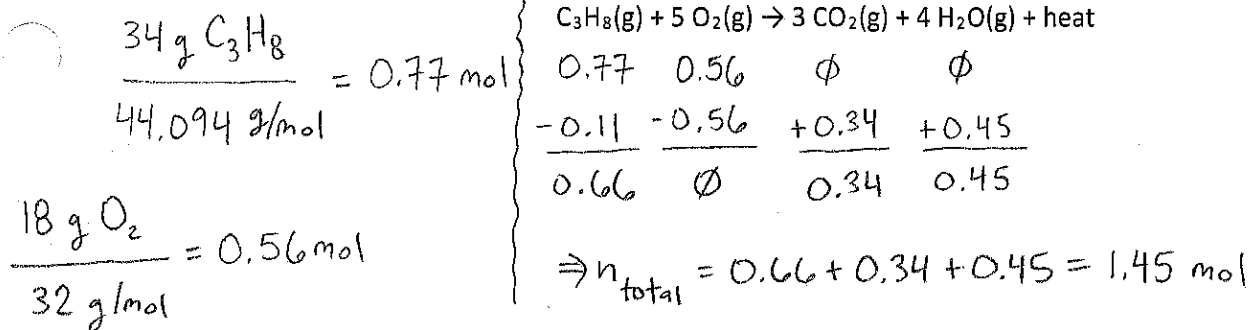


**Example #3:** If 34 grams of propane gas,  $C_3H_8$ , reacts with 18 grams of oxygen gas in a 0.75 L sealed bomb calorimeter, what is the pressure inside the container after the reaction is complete? Assume the reaction happens at  $25^\circ C$ .

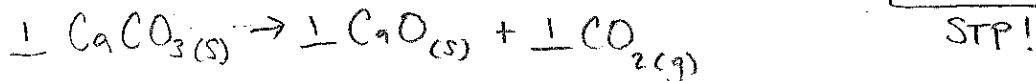


$$P_{\text{tot}} = \frac{n_{\text{tot}} RT}{V} = \frac{(1.45 \text{ mol})(0.08206 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}})(298 \text{ K})}{0.75 \text{ L}} = \boxed{47 \text{ atm}}$$

yikes!

### Let's Practice!

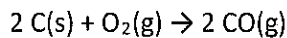
1. Solid calcium carbonate, also known as limestone, will decompose upon heating to produce solid calcium oxide, also known as lime (an industrial chemical with a wide variety of uses), and carbon dioxide gas. How many grams of calcium carbonate must be decomposed to produce 5.00 L of carbon dioxide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



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

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

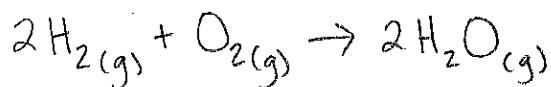
3. How many milliliters of 2.5 molar hydrochloric acid, HCl, would be required to produce 1.25 L of carbon dioxide gas, assuming sufficient calcium carbonate? Assume the reaction takes place at STP.



$$1.25 \text{ L CO}_2 \times \frac{1 \text{ mol CO}_2}{22.4 \text{ L CO}_2} \times \frac{2 \text{ mol HCl}}{1 \text{ mol CO}_2} = 0.112 \text{ mol HCl}$$

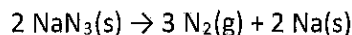
$$L = \frac{\text{mol}}{M} = \frac{0.112 \text{ mol}}{2.5 \text{ M}} = 0.045 \text{ L} = \boxed{45 \text{ mL HCl}}$$

4. Assuming all volume measurements are made at the same temperature and pressure, what volume of hydrogen gas is needed to react completely with 4.55 L of oxygen gas to produce water vapor?



$$4.55 \text{ L O}_2 \times \frac{2 \text{ L H}_2}{1 \text{ L O}_2} = \boxed{9.10 \text{ L H}_2}$$

5. Air bags in cars are inflated by the sudden decomposition of sodium azide,  $\text{NaN}_3$ , by the following reaction.



What volume of  $\text{N}_2$  gas, measured at  $\boxed{1.30 \text{ atm and } 87^\circ\text{C}}$ , would be produced by the reaction of 70.0 g of  $\text{NaN}_3$ ?  
not STP!

$$70.0 \text{ g NaN}_3 \times \frac{1 \text{ mol NaN}_3}{65.02 \text{ g NaN}_3} \times \frac{3 \text{ mol N}_2}{2 \text{ mol NaN}_3} = 1.61 \text{ mol N}_2$$

$$V = \frac{nRT}{P} = \frac{(1.61 \text{ mol})(0.08206 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}})(360. \text{K})}{1.30 \text{ atm}} = \boxed{36.7 \text{ L N}_2}$$