DALTON'S LAW OF PARTIAL PRESSURES

Name Key

Dalton's Law says that the sum of the individual pressures of all the gases that make up a mixture is equal to the total pressure or: $P_T = P_1 + P_2 + P_3 + \ldots$ The partial pressure of each gas is equal to the mole fraction of each gas x total pressure.

$$P_T = P_1 + P_2 + P_3 + \ldots \quad \text{or} \quad \frac{\text{moles gas}_x}{\text{total moles}} \times P_T = P_x$$

Solve the following problems.

1. A 250. mL sample of oxygen is collected over water at 25° C and 760.0 torr pressure. What is the pressure of the dry gas alone? (Vapor pressure of water at 25° C = 23.8 torr)

760 − 23.8 =

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

736.2 torr

2. A 32.0 mL sample of hydrogen is collected over water at 20° C and 750.0 torr pressure. What is the volume of the dry gas at STP? (Vapor pressure of water at 20° C = 17.5 torr)

750 − 17.5 = 732.5 torr P_{gas}

$P_1 = 750$ torr $P_2 = 732.5$ torr

$V_1 = 32$mL $V_2 = ?$

$\frac{P_1V_1}{P_2} = V_2$

$\frac{750\text{torr} \cdot 32\text{mL}}{732.5\text{torr}} = 32.8\text{mL}$

3. A 54.0 mL sample of oxygen is collected over water at 23° C and 770.0 torr pressure. What is the volume of the dry gas at STP? (Vapor pressure of water at 23° C = 21.1 torr).

770 − 21.1 = 748.9 torr

$P_1 = 770$ $P_2 = 748.9$

$V_1 = 54$mL $V_2 = ?$

$\frac{770\text{torr} \cdot 54\text{mL}}{748.9\text{torr}} =$ 55.5mL

4. A mixture of 2.00 moles of H_2, 3.00 moles of NH_3, 4.00 moles of CO_2 and 5.00 moles of N_2 exerts a total pressure of 800 torr. What is the partial pressure of each gas?

H_2: $\frac{2\text{ mol}}{14\text{ mol}} \times 800 =$ 114.3 torr

NH_3: $\frac{3}{14} \times 800 =$ 171.4 torr

CO_2: $\frac{4}{14} \times 800 =$ 228.6 torr

N_2: $\frac{5}{14} \times 800 =$ 285.7 torr

5. The partial pressure of F_2 in a mixture of gases where the total pressure is 1.00 atm is 300. torr. What is the mole fraction of F_2?

$\frac{\text{mol gas}_x}{\text{tot mol}} = X$ $300\text{ torr} = 760\text{ torr} \cdot X$ $.395 = X$