$PV = nRT$  
$P \cdot M = dRT$  
$R = 0.08206 \text{ L} \cdot \text{atm} \cdot \text{K}^{-1} \cdot \text{mol}^{-1}$  
$OR \ 8.314 \ (\text{kg} \cdot \text{m}^2)/(s^2 \cdot \text{K} \cdot \text{mol})$  
$u = (3RT/M)^{1/2}$

1. Indicate whether each of the following statements is True or False:
   a. STP corresponds to 298 °C and 1 atm pressure.  
      ______________
   b. The rms speed of He atoms at 10°C is greater than the rms speed of Ne atoms at 283 K.  
      ______________
   c. Consider a sample of gas at constant T. The kinetic molecular theory predicts that the pressure exerted by this gas
      will decrease as volume increases because the frequency of particle collisions decreases.  
      ______________
   d. Consider a mixture of nonreactive gases X, Y, and Z. For this mixture $P_X + P_Y + P_Z$ must equal 1.  
      ______________

2. a. Calculate the rms speed (in m/s) of $O_2$ molecules at 350°C.  
      ______________
   b. In an experiment, 50.0 mL of $O_2$ effuses in 1.76 s. Under identical experiment conditions, 100.0 mL of an unknown
      gas requires 5.18 s to effuse. Calculate the molar mass of the unknown gas.  
      ______________

3. Consider a mixture of Ne (g) and $N_2$ (g) at 254 K and 7.50 L. For this mixture $n_{tot} = 0.626 \text{ mol}$, and $P_{Ne} = 1.02 \text{ atm}$.  
   a. Determine the total pressure (in atm) exerted by this mixture.  
      ______________
   b. Calculate the mole fraction of $N_2$ in the mixture ($\chi_{N_2}$).  
      ______________

4. Consider the following reaction: $\text{Mg}_3\text{N}_2 (s) + 6 \text{ H}_2\text{O} (l) \rightarrow 3 \text{ Mg(OH)}_2 (s) + 2 \text{ NH}_3 (g)$.  
   If 0.575 g $\text{Mg}_3\text{N}_2$ is allowed to react completely with excess water, determine the volume (in mL) of $\text{NH}_3 (g)$ that will form
   at 792 torr and 29°C. For $\text{Mg}_3\text{N}_2$, molar mass = 101.0 g/mol.  
   ______________
5. Consider the following reaction run at constant T in a constant volume container: \( \text{N}_2 (g) + 3 \text{H}_2 (g) \rightarrow 2 \text{NH}_3 (g) \). 0.256 atm \( \text{N}_2 (g) \) is combined with 0.845 atm \( \text{H}_2 (g) \), and the reaction proceeds.

a. Identify the limiting reactant in this system. 

b. Determine the total pressure (in atm) in the reaction vessel when the reaction is complete.

6. Consider a 5.00 L sample of \( \text{Cl}_2 \) at 33°C exerting a pressure of 3.65 atm to answer a – c below. Take these to be the starting conditions for each part of the problem that follows.

a. With the sample held at constant T, \( P \) is adjusted to 1824 mmHg. Calculate the volume occupied.

b. Circle the one best answer below to complete the following statement. If this sample is held at constant volume and the temperature is changed to 300 K, the pressure will ______ .

   - increase
   - decrease
   - remain constant

c. Circle the one best answer below to complete the following statement. If \( 1 \times 10^{10} \text{Cl}_2 \) molecules are added at constant temperature and volume, the pressure will ______ .

   - increase
   - decrease
   - remain constant

7. At 305 K and some pressure the density of carbon monoxide (CO, molar mass \( 28.01 \text{ g/mol} \)) is 1.80 g/L. Determine this pressure (in atm).

   ____________________
1. Consider a 5.00 L sample of $F_2$ at 33°C exerting a pressure of 3.65 atm to answer $a - c$ below. Take these to be the starting conditions for each part of the problem that follows.
   a. With the sample held at constant $T$, $P$ is adjusted to 1824 mmHg. Calculate the volume occupied. __________
   
   b. Circle the one best answer below to complete the following statement. If $1 \times 10^{10}$ $Cl_2$ molecules are added at constant temperature and volume, the pressure will __________.
      
      increase  decrease  remain constant

   c. Circle the one best answer below to complete the following statement. If this sample is held at constant volume and the temperature is changed to 300 K, the pressure will __________.
      
      increase  decrease  remain constant

2. Consider the following reaction: $Mg_3N_2$ (s) + $6$ $H_2O$ (l) $\rightarrow$ $3$ $Mg(OH)_2$ (s) + $2$ $NH_3$ (g).
   If 0.575 g $Mg_3N_2$ is allowed to react completely with excess water, determine the volume (in mL) of $NH_3$ (g) that will form at 792 torr and 29°C. For $Mg_3N_2$, molar mass = 101.0 g/mol.

   ________________

3. At 305 K and some pressure the density of carbon monoxide (CO, molar mass 28.01 g/mol) is 1.80 g/L. Determine this pressure (in atm).

   ________________

4. Indicate whether each of the following statements is True or False:
   a. Consider a sample of gas at constant $T$. The kinetic molecular theory predicts that the pressure exerted by this gas will decrease as volume increases because the frequency of particle collisions decreases. ______________
   b. Consider a mixture of nonreactive gases X, Y, and Z. For this mixture $P_X + P_Y + P_Z$ must equal 1. ______________
   c. STP corresponds to 298 °C and 1 atm pressure. ______________
   d. The rms speed of He atoms at 10°C is greater than the rms speed of Ne atoms at 283 K. ______________
5. a. Calculate the rms speed (in m/s) of O\textsubscript{2} molecules at 350\(^\circ\)C.

b. In an experiment, 50.0 mL of O\textsubscript{2} effuses in 1.76 s. Under identical experiment conditions, 100.0 mL of an unknown gas requires 5.18 s to effuse. Calculate the molar mass of the unknown gas.

6. Consider a mixture of Ne (g) and N\textsubscript{2} (g) at 254 K and 7.50 L. For this mixture \(n_{\text{tot}} = 0.626\) mol, and \(P_{\text{Ne}} = 1.02\) atm.

a. Determine the total pressure (in atm) exerted by this mixture.

b. Calculate the mole fraction of N\textsubscript{2} in the mixture (\(\chi_{\text{N}_2}\)).

7. Consider the following reaction run at constant T in a constant volume container: \(\text{N}_2 (g) + 3\ \text{H}_2 (g) \rightarrow 2\ \text{NH}_3 (g)\). 0.256 atm N\textsubscript{2} (g) is combined with 0.845 atm H\textsubscript{2} (g), and the reaction proceeds.

a. Identify the limiting reactant in this system.

b. Determine the total pressure (in atm) in the reaction vessel when the reaction is complete.