

Name:

Date:

**STOICHIOMETRY REVIEW**

*A. Determine the Molar Mass of the following substances:*



*B. Convert to Moles:*



*C. Covert to Mass in Grams*



D. Percent Composition and Molecular Formula

- 1) A particular hydrocarbon containing chlorine atoms was analyzed and it was determined that it was 82.4% nitrogen by mass, and 17.6% hydrogen by mass. The molar mass was determined to be 34 g/mol. What is the empirical formula? What is the molecular formula?

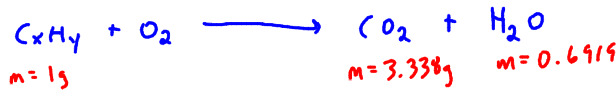
$M_m = 34 \text{ g/mol}$

<u>N</u>	<u>H</u>	∞ Molecular formula 15 <span style="border: 1px solid red; padding: 5px;"><math>N_2H_6</math></span>
$m = .824 \times 34$	$m = 0.176 \times 34$	
$m = 28.016 \text{ g}$	$m = 5.984 \text{ g}$	
$n = \frac{28.016}{14}$	$n = \frac{5.984}{1.008}$	
$n = 2 \text{ mol}$	$n = 6 \text{ mol}$	

- 2) A chemical was found to contain 43.7% phosphorous by mass and 56.3% oxygen by mass. It was also determined that the molar mass of the compound was 283.88 g/mol. What is the molecular formula?

<u>P</u>	<u>O</u>	∞ molecular formula <span style="border: 1px solid red; padding: 5px;"><math>P_4O_{10}</math></span>
$m = 0.437 \times 283.88$	$m = 0.563 \times 283.88$	
$m = 124.05$	$m = 159.82$	
$n = \frac{124.05}{30.97}$	$n = \frac{159.82}{16}$	
$n = 4$	$n = 10$	

- 3) An unknown hydrocarbon with a mass of 1.00g was run through a carbon hydrogen analyzer. In the end, 3.338 g  $CO_2$  were produced as well as 0.6919 g of  $H_2O$ . The molar mass of the hydrocarbon is 39 g/mol. What hydrocarbon was tested?



Mass of Carbon

$$\%C = \frac{C}{CO_2} = \frac{12}{44} = 0.2727$$

$$m_C = 0.2727 \times 3.338$$

$$= 0.91027 \text{ g}$$

$$n_C = \frac{0.91027}{12}$$

$$= \frac{0.0759}{0.0759}$$

(1)

Empirical  $C_1H_1$

Mass of Hydrogen

$$\%H = \frac{H_2}{H_2O} = \frac{2}{18} = 0.1111$$

$$m_H = 0.1111 \times 0.6919$$

$$= 0.0769 \text{ g}$$

$$n_H = \frac{0.0769}{1.01}$$

$$= \frac{0.076109}{0.0759}$$

(1)

Molecular Mass = 39 g/mol

Empirical Mass = 13 g/mol

$$\frac{39}{13} = 3$$

∞ Molecular Formula

$$C_1H_1 \times 3 = \boxed{C_3H_3}$$

- 4) An unknown hydrocarbon with a mass of 0.874g was run through a carbon hydrogen analyzer. In the end, 2.23 g CO<sub>2</sub> was produced as well as 0.652 g of H<sub>2</sub>O. The molar mass of the hydrocarbon that contains carbon, hydrogen and oxygen is 362 g/mol. What hydrocarbon was tested?

$$\%C \text{ in } CO_2$$

$$\frac{12}{44} = 0.2727$$

$$m_C = 0.2727 \times 2.23$$

$$= 0.608g$$

$$\%H \text{ in } H_2O$$

$$\frac{2}{18} = 0.1111$$

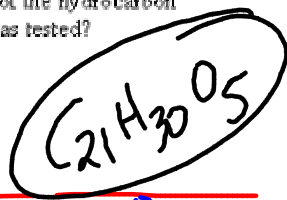
$$m_H = 0.1111 \times 0.652$$

$$= 0.0724372g$$

$$M_O = M_T - M_C - M_H$$

$$= 0.874 - 0.608 - 0.0724$$

$$= 0.1936g$$



$$m = 0.608g$$

$$n = \frac{0.608}{12}$$

$$n = \frac{0.050666}{0.0121}$$

$$= 4.2 (\times 5)$$

$$m = 0.0724g$$

$$n = \frac{0.0724}{1}$$

$$n = \frac{0.0724}{0.0121}$$

$$= 6 (\times 5)$$

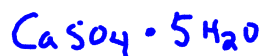
$$m = 0.1936g$$

$$n = \frac{0.1936}{16}$$

$$n = \frac{0.0121}{0.0121}$$

$$= 1 (\times 5)$$

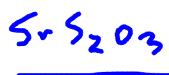
- 5) What is the percent by mass of water in calcium sulfate pentahydrate?



$$\%H_2O = \frac{5H_2O}{CaSO_4 \cdot 5H_2O} = \frac{5(18)}{136 + 5(18)} = \frac{90}{226}$$

$$= 40\%$$

- 6) A 3.34 g sample of SrS<sub>2</sub>O<sub>3</sub>·xH<sub>2</sub>O contains 2.3 g of anhydrous SrS<sub>2</sub>O<sub>3</sub>. Calculate x.



