Today: continue w/ chapter 10 November 15th
→ study pre-lab to expt 12
Sunday: problem club w/ Kendall
Monday: Finish ch.10 & start ch.11

A sample of gas with a mass of 3.21g has a volume of 1072 mL at 100°C and 720 mmHg. What is its molar mass?

→ Type 1: $PV = nRT$

↳ $n = \frac{m}{mm}$ ↪ $PV = \frac{mRT}{MM}$

↳ $MM = \frac{mRT}{PV}$

m 3.21 g

T 373 K

P $\frac{720}{760}$ atm = 0.947 atm

V 1.072 L

$MM = \frac{3.21\,g \mid 0.0821\,L\,atm \mid 373\,K}{\mid mol\,K \mid \mid 0.947\,atm \mid 1.072}$

$MM = 96.8$ g/mol

What is the density of air in this room at 23°C and 705 mmHg? (avg MM = 29) → density units = g/L

↳ $PV = nRT$

↳ $\frac{mRT}{mm} = PV$

↳ $\frac{mRT}{mm \cdot V} = P$

↳ $\frac{DRT}{mm} = P$ → $\frac{P \cdot mm}{RT} = D$ → $\frac{0.93 \cdot 29}{0.0821 \cdot 296}$ = **1.11 g/L**

$P = \frac{705\,mmHg}{760\,mmHg}$

$mm = 29$

$R = 0.0821$ L·atm/mol·K

$T = 296$ K

· Gases behave ideally at high temp. & low pressure   November 15th

→ Stoichiometric relationships

↳ $2NaN_3(s) \longrightarrow 2Na(s) + 3N_2(g)$

45g   TY = $\frac{0.692 \text{ mol } NaN_3}{} \Big| \frac{3 \text{ mol } N_2}{2 \text{ mol } NaN_3}$ = 1.04 mol

→ what volume of N_2 can be formed from 45g NaN_3 at 300K and 1.15 atm?

$\frac{45g}{} \Big| \frac{1 \text{ mol}}{65g} = 0.692 \text{ mol}$ $PV = nRT$

↳ $V = \frac{nRT}{P}$ = **21.42 L**

$n_{CO_2} \rightarrow n_{NaOH}$

10.0L $n = M \cdot V$

V_{NaOH}

Demonstration: $CO_2(g) + 2NaOH(aq) \longrightarrow Na_2CO_{3(aq)} + H_2O(l)$

* Law of combining volumes

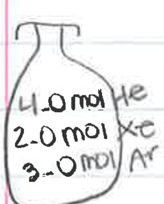
$N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$ $PV = nRT$

5 mol	15 mol	10 mol
10.0L	30.0L	20.0L

* At constant P and T, $V \propto n$

Dalton's Law of Partial Pressures:

* $P_{tot} = P_1 + P_2 + \ldots$



$P_{TOT} = P_{He} + P_{Xe} + P_{Ar}$

$n_{TOT} = n_{He} + n_{Xe} + n_{Ar}$ * $n_{TOT} = n_1 + n_2 + \ldots$

mol fraction $X_{He} = \frac{n_{He}}{n_{tot}} = \frac{4.0 \text{ mol}}{9.0 \text{ mol}} = 0.444$

$X_{Xe} = \frac{n_{Xe}}{n_{tot}} = \frac{2.0 \text{ mol}}{9.0 \text{ mol}} = 0.222$

$\Sigma X = 1.00$

$PV = nRT$

$P_{tot}V = n_{tot}RT$ → use if you have a combination of gases

November 15th

$P_{He}V = n_{He}RT$

↑ partial pressure of He

$n_{tot} = \frac{P_{tot}V}{RT}$ $n_{He} = \frac{P_{He}V}{RT}$

→ what is the partial pressure of He if $P_{tot} = 705$ mmHg?

$X_{He} = \frac{n_{He}}{n_{tot}} = \frac{\frac{P_{He}V}{RT}}{\frac{P_{tot}V}{RT}}$

