LAB 10-2
PROBLEM SET

1. What is the formula weight of a gas if one liter of the gas weighs 1.43 grams at STP?

$$\frac{1\text{ L gas}}{22.4\text{ L gas}} \left| \frac{1\text{ mol gas @ STP}}{} \right. = .04464\text{ mol} \qquad \frac{1.43\text{ g}}{.04464\text{ mol}} = \boxed{32.0\ \text{g/mol}}$$

2. What would one liter of CO_2 weigh (density) at STP ? What would one liter of N_2 weigh at STP?

$$\frac{1\text{ L } CO_2}{22.4\text{ L } CO_2} \left| \frac{1\text{ mol } CO_2}{} \right. = .04464\text{ mol } CO_2 \left| \frac{44\text{ g } CO_2}{1\text{ mol } CO_2\text{ @ STP}} \right. = 1.96\text{ g } CO_2$$

$$(28\text{ g } N_2) = 1.25\text{ g } N_2$$

3. A carbon dioxide fire extinguisher contains 6.8 kg of CO_2. What volume of gas could it deliver at STP ? (stoich)

$$\frac{6800\text{ g } CO_2}{44\text{ g } CO_2} \left| \frac{1\text{ mol } CO_2}{1\text{ mol } CO_2\text{ @ STP}} \right. \left| \frac{22.4\text{ L } CO_2}{} \right. = 3462\text{ L } CO_2$$

2 S.F. = 3500 L

4. What volume will 3 moles of CH_4 occupy when the pressure is 900 mm Hg and the temperature is 200K ?

$$\frac{3\text{ mol } CH_4}{1\text{ mol } CH_4} \left| \frac{22.4\text{ L @ STP}}{} \right. = 67.2\text{ L } CH_4 \left(\frac{760\text{ mm}}{900\text{ mm}}\right)\left(\frac{200\text{ K}}{273\text{ K}}\right) = \boxed{41.6\text{ L}}$$

5. What volume would be occupied by 6 moles of N_2 under a pressure of 5 atm and a temperature of 30 °C ?

$$\frac{6\text{ mol } N_2}{1\text{ mol } N_2} \left| \frac{22.4\text{ L } N_2\text{ @ STP}}{} \right. = 134.4\text{ L } N_2 \left(\frac{1\text{ atm}}{5\text{ atm}}\right)\left(\frac{303\text{ K}}{273\text{ K}}\right) = 30\text{ L}$$

6.. How many moles of oxygen will be contained in a 40 L cylinder at 30 °C and 150 atm ? How many kg of oxygen will this be ?

303 K

$$40\text{ L } O_2 \left(\frac{273\text{ K}}{303\text{ K}}\right)\left(\frac{150\text{ atm}}{1\text{ atm}}\right) = 5405.9\text{ L } O_2 \left| \frac{1\text{ mol } O_2}{22.4\text{ L } O_2\text{ @ STP}} \right. = 241\text{ mol } O_2 \left| \frac{32\text{ g}}{1\text{ mol } O_2} \right.$$

$$= 7.7\text{ Kg } O_2$$

760 → 273 K → 293 K

7. What volume will .086 mols of O_2 gas occupy at 692 mm Hg and 20 °C ?

$$.086 \text{ mol } O_2 \left| \frac{22.4 \text{ L @STP}}{1 \text{ mol } O_2} \right. = 1.9264 \text{ L } O_2 \text{ @STP} \left(\frac{760 \text{ mm Hg}}{692 \text{ mm Hg}}\right)\left(\frac{293 \text{ K}}{273 \text{ K}}\right) = 2.3 \text{ L}$$

8. A gas sample has a mass of .0534 g, occupies a volume of 90 mL at 125 °C and 725 mm Hg. Solve for the molar mass of the gas

398 K

$$.09 \text{ L} \left(\frac{273 \text{ K}}{398 \text{ K}}\right)\left(\frac{725 \text{ mm Hg}}{760 \text{ mm Hg}}\right) = .05889 \text{ L gas @STP} \left| \frac{1 \text{ mol gas}}{22.4 \text{ L gas @STP}} \right. = .0026 \text{ mol}$$

$$\frac{.0534 \text{ g}}{.0026 \text{ mol}} = 20.3 \frac{\text{g}}{\text{mol}}$$

9. What is the density of CH_4 gas at STP ?

$d = \frac{m}{V}$

$$1 \text{ mol } CH_4 = \frac{16 \text{ g}}{22.4 \text{ L}} = .714 \frac{\text{g}}{\text{L}}$$

10. What is the density of NH_3 at 720 mm Hg and 123 °C ? (396 K)

$d = \frac{m}{V}$

$$\frac{17 \text{ g}}{34.3 \text{ L}} = 0.496 \frac{\text{g}}{\text{L}}$$

$$22.4 \text{ L} \left(\frac{760 \text{ mm Hg}}{720 \text{ mm Hg}}\right)\left(\frac{396 \text{ K}}{273 \text{ K}}\right) = 34.297 \text{ L } NH_3$$

11. What pressure is being exerted by neon gas when 45 grams of it occupy 35 L at 10 °C ? (283 K)

$$45 \text{ g Ne} \left| \frac{1 \text{ mol Ne}}{20.1797 \text{ g Ne}} \right. = 2.2299 \text{ mol Ne} \left| \frac{22.4 \text{ L @STP}}{1 \text{ mol Ne}} \right. = 49.95 \text{ L}$$

$$35 \text{ L Ne @STP} \left(\frac{273 \text{ K}}{283 \text{ K}}\right)\left(\frac{X \text{ mm Hg}}{760 \text{ mm Hg}}\right) = 49.95 \text{ L at STP}$$

$X = 1124 \text{ mm Hg}$ or 1.5 atm

12. At 790 mm Hg and 31 °C (304 K), 265 mL of a gas weighs 0.675 grams. Find the molar mass using molar volume and the combined gas law.

$$.265 \text{ L} \left(\frac{790 \text{ mm Hg}}{760 \text{ mm Hg}}\right)\left(\frac{273 \text{ K}}{304 \text{ K}}\right) = .247 \text{ L at STP}$$

$$.247 \text{ L at STP} \left| \frac{1 \text{ mol gas}}{22.4 \text{ L at STP}} \right. = .01104 \text{ mol gas}$$

$$\text{molar mass} = \frac{.675 \text{ g}}{.01104 \text{ mol}} = 61 \frac{\text{g}}{\text{mol}}$$