5. Ex: A balloon is put in a bell jar and the pressure is reduced from 782 torr to 0.500 atm. If the volume of the balloon is now $2.78 \times 10^3$ mL, what was it originally?

\[
P_1V_1 = P_2V_2
\]

\[
(1.03 \text{ atm})(2.78 \times 10^3 \text{ mL}) = (0.500 \text{ atm})V_2
\]

\[
V_2 = 5.73 \times 10^3 \text{ mL}
\]

4. Ex: A gas has a volume of 2.57 L at 0.00 °C. What was the temperature at 2.80 L?

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

\[
\frac{2.57 \text{ L}}{273 \text{ K}} = \frac{2.80 \text{ L}}{T_2}
\]

\[
T_2 = 297 \text{ K} = 24^\circ \text{C}
\]
F. Ex: A high-performance bicycle tire has a pressure of 132 psi. What is the pressure in mmHg?

\[
\frac{132 \text{ psi}}{760 \text{ mmHg}} = 6.82 \times 10^3 \text{ mmHg}
\]

G. Ex: Convert 45.5 psi into kPa

\[
\frac{45.5 \text{ psi}}{101.325 \text{ kPa}} = 314 \text{ kPa}
\]

4. Ex: A cylinder with a movable piston has a volume of 7.25 L at 4.52 atm. What is the volume at 1.21 atm?

\[
P_1V_1 = P_2V_2
\]

\[
(4.52 \text{ atm})(7.25 \text{ L}) = (1.21 \text{ atm})V_2
\]

\[
V_2 = 27.1 \text{ L}
\]
5. Ex: The temperature inside a balloon is raised from 25.0°C to 250.0°C. If the volume of cold air was 10.0 L, what is the volume of hot air?

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

\[
\frac{10.0 \text{ L}}{298 \text{ K}} = \frac{V_2}{523 \text{ K}} \quad V_2 = 17.6 \text{ L}
\]

4. Ex: How many moles of gas are in a basketball with total pressure 24.3 psi, volume of 3.24 L at 25°C?

\[
P \cdot V = nRT
\]

\[
(1.65 \text{ atm})(3.24 \text{ L}) = n \left(0.08206 \frac{\text{L atm}}{\text{mol K}}\right)(298 \text{ K})
\]

\[
n = 0.219 \text{ mol gas}
\]
3. Ex: What volume will 1.00 mol of O₂ occupy at 1.00 atm and 273 K?

\[
\frac{P_o V}{n_o} = \frac{P_{o_2}}{(1.00 \text{ atm}) (1 \text{ mol}) (0.08206 \text{ L atm mol}^{-1} \text{ K}^{-1}) (273 \text{ K})}
\]

\[V = \frac{n_{o_2} R T}{P_{o_2}} = \frac{1 \text{ mol}}{1.00 \text{ atm}} = 22.40 \text{ L}
\]

4. Ex: A gas occupies 10.0 L at 44.1 psi and 27 °C. What volume will it occupy at 1.00 atm and 273 K?

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

\[
(3.00 \text{ atm})(10.0 \text{ L}) = \frac{(1.00 \text{ atm})(V_2)}{300 \text{ K}} (273 \text{ K})
\]

\[V_2 = 27.3 \text{ L}
\]
5. Ex: Calculate the volume occupied by 637 g of SO\textsubscript{2} (MM 64.07) at 6.08 \times 10^{4} \text{ mmHg} and -23 \degree \text{C}.

\[
\frac{637 \text{ g SO}_2}{1 \text{ mol SO}_2} \times \frac{1 \text{ mol SO}_2}{64.07 \text{ g SO}_2} = 9.94 \text{ mol SO}_2
\]

\[
P_{\text{SO}_2} = n_{\text{SO}_2} \cdot RT
\]

\[
V = \frac{n_{\text{SO}_2} \cdot RT}{P_{\text{SO}_2}} = \frac{(9.94 \text{ mol}) \cdot 12 \text{ (250 K)}}{80 \text{ atm}}
\]

\[
V = 2.55 \text{ L}
\]

