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

Gas Stoichiometry

What volume of oxygen gas is needed for the complete combustion of 4.0 L of propane gas at STP conditions?

$$C_3H_8\,(g) + 5\,O_2\,(g) \Rightarrow 3\,CO_2\,(g) + 4\,H_2O\,(g)$$

$$\frac{4.0\text{ L } C_3H_8 \mid 1\text{ mol } C_3H_8 \mid 5\text{ mol } O_2 \mid 22.4\text{ L } O_2}{\quad \mid 22.4\text{ L } C_3H_8 \mid 1\text{ mol } C_3H_8 \mid 1\text{ mol } O_2} = 200\text{ L } O_2$$

Calculate the grams of oxygen gas and potassium chloride produced at 1.00 atm and 25 ^{o}C by the complete decomposition of 10.5 L of potassium chlorate.

$$2\,KClO_3\,(s) \Rightarrow 2\,KCl\,(s) + 3\,O_2\,(g)$$

$$25\,^{o}C + 273.15\text{ K} = 298.15\text{ K}$$

$$\frac{(1\text{ atm})(10.5\text{ L})}{(0.08206\text{ Latm/Kmol})(298.15\text{ K})} = 0.429\text{ mol } KClO_3$$

$$\frac{0.429\text{ mol } KClO_3 \mid 3\text{ mol } O_2 \mid 31.998\text{ g } O_2}{\quad \mid 2\text{ mol } KClO_3 \mid 1\text{ mol } O_2} = 20.591\text{ g } O_2$$

$$\frac{0.429\text{ mol } KClO_3 \mid 2\text{ mol } KCl \mid 74.551\text{ g } KCl}{\quad \mid 2\text{ mol } KClO_3 \mid 1\text{ mol } KCl} = 31.982\text{ g } KCl$$

If 14.4 L of ethane is combusted at 102.7 ^{o}C and 99.3 kPa, how many grams of water will be produced? How many moles of carbon dioxide will be produced? How many liters of oxygen gas is needed for the combustion reaction?

$$2\,C_2H_6\,(g) + 7\,O_2\,(g) \Rightarrow 4\,CO_2\,(g) + 6\,H_2O\,(g)$$

$$102.7\,^{o}C + 273.15\text{ K} = 375.85\text{ K}$$

$$\frac{99.3\text{ kPa} \mid 1\text{ atm}}{\quad \mid 101.3\text{ kPa}} = 0.980\text{ atm}$$

$$\frac{(0.980\text{ atm})(14.4\text{ L})}{(0.08206\text{ Latm/Kmol})(375.85\text{ K})} = 0.458\text{ mol } C_2H_6$$

$$\frac{0.458\text{ mol } C_2H_6 \mid 6\text{ mol } H_2O \mid 18.015\text{ g } H_2O}{\quad \mid 2\text{ mol } C_2H_6 \mid 1\text{ mol } H_2O} = 24.753\text{ g } H_2O$$

$$\frac{0.458\text{ mol } C_2H_6 \mid 4\text{ mol } CO_2}{\quad \mid 2\text{ mol } C_2H_6} = 0.916\text{ mol } CO_2$$

$$\frac{0.458\text{ mol } C_2H_6 \mid 7\text{ mol } O_2 \mid 22.4\text{ L } O_2}{\quad \mid 2\text{ mol } C_2H_6 \mid 1\text{ mol } O_2} = 35.907\text{ L } O_2$$

If 1.39 grams of carbon monoxide reacts with oxygen, what volume of carbon dioxide is produced at 12.3 ^{o}C at 107.4 kPa?

$$2\,CO\,(g) + O_2\,(g) \Rightarrow 2\,CO_2$$

$$\frac{1.39\text{ g CO} \mid 28.005\text{ g CO} \mid 2\text{ mol } CO_2}{\quad \mid 1\text{ mol CO} \mid 2\text{ mol CO}} = 38.927\text{ mol } CO_2$$

$$12.3\,^{o}C + 273.15\text{ K} = 285.45\text{ K}$$

$$\frac{107.4\text{ kPa} \mid 1\text{ atm}}{\quad \mid 101.3\text{ kPa}} = 1.060\text{ atm}$$

$$\frac{(38.927\text{ mol})(0.08206\text{ Latm/Kmol})(285.45\text{ K})}{(1.060\text{ atm})} = 860.214\text{ L } CO_2$$