Reference Packet #4

WS 4.1 Balancing Equations

____ H_2 + ____ O_2 ---> ____ H_2O

____ Fe + ____ O_2 ---> ____ Fe_2O_3

____ C_3H_8 + ____ O_2 ---> ____ H_2O + ____ CO_2

____ Fe_2S_3 + ____ C -----> ____ Fe + ____ CS_2

Do an atom inventory & find the formula weight for: $\mathbf{Ca_3(PO_4)_2}$

Do an atom inventory & find the formula weight for: $\mathbf{Fe(OH)_3}$

WS 4.2 Gram / Mole / Atom Conversions

1. 8.33 x 10^{23} atoms of _____ into moles

2. 1.95 moles of _____ into atoms

3. 17.2 grams of _____ into moles

4. 0.650 moles of _____ into grams

5. 38.8 grams of _____ into molecules

6. 4.66 x 10^{22} molecules of _____ into grams

Stoichiometry - day 1

$$4\ Fe + 3\ O_2 \rightarrow 2\ Fe_2O_3$$

1) How many moles of Fe_2O_3 can be produced from 6.92 moles of O_2?

2) How many moles of Fe_2O_3 can be produced from 5.30 grams of O_2?

3) How many grams of Fe are needed to react with 21.5 grams of O_2?

Stoichiometry - day 2

The amount of product you can theoretically make during a chemical reaction is called the _____

In a chemical reaction, the reactant which you run out of 1st is called the _____

In a chemical reaction, the reactants which are left-over are called _____

The amount of product you ***actually*** make after a chemical reaction is called the _____

The efficiency of the reaction, calculated by taking (actual ÷ theoretical x 100) is called the _____

$$3\ NaOH + AlI_3 \longrightarrow Al(OH)_3 + 3\ NaI$$

1. How many grams Al(OH)3 will be produced from **31.0 g NaOH** and **75.0 g AlI3**?

2. Which is the limiting reactant? _____

3. Which is the excess reactant? _____

4. Suppose after the reaction, you recovered 11.3 grams of Al(OH)3. Calculate % yield.

You want to make aluminum, using the following "recipe": **Al_2S_3 + Ca ---> CaS + Al**

Starting with **45.0 g of aluminum sulfide** and **35.0 g of calcium**, how many g of aluminum can you make?

Step 1: Balance the equation: ____ **Al_2S_3** + ____ **Ca** ---> ____ **CaS** + ____ **Al**

Step 2: Find out how many g of aluminum can be made from 45.0 g of aluminum sulfide:

45.0 g Al2S3 x

Step 3: Find out how many g of aluminum can be made from 35.0 g Ca:

35.0 g Ca x

Step 4: Determine which value is smaller in steps 2 & 3. The smaller value is your *theoretical yield*: _____

Step 5: The reactant which gave you the theoretical yield is the *limiting reactant*: _____

Step 6: Suppose, after the reaction, you only recovered 14.2 g of aluminum. What is your **% yield**? _____

Packet #4 Objectives: (know these for quiz)

- balance equations **(WS 4.1)**
- convert grams --> moles --> molecules **(WS 4.2)**
- use stoichiometry (mole shuffle) to calculate amt. of reactants and/or products needed **(WS 4.3)**
- use stoichiometry to calculate theoretical yields, limiting reactant, and % yield **(WS 4.4)**
- predict the products of various types of reactions **(WS 4.6)** -- *this includes knowing the 7 diatomic gases and how to write chemical formulas **(WS 2.6 & 3.1)***
- the chemical reaction you did in the 'penny lab' **(penny lab)**
- the metal we used in the lab "evidence of a chemical change" **(see lab)**
- calculate the % composition by mass for formulas **(WS 4.5.1)**
- calculate the empirical formula given % composition **(WS 4.5.2)**
- the concepts behind the Micro-Rockets demo (how to find proper "fuel : oxygen" ratio)
- the products which were produced during the lab "baking soda stoichiometry"

Empirical Formula, Example Problems: (WS 4.5.2)

#1. An unknown substance is analyzed by a mass spectrometer, and found to be composed of:

44.7 % P

rest % O

Determine its empirical formula

Further analysis shows the molecular weight is: 694 g/mol. What is the molecular formula?

Demo, "Dehydration of Sugar".

What is the reaction which takes place in this demo?

#2. An unknown substance is analyzed by a mass spectrometer, and found to be composed of:

52.2 % C

13.0 % H

rest % O

Determine its empirical formula

Further analysis shows the molecular weight is: 46 g/mol. What is the molecular formula?

Combustion- *occurs when a fuel (which contains carbon, hydrogen, and sometimes oxygen) burns. This reaction requires oxygen. The 2 products are always carbon dioxide and water.*

fuel + O_2 --->

CH_4 + O_2 --->

try this:

$C_6H_{12}O_6$ + O_2 --->

Synthesis (Composition)- *occurs when two simple elements combine to form a compound.*

Al + S --->

try these:

H_2 + Cl_2 --->

K + N_2 --->

Decomposition- *occurs when a compound splits apart into simple elements.*

$FeCl_3$ --->

try these:

HgS ---> N_2O --->

decomposition of carbonates - carbonates decompose to form metal oxides and carbon dioxide

$CaCO_3$ --->

Na_2CO_3 --->

Single Replacement- *occurs when a lone metal switches places with a metal in a compound.*

**** This will **only occur** if the lone metal is higher on the activitity series than the metal it's trying to replace.*

Li
K
Ca
Na
Mg
Al
Mn
Zn
Cr
Fe
Cd
Co
Ni
Sn
Pb
H
Cu
Hg
Ag
Pt
Au

$Al + FeCl_2 \rightarrow$

$Fe + AlCl_3 \rightarrow$

$Na + H_2O \rightarrow$

try these:

$Mg + CrCl_3 \rightarrow$

$Cu + H_2SO_4 \rightarrow$

$Pb(NO_3)_4 + Zn \rightarrow$

$Al + Fe_2O_3 \rightarrow$

single replacement of halogens - one halogen replaces another. The most reactive halogen is at the top (fluorine), and they become less reactice as you move down the family. The halogen needs to be higher in activity than the one its trying to replace.

$Br_2 + NaCl \rightarrow$

$Cl_2 + KI \rightarrow$

Double Replacement- *Two metals in a compound switch places. An insoluble substance must be produced.*

$CaCl_2 + NaOH \rightarrow$

try these:

$Li_3PO_4 + MgCl_2 \rightarrow$

$AlBO_3 + NaCN \rightarrow$

Micro-Rockets Notes Page

1. How is the hydrogen gas created? (What is the chemical reaction?)

2. What is the chemical reaction which occurs when the rocket is launched?

3. For optimal results, what is the correct ratio of fuel to oxygen (H_2 : O_2)? _____

4. Suppose someone wanted to make a methane (CH_4) rocket...
   What would be the correct reaction & the correct ratio of fuel to oxygen (CH_4 : O_2)? _____

5. Suppose someone wanted to make an ethanol ($C_2H_6O_2$) rocket...
   What would be the correct reaction & the correct ratio of fuel to oxygen? _____

6. Suppose someone wanted to make a gasoline (C_8H_{18}) rocket...
   What would be the correct reaction & the correct ratio of fuel to oxygen? _____