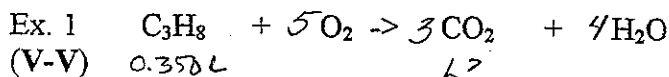


GAS STOICHIOMETRY

Key



At STP

- a) At what volume, in liters of oxygen, is required for the complete combustion of 0.350 L of propane?
 b) What volume of carbon dioxide is produced in the reaction?

$$0.350 \text{ L } C_3H_8 \left(\frac{1 \text{ mol } C_3H_8}{22.411 \text{ L } C_3H_8} \right) \left(\frac{3 \text{ mol } CO_2}{1 \text{ mol } C_3H_8} \right) \left(\frac{22.411 \text{ L } CO_2}{1 \text{ mol } CO_2} \right) = 1.05 \text{ L } CO_2$$

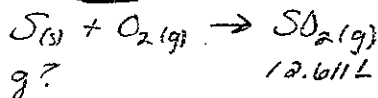
$1.75 \text{ L } O_2$

or $0.350 \text{ L } C_3H_8 \left(\frac{3 \text{ L } CO_2}{1 \text{ L } C_3H_8} \right) = 1.05 \text{ L } CO_2$

↑ Gay-Lussac's Law of Combining Volumes

- Ex. 2 Sulfur is added to oxygen gas to produce sulfur dioxide gas.
 (V-m) What mass of sulfur when added to oxygen will produce 12.611 L of sulfur dioxide at STP?

STP

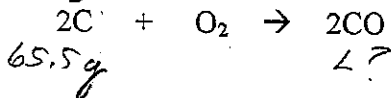


$$12.611 \text{ L } SO_2 \left(\frac{1 \text{ mol } SO_2}{22.411 \text{ L } SO_2} \right) \left(\frac{1 \text{ mol } S}{1 \text{ mol } SO_2} \right) \left(\frac{32.07 \text{ g } S}{1 \text{ mol } S} \right) = 18.05 \text{ g } S$$

Mass → Volume

- Ex. 3 How many liters of CO at 27°C and 188 mm Hg can be produced from the (m-V) burning of 65.5 g of C?

at STP



$T = 27^\circ C$

$P = 188 \text{ mm Hg} \left(\frac{1 \text{ atm}}{760 \text{ mm Hg}} \right) = 0.247 \text{ atm}$

$$65.5 \text{ g } C \left(\frac{1 \text{ mol } C}{12.01 \text{ g } C} \right) \left(\frac{2 \text{ mol } CO}{2 \text{ mol } C} \right) = 5.45 \text{ mol } CO$$

$PV = nRT$

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

$= 543 \text{ L } CO$

1) stoich

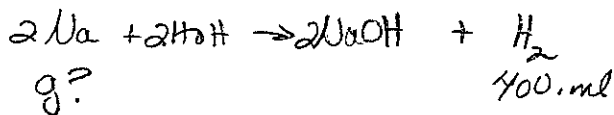
g given → n gas

2) IGL

Solve for Vol. of gas

Ex. 4 How many grams of Na are needed to react with water to liberate 400. ml (V-m) of hydrogen at STP?

At STP

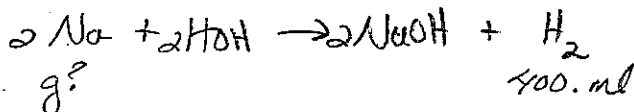


Ex. 5 What volume of oxygen in liters can be collected at 750. mm Hg and 25°C when 30.6 g of potassium chlorate decomposes?

Volume → Mass

EX. 6 How many grams of sodium are needed to react with water to liberate 400. ml of hydrogen gas at 720 mm Hg and 37°C?

Not at STP



$$P = 720 \text{ mmHg} \left(\frac{1 \text{ atm}}{760 \text{ mmHg}} \right) = 0.95 \text{ atm}$$

$$T = 37^\circ\text{C}$$

$$PV = nRT$$

$$n = \frac{PV}{RT} = \frac{(0.95 \text{ atm})(0.400 \text{ L})}{(0.08206 \text{ L}\cdot\text{atm}/\text{K}\cdot\text{mol})(310. \text{ K})} = 0.015 \text{ mol H}_2$$

$$0.015 \text{ mol H}_2 \left(\frac{2 \text{ mol Na}}{1 \text{ mol H}_2} \right) \left(\frac{22.99 \text{ g Na}}{1 \text{ mol Na}} \right) = 0.69 \text{ g Na}$$

1) IGL
solve for
n of gas

2) Stick
n gas → g (answer)

GAS STOICHIOMETRY

1. Acetylene gas, C_2H_2 , undergoes combustion to produce carbon dioxide and water vapor. If 50.0 L of CO_2 are produced, how many liters of Acetylene are required?
2. Consider the reaction: $3H_2(g) + N_2(g) \rightarrow 2NH_3(g)$
performed at $550^\circ C$ and 14.50 atm. If 45,000 g of nitrogen is used, what volume of ammonia is produced?
3. What mass of carbon is required to produce 250.0 L of CO at $25^\circ C$ and 0.345 atm?
 $2C(s) + O_2(g) \rightarrow 2CO(g)$
4. What volume of oxygen gas, in liters, can be collected at 734.7 mm Hg and $25^\circ C$ when 24.0 g of $KClO_3$ is decomposed by heating?
5. How many grams of lithium are needed to react with water to create 125.0 ml of hydrogen gas at STP?
6. Sodium is reacted with water: $2Na + 2H_2O \rightarrow H_2 + 2NaOH$
How many ml of hydrogen gas will result from the reaction of 10.50 g of sodium at $30.0^\circ C$ and 0.980 atm?
7. If 29.0 L of methane, CH_4 , undergo complete combustion at 0.961 atm and $20.0^\circ C$, how many liters of each product are formed?