

Using your text book and these descriptions of chemical reactions, complete this worksheet Parts 1,2 and 3.

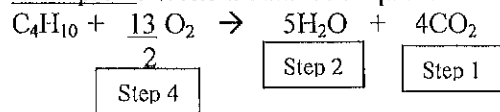
DESCRIPTIONS:

1. COMBINATION REACTION: Two reactants combine to form a single product.
2. DECOMPOSITION REACTION: One reactant decomposes into two or more products.
3. COMBUSTION REACTION: A reactant (a carbon compound made of C, H and sometimes O) combines with oxygen to give CO<sub>2</sub> and H<sub>2</sub>O as the only products.
4. SINGLE DISPLACEMENT (REPLACEMENT) REACTION: Reactants are an element and a compound. Products are an element and compound. The reactant element replaces a similar element in the compound and the replaced element becomes the product element.
5. DOUBLE DISPLACEMENT (REPLACEMENT) REACTION. Two reactant compounds and two product compounds. One of the product compounds has to be a covalent compound, a gas, or a solid (precipitate).

Balancing Combustion Reactions

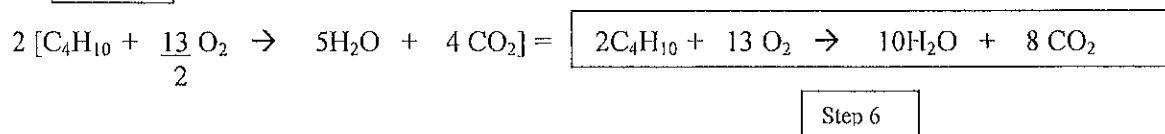
1. Balance carbon first
2. Balance hydrogen second
3. Sum the number of oxygens from water and CO<sub>2</sub> the right side.
  - 3a) Subtract any oxygens in the carbon compound on the left (reactant) side of the equation from the total number of oxygens on the right.
4. Put this number of oxygen atoms divided by 2 in front of O<sub>2</sub> as the coefficient.
5. If the coefficient is divisible by 2 then divide and place that number in front of the oxygen as the coefficient.
  - 5a) If the coefficient is not divisible by 2 then multiply the whole equation by 2 to clear the X/2 in the oxygen coefficient.
6. Write the balanced equation.

Example 1. Write a balanced equation for the combustion of C<sub>4</sub>H<sub>10</sub>

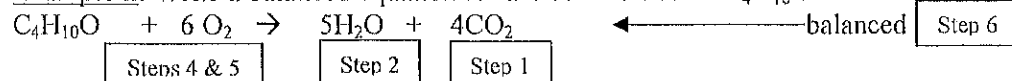


Step 3 Total oxygen = 5 (5H<sub>2</sub>O) + 8 (4CO<sub>2</sub>) = 13 oxygen

Step 5a Multiply the whole equation by 2:



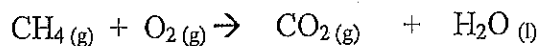
Example 2. Write a balanced equation for the combustion of C<sub>4</sub>H<sub>10</sub>O



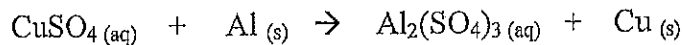
Step 3 Total oxygen = 5 (5H<sub>2</sub>O) + 8 (4CO<sub>2</sub>) = 13 oxygen - 1 oxygen = 12 oxygen

Step 3a

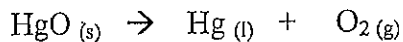
**PART 1.** Match the following reactions with the type reaction (draw a line from one to the other):



