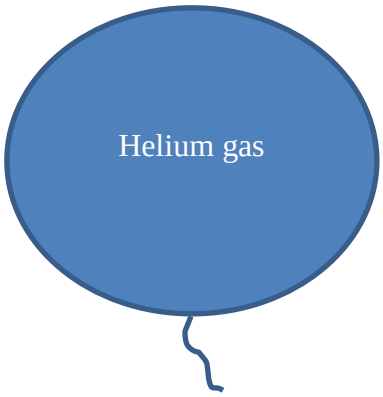
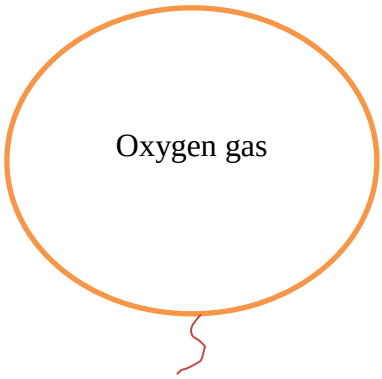
# Chemistry Lecture #72: Avogadro's Principle

Suppose we have two balloons each filled with different gases. One balloon is filled with helium, and another is filled with oxygen gas. Both balloons have a volume of 22.4 L. The gas in each balloon has a temperature of 0 °C and exerts a pressure of one atm (or 760 mm Hg, which is also 101.325 kPa).




Volume: 22.4 L
Temperature: 0 °C
Pressure: 1 atm

Gas particles in balloon:
$6.02 \times 10^{23}$ He atoms

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Gas particles in balloon:
$6.02 \times 10^{23}$ $O_2$ molecules

According to Avogadro's principle, both balloons will contain the same number of gas particles. This occurs when two gases have the same volume, temperature, and pressure. In this case, both balloons contain $6.02 \times 10^{23}$ particles, or one mole. The helium balloon will contain 1 mole of He atoms, and the oxygen balloon will contain 1 mole of $O_2$ molecules.

When the temperature of a gas is 0 °C and its pressure is 1 atm, the gas is under Standard Temperature and Pressure (STP). At STP, the volume of one mole of any gas will be 22.4 L

1 mole of gas at STP = 22.4 L

Find the volume of 0.881 mol of gas at STP.

mol → liters  1 mole gas = 22.4 L

$$\frac{0.881 \text{ mol}}{1} \times \frac{22.4 \text{ L}}{\text{mol}} = 19.7 \text{ L}$$

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Find the volume of 217 g $CH_4$ gas at STP.

g → moles → liters

1 mole $CH_4$ = 16.0 g  1 mole $CH_4$ = 22.4 L

$$\frac{217 \text{ g } CH_4}{1} \times \frac{\text{mole } CH_4}{16.0 \text{ g } CH_4} \times \frac{22.4 \text{ L } CH_4}{\text{mole } CH_4} = 303.8 \text{ or } 304 \text{ L } CH_4$$

Find the mass of 3.00 L of $CO_2$ gas at STP.


1 mole $CO_2$ = 22.4 L  1 mole $CO_2$ = 44.0 g

$$\frac{3.00\ L}{1} \times \frac{\text{mole } CO_2}{22.4\ L} \times \frac{44.0\ g\ CO_2}{\text{mole } CO_2} = 5.89\ g\ CO_2$$