Stoichiometry with Gasses

The most common way to measure gasses is by volume. To do stoichiometry we need moles. So, we need to be able to convert.

To make our calculations easier we define a set of standard conditions (STP), temperature is 0°C, and pressure is 1 atm.

$$V = \frac{1mol \ \cdot R \cdot 273.15K}{1atm} = 22.42L$$

At STP 1 mole of a gas occupies 22.4 L, we can use this shortcut whenever we are dealing with a gas at STP. If your conditions are not standard then we need to use the ideal gas law.

Determine the volume of gas from moles

Mg + 2 HCl --> $MgCl_2$ + H_2

$$50.0\text{g Mg} \cdot \frac{1\text{mol Mg}}{24.3\text{g Mg}} \cdot \frac{1\ \text{H}_2}{1\ \text{Mg}} \cdot \frac{22.4\text{L H}_2}{1\text{mol H}_2} =$$

$$46.1\text{L H}_2$$

Ex:

Use the density to find molar mass

With the density, pressure and temperature we can calculate the molar mass of the gas.

$$n = \frac{m}{\text{molar mass}} \qquad P = \frac{nRT}{V}$$

$$P = \frac{m}{V}\frac{RT}{\text{molar mass}} \qquad P = d\frac{RT}{\text{molar mass}}$$

$$\text{molar mass} = d\frac{RT}{P}$$

The sample of CO_2 had a density of 10.3g/L at 5.25atm and 273K

$$\text{MolarMass} = 10.3\text{g/L} \cdot \frac{0.0821\frac{\text{atm L}}{\text{mol K}} \cdot 273\text{K}}{5.25\text{atm}}$$

$$\text{MolarMass} = 44.0\frac{g}{mol}$$

Ex: