4. Describe how a mercury barometer and manometer are used to measure gas pressure.
   - A barometer measures the pressure of the atmosphere by measuring the height to which a column of mercury rises to offset the force per unit area exerted by the atmosphere on a pool of mercury.
   - A manometer measures the pressure of a gas in a container by measuring the height of a column of mercury representing the difference between the pressure of the gas and atmospheric pressure (open manometer) or the absolute pressure (closed manometer).

7. Would it be easier to drink water with a straw on top of Mt. Everest or at the foot of the mountain?
   It would be harder on the top of the mountain because the external pressure pushing on the liquid to force it up the straw is less.

14. The atmospheric pressure at the summit of Denali is 606 mmHg on a certain day. What is this pressure in atm and in kPa?
   \[ 606 \text{ mmHg} \times \frac{1 \text{ atm}}{760 \text{ mmHg}} = 0.797 \text{ atm} \]
   \[ 0.797 \text{ atm} \times \frac{101.325 \text{ kPa}}{1 \text{ atm}} = 80.8 \text{ kPa} \]

18. Given the cylinder at right that represents volume & density of a gas at \( n, P, \) and \( T \), select the cylinder below that best represents the following changes. Explain your selections.
   (1) Pressure tripled at constant \( n \) & \( T \)
      \( (b) \). \( V \propto \frac{1}{P} \), so as the pressure is tripled at constant \( n \) and \( T \), the volume will decrease to \( \frac{1}{3} \) of its original volume.

   (2) Temperature doubled at constant \( n \) & \( P \)
      \( (a) \). \( V \propto T \), so as the temperature is doubled constant \( n \) and \( P \), the volume will also double and the density of the gas will decrease. This decrease in gas density is indicated by the lighter shading.

   (3) \( n \) moles of another gas added at constant \( T \) & \( P \)
      \( (c) \). \( V \propto n \), so doubling \( n \) will double the volume. The density of the gas will remain the same as moles are doubled and volume is doubled.

(4) \( T \) halved and \( P \) reduced to \( \frac{1}{4} \)
      \( (a) \). \( V \propto T \) and \( V \propto \frac{1}{P} \). Halving the temperature would decrease the volume to \( \frac{1}{2} \) its original volume.

20. At 46°C a sample of ammonia gas exerts a pressure of 5.3 atm. What is the pressure when the volume of the gas is reduced to one-tenth (0.10) of the original value at the same temperature.
   \[ P_1 V_1 = P_2 V_2 \rightarrow P_2 = \frac{P V_1}{V_2}, \text{ so } P_2 = \frac{(5.3 \text{ atm})V_1}{0.10V_1} = 53 \text{ atm} \]
22 A sample of air occupies 3.8 L when the pressure is 1.2 atm.
(a) What volume does it occupy at 6.6 atm? (constant T)

\[ P_1 V_1 = P_2 V_2 \quad \Rightarrow \quad V_2 = \frac{P_1 V_1}{P_2} \]

so

\[ V_2 = \frac{(1.2 \text{ atm})(3.8 \text{ L})}{(6.6 \text{ atm})} = 0.69 \text{ L} \]

(b) What pressure is required in order to compress it to 0.075 L? (constant T)

\[ P_1 V_1 = P_2 V_2 \quad \Rightarrow \quad P_2 = \frac{P_1 V_1}{V_2} \]

so

\[ P_2 = \frac{(1.2 \text{ atm})(3.8 \text{ L})}{(0.075 \text{ L})} = 61 \text{ atm} \]

24 Under constant-pressure conditions a sample of hydrogen gas initially at 88°C and 9.6L is cooled until its final volume is 3.4L. What is its final temperature?

\[ \frac{V_1}{T_1} = \frac{V_2}{T_2} \quad \Rightarrow \quad T_2 = \frac{T V_2}{V_1} \]

so

\[ T_2 = \frac{(361 \text{ K})(3.4 \text{ L})}{(9.6 \text{ L})} = 1.3 \times 10^2 \text{ K} \]

26 Molecular chlorine and molecular fluorine combine to form a gaseous product. Under the same conditions of temperature and pressure it is found that one volume of Cl\textsubscript{2} reacts with three volumes of F\textsubscript{2} to yield two volumes of the product. What is the formula of the product?

The volume ratio, 1 vol. Cl\textsubscript{2} : 3 vol. F\textsubscript{2} : 2 vol. product, can be written as a mole ratio: 1 mol Cl\textsubscript{2} : 3 mol F\textsubscript{2} : 2 mol product since mol Cl\textsubscript{2} = 1 Cl

Thus, \[ \text{1 Cl}_2(g) + \text{3 F}_2(g) \rightarrow \text{2 ClF}_3(g) \]

Making \( x = 1 \) gives two Cl atoms on each side of the equation. Likewise, if \( y = 3 \) then there are 6 atoms of F on each side:

\[ \text{Cl}_2(g) + 3 \text{ F}_2(g) \rightarrow 2 \text{ ClF}_3(g) \] so the formula of the product is ClF\textsubscript{3}.

A Given the diagrams of the two manometer diagrams below:

(a) For \( h_{\text{open}} > h_{\text{closed}} \), determine \( P_{\text{gas}} \) in kPa if \( P_{\text{atm}} = 748 \text{ mmHg} \) and \( \Delta h = 125 \text{ mm} \)

\[ P_{\text{gas}} = \frac{748 \text{ mmHg} + 125 \text{ mmHg}}{873 \text{ mmHg}} \times \frac{101.3 \text{ kPa}}{760 \text{ mmHg}} = 116 \text{ kPa} \]

(b) For \( h_{\text{open}} < h_{\text{closed}} \), determine \( P_{\text{gas}} \) in kPa if \( P_{\text{atm}} = 752 \text{ mmHg} \) and \( \Delta h = 93 \text{ mm} \)

\[ P_{\text{gas}} = \frac{752 \text{ mmHg} - 93 \text{ mmHg}}{659 \text{ mmHg}} \times \frac{101.3 \text{ kPa}}{760 \text{ mmHg}} = 87.8 \text{ kPa} \]