$$m = 2.3g$$

$$n = \frac{2.3}{199}$$

$$= \frac{0.01155}{0.01155}$$

$$= 1$$



$$m = 3.34 - 2.3$$

$$= 1.04g$$

$$n = \frac{1.04}{18}$$

$$= \frac{0.05777}{0.01155}$$

$$= 5$$

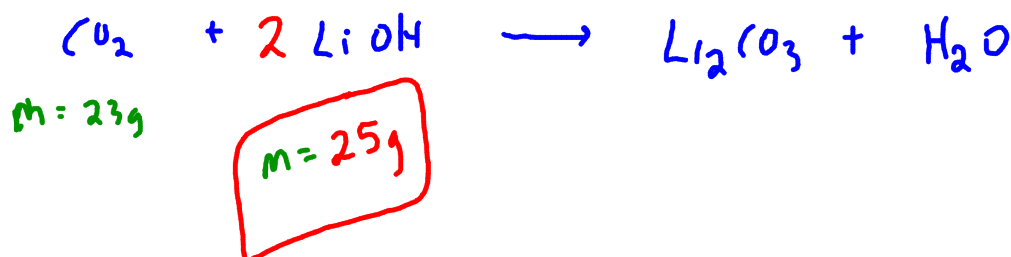
E. Stoichiometry

7) In the following reaction (hard)

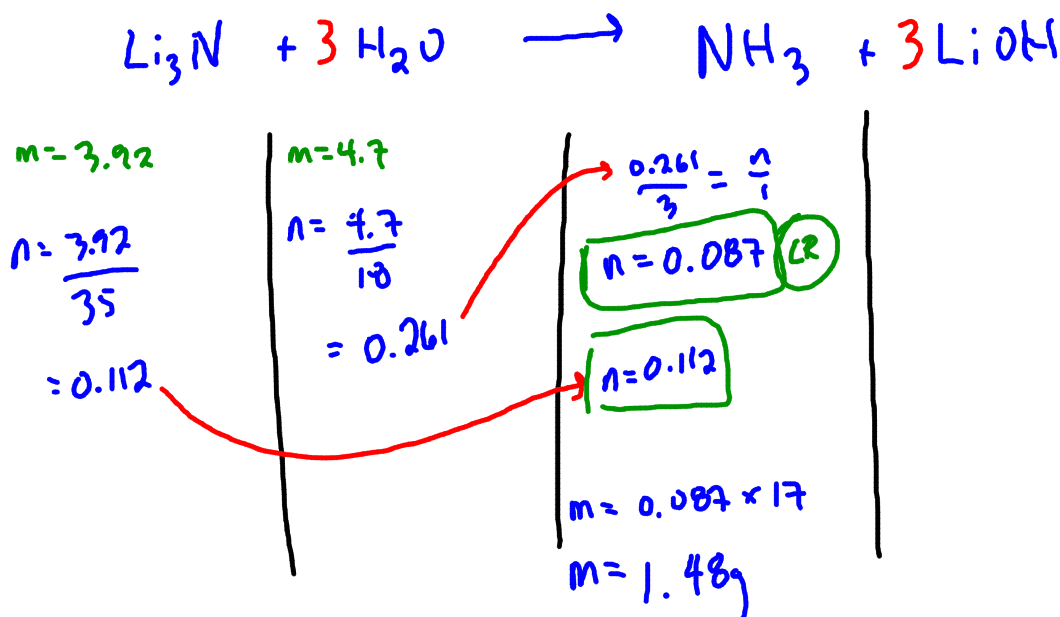


- 17 moles of  $\text{C}_3\text{H}_8$  makes how many moles of  $\text{H}_2\text{O}$ ? ( )
- 17 moles of  $\text{H}_2\text{O}$  are made, how many moles of  $\text{C}_3\text{H}_8$  reacted? ( )
- 3.41 moles of  $\text{O}_2$  makes how many moles of  $\text{CO}_2$ ? ( )
- 15.9 moles of  $\text{H}_2\text{O}$  are made, how many moles of  $\text{C}_3\text{H}_8$  reacted? ( )
- 142 moles of  $\text{CO}_2$  are made, how many moles of  $\text{H}_2\text{O}$  are made? ( )
- 0.121 moles of  $\text{C}_3\text{H}_8$  makes how many moles of  $\text{CO}_2$ ? ( )
- 99.9 moles of  $\text{O}_2$  reacts with how many moles of  $\text{C}_3\text{H}_8$ ? ( )
- 44 moles of  $\text{CO}_2$  are made, how many moles of  $\text{H}_2\text{O}$  are made? ( )
- 2.22 moles of  $\text{CO}_2$  are made, how many moles of  $\text{O}_2$  reacted? ( )
- 1 mole of  $\text{C}_3\text{H}_8$  makes how many moles of  $\text{H}_2\text{O}$ ? ( )

7) Carbon dioxide reacts with lithium hydroxide to produce lithium carbonate and water. What mass of lithium hydroxide do you need to react with 23 g of carbon dioxide?



8) Lithium nitride reacts with water to form ammonia and lithium hydroxide. If 3.92 g of lithium nitride reacts with 4.7 g of water, how many grams of ammonia will be created?



9) Hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) decomposes into hydrogen gas and oxygen gas with a 82.6 % yield of oxygen gas. What is the actual yield that can be expected if 12.4 g of hydrogen peroxide is reacted?

10) Ammonia is created by reacting nitrogen gas with hydrogen gas. During an experiment, 40 g of nitrogen was reacted with 500 g of hydrogen to produce an actual yield of 0.74 g of ammonia. What is the percentage yield of the reaction?

*F. Short Answer Definitions*

- a) What is a mole? How would you describe the concept to a 10 year old?
- b) What is a hydrate? What type of compounds are they specific to? Do you have to consider the molar mass of the water in your stoichiometric calculations? Does the water participate in the reaction?
- c) What is the limiting reagent? How does the limiting reagent affect the reaction?
- d) What is the percent yield? Is it possible to have a percent yield over 100%? What would this mean?

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