↳ $P_{He} = X_{He} * P_{tot}$

$= 0.444 * 705$ mmHg

$X_{He} = \frac{P_{He}}{P_{tot}}$

$P_{tot} = P_{He} + P_{Xe} + P_{Ar} = 705$ mmHg

$\boxed{P_{He} = X_{He} * P_{tot}}$

$P_{He}V = n_{He}RT$

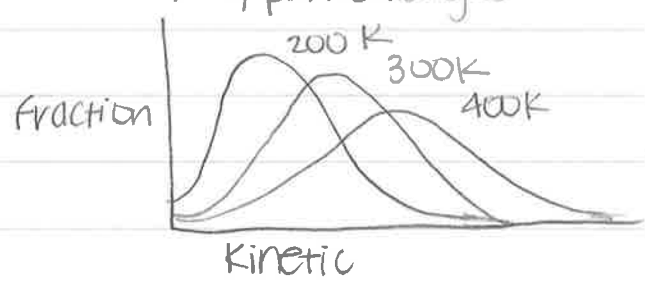
Kinetic Molecular Theory

$E_K = \frac{1}{2}mu^2 = \frac{3RT}{2N_A}$

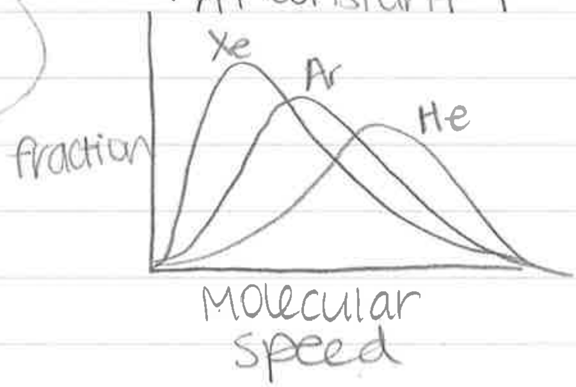
↳ $u^2 = \frac{3RT\,2}{2N_A\,m}$

↳ $u = \sqrt{\frac{3RT}{M}}$ ← molar mass in kg/mol

→ Any particular gas



→ At constant T



Chapter 10 Day 2 (Sections 10.5 – 10.8) (Unit 5) 15 November 2019

1. A mixture of gas consists of 2.5 mol nitrogen and 1.4 mol of oxygen. What is the mole fraction of each gas?

2. Medical oxygen is a mixture of oxygen and carbon dioxide. Oxygen content varies from 30% up to 99%. What is the partial pressure of oxygen in a cylinder of medical oxygen that is 65 mole percent oxygen and a total pressure of 1850 psi?

3. What is the average molecular speed of carbon dioxide in the room today (21 ^oC)?

4. What is the relative rates of effusion or diffusion for nitrogen vs. ammonia? Which is faster?

5. How many grams of H_2 gas are there in a 5.00-L cylinder at 4.00×10^3 mm Hg and 23 ^oC?

6. Methane, CH_4, gas is sold in 43.8 L tanks containing 5.54 kg. What is the pressure in kPa inside the tank at 20 ^oC?

Questions in final exam format (multiple choice):

7. A balloon contains 0.76 mol N_2, 0.18 mol Ar, 0.031 mol He, and 0.026 mol H_2 at 739 mm Hg. What is the partial pressure of Ar?

   A. 19 mm Hg B. 134 mm Hg
   C. 30 mm Hg D. 60 mm Hg

8. If the Earth's ozone (O_3) layer has a total volume of 1.00×10^{20} km^3, a partial pressure of 1.6×10^{-9} atm, and an average temperature of 230 K, how many ozone molecules are in the Earth's ozone layer?

   A. 2.3×10^{35} molecules B. 5.1×10^{35} molecules
   C. 2.3×10^{45} molecules D. 5.1×10^{45} molecules

9. How many liters of H_2 gas, collected over water at an atmospheric pressure of 752 mm Hg and a temperature of 21.0 ^oC, can be made from 3.132 g of Zn and excess HCl? The partial pressure of water vapor is 18.65 mm Hg at 21.0 ^oC.

   A. 0.0856 L B. 1.15 L C. 1.17 L D. 1.20 L

10. An unknown gas contains 83% C and 17% H by mass. If effuses at 0.87 times the rate of CO_2 gas under the same conditions. What is the molecular formula of the unknown gas?

    A. C_2H_5 B. C_3H_3 C. C_4H_{10}

11. Each of three identical 15.0-L gas cylinders contains 7.50 mol of gas at 295 K. Cylinder A contains Ar, cylinder B contains Cl_2, and cylinder C contains N_2. According to the kinetic molecular theory, which gas has the highest collision frequency?

    A. Ar B. Cl_2 C. N_2
    D. All have identical collision frequencies

Preparing for the final exam. Go to our Chm 203 course website and scroll down past the old exams and right before the pictures. There is a link to 96 practice questions (in three parts).

Now try these problems from the book:

Section 10.5. (Mixtures of gases) Problem 15, 16, 34, 80 – 90, even.

Section 10.6. (Kinetic molecular theory) Problems 30, 32, 92 – 100, even.

Section 10.7. (Graham's law) Problems 17, 18, 102 – 108, even

Section 10.8. (Real gases) Problem 110

Section 10.9 and 10.10 The Greenhouse Effect

Practice Test 7 – 13.