2.70 \text{ g Al}) \left( \frac{\text{mol Al}}{26.98 \text{ g Al}} \right) = 0.100 \text{ mol Al}$$

$$\text{mol Cl}_2 = (4.05 \text{ g Cl}_2) \left( \frac{\text{mol Cl}_2}{70.90 \text{ g Cl}_2} \right) = 0.0571_2 \text{ mol Cl}_2$$

(a) To determine the limiting reagent, take the number of moles of each reactant and divide by its stoichiometric coefficient in the balanced reaction equation. The smaller result identifies the limiting reagent. Then, use the number of moles of that reagent (*not* the number obtained by dividing by its coefficient) for all subsequent calculations.

$$\text{Al: } 0.100/2 = 0.0500$$

$$\text{Cl}_2: 0.0571/3 = 0.0190$$

Therefore,  $\text{Cl}_2$  is the limiting reagent.

(b) Calculate the grams of  $\text{AlCl}_3$  on the basis of the moles of  $\text{Cl}_2$ , the limiting reagent.

$$\text{g AlCl}_3 = (0.0571_2 \text{ mol Cl}_2) \left( \frac{2 \text{ mol AlCl}_3}{3 \text{ mol Cl}_2} \right) \left( \frac{133.33 \text{ g AlCl}_3}{\text{mol AlCl}_3} \right) = 5.08 \text{ g AlCl}_3$$

(c) Calculate the number of grams of Al used, based on the limiting reagent  $\text{Cl}_2$ . Then subtract the grams of Al used from the grams of Al given (2.70 g) to find the grams of Al left over.

$$\text{g Al used} = (0.0571_2 \text{ mol Cl}_2) \left( \frac{2 \text{ mol Al}}{3 \text{ mol Cl}_2} \right) \left( \frac{26.98 \text{ g Al}}{\text{mol Al}} \right) = 1.03 \text{ g Al}$$

$$\text{g Al left} = 2.70 \text{ g} - 1.03 \text{ g} = 1.67 \text{ g}$$