Chemistry H

Exercise 11.3a

Gas Stoichiometry

Name: _____

Date:_____ Per:_____

Many chemical reactions (e.g., rusting of metal, cellular respiration, photosynthesis) involve the reaction or production of gases. Due to the variable volume of gases, special consideration must be made when calculating stoichiometric relationships. Use of the:

- Ideal Gas Law: ($PV = nRT$)
- Combined Gas Law formula: ($P_1V_1/T_1 = P_2V_2/T_2$), and
- Avogadro's Principle: (1mol of any gas at STP has a volume of 22.4L)

allow for the conversion of gas volumes at various pressures and temperatures into moles that may be compared via the mole ratios central to stoichiometry.

Example:
Using the equation $CaCO_3(s) \rightarrow CaO(s) + CO_2(g)$, calculate the volume of carbon dioxide produced at STP if 24.8 grams of calcium carbonate decomposes.

Analyze, rewrite, balance equation

$CaCO_3$	$\rightarrow$	CaO	+	CO_2
24.8g				*?L*

Solve for only reactant

$$\frac{24.8\text{g } CaCO_3}{} \left| \frac{1 \text{ mol } CaCO_3}{100.086\text{g } CaCO_3} \right| \frac{1 \text{ mol } CO_2}{1 \text{ mol } CaCO_3} \left| \frac{22.4 \text{ L } CO_{2\,(STP)}}{1 \text{ mol } CO_{2\,(STP)}} \right. = 5.55 \text{ L } CaO_{\,(STP)}$$

DIRECTIONS: Solve the following problems in the space provided.

1. Convert 65.0 grams of oxygen gas to liters of oxygen gas at STP.

2. Find the mass of 83.7 liters of methane gas (CH_4) at STP.

3. Given the <u>unbalanced</u> equation C_4H_{10} *(g)* + O_2 *(g)* $\rightarrow$ CO_2 *(g)* + H_2O *(l)*, find the mass of CO_2 formed if 105 liters of C_4H_{10} at STP reacts with an excess of oxygen.

4. You are asked to prepare 0.500 moles of Na_2SO_3 by way of the reaction, SO_2 *(g)* + NaOH *(aq)* $\rightarrow$ Na_2SO_3 *(aq)* + H_2O *(l)*. How many liters of SO_2 *(g)* at STP must you use to do this?

5. What mass of KBr could be produced from the reaction of 34.7 L of Br_2 at STP with an excess of KI according to the equation Br_2 *(g)* + KI *(aq)* $\rightarrow$ KBr *(aq)* + I_2 *(s)*?

Answers: 1) 45.5 L O_2 2) 59.9 g CH_4 3) 825 g CO_2 4) 11.2 L SO_2 5) 369 g KBr 6) 44.0 L CO_2 7) 7.3 L O_2 8) 317 L NO_2 9) 1500 mmHg 10) 21.0 g $KClO_3$

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6. Given the unbalanced equation $C_6H_{10}O_5$ *(g)* + O_2 *(g)* → CO_2 *(g)* + H_2O *(l)*, find the volume of CO_2 produced from the reaction of $2.3x10^{24}$ molecules of $C_6H_{10}O_5$ with 44.0 L of O_2.

7. Given the unbalanced equation H_2O_2 *(aq)* → H_2O *(l)* + O_2 *(g)*, what volume of O_2 is produced when 28.5 g of hydrogen peroxide (H_2O_2) decomposes to form water and oxygen at 150°C and 2.0 atm?

8. When 62.7 g nitrogen and excess oxygen react, they generate nitrogen dioxide via the unbalanced equation N_2 *(g)* + $2O_2$ *(g)* → $2NO_2$ *(g)*. If the NO_2 is collected at 625 K and 0.724 atm, what volume will it occupy?

9. When 2.4 g zinc is added to hydrochloric acid, 450 mL of hydrogen gas forms at a temperature of 32°C via the reaction, Zn (s) + 2HCl (aq) → $ZnCl_2$ (aq) + H_2 (g). What is the pressure of the gas in ***mmHg***?

10. The following reaction forms 6.41 L of oxygen at a temperature of 18.7 °C and a pressure of 731 mmHg, what mass of $KClO_3$ must have decomposed?

$2KClO_3$ (s) → $2KCl$ (s) + $3O_2$ (g)

Answers: 1) 45.5 L O_2 2) 59.9 g CH_4 3) 825 g CO_2 4) 11.2 L SO_2 5) 369 g KBr 6) 44.0 L CO_2 7) 7.3 L O_2 8) 317 L NO_2 9) 1500 mmHg 10) 21.0 g $KClO_3$