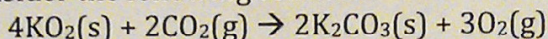


MORE STOICHIOMETRY PRACTICE

1. Consider the following reaction:



How many moles of KO_2 are needed to react with 75.0 L of carbon dioxide at -25°C and 215 kPa?

1 unit conversions

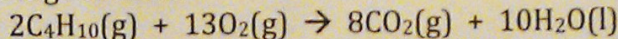
$$-25^\circ\text{C} = -25 + 273.15\text{K} = 248.15\text{K}$$

$$215\text{ kPa} = \frac{215}{101.325}\text{ atm} = 2.122\text{ atm}$$

$$2 \quad n_{\text{CO}_2} = \frac{PV}{RT} = \frac{(2.122\text{ atm})(75.0\text{ L})}{(0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(248.15\text{ K})} = 7.8156\text{ mol}$$

$$3 \quad \frac{n_{\text{KO}_2}}{n_{\text{CO}_2}} = \frac{4}{2} \Rightarrow n_{\text{KO}_2} = 2n_{\text{CO}_2} = 2(7.8156\text{ mol}) = 15.631\text{ mol}$$

2. Consider the following reaction:



(a) How many grams of carbon dioxide are formed when 55.5 g of butane reacts with 45.5 g O_2 ?

$$1 \quad n_{\text{butane}} = \frac{m_{\text{butane}}}{\text{MW}_{\text{butane}}} = \frac{55.5\text{ g}}{58\text{ g/mol}} = 0.9569\text{ mol}$$

$$n_{\text{O}_2} = \frac{m_{\text{O}_2}}{\text{MW}_{\text{O}_2}} = \frac{45.5\text{ g}}{32\text{ g/mol}} = 1.4219\text{ mol}$$

$$2 \quad \text{Limiting reagent is } \text{O}_2 \text{ b/c } n_{\text{O}_2} \rightarrow \frac{1.4219}{13} = 0.1094 < 0.4784 = \frac{0.9569}{2}$$

$$3 \quad \frac{n_{\text{O}_2}}{n_{\text{CO}_2}} = \frac{13}{8} \Rightarrow n_{\text{CO}_2} = n_{\text{O}_2} \left(\frac{8}{13}\right) = 0.1094 \left(\frac{8}{13}\right) = 0.0673\text{ mol}$$

(b) If $P=135\text{ kPa}$ and $T=270\text{ K}$, what is the volume of this amount of carbon dioxide? What is the total final volume of this system?

$$1 \quad V_{\text{CO}_2} = \frac{nRT}{P} = \frac{(0.0673\text{ mol})(0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}})(270\text{ K})}{\left(\frac{135}{101.325}\text{ atm}\right)} = 1.11\text{ L}$$

$$4 \quad m_{\text{CO}_2} = n_{\text{CO}_2} \times \text{MW}_{\text{CO}_2} = (0.0673\text{ mol}) \times (44\text{ g/mol}) = 2.96\text{ g}$$

$$2 \quad n_{\text{butane remaining}} = 0.9569 - 2(0.1094) = 0.7381\text{ mol}$$

$$V_{\text{butane remaining}} = \frac{nRT}{P} = 12.275\text{ L}$$

(c) Starting over, 43.2 L of butane is mixed with 76.0 L of O_2 at the same pressure and temperature to give an initial volume of 119.2 L. After butane and O_2 react, the total volume changes, Assuming that the reaction runs to completion, what is the final volume?

1 B/c $P = \text{cte}$ + $T = \text{cte}$, the problem can be worked in liters ($n \propto V$ b/c $n = \frac{P}{RT} V$)

$$2 \quad \text{Limiting reagent is } \text{O}_2 \text{ b/c } \frac{43.2}{2} = 21.6 > 5.85 = \frac{76}{13}$$

$$3 \quad V_{\text{final}} = V_{\text{CO}_2} + V_{\text{C}_4\text{H}_{10} \text{ remain}} = 8(5.85) + (43.2 - 2(5.85)) = 46.8 + (43.2 - 11.7) = 78.3\text{ L}$$

$$3 \quad V_{\text{Total}} = V_{\text{CO}_2} + V_{\text{butane remaining}} = 1.11 + 12.275 = 13.385\text{ L}$$