Problem 54 (continued)

The total number of moles is

\[ n_{\text{tot}} = n_O_2 + n_N_2 + n_H_2 = 0.156 + 0.268 + 0.496 = 0.920 \text{ mol} \]

The mole fractions of each gas are:

\[ X_O_2 = \frac{0.156 \text{ mol}}{0.920 \text{ mol}} = 0.170 \]
\[ X_N_2 = \frac{0.268 \text{ mol}}{0.920 \text{ mol}} = 0.291 \]
\[ X_H_2 = \frac{0.496 \text{ mol}}{0.920 \text{ mol}} = 0.539 \]

b) The total pressure can be calculated from the ideal gas law

\[ P = \frac{nRT}{V} = \frac{(0.920 \text{ mol})(0.08206 \text{ L atm/mol K})(288 \text{ K})}{10.0 \text{ L}} = 2.17 \text{ atm} \]

Using the mole fractions and the total pressure I can calculate the partial pressure of each gas

\[ P_{O_2} = X_{O_2} P_{\text{tot}} = (0.170)(2.17) \text{ atm} = 0.370 \text{ atm} \]
\[ P_{N_2} = X_{N_2} P_{\text{tot}} = (0.291)(2.17) \text{ atm} = 0.633 \text{ atm} \]
\[ P_{H_2} = X_{H_2} P_{\text{tot}} = (0.539)(2.17) \text{ atm} = 1.17 \text{ atm} \]

Problem 58

a) False. The average kinetic energy of the gas molecules is proportional to the absolute temperature.

b) True.

c) False. For a gas at a given temperature, the individual molecules move at varying speeds.

d) True.