AP Chemistry
Gas Laws

Name_____

1. A 15 liter sample of hydrogen is collected over water at 18 °C and .92 atm of pressure. What would be the volume of **dry** hydrogen gas at STP? (P_{total})
Pressure of water at 18 °C = 15.5 mm Hg.

$15.5\ mm \left| \frac{1\ atm}{760\ mm} \right. = 0.0204\ atm$ $\quad 0.92 - 0.0204 = 0.90\ atm$ $P_{(H_2)}$

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ $\quad \frac{(0.90)(15)}{291} = \frac{(1)(V_2)}{273.15}$ $\quad \boxed{V_2 = 13\ L}$

2. What is the density of krypton gas at 780. mm Hg and 35 °C?

$PV = nRT$ $\quad 780.\ mm \left| \frac{1\ atm}{760\ mm} \right. = 1.03\ atm$

$D = \frac{PM}{RT} = \frac{(1.03)(83.80)}{(0.08206)(308.15)} = \boxed{3.42\ \frac{g}{L}}$

3. The density of an unknown gas is 2.65 g/L at 2.1 atm and 27 °C. What is the molar mass of the gas?

$M = \frac{DRT}{P} = \frac{(2.65)(0.08206)(300.15)}{2.1} = \boxed{31.\ \frac{g}{mol}}$

4. How many mL of O_2 will be produced at 743 torr and 27 °C from the decomposition of 100. mL of a 0.5 M solution of H_2O_2?

$743\ torr \left| \frac{1\ atm}{760\ torr} \right. = 0.978\ atm$

$2H_2O_2 \rightarrow 2H_2O + O_2$

$0.100\ L\ H_2O_2 \left| \frac{0.500\ mol\ H_2O_2}{1\ L\ H_2O_2} \right| \frac{1\ mol\ O_2}{2\ mol\ H_2O_2} = 0.0250\ mol\ O_2$

$PV = nRT$

$(0.978)(V) = (0.0250)(0.08206)(300.15)$

$\boxed{V = 629\ mL\ O_2}$

5. What is the volume of hydrogen gas produced when 2.00 g of Mg reacts with excess HCl at 750. torr and 25 °C?

$$Mg + 2HCl \rightarrow H_2(g) + MgCl_2$$

$$750.\ torr \left| \frac{1\ atm}{760\ torr} \right. = 0.987\ atm$$

$$2.00\ g\ Mg \left| \frac{1\ mol\ Mg}{24.31\ g\ Mg} \right| \frac{1\ mol\ H_2}{1\ mol\ Mg} = 0.0823\ mol\ H_2$$

$$(0.987)(V) = (0.0823)(0.08206)(298.15) \quad \boxed{V = 2.04\ L}$$

6. What is the pressure (in mm Hg) of gas produced when 4.50 g of sodium carbonate reacts with hydrochloric acid in a sealed 250. mL container at 45 °C?

$$Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2(g)$$

$$4.50\ g\ Na_2CO_3 \left| \frac{1\ mol\ Na_2CO_3}{105.99\ g\ Na_2CO_3} \right| \frac{1\ mol\ CO_2}{1\ mol\ Na_2CO_3} = 0.0425\ mol\ CO_2$$

$$PV = nRT$$

$$(P)(0.250) = (0.0425)(0.08206)(318.15)$$

$$P = 4.44\ atm \left| \frac{760\ mm}{1\ atm} \right. = \boxed{3370\ mm\ Hg}$$

7. How many liters of hydrogen sulfide gas are produced when 23.3 g of sodium sulfide reacts with excess sulfuric acid at 30 °C and a pressure of 1.10 atms?

$$Na_2S + H_2SO_4 \rightarrow Na_2SO_4 + H_2S(g)$$

$$23.3\ g\ Na_2S \left| \frac{1\ mol\ Na_2S}{78.05\ g\ Na_2S} \right| \frac{1\ mol\ H_2S}{1\ mol\ Na_2S} = 0.299\ mol\ H_2S$$

$$PV = nRT$$

$$(1.10)(V) = (0.299)(0.08206)(303.15)$$

$$\boxed{V = 6.76\ L\ H_2S}$$