1. A sample of a gas occupies 1.40 x 10^3 mL at 25°C and 760 mmHg. What volume will it occupy at the same temperature and 380 mmHg?

\[
\begin{align*}
\frac{P_1 V_1 T_1}{T_2} &= \frac{P_2 V_2 T_2}{T_1} \\
V_2 &= \frac{P_1 V_1 T_1}{T_2} \\
T_2 &= 298 \text{ K} \\
V_2 &= 2.8 \text{ L}
\end{align*}
\]

2. A sample of N₂ gas occupies 2.40 L at 20°C. If the gas is in a container that can contract or expand at constant pressure, at what temperature will the N₂ occupy 4.80 L?

\[
\begin{align*}
V_1 &= 2.40 \text{ L} \\
V_2 &= 4.80 \text{ L} \\
T_1 &= 293 + 20 = 313 \text{ K} \\
T_2 &= \frac{T_1 V_1}{V_2} = \frac{313 \times 2.40}{4.80} = 156.5 \text{ K} \\
T_2 &= 2.87 \text{ K}
\end{align*}
\]

3. Calculate the volume occupied by 35.2 g of methane gas (CH₄) at 25°C and 1.0 atm.

\[
\begin{align*}
\text{Volume} &= \frac{\text{mass}}{\text{molar mass}} \times \frac{\text{R}}{T} \\
&= \frac{35.2 \text{ g}}{16.04 \text{ g/mol}} \times \frac{2.194 \text{ L atm/mol K}}{1 \text{ L atm/mol K}} \\
&= 53.7 \text{ L}
\end{align*}
\]

4. Calculate the density of CO₂(g) at 100°C and 10.0 atm pressure.

\[
\begin{align*}
\text{Density} &= \frac{\rho \times V}{n} \\
\rho &= \frac{m}{V} \\
&= \frac{44.01 \text{ g/mol} \times 0.0821 \text{ L atm/mol K} \times 273 \text{ K}}{1 \text{ L atm/mol K}} \\
&= 1.94 \text{ g/L}
\end{align*}
\]

5. Determine the molar mass of chloroform gas if a sample weighing 0.389 g is collected in a flask with a volume of 102 cm³ at 97°C. The pressure of the chloroform is 728 mmHg.

\[
\begin{align*}
\text{molar mass} &= \frac{m}{n} \times \frac{\text{R}}{T} \\
&= \frac{0.389 \text{ g}}{0.0032 \text{ mol}} \times \frac{0.0821 \text{ L atm/mol K} \times 373 \text{ K}}{1 \text{ L atm/mol K}} \\
&= 12.3 \text{ g/mol}
\end{align*}
\]

6. What volume of CO₂ gas at 645 torr and 800 K could be produced by the reaction of 45 g of CaCO₃ according to the equation?

\[
\begin{align*}
\text{CaCO₃(s)} &\rightarrow \text{CaO(s)} + \text{CO₂(g)} \\
45 \text{ g CaCO₃} &\rightarrow n \text{ mol CO₂} \\
\text{molar mass of CO₂} &= \frac{44.01 \text{ g/mol}}{62.07 \text{ g/mol}} \\
0.7496 \text{ mol CO₂} &= \frac{44.01 \text{ g/mol}}{62.07 \text{ g/mol}} \\
V &= \frac{nRT}{P} \\
&= \frac{0.7496 \text{ mol} \times 0.0821 \text{ L atm/mol K} \times 800 \text{ K}}{645 \text{ torr}} \\
&= 34.8 \text{ L}
\end{align*}
\]