1. A small bubble rises from the bottom of a lake, where the temperature and pressure are 4°C and 3.0 atm, to the water's surface, where the temperature is 25°C and pressure is 0.95 atm.

Calculate the final volume of the bubble if its initial volume was 2.1 mL.

\[ P_1 V_1 T_1 = P_2 V_2 T_2 \]

\[ P_1 = 3.0 \text{ atm}, \quad P_2 = 0.95 \text{ atm}, \quad V_1 = 2.1 \text{ mL}, \quad V_2 = ? \]

\[ T_1 = 273 + 4 = 277 \text{ K}, \quad T_2 = 273 + 25 = 308 \text{ K} \]

\[ V_2 = \left( \frac{P_1 V_1 T_1}{P_2 T_2} \right) \]

\[ V_2 = \left( \frac{(3.0 \text{ atm})(2.1 \text{ mL})(277 \text{ K})}{(0.95 \text{ atm})(308 \text{ K})} \right) \]

\[ V_2 = 7.1 \text{ mL} \]

2. Calculate the density, in g/L, of CO₂ gas at 27°C and 0.50 atm pressure.

\[ \rho = \frac{m}{V} \]

\[ m = \text{mass of CO₂} \]

\[ V = \text{volume of CO₂} \]

\[ n = \frac{m}{M} \]

\[ M = \text{molar mass of CO₂} \]

\[ V = \frac{nRT}{P} \]

\[ P = 0.50 \text{ atm} \]

\[ R = 0.0821 \text{ L atm/mol K} \]

\[ T = 273 + 27 = 300 \text{ K} \]

\[ \rho = \frac{m}{V} = \frac{\frac{m}{M}}{\frac{nRT}{P}} = \frac{mRT}{MP} \]

\[ \rho = \frac{(0.0821 \text{ L atm/mol K})(300 \text{ K})}{0.50 \text{ atm}} \]

\[ \rho = 49.2 \text{ g/L} \]

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

\[ \text{R} = 0.0821 \text{ L atm/mol K} \]

\[ n = \frac{m}{M} \]

\[ M = \text{molar mass of CH₄} \]

\[ n = \frac{35.2 \text{ g}}{(16.043 \text{ g/mol})} \]

\[ n = 2.19 \text{ mol} \]

\[ V = \frac{nRT}{P} \]

\[ V = \frac{(2.19 \text{ mol})(0.0821 \text{ L atm/mol K})(273 \text{ K})}{1.0 \text{ atm}} \]

\[ V = 54.1 \text{ L} \]

4. If 30.0 L of oxygen is cooled from 200°C to 1°C at constant pressure, what is the new volume of oxygen?

\[ \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \]

\[ (30.0 \text{ L})(274 \text{ K}) = V_2 (273 \text{ K}) \]

\[ V_2 = 17.4 \text{ L} \]

5. Determine the molar mass of Freon-11 gas if a sample weighing 0.597 g occupies 100 cm³ at 95°C, and 1.000 mmHg.

\[ \text{molar mass} = \frac{P V}{nRT} \]

\[ P = 100 \text{ torr} \]

\[ V = 100 \text{ cm}³ = 0.100 \text{ L} \]

\[ n = ? \]

\[ R = \frac{6.23 \text{ L atm/mol K}}{mol K} \]

\[ T = 368 \text{ K} \]

\[ n = \frac{0.597 \text{ g}}{0.00435 \text{ g/mol}} \]

\[ n = 137 \text{ g/mol} \]