

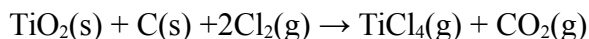
CHM 110

Gas Laws Practice Set

SOLUTIONS

Solve the following problems Write the answer in the answer blank, and show work in the space provided.

1) What volume of CO₂ gas would (given enough carbon and chlorine) be produced at 504 °C and 1.10 atm by the reaction of 45.0 g of TiO₂ in the following reaction?



Answer: 32.7 L CO₂

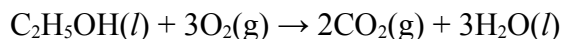
$$79.87 \text{ g TiO}_2 = \text{mol TiO}_2 \quad \text{mol TiO}_2 = \text{mol CO}_2$$

$$45.0 \text{ g TiO}_2 \times \frac{\text{mol TiO}_2}{79.87 \text{ g TiO}_2} \times \frac{\text{mol CO}_2}{\text{mol TiO}_2} = 0.56341555 \text{ mol CO}_2$$

$$V = \frac{nRT}{P} \quad \left| \quad \begin{array}{l} n = 0.56341555 \text{ mol CO}_2 \quad T = 504^\circ\text{C} = 777 \text{ K} \\ R = 0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}} \quad P = 1.10 \text{ atm} \end{array} \right.$$

$$V = \frac{(0.56341555 \text{ mol CO}_2) \left(0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}} \right) (777 \text{ K})}{(1.10 \text{ atm})} = 32.657931639 \text{ L}$$

2) C₂H₅OH burns in air to form CO₂ and H₂O. What volume of carbon dioxide gas (at 25.0°C and 1.07 atm) can be produced when 55.0 grams of C₂H₅OH burns in sufficient oxygen?



Answer: 54.6 L CO₂

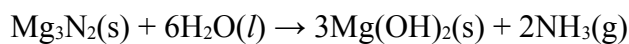
$$46.068 \text{ g C}_2\text{H}_5\text{OH} = \text{mol C}_2\text{H}_5\text{OH} \quad 2 \text{ mol CO}_2 = \text{mol C}_2\text{H}_5\text{OH}$$

$$55.0 \text{ g C}_2\text{H}_5\text{OH} \times \frac{\text{mol C}_2\text{H}_5\text{OH}}{46.068 \text{ g C}_2\text{H}_5\text{OH}} \times \frac{2 \text{ mol CO}_2}{\text{mol C}_2\text{H}_5\text{OH}} = 2.387774594 \text{ mol CO}_2$$

$$V = \frac{nRT}{P} \quad \left| \quad \begin{array}{l} n = 2.387774594 \text{ mol CO}_2 \quad R = 0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}} \\ T = 25.0^\circ\text{C} = 298.2 \text{ K} \quad P = 1.07 \text{ atm} \end{array} \right.$$

$$V = \frac{(2.387774594 \text{ mol CO}_2) \left(0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}} \right) (298.2 \text{ K})}{(1.07 \text{ atm})} = 54.607048175 \text{ L}$$

3) What mass of magnesium nitride is required to produce 475 L of ammonia gas at STP via the following reaction??



Answer: 1070 g Mg_3N_2

$$n = \frac{PV}{RT} \quad \left| \quad \begin{array}{l} P = 1.00 \text{ atm} \quad V = 475 \text{ L} \quad R = 0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}} \\ T = 0^\circ\text{C} = 273.15 \text{ K} \end{array} \right.$$

$$n_{\text{NH}_3} = \frac{(1.00 \text{ atm})(475 \text{ L})}{\left(0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}}\right)(273.15 \text{ K})} = 21.191460653 \text{ mol NH}_3$$

$$100.95 \text{ g Mg}_3\text{N}_2 = 1 \text{ mol Mg}_3\text{N}_2 \quad 2 \text{ mol NH}_3 = 1 \text{ mol Mg}_3\text{N}_2$$

$$21.191460653 \text{ mol NH}_3 \times \frac{1 \text{ mol Mg}_3\text{N}_2}{2 \text{ mol NH}_3} \times \frac{100.95 \text{ g Mg}_3\text{N}_2}{1 \text{ mol Mg}_3\text{N}_2} = 1069.63897646 \text{ g Mg}_3\text{N}_2$$

4) A 4.50 L flask contains pure nitrogen gas (N_2) at 0.979 atm and 30.0 °C. What is the mass of nitrogen gas inside the flask?

Answer: 4.96 g N_2

$$n = \frac{PV}{RT} \quad \left| \quad \begin{array}{l} P = 0.979 \text{ atm} \quad V = 4.50 \text{ L} \\ R = 0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}} \quad T = 30.0^\circ\text{C} = 303.2 \text{ K} \end{array} \right.$$

$$n_{\text{N}_2} = \frac{(0.979 \text{ atm})(4.50 \text{ L})}{\left(0.08206 \frac{\text{L}\cdot\text{atm}}{\text{mol}\cdot\text{K}}\right)(303.2 \text{ K})} = 0.177065723 \text{ mol N}_2$$

$$28.02 \text{ g N}_2 = 1 \text{ mol N}_2$$

$$0.177065723 \text{ mol N}_2 \times \frac{28.02 \text{ g N}_2}{1 \text{ mol N}_2} = 4.961381546 \text{ g}$$