Unit 8 Stoichiometry
Intro to Stoichiometry and Density

Name ______________________
Block ______

Density = Mass/ Volume **1 Mole = 22.4 Liters of Gas**

1. Calculate the density of carbon dioxide at STP.

$$Density = \frac{mass}{volume} = \frac{molar\ mass}{molar\ volume} = \frac{44.0\ grams/mole}{22.4\ liters/mole} = \mathbf{1.96\ grams/liter}$$

2. Calculate the density of helium gas at STP.

$$Density = \frac{mass}{volume} = \frac{molar\ mass}{molar\ volume} = \frac{4.0\ grams/mole}{22.4\ liters/mole} = \mathbf{0.18\ grams/liter}$$

3. Calculate the density of ammonia at STP.

$$Density = \frac{mass}{volume} = \frac{molar\ mass}{molar\ volume} = \frac{17.0\ grams/mole}{22.4\ liters/mole} = \mathbf{0.759\ grams/liter}$$

The following problems are NOT at STP:

4. If the density of oxygen gas is 1.29 g/L, how many grams of magnesium will react with 100 ml of oxygen gas at STP?

2 Mg $_{(s)}$ + 1 O$_{2\,(g)}$ → 2 MgO $_{(s)}$

$$\frac{100\ ml}{1}\left|\frac{1\ Liter}{1000\ ml}\right|\frac{1.29\ grams\ O_2}{1\ Liter\ O_2}\left|\frac{1mole\ O_2}{32\ grams\ O_2}\right|\frac{2\ moles\ Mg}{1\ mole\ O_2}\left|\frac{24.305\ grams\ Mg}{1\ mole\ Mg}\right| = 0.1959\ldots g\ Mg$$

Sig fig answer = **0.2 g Mg**

5. In 1905, Fritz Haber discovered a method for producing ammonia from the nitrogen in air use the reaction below:

1 N$_{2\,(g)}$ + 3 H$_{2\,(g)}$ → 2 NH$_{3\,(g)}$

The process involves heating the reactants to 450 °C and increasing the pressure to 200 atmospheres in the presence of an iron catalyst. The density of the hydrogen gas under these conditions is 6.724 g/L, and the density of ammonia gas is 57.15 g/L. How many liters of ammonia gas will be produced, if 500.0 L of hydrogen gas react with excess nitrogen gas?

$$\frac{500.0\ L\ H_2}{1}\left|\frac{6.724\ grams\ H_2}{1\ Liter\ H_2}\right|\frac{1mole\ H_2}{2\ grams\ H_2}\left|\frac{2\ moles\ NH_3}{3\ mole\ H_2}\right|\frac{17\ gram\ NH_3}{1\ mole\ NH_3}\left|\frac{1\ Liter\ NH_3}{57.15\ gram\ NH_3}\right| = \mathbf{333.3\ L\ NH_3}$$