Pre-AP Chemistry/AP Chemistry
Unit #17—Gas Laws

Partial Pressure and Mole Ratio

A gaseous mixture made from 6.0 grams oxygen gas and 9.0 grams methane gas is placed in a 15 L vessel at 0 ^{o}C. What is the partial pressure for each gas? What is the total pressure in the vessel?

$$\frac{6.0\text{ g } O_2}{} \left| \frac{1\text{ mol } O_2}{31.998\text{ g } O_2} \right. = 0.188\text{ mol } O_2$$

$$\frac{9.0\text{ g } CH_4}{} \left| \frac{1\text{ mol } CH_4}{16.043\text{ } CH_4} \right. = 0.561\text{ mol } CH_4$$

$$0\ ^{o}C + 273.15\text{ K} = 273.15\text{ K}$$

$$\frac{(0.188\text{ mol})(0.08206\text{ Latm/kmol})(273.15\text{ K})}{15\text{ L}} = 0.281\text{ atm} = P_{O_2}$$

$$\frac{(0.561\text{ mol})(0.08206\text{ Latm/kmol})(273.15\text{ K})}{15\text{ L}} = 0.838\text{ atm} = P_{CH_4}$$

$$P_t = 0.838\text{ atm} + 0.281\text{ atm} = 1.119\text{ atm}$$

From the data gathered by Voyager 1, scientists have estimated the composition of the atmosphere of Titan, Saturn's largest moon. The total pressure on the surface of Titan is 1200 torr. The atmosphere consists of 82 mol percent N_2, 12 mol percent Ar, and 6.0 mol percent CH_4. Calculate the partial pressure of each of these gases in Titan's atmosphere.

$$N_2 = \frac{82}{100} = 0.82$$

$$P_{N_2} = (0.82)(1200\text{ torr}) = 984\text{ torr}$$

$$\frac{984\text{ torr}}{} \left| \frac{1\text{ atm}}{760\text{ torr}} \right. = 1.295\text{ atm}$$

$$Ar = \frac{12}{100} = 0.12$$

$$P_{Ar} = (0.12)(1200\text{ torr}) = 144\text{ torr}$$

$$\frac{144\text{ torr}}{} \left| \frac{1\text{ atm}}{760\text{ torr}} \right. = 0.189\text{ atm}$$

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$$CH_4 = \frac{6}{100} = 0.060$$

$$P_{CH_4} = (0.060)(1200 \text{ torr}) = 72 \text{ torr}$$

$$\frac{72 \text{ torr} \mid 1 \text{ atm}}{\mid 760 \text{ torr}} = 0.095 \text{ atm}$$

If the volume of Titan is 7.156×10^{25} mL, and its temperature is 93.7 K on the surface, how many moles of each gas are present on the moon?

$$\frac{(1.295 \text{ atm})(7.156 \times 10^{22} \text{ L})}{(0.08206 \text{ Latm/kmol})(93.7 \text{ K})} = 1.205 \times 10^{22} \text{ mol } N_2$$

$$\frac{(0.189 \text{ atm})(7.156 \times 10^{22} \text{ L})}{(0.08206 \text{ Latm/kmol})(93.7 \text{ K})} = 1.759 \times 10^{21} \text{ mol Ar}$$

$$\frac{(0.095 \text{ atm})(7.156 \times 10^{22} \text{ L})}{(0.08206 \text{ Latm/kmol})(93.7 \text{ K})} = 8.841 \times 10^{20} \text{ mol } CH_4$$