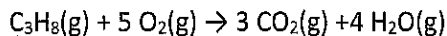


# Gas Stoichiometry! ♥

## Two Types of Gas Stoich

1. **Gas Stoich at STP:** use  $1 \text{ mol} = 22.4 \text{ L}$ . Follow normal stoichiometry process!

**Example #1:** Propane,  $\text{C}_3\text{H}_8$ , is a gas that is sometimes used as fuel for cooking and heating. The complete combustion of propane occurs according to the following equation.



- a. What will be the volume, in liters, of oxygen required for the complete combustion of 0.250 L of propane? Assume that all volume measurements are made at STP.

$$0.250 \text{ L C}_3\text{H}_8 \times \frac{1 \text{ mol C}_3\text{H}_8}{22.4 \text{ L C}_3\text{H}_8} \times \frac{5 \text{ mol O}_2}{1 \text{ mol C}_3\text{H}_8} \times \frac{22.4 \text{ L O}_2}{1 \text{ mol O}_2} = \boxed{1.25 \text{ L O}_2}$$

- b. What will be the volume of gaseous products created in the reaction? Assume that all volume measurements are made at STP.

$$0.250 \text{ L C}_3\text{H}_8 \times \frac{7 \text{ L products}}{1 \text{ L C}_3\text{H}_8} = \boxed{1.75 \text{ L products}}$$

**\*Note:** this shortcut works when the volume of ALL gases is measured at the same T and P, not just STP!

2. **Gas Stoich NOT at STP:** OR not at the same T and P (when calculating volume  $\rightarrow$  volume)

$\rightarrow$  you must use the **Ideal Gas Law** to:

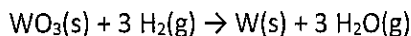
- Calculate the number of moles from the provided volume of gas (if needed)
- Calculate the final volume of gas produced from the number of moles (if needed)

**A cheer to help you remember!**

When you're **NOT** at STP,  
Use  $PV = nRT$ !

Go chemistry!!

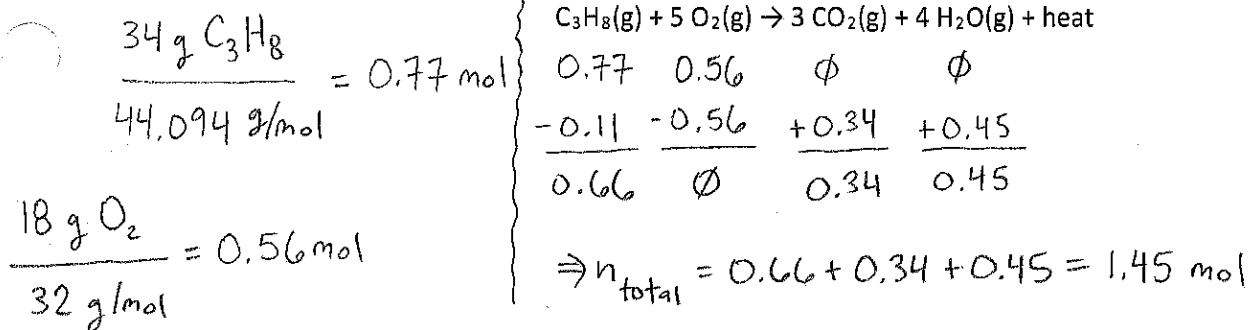
**Example #2:** Tungsten, W, a metal used in light-bulb filaments, is produced industrially by the reaction of tungsten oxide with hydrogen according to the reaction below. How many liters of hydrogen gas at 35°C and 0.980 atm are needed to react completely with 875 g of tungsten oxide?



$$\textcircled{1} 875 \text{ g WO}_3 \times \frac{1 \text{ mol WO}_3}{231.85 \text{ g WO}_3} \times \frac{3 \text{ mol H}_2}{1 \text{ mol WO}_3} = 11.3 \text{ mol H}_2$$

$$\textcircled{2} V = \frac{nRT}{P} = \frac{(11.3 \text{ mol})(0.980 \text{ atm})(308 \text{ K})}{0.980 \text{ atm}} = \boxed{292 \text{ L H}_2}$$

**Example #3:** If 34 grams of propane gas,  $C_3H_8$ , reacts with 18 grams of oxygen gas in a 0.75 L sealed bomb calorimeter, what is the pressure inside the container after the reaction is complete? Assume the reaction happens at  $25^\circ C$ .

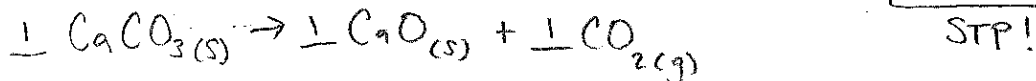


$$P_{\text{tot}} = \frac{n_{\text{tot}} RT}{V} = \frac{(1.45 \text{ mol})(0.08206 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}})(298 \text{ K})}{0.75 \text{ L}} = \boxed{47 \text{ atm}}$$

yikes!

### Let's Practice!

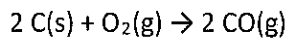
1. Solid calcium carbonate, also known as limestone, will decompose upon heating to produce solid calcium oxide, also known as lime (an industrial chemical with a wide variety of uses), and carbon dioxide gas. How many grams of calcium carbonate must be decomposed to produce 5.00 L of carbon dioxide gas at  $273 \text{ K}$  and  $760 \text{ torr}$ ?



$$5.00 \text{ L CO}_2 \times \frac{1 \text{ mol CO}_2}{22.4 \text{ L CO}_2} \times \frac{1 \text{ mol CaCO}_3}{1 \text{ mol CO}_2} \times \frac{100.09 \text{ g CaCO}_3}{1 \text{ mol CaCO}_3} = \boxed{22.3 \text{ g CaCO}_3}$$

must show to  
earn credit!

2. How many liters of gaseous carbon monoxide at  $27^\circ C$  and  $0.247 \text{ atm}$  can be produced from the burning of  $65.5 \text{ g}$  of carbon according to the following equation?



$$65.5 \text{ g C} \times \frac{1 \text{ mol C}}{12.01 \text{ g C}} \times \frac{2 \text{ mol CO}}{2 \text{ mol C}} = 5.45 \text{ mol CO}$$

$$V = \frac{nRT}{P} = \frac{(5.45 \text{ mol})(0.08206 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}})(300. \text{ K})}{0.247 \text{ atm}} = \boxed{544 \text{ L CO}}$$