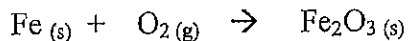
combination reaction



decomposition reaction



combustion reaction



single replacement reaction



double replacement reaction

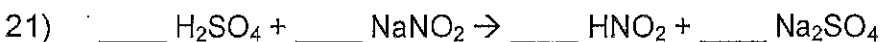
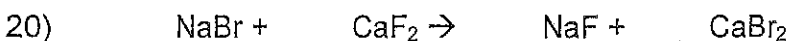
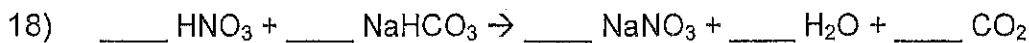
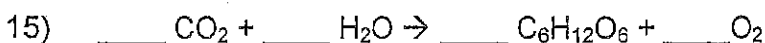
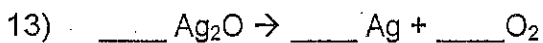
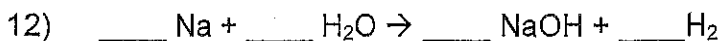
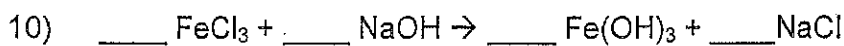
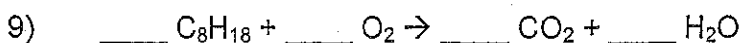
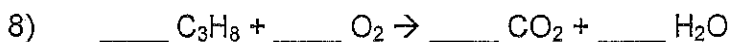
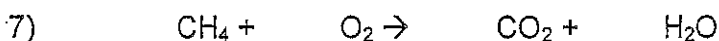
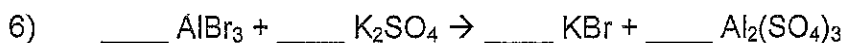
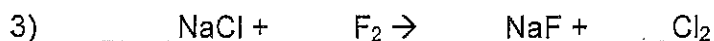
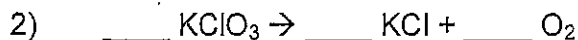
**PART 2.** Rewrite each of the equations above so they are balanced.

**PART 3.** FOR EACH OF THE FOLLOWING WORD REACTIONS, WRITE A BALANCED EQUATION AND GIVE THE NAME OF TYPE REACTION

1. Solid carbon reacts with oxygen gas to produce carbon dioxide gas.
2. Water reacts with sodium metal to produce hydrogen gas and aqueous sodium hydroxide
3. Aqueous aluminum chloride reacts with aqueous sodium hydroxide to produce solid aluminum hydroxide and aqueous sodium chloride.
4. Propane ( $\text{C}_3\text{H}_8$ ) reacts with oxygen gas to produce carbon dioxide gas and water.
5. Hydrogen peroxide produces water and oxygen gas.

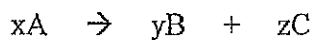
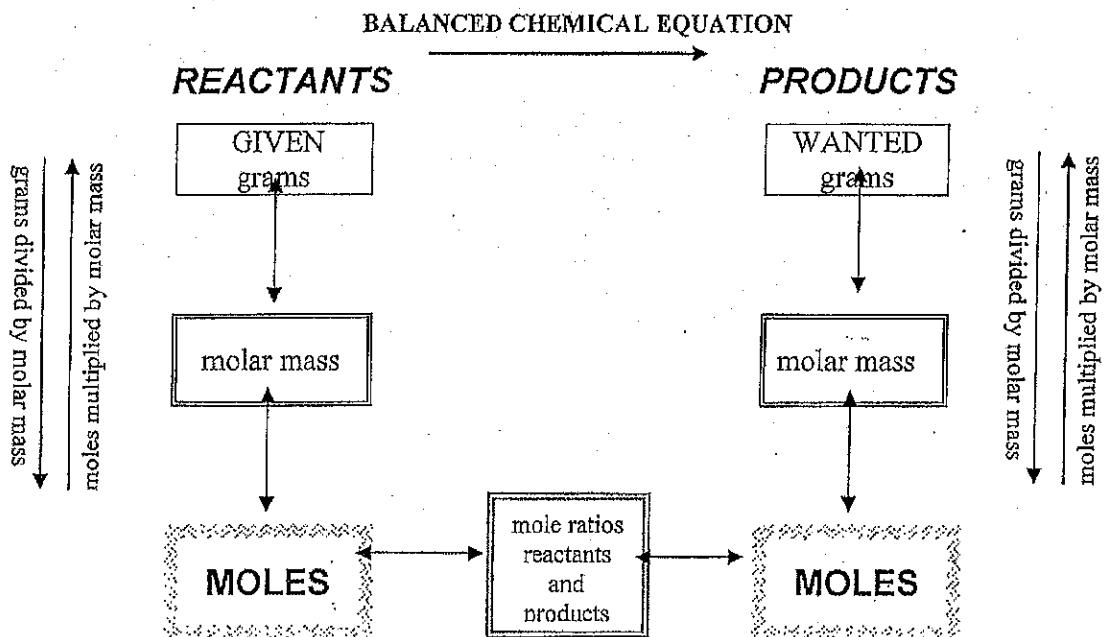
## Balancing Chemical Equations

