Name STURMAN key

14.3 IDEAL GASES

**What if the number of particles doesn't remain constant?*

THE IDEAL GAS LAW IS: $PV = nRT$ n = amt of gas in moles $R = 8.31\ L\,kPa/K\,mol$

When do gases not act "ideal"?

At low temps or high pressures. This is when the EM forces start taking over.

Sample problems

1. How many moles of a gas at 100.0°C does it take to fill a 1000.0ml flask to a pressure of 1.50atm?

n = ?
T = 100.0° + 273 = 373 K
V = 1000.0 mL = 1.0000 L
P = 1.50 atm = 152 kPa

152(1.000) = n(8.31)(373)

n = .0490 mol

2. A camping stove uses a 5.00L propane tank that holds 3.00kg of liquid C_3H_8. How large a container would be needed to hold the same amount of propane as a gas at 25.0°C and a pressure of 2280.0mmHg.

V_1 = 5.00 L
m = 3.00 kg
V_2 = ?
T = 25.0° + 273 = 298 K

P = $\frac{2280.0}{1} \cdot \frac{101.3}{760.0}$ = 303.9 kPa

$\frac{3.00 kg}{1} \cdot \frac{1 mol}{.04411}$ = 68.0 mol

PV = nRT

(303.9)V = 68.0(8.31)(298)

V = 554 L

14.4 GASES: MIXTURES AND MOVEMENTS

DALTON'S LAW of partial pressures

Different gases in a mixture act independently.

Dalton's law of partial pressures states: the sum of partial pressures of all the components in a gas mixture is equal to the total pressure of the gas mixture.

Sample Problems **Remember precision rule when adding or subtracting.*

1. What is the atmospheric pressure if the partial pressures of nitrogen, oxygen, and argon are 604.5mmHg, 162.8mmHg, and 0.5mmHg, respectively? Convert to atm, kPa, Pa

604.5 + 162.8 + .5 = 767.8 mmHg

$\frac{767.8 mmHg}{1} \cdot \frac{atm}{760.0}$ = 1.01 atm $\cdot \frac{101.3}{1 atm}$ = 102.3 kPa = 102,300 Pa

2. A person using an oxygen mask is breathing air with 33.0% oxygen. What is the partial pressure of O_2 when the air pressure in the mask is 110.0kPa?

.330(110.0 kPa) = 36.3 kPa

3. The gases carbon dioxide, oxygen, nitrogen, neon, and krypton are mixed in a container. All gases have the same partial pressure and total pressure in the container is 33,500Pa. What is the partial pressure of nitrogen?

33,500 Pa ÷ 5 = 6700 Pa

GRAHAM'S LAW

Diffusion is molecules move from higher pressure to lower pressure until pressures are equal; process where one substance moves through another, ie. odor detection → faster w/ smaller molecules because $KE = \frac{1}{2}mv^2$ & Temp = avg KE

Effusion is closely related to diffusion except movement of atoms or molecules is one by one through a sm opening whereas diffusion is a stream.

Graham's law of effusion states rate of effusion of a gas is inversely proportional to sq root of gas molar mass. Can also be applied to diffusion of gases.

Graham's equation is

$$\frac{Rate_A}{Rate_B} = \sqrt{\frac{molar\ mass_B}{molar\ mass_A}}$$

Sample problems

1. Compare the effusion rate of helium to oxygen.

$$\frac{Rate_{He}}{Rate_{O_2}} = \sqrt{\frac{32.0g}{4.00g}} = 2.83$$

2. Calculate the ratio of the velocity of hydrogen atoms to the velocity of nitrogen atoms at the same temperature.

$$\frac{Rate_{H_2}}{Rate_{N_2}} = \sqrt{\frac{28.0g}{2.00g}} = 3.74$$

* Another sample ideal gas law:
Find mass of CO_2 in a 125 mL flask at a pressure of 645.7 mmHg at 20.0°C.

PV = nRT

R = 8.31 L kPa/K mol
T = 293 K
V = 125 mL = .125 L
P = $\frac{645.7 mmHg}{1} \cdot \frac{101.3 kPa}{760.0 mm}$ = 86.07 kPa

86.07(.125) = n(8.31)(293)

n = .00537 mol

$\frac{.00537 mol}{1} \cdot \frac{44.0}{1 mol}$ = .236 g