Honors Chem Unit 11 Gases
Dalton's Law of Partial Pressures Notes

Dalton's Law: When multiple gases are mixed each gas has its own pressure, but each gas shares a common volume and temperature.

Review:

- Ideal gas Law PV=nRT (R= .0821 L*atm/mol*K)

Notes:

- This gas law is very simple. Just add the partial pressures to get the total pressure.
- Page 465 through 469 in the book.
- Mathematically: $P_{Total} = P_1 + P_2 + P_3 \ldots$ where the pressures are for each individual gas.
- Can be combined with the Ideal Gas Law: $P_{Total} = n_{Total}(RT/V)$
- Also ntotal = n1 + n2 + n3 … where the moles are for each individual gas.

Cautions:

1. Always use Kelvin (K) and moles not Celsius (°C) and grams!
2. The volume is the SAME for all the gasses!
3. The temperature is the SAME for all the gasses

Examples:

1. What is the total pressure when 5.0 L of Hydrogen (H_2) at 1.00 atm is pumped into a 5.0 L container along with 5.0 L of Oxygen (O_2) at 1.00 atm?

$P_{Total} = P_{H_2} + P_{O_2}$

$P_{Total} = 1.00\,atm + 1.00\,atm = 2.00\,atm$

2. Mixtures of helium and oxygen are used in the "air" tanks of underwater divers for deep dives. For a particular dive, 12 L of O_2 at 25 °C and 1.0 atm and 46 L of He at 25 °C and 1.0 atm were both pumped into a 5.0-L tank. Calculate the partial pressure of each gas and the total pressure in the tank at 25 °C.

$T = 298\ K$ (Constant) $25 + 273 = 298\ K$

$V = 5.0\ L$ (Final)

Can Calculate the total pressure from the partial pressures of O_2 and He.

$\therefore\ P_{Total} = P_{O_2} + P_{He}$

Since T is constant as is n for each gas ... can use $\frac{P_1 V_1}{T_1 n_1} = \frac{P_2 V_2}{T_2 n_2}$

or Boyle's Law

$\therefore\ P_2 = \frac{P_1 V_1}{V_2}$

so → O_2 $P_2 = \frac{1.0\ atm \,/\, 12.\ L}{5.0\ L} = 2.4\ atm$

→ He $P_2 = \frac{1.0\ atm \,/\, 46\ L}{5.0\ L} = 9.2\ atm$

$P_T = 2.4\ atm + 9.2\ atm = \boxed{11.6\ atm}$

Dalton's Law of Partial Pressure

1.) A tank contains a mixture of 3.0 mole N_2, 2.0 mole O_2, and 1.0 mole CO_2 at 298K and a total pressure of 10.0 atm. Calculate the partial pressure (in torr) of each gas in the mixture.

Need Ideal ($PV=nRT$) and Dalton $P_T = P_1 + P_2 + P_3 \ldots$

Gas	n(mol)	P(atm)	V(L)	T(K)
N_2	3.0	4.9	15L	298
O_2	2.0	3.3	15L	298
CO_2	1.0	1.6	15L	298
Total	6.0 mol	10.0 atm	15L	298

(V: SAME; T: SAME)

$$V = \frac{n_T RT}{P_T} \qquad \frac{6.0\,\text{mol} / .0821\,\text{L·atm/mol·K} / 298\,\text{K}}{10.0\,\text{atm}} = 15\,\text{L}$$

2.) A sample of oxygen gas is saturated with water vapor at 27°C. The total pressure of the mixture is 772 torr, and the vapor pressure of water is 26.7 torr at 27°C. What is the partial pressure of the oxygen gas?

$$P_T = P_{H_2O} + P_{O_2}$$

$$P_T - P_{H_2O} = P_{O_2}$$

$772 - 26.7 = 745$ torr convert to atm

$$\frac{745\,\text{torr} / 1\,\text{atm}}{760\,\text{torr}} = \boxed{.980\,\text{atm}}$$

3.) Assume that oxygen gas is being collected over water at 25°C. Write an equation for the pressure of oxygen gas (assume the pressure in the bottle is P_T)

$$P_T = P_{O_2} + P_{H_2O}$$

$$P_{O_2} = P_T - P_{H_2O}(25°C)$$

will just "look" up this pressure!

4.) If 4.0 g of $O_2(g)$ and 4.0 g of He(g) are placed in a 5.0 L vessel at 65°C, what will be the partial pressure of each gas and the total pressure in the vessel?

Need Ideal Gas law + Dalton +273

Gas	n(mol)	P(atm)	V(L)	T(K)
O_2	.13	.73	5.0	338
He	1.0	5.6	5.0	338
Total	1.13	6.33	5.0	338

↑ Dalton

ideal →

need moles!

use molar mass

O_2 $\frac{4.0\text{ g } O_2}{32.00\text{ g}/1\text{ mol}} = .13\text{ mol } O_2$

He $\frac{4.0\text{ g He}}{4.00\text{ g}/1\text{ mol}} = 1.0\text{ mol He}$

$$P = \frac{nRT}{V}$$

$$\frac{.13\text{ mol} \cdot .0821\text{ L·atm/mol K} \cdot 338\text{ K}}{5.0\text{ L}}$$

$$\frac{1.0\text{ mol} \cdot .0821\text{ L·atm/mol K} \cdot 338\text{ K}}{5.0\text{ L}}$$