Balance the equations below:



# STOICHIOMETRY MAP FOR CHEMICAL REACTIONS

Double lined boxes are Conversion Factors to convert from one quantity to another.



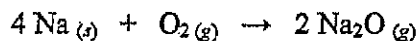
GIVEN:

WANTED:

$$\text{Grams A} \times \underbrace{\frac{1 \text{ mole A}}{g \text{ A}}}_{\text{molar mass A}} \times \underbrace{\frac{y \text{ mole B}}{x \text{ mole A}}}_{\text{balanced reaction}} \times \underbrace{\frac{g \text{ B}}{1 \text{ mole B}}}_{\text{molar mass B}} = \text{Gram B}$$

## Stoichiometric Calculations

1. Sodium metal burns in air according to the balanced reaction shown below.



Complete the setups with the correct factors to answer the following questions:

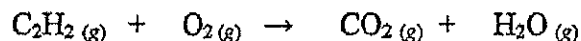
- (a) How many moles of oxygen are needed to completely react with 9.5 g of sodium?

$$\boxed{\phantom{00}} \text{ g Na} \times \frac{1 \text{ mol Na}}{\boxed{\phantom{00}} \text{ g Na}} \times \frac{\boxed{\phantom{00}} \text{ mol O}_2}{\boxed{\phantom{00}} \text{ mol Na}} = \boxed{\phantom{00}} \text{ mol O}_2$$

- (b) How many grams of sodium are needed to produce 12.5 g of sodium oxide?

$$12.5 \text{ g Na}_2\text{O} \times \frac{1 \text{ mol Na}_2\text{O}}{62.0 \text{ g Na}_2\text{O}} \times \frac{\boxed{\phantom{00}} \text{ mol Na}}{\boxed{\phantom{00}} \text{ mol Na}_2\text{O}} \times \frac{\boxed{\phantom{00}} \text{ g Na}}{\boxed{\phantom{00}} \text{ mol Na}} =$$

2. Acetylene gas  $\text{C}_2\text{H}_2$  undergoes combustion to form carbon dioxide and water when it is used in the oxyacetylene torch for welding. Balance the reaction and answer the following questions.



- (a) How many grams of water can form if 113 g of acetylene is burned?

- (b) How many grams of acetylene react if 1.10 mol of  $\text{CO}_2$  are produced?

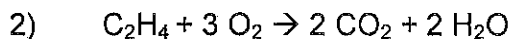
## Mass to Mass Stoichiometry Problems

*g* → *mole* → *mole* → *gram*

In the following problems, calculate how much of the indicated product is made. Show all your work.



If you start with <sup>10.0g</sup> ten grams of lithium hydroxide, how many grams of lithium bromide will be produced?



If you start with 45 grams of ethylene ( $\text{C}_2\text{H}_4$ ), how many grams of carbon dioxide will be produced?



If you start with 5.5 grams of <sup>sodium fluoride</sup> lithium-chloride, how many grams of <sup>magnesium</sup> calcium chloride will be produced?  
*Fluoride*

