CHM 111 Chapter 9 Worksheet and Study Guide

Purpose: This is a guide for your as you work through the chapter. The major topics are provided so that you can write notes on each topic and work the corresponding problems.

This should serve a s a study guide as you go on to do the problems in Sapling and take the quizzes and exams.

The Problems are embedded in the Topics and Space for Notes

1. **Define the property of pressure**
   Define and convert among the units of pressure measurements (know atm, kPa, mmHg and Torr)
   Describe the operation of common tools for measuring gas pressure (barometer.)
   Calculate pressure from manometer data.

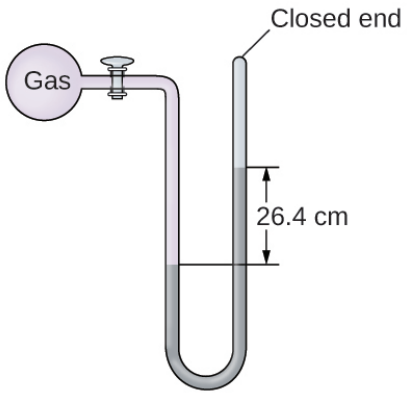
(A) The pressure of a sample of gas is measured at sea level with a closed-end manometer. The liquid in the manometer is mercury.

Determine the pressure of the gas in:

(a) torr

(b) Pa

(c) bar



(B) Convert Pressure:

Convert 1.57 atm to kPa, mmHg and Torr.

2. Identify the mathematical relationships between the various properties of gases.
Use the ideal gas law, and related gas laws, to compute the values of various gas properties under specified conditions. <u>Remember Temperature in Kelvins always!</u>

Boyle's law: $P_1V_1 = P_2V_2$ **at constant at constant T and n**

Amontons's law $\frac{P_1}{T_1} = \frac{P_2}{T_2}$ **at constant at constant V and n**

Charles's law $\frac{V_1}{T_1} = \frac{V_2}{T_2}$ **at constant at constant P and n**

Avogadro's law $\frac{V_1}{n_1} = \frac{V_2}{n_2}$ **at constant at constant P and T**

Combined Gas Law $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ **at constant n**

(A) A gas with a volume of 500. mL at 75 °C is heated to 225 °C. What is the new volume of the gas?

(B) 250. mL of an ideal gas at 225 Torr is compressed to a pressure of 5.76 atm at constant pressure. What is the final volume of the gas?

(C) A sample of hydrogen gas at a temperature of 275 K and a pressure of 0.456 atm is allowed to expand to a pressure of 845 mmHg. What is the new Temperature of the gas?

(D) A weather balloon with a volume of 50.0 L at 25 °C and a pressure of .975 atm is released into the air. It rises to an altitude where the pressure is .125 atm and the Temperature is –15 °C. What is the new volume of the balloon?

Ideal Gas Law **PV = nRT** **where R =0.08206** $\frac{Liters \cdot atmospheres}{mole \cdot Kelvin}$

Know STP **STP, standard temperature (273 K or 0°C) and standard pressure (1 atm)**
The volume of 1 mole of any ideal gas is 22.4 L

V of a gas at STP = 22.4 $\frac{Liters}{mole}$

(E) 15.8 grams of Ne is placed in a 8.75 L flask at 35.0 °C. What is the pressure in the flask?

(F) What is the volume of 15.8 grams of SF_6 (g) at STP?

3. Use the ideal gas law to compute gas densities and molar masses
Perform stoichiometric calculations involving gaseous substances
State Dalton's law of partial pressures and use it in calculations involving gaseous mixtures

density = $\frac{Pressure \cdot Molar\ Mass}{R \cdot T}$

Molar mass = $\frac{grams\ of\ gas \cdot R \cdot T}{P \cdot V}$

Pressure Total = Pressure$_A$ + Pressure$_B$ + …

(A) Determine the volume of H_2S (at 75.0 °C and 845 mm Hg) needed to produce 55.0 g of S. Assume that there is excess SO_2 present: $2\ H_2S(g) + SO_2(g) \rightarrow 3\ S(s) + 2\ H_2O(g)$

(B) 25.0 grams of $(NH_4)_2CO_3$ is decomposed in an empty container at 100.0 °C and 1.00 atm. If the reaction is: $(NH_4)_2CO_3(s) \rightarrow 2\ NH_3(g) + H_2O(g) + CO_2(g)$, What is the final volume?

(C) If 0.364 grams of a gas has a volume of 260. mL at a pressure of 740. Torr and a temperature of 100. °C, what is the Molar Mass of the gas?

(D) The density of a sulfur vapor at 445 °C and 755 Torr is 4.33 g/L. What is the molecular formula of the sulfur**?**

4. **Define and explain effusion and diffusion**

State Graham's law and use it to compute relevant gas properties.

$$\frac{Rate_1}{Rate_2} = \sqrt{\frac{Molar\ Mass_2}{Molar\ Mass_1}}$$

(A) Identify the molecule that effuses the fastest.

a) CO
b) Ar
c) CH_4
d) CO_2

(B) Calculate the ratio of effusion rates of Cl_2 to F_2.

a) 1.3661
b) 0.53588
c) 1.8661
d) 0.28716
e) 0.73204

5. **The Kinetic-Molecular Theory: State the postulates of the kinetic-molecular theory. Use this theory's postulates to explain the gas laws.**

Kinetic Theory of Gases

a) **Gases are composed of molecules that are in continuous motion, travelling in straight lines and changing direction only when they collide with other molecules or with the walls of a container.**
b) **The molecules composing the gas are negligibly small compared to the distances between them.**
c) **The pressure exerted by a gas in a container results from collisions between the gas molecules and the container walls.**
d) **Gas molecules exert no attractive or repulsive forces on each other or the container walls; therefore, their collisions are elastic (do not involve a loss of energy).**

e) The average kinetic energy of the gas molecules is proportional to the kelvin temperature of the gas.

6. Explain how real gases deviate from ideal gases.

Describe the physical factors that lead to deviations from ideal gas behavior

(A) Which of the following samples will have the greatest average speed at 355 K?

a) Ne
b) C_2H_4
c) Cl_2
d) CH_4
e) They all have the same speed.

(B) Which of the following compounds will behave **least** like an ideal gas at low temperatures?

a) He
b) SO_2
c) H_2
d) N_2
e) F_2