Gas Law Problems

1.) A tank contains a mixture of 3.0 mole N_2, 2.0 mole O_2, and 1.0 mole CO_2 at 273K and a total pressure of 20.0 atm. Calculate the partial pressure (in mmHg) of each gas in the mixture.

$P_{N_2} = \frac{n_{N_2}}{n_T} P_T \qquad \frac{3.0}{6.0} 20.0 atm = 10.0 atm \frac{760 mmHg}{1 atm} =$

$P_{O_2} = \qquad \frac{2.0}{6.0} 20.0 atm = 6.66 atm \frac{760 mmHg}{1 atm} =$

$P_{CO_2} = \qquad \frac{1.0}{6.0}(20.0 atm) = 3.33 atm \frac{760 mmHg}{1 atm} =$

2.) A sample of 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. The temperature is 27.0°C, the volume is 500.0mL, and the mass of the collected gas is .638 g. What gas is it?

$P_T = 772 torr \quad P_{gas} = 772 - 26.7 = 745.3 torr$

$\boxed{745 torr} \; P_{gas}$

$molar\ mass = \frac{MRT}{PV} \qquad T = 300.0 K$

$\frac{.638 g}{745 torr} \left| \frac{760 torr}{1 atm} \right/ \frac{.0821 L \cdot atm}{mol \cdot K} \left/ \frac{300.0 K}{.5000 L} \right. = \boxed{32.1 g/mol}$

$\boxed{O_2 = 32.00 g/mol}$

3.) Assume that oxygen gas is being collected over water (P_{H2O}). Write an equation for the density of oxygen gas (assume the pressure in the bottle is P_T)

$D = \frac{M}{V}$ $\quad PV = nRT$ $\quad V = \frac{nRT}{P}$

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

$D = \frac{(M)P}{nRT}$ $\quad \frac{M}{n}$ = molar mass (mm)

$$D = \frac{(P_T - P_{H_2O})\,mm}{RT}$$

4.) If 3.0 g of $O_2(g)$ and 3.0 g of He(g) are placed in a 4.0 L vessel at 55°C, what will be the partial pressure of each gas and the total pressure in the vessel?

$P_T = \frac{n_T RT}{V}$ $\quad 328\,K$

$P_T = \frac{.84\,mol / .0821\,L\cdot atm / mol\cdot K / 328\,K}{4.0\,L}$

$P_T = 5.6\,atm$

$n_T = n_{O_2} + n_{He}$

$n_{O_2} = \frac{3.0\,g / mol}{32.00\,g}$ $\quad n_{He} = \frac{3.0\,g / mol}{4.00\,g}$

$.094 + .75$

$n_T = .84\,mol$ of gas

$P_{O_2} = \frac{(.094)}{.84} 5.6\,atm = .63\,atm$

$P_{He} = \frac{.75}{.84} 5.6\,atm = 5.0\,atm$

5.) Ethylene burns in oxygen to form carbon dioxide and water vapor:

$$C_2H_4 + 3\,O_2 \rightarrow 2\,CO_2 + 2\,H_2O$$

How many liters of water vapor can be formed if 1.25 L of ethylene at STP are combined with 10.0L of oxygen in this reaction?

$\frac{1.25\,L\,C_2H_4 / mol / 2\,mol\,H_2O / 22.4\,L}{22.4\,L / 1\,mol\,C_2H_4 / mol} = 2.50\,L\,H_2O$

$\frac{10.0\,L\,H_2O / mol / 2\,mol\,H_2O / 22.4\,L}{22.4\,L / 3\,mol\,O_2 / mol} = 6.67\,L\,H_2O$