

$$\text{Density} = \text{Mass/ Volume}$$

$$1 \text{ Mole} = 22.4 \text{ Liters of Gas}$$

1. Calculate the density of carbon dioxide at STP.

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

2. Calculate the density of helium gas at STP.

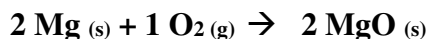
$$\text{Density} = \frac{\text{mass}}{\text{volume}} = \frac{\text{molar mass}}{\text{molar volume}} = \frac{4.0 \text{ grams/mole}}{22.4 \text{ liters/mole}} = \mathbf{0.18 \text{ grams/liter}}$$

3. Calculate the density of ammonia at STP.

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

The following problems are NOT at STP:

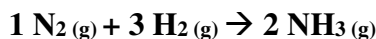
4. If the density of oxygen gas is 1.29 g/L, how many grams of magnesium will react with 100 ml of oxygen gas at STP?



$$\frac{100 \text{ ml}}{1} \left| \frac{1 \text{ Liter}}{1000 \text{ ml}} \right| \frac{1.29 \text{ grams O}_2}{1 \text{ Liter O}_2} \left| \frac{1 \text{ mole O}_2}{32 \text{ grams O}_2} \right| \frac{2 \text{ moles Mg}}{1 \text{ mole O}_2} \left| \frac{24.305 \text{ grams Mg}}{1 \text{ mole Mg}} \right| = 0.1959 \dots \text{ g Mg}$$

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:



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?

$$\frac{500.0 \text{ L H}_2}{1} \left| \frac{6.724 \text{ grams H}_2}{1 \text{ Liter H}_2} \right| \left| \frac{1 \text{ mole H}_2}{2 \text{ grams H}_2} \right| \frac{2 \text{ moles NH}_3}{3 \text{ mole H}_2} \left| \frac{17 \text{ gram NH}_3}{1 \text{ mole NH}_3} \right| \left| \frac{1 \text{ Liter NH}_3}{57.15 \text{ gram NH}_3} \right| = \mathbf{333.3 \text{ L NH}_3}$$