Gases and Stoichiometry Part 1 Answer Key

1. How many L of nitrogen are required to produce 646 L of NH_3?

$N_2\ (g) + 3\ H_2\ (g) \rightarrow 2\ NH_3\ (g)$

$$646\ L\ NH_3 \times \frac{1\ mol\ N_2}{2\ mol\ NH_3} = \mathbf{323\ L\ N_2}$$

2. How many liters of O_2 are needed to react with 125.62 g of methane? The experiment was run under a pressure of 780 mmHg at a temperature of 128.5 °C.

$CH_4\ (g) + 2\ O_2\ (g) \rightarrow\ CO_2\ (g) + 2\ H_2O\ (g)$

$$125.62\ g\ CH_4\ \times \frac{1\ mol\ CH_4}{16.04\ g} \times \frac{2\ mol\ O_2}{1\ mol\ CH_4} = 15.663\ mol\ O_2$$

T = 128.5 °C + 273.15 K = 401.65 K, $P = 780\ mmHg \times \frac{1\ atm}{760\ mmHg} = 1.03\ atm$

$$V = \frac{nRT}{P} = \frac{15.663\ mol \times 0.0821 \frac{L \cdot atm}{mol \cdot K} \times 401.65\ K}{1.03\ atm} = \mathbf{501\ L}$$

3. Consider the following reaction.

$HC_3H_3O_3\ (aq) \rightarrow C_2H_4O\ (aq) + CO_2\ (g)$

How many grams of pyruvic acid, $HC_3H_3O_3$, were reacted if the sample gives 285.52 mL CO_2 gas at 756 mmHg at 28.0°C?

V = 0.28552 L, $P = 756\ mmHg \times \frac{1\ atm}{760\ mmHg} = 0.995\ atm$

$$n = \frac{PV}{RT} = \frac{0.995\ atm\ \times\ 0.28552\ L}{0.0821 \frac{L \cdot atm}{mol \cdot K}\ \times\ 301.15\ K} = 0.01149\ mol\ CO_2$$

$$0.01149\ mol\ CO_2 \times \frac{1\ mol\ HC_3H_3O_3}{1\ mol\ CO_2} \times \frac{88.06\ g\ HC_3H_3O_3}{1\ mol\ HC_3H_3O_3} = \mathbf{1.01\ g\ HC_3H_3O_3}$$