Name: **Date:**

STOICHIOMETRY REVIEW

A. Determine the Molar Mass of the following substances:

1) Br_2 **2)** H_2PO_3

3) $C_{10}H_{22}$ **4)** $Mg(NO_3)_2 \cdot 8H_2O$

B. Convert to Moles:

1) 3.01×10^{23} atoms Cl **2)** 12.04×10^{23} atoms Mg

3) 48 grams of aluminum **4)** 156.3 grams of lead

5) 19 000 molecules of KI **6)** 56.2 grams of $Ca(ClO_3)_2 \cdot 4H_2O$

C. Covert to Mass in Grams

1) 5.0 moles Li **2)** 7.5 moles Co

3) 0.3 mole of bromine gas **4)** 2.67 moles of dialuminum trioxide

5) 7.0 moles NH_3 **6)** 1.8 moles $NaCO_3 \cdot 5H_2O$

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?

$M_m = 34 g/mol$

N	H
$m = .824 \times 34$	$m = 0.176 \times 34$
$m = 28.016 g$	$m = 5.984 g$
$n = \frac{28.016}{14}$	$n = \frac{5.984}{1.008}$
$n = 2 mol$	$n = 6 mol$

∴ Molecular formula is N_2H_6

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 283.88g/mol. What is the molecular formula?

P	O
$m = 0.437 \times 283.88$	$m = 0.563 \times 283.88$
$m = 124.05$	$m = 159.82$
$n = \frac{124.05}{30.97}$	$n = \frac{159.82}{16}$
$n = 4$	$n = 10$

∴ molecular formula P_4O_{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?

$C_xH_y + O_2 \longrightarrow CO_2 + H_2O$

$m = 1g$ $\quad m = 3.338g$ $\quad m = 0.6919$

Mass of Carbon

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

$m_C = 0.2727 \times 3.338$

$= 0.91027 g$

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

$= \frac{0.0759}{0.0759}$

$= 1$

Mass of Hydrogen

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

$m_H = 0.1111 \times 0.6919$

$= 0.0769 g$

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

$= \frac{0.07610}{0.0759}$

$= 1$

Empirical C_1H_1

Molecular Mass = 39 g/mol

Empirical Mass = 13 g/mol

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

∴ Molecular Formula

$C_1H_1 \times 3 = C_3H_3$

4) An unknown hydrocarbon with a mass of 0.874g was run through a carbon hydrogen analyzer. In the end, 2.23 g CO_2 was produced as well as 0.652 g of H_2O. The molar mass of the hydrocarbon that contains carbon, hydrogen and oxygen is 362 g/mol. What hydrocarbon was tested?

%C in CO_2

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

$m_C = 0.2727 \times 2.23$

$= 0.608g$

%H in H_2O

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

$m_H = 0.1111 \times 0.652$

$= 0.0724372g$

$m_O = m_T - m_C - m_H$

$= 0.874 - 0.608 - 0.0724$

$= 0.1936g$

$C_{21}H_{30}O_5$

C	H	O
$m = 0.608g$	$m = 0.0724g$	$m = 0.1936g$
$n = \frac{0.608}{12}$	$n = \frac{0.0724}{1}$	$n = \frac{0.1936}{16}$
$n = \frac{0.050666}{0.0121}$	$n = \frac{0.0724}{0.0121}$	$n = \frac{0.0121}{0.0121}$
$= 4.2$ (x5)	$= 6$ (x5)	$= 1$ (x5)

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

$CaSO_4 \cdot 5H_2O$

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

$= 40\%$

6) A 3.34 g sample of $SrS_2O_3 \cdot xH_2O$ contains 2.3 g of anhydrous SrS_2O_3. Calculate x.

SrS_2O_3

$m = 2.3g$

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

$= \frac{0.01155}{0.01155}$

$= 1$

H_2O

$m = 3.34 - 2.3$

$= 1.04g$

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

$= \frac{0.05777}{0.01155}$

$= 5$

E. Stoichiometry

7) In the following reaction (hard)

$$C_3H_8 + 5\,O_2 \rightarrow 4\,H_2O + 3\,CO_2$$

17 moles of C_3H_8 makes how many moles of H_2O?	( )
17 moles of H_2O are made, how many moles of C_3H_8 reacted?	( )
3.41 moles of O_2 makes how many moles of CO_2?	( )
15.9 moles of H_2O are made, how many moles of C_3H_8 reacted?	( )
142 moles of CO_2 are made, how many moles of H_2O are made?	( )
0.121 moles of C_3H_8 makes how many moles of CO_2?	( )
99.9 moles of O_2 reacts with how many moles of C_3H_8?	( )
44 moles of CO_2 are made, how many moles of H_2O are made?	( )
2.22 moles of CO_2 are made, how many moles of O_2 reacted?	( )
1 mole of C_3H_8 makes how many moles of H_2O?	( )

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?

$CO_2 + 2\,LiOH \longrightarrow Li_2CO_3 + H_2O$

$m = 23g$

$m = 25g$

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?

$Li_3N + 3\,H_2O \longrightarrow NH_3 + 3\,LiOH$

$m = 3.92$

$n = \frac{3.92}{35}$

$= 0.112$

$m = 4.7$

$n = \frac{4.7}{18}$

$= 0.261$

$\frac{0.261}{3} = \frac{n}{1}$

$n = 0.087$ (LR)

$n = 0.112$

$m = 0.087 \times 17$

$m = 1.48g$

9) Hydrogen peroxide (H_2O_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 stoiciometric 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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