Chapter 5

5. A mixture of gas contains 4 moles of O₂, 5 moles of N₂, and 2 moles of CO₂. The total pressure is 12.1 atmospheres. What is the partial pressure of each gas?

\[
P_{\text{total}} = \frac{4}{11} \times 12.1 = 4.45 \text{ atm} \quad \frac{5}{11} \times 12.1 = 5.54 \text{ atm} \quad \frac{2}{11} \times 12.1 = 2.20 \text{ atm}
\]

6. What is the formula for gas laws? (ideal gas law and real gas law)

\[
P \cdot V = n \cdot R \cdot T \quad \text{(ideal)} \quad P + \frac{\alpha_n}{v} \cdot (V - n_b) = n \cdot R \cdot T \quad \text{(real)}
\]

7. Which of the following is not a postulate of the kinetic molecular theory of gases?
   - Gas molecules are in constant random motion
   - Gas molecules are attracted to each other.
   - Gas molecules are infinitely small.
   - All gas molecules behave the same.
   - Gas molecules have elastic collisions.

8. What conditions do you expect in non-ideal gasses?

   \[
   \text{High pressure} \quad \text{Low temperature}
   \]

9. A 0.5 mol sample of oxygen is confined at 0°C and 1 atm in a cylinder with a movable piston. The piston compresses the gas so that the final volume is half the initial volume and the final pressure is 2.2 atm. What is the final temperature of the gas in degree Celsius?

\[
\frac{0.5 \text{ mol} \times 273.15 \text{ K}}{1 \text{ atm} \times 1 \text{ L}} = \frac{(0.5 \text{ mol})(T)(2.2 \text{ atm})}{(2.2 \text{ atm})(1 \text{ L})} \quad T = 27.36 \text{ K}
\]

10. How many moles will 5L of O₂ will exist at STP? (Assume ideal behavior)

\[
(1 \text{ atm})(5 \text{ L}) = n \cdot R \cdot 273.15 \text{ K} \quad n = 0.22 \text{ moles}
\]

11. 2.024 g of an unknown compound is vaporized and at a temperature of 99.0°C and a pressure of 0.976 atm has a volume of 708 mL. What is the molar mass of the compound?

\[
\frac{0.976 \text{ atm}}{1 \text{ atm}} \cdot \frac{0.708}{1} = n \cdot \frac{273.15 \text{ K}}{1 \text{ mol}} \quad n = 0.022627 \text{ moles}
\]

\[
\text{Molar mass} = \frac{2.024 \text{ g}}{0.022627 \text{ mol}} = 89.45 \text{ grams}
\]

12. When chlorine is added to acetylene, tetrachloroethane is formed: \(2\text{Cl}_2(g) + \text{C}_2\text{H}_2(g) \rightarrow \text{C}_2\text{H}_2\text{Cl}_4(l)\). How many liters of chlorine will be needed to make 75.0 g of \(\text{C}_2\text{H}_2\text{Cl}_4\)? (The pressure is 1.0 atm, and the temperature is 298 K.)

\[
75.0 \text{ g} = \text{moles} \cdot \frac{44 \text{ g}}{1 \text{ mol}} \quad \frac{2 \text{ mol} \text{Cl}_2}{1 \text{ mol} \text{C}_2\text{H}_2\text{Cl}_4} = 0.8937 \text{ moles Cl}_2
\]

\[
\left(1.0 \text{ atm}\right)\left(298 \text{ K}ight) = n \cdot R \cdot T
\]

\[
21.85 \text{ L}
\]