Problem 41

First I will use the ideal gas equation to determine the number of moles of \( \text{O}_2 \) in the enclosed volume.

\[
\begin{align*}
P &= 3.5 \times 10^{-3} \text{ torr} \\ &= \frac{1 \text{ atm}}{760 \text{ torr}} = 4.6 \times 10^{-3} \text{ atm} \\
V &= 0.382 \text{ L} \\
T &= 273 + 273 = 300 \text{ K} \\
n &= \frac{PV}{RT} = \frac{(4.6 \times 10^{-3} \text{ atm})(0.382 \text{ L})}{(0.08206 \text{ L atm/mol K})(300 \text{ K})} = 7.1 \times 10^{-11} \text{ mol O}_2
\end{align*}
\]

\[
7.1 \times 10^{-11} \text{ mol O}_2 \times \frac{2 \text{ mol Mg}}{1 \text{ mol O}_2} = \frac{24.3 \text{ g Mg}}{1 \text{ mol Mg}} = 3.5 \times 10^{-9} \text{ g Mg}
\]

Problem 47

a) The volume occupied by \( \text{N}_2 \) goes from 2.0 L to 5.0 L \((2 \times 2.5)\), but the temperature and number of moles remain unchanged.

\[
\frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2} \quad \Rightarrow \quad P_1V_1 = P_2V_2 \quad (\text{Since } n_1 = n_2 \text{ and } T_1 = T_2)
\]

\[
P_2(\text{N}_2) = \frac{P_1(\text{N}_2)V_1}{V_2} = \frac{(1.0 \text{ atm})(2.0 \text{ L})}{5.0 \text{ L}} = 0.4 \text{ atm}
\]

b) The volume of \( \text{O}_2 \) gas goes from 3.0 L to 5.0 L. The partial pressure of oxygen can be calculated just as was done for \( \text{N}_2 \).

\[
P_2(\text{O}_2) = \frac{P_1(\text{O}_2)V_1}{V_2} = \frac{(2.0 \text{ atm})(3.0 \text{ L})}{(5.0 \text{ L})} = 1.2 \text{ atm}
\]

c) \( P_{\text{tot}} = P_{\text{N}_2} + P_{\text{O}_2} = 0.4 \text{ atm} + 1.2 \text{ atm} = 1.6 \text{ atm} \)

Problem 54

a) 5.00 g \( \text{O}_2 \) \( \times \frac{1 \text{ mol O}_2}{32.00 \text{ g O}_2} = 0.156 \text{ mol O}_2 \)

7.50 g \( \text{N}_2 \) \( \times \frac{1 \text{ mol N}_2}{28.01 \text{ g N}_2} = 0.268 \text{ mol N}_2 \)

1.00 g \( \text{H}_2 \) \( \times \frac{1 \text{ mol H}_2}{2.016 \text{ g H}_2} = 0.494 \text{ mol H}_2 \)