4. Ex: Determine the mass of Ar in a mixture of He, Ne and Ar with: \(P_{\text{He}} = 341 \text{ mmHg}, P_{\text{Ne}} = 112 \text{ mmHg}, P_{T} = 662 \text{ mmHg}, V = 1.00 \text{ L}, T = 298 \text{ K}\).

\[
P_{T} = P_{\text{He}} + P_{\text{Ne}} + P_{\text{Ar}}
\]

\[
662 = 341 + 112 + P_{\text{Ar}}
\]

\[
P_{\text{Ar}} = 209 \text{ mmHg} = 0.275 \text{ atm}
\]

\[
P_{\text{Ar}} \cdot V = n_{\text{Ar}} \cdot RT
\]

\[
v = \frac{n_{\text{Ar}}}{R \cdot T} = \frac{P_{\text{Ar}} \cdot V}{R \cdot (298 \text{ K})} = \frac{0.275 \text{ atm} \times 1.00 \text{ L}}{R \cdot (298 \text{ K})}
\]

\[
n_{\text{Ar}} = 0.0112 \text{ mol}
\]

\[
\text{mass } \text{Ar} = n_{\text{Ar}} \cdot M_{\text{Ar}} = 0.0112 \text{ mol} \times 39.94 \text{ g/mol}
\]

\[
\text{mass } \text{Ar} = 0.449 \text{ g}
\]
5. Ex: Find the partial pressure of neon in a mixture with total pressure 3.9 atm, volume = 8.7 L, temperature = 598 K, and 0.17 moles Xe.

\[ P_{\text{Xe}} \quad P_{\text{Ne}} \quad P_{\text{T}} \]

\[ P_{\text{T}} = P_{\text{Ne}} + P_{\text{Xe}} \]

\[ 3.9 \text{ atm} = P_{\text{Ne}} + 0.956 \text{ atm} \]

\[ P_{\text{Ne}} = 2.94 \text{ atm} \]

\[ P_{\text{Xe}} = \frac{(0.17 \text{ mol}) R (598 \text{ K})}{8.7 \text{ L}} \]

\[ P_{\text{Xe}} = 0.956 \text{ atm} \]

6. Ex: Find the mole fractions and partial pressures in a 12.5 L tank with 24.2 g He and 4.32 g O₂ at 298 K.

\[ X_{\text{He}} = \frac{6.05}{6.19} = 0.977 \]

\[ X_{\text{O₂}} = 1 - 0.977 = 0.023 \]

\[ V = 12.5 \text{ L} \]

\[ T = 298 \text{ K} \]

\[ n_{\text{total}} = 6.19 \text{ mol} \]

\[ P_{\text{He}} = X_{\text{He}} P_{\text{T}} = 11.4 \text{ atm} \]

\[ P_{\text{O₂}} = X_{\text{O₂}} P_{\text{T}} = 0.30 \text{ atm} \]

\[ P_{\text{T}} = \frac{nRT}{V} = \frac{(6.19) (R) (298 \text{ K})}{12.5 \text{ L}} \]

\[ P_{\text{T}} = 12.1 \text{ atm} \]
7. Ex: Find the mole fraction of neon in a mixture with total pressure 3.9 atm, volume 8.7 L, temperature 598 K, and 0.17 moles Xe.

\[
\begin{align*}
P_{Xe} &= \frac{nRT}{V} \\
P_{Xe} &= \frac{(0.17 \text{ mol})(1)(598 \text{ K})}{8.7 \text{ L}} = 0.956 \text{ atm} \\
\frac{P_{Xe}}{P_T} &= \frac{0.956 \text{ atm}}{3.9 \text{ atm}} = 0.247 \\
X_{Ne} &= \frac{P_{Ne}}{P_T} = \frac{2.94 \text{ atm}}{3.9 \text{ atm}} = 0.754
\end{align*}
\]

3. Ex: 1.02 L of O\textsubscript{2} collected over water at 293 K with a total pressure of 755.2 mmHg. Find the mass of O\textsubscript{2}.

\[
\begin{align*}
P_T &= P_{O_2} + P_{H_2O} \\
755.2 \text{ mmHg} &= P_{O_2} + 17.55 \\
P_{O_2} &= 737.7 \text{ mmHg} = 0.971 \text{ atm} \\
P_{O_2} V &= n_{O_2} RT \\
n_{O_2} &= \frac{P_{O_2} V}{RT} = \frac{(0.971 \text{ atm})(1.02 \text{ L})}{12 \text{ L} \text{ mol} \text{ K}/\text{mol}} = 0.041 \text{ mol O}_2
\end{align*}
\]
4. Ex: 0.12 moles of H₂ is collected over water in a 10.0 L container at 323 K. Find the total pressure.

\[ P_{H_2}V = n_{H_2}RT \]

\[ P_{H_2} = \frac{(0.12)(12)(323K)}{10.0L} = 0.318 \text{ atm} = 242 \text{ mm Hg} \]

\[ P_T = P_{H_2} + P_{H_2O} \]

\[ = 242 \text{ mm Hg} + 92.6 \text{ mm Hg} = 335 \text{ mm Hg} \]

1. Ex: What volume of H₂ is needed to make 35.7 g of CH₃OH at 738 mmHg and 355 K?

\[ \text{CO(g)} + 2 \text{H}_2(g) \rightarrow \text{CH}_3\text{OH(g)} \]

\[ \frac{35.7 \text{ g CH}_3\text{OH}}{32.04 \text{ g CH}_3\text{OH}} \times \frac{1 \text{ mol CH}_3\text{OH}}{2 \text{ mol H}_2} = 2.23 \text{ mol H}_2 \]

\[ P_{H_2}V = n_{H_2}RT \]

\[ V = \frac{n_{H_2}RT}{P_{H_2}} = \frac{(2.23 \text{ mol}) R (355 \text{ K})}{0.971 \text{ atm}} \]

\[ V = 66.9 \text{ L} \]
2. Ex: How many grams of H₂O form when 1.24 L H₂ reacts completely with O₂ at 1.00 atm and 273 K?

\[ \text{O}_2(g) + 2 \text{H}_2(g) \rightarrow 2 \text{H}_2\text{O}(g) \]

\[ \frac{P_{\text{H}_2}}{P_{\text{O}_2}} = \frac{n_{\text{H}_2}}{n_{\text{O}_2}} \frac{RT}{RT} = \frac{(1.00 \text{ atm})(1.24 \text{ L})}{12 \text{ mol} \text{H}_2 \cdot (273 \text{ K})} \]

\[ n_{\text{O}_2} = 0.0554 \text{ mol H}_2 \]

\[ 0.0554 \text{ mol O}_2 \cdot 2 \text{ mol H}_2\text{O} \cdot 18.02 \text{ g H}_2\text{O} = 2.00 \text{ g H}_2\text{O} \]

\[ 1 \text{ mol O}_2 \cdot 2 \text{ mol H}_2\text{O} \cdot 1 \text{ mol H}_2\text{O} \]

3. Ex: What volume of O₂ at 0.750 atm and 313 K is generated by the thermolysis of 10.0 g of HgO?

\[ \text{HgO(s)} \rightarrow \text{Hg(l)} + \text{O}_2(g) \]

\[ \frac{10.0 \text{ g HgO}}{216.6 \text{ g HgO}} = 0.0231 \text{ mol O} \]

\[ \frac{P_{\text{H}_2}}{P_{\text{O}_2}} = \frac{n_{\text{O}_2} \cdot RT}{RT} \]

\[ V = \frac{n_{\text{O}_2} \cdot RT}{P_{\text{O}_2}} = \frac{(0.0231) \cdot (2) \cdot (313 \text{ K})}{0.750 \text{ atm}} = 0.791 \text{ L} \]
6. Ex: Draw a Boltzmann Distribution using molecular speed on the x-axis for methane at $T = 300 \, \text{K}$ and at $T = 500 \, \text{K}$.

Two things we know:

$$\frac{KE}{RT}$$

So at the different temps with $KE$ on the x-axis, you get different curves.

$$T \propto \frac{KE}{\frac{1}{2} m v^2}$$

at the same $T_i$ lighter gases move faster.

This question: for the same gas, it has higher velocity @ higher $T$. 