1. A balloon is filled with 1.00 L of helium at 27.0 °C and 1.00 atm. The balloon rises to a point in the atmosphere where the temperature is -35.0 °C and the pressure is 250. torr. What is the change in volume the balloon underwent?

2. When 0.72 g of a liquid is vaporized at 110°C and 0.967 atm, the gas occupies a volume of 0.559 L. The empirical formula of the gas is CH₂. What is the molecular formula of the gas?

3. A mixture of 1.00 g of hydrogen, 1.00 g of helium and 10.1 g of neon exerts a pressure of 0.480 atm. What is the partial pressure of each gas?

4. A flask contains a mixture of Ne and Ar. There are 0.250 mol of Ne which exerts a pressure of 0.205 atm. If the Ar exerts a pressure of 492 torr, what mass of Ar is in the flask?
5. The nitrogen content of an organic compound can be determined by producing nitrogen gas which is collected over water. In a given experiment, a sample produces 31.8 mL of N\textsubscript{2} at 25.0°C and 726 torr. What mass of nitrogen is in the compound? (The vapor pressure of water at 25.0 °C is 23.8 torr)

6. 2.5 mol of O\textsubscript{2} gas and 3.0 mol of solid carbon, C (s) are put into a 3.50 L container at 23°C. If the carbon and oxygen react completely to form CO (g), what will be the final pressure (in atm) in the container at 23°C?

7. It took 10.0 minutes for a sample of hydrogen gas to effuse through a porous barrier. How long will it take for the same amount of chlorine gas to effuse under identical conditions?

8. Calculate the temperature at which the average velocity of Ar (g) equals the average velocity of Ne (g) at 25°C.
9. Answer the following, given the velocity curves below:

![Velocity Curves](image)

a. If the plots represent 1.0 L H₂ versus 1.0 L N₂ at STP, which corresponds to each gas?

b. If the plots represent 1.0 L H₂ at 273 K versus 1.0 L H₂ at 1000 K, which corresponds to each temperature?

10. Consider 1.0 mol of nitrogen gas in 500 mL at 40.0 °C. Calculate the pressure using the van der Waals equation. (a = 1.39 atm L²/mol², b = 0.0391 L / mol)

11. True or false:
   a. Gases tend to behave more ideally at low temperatures and pressures.
   b. CO₂ and N₂O₄ gas have the same average kinetic energy at STP.
   c. Ideal gases experience intermolecular forces whereas real gases do not.
   d. 1 mol of CO at 1 atm and 25 °C has a greater collision frequency than 1 mol of N₂ at 0.9 atm and 25 °C.
   e. In the van der Waals equation the b value for helium is greater than the b value for methane.
\[ R = 0.08206 \ \frac{\text{L atm}}{\text{mol K}} \quad R = 8.314 \ \frac{\text{kg m}^2}{\text{sec}^2 \text{ mol K}} \quad 1 \ \text{atm} = 760 \ \text{torr} \quad PV = nRT \quad \pi = 3.14159 \]

\[ \frac{P_1V_1}{n_1T_1} = \frac{P_2V_2}{n_2T_2} \quad P_1 = X_iP_{\text{tot}} \quad X_i = \frac{n_i}{n_{\text{tot}}} \quad K_p = K(RT)^{\lambda_{\text{gas}}} \quad \text{STP} = 0^\circ \text{C}, 1 \ \text{atm} \]

\[ (KE)_{\text{av}} = \frac{1}{2}n u^2 = \frac{3}{2}RT \quad u_{\text{av}} = \bar{u} = \sqrt{\frac{8RT}{\pi M}} \quad u_{\text{rms}} = \sqrt{u^2} = \sqrt{\frac{3RT}{M}} \quad Z = \frac{4\left(\frac{N}{V}\right)}{V}d^2\sqrt{\frac{\pi RT}{M}} \]

\[ 0^\circ \text{C} = 273.15 \ \text{K} \quad \text{effusion rate of gas}_1 = \sqrt{\frac{M_2}{M_1}} \quad N = 6.02 \times 10^{23} \ \text{mol}^{-1} \]

**PERIODIC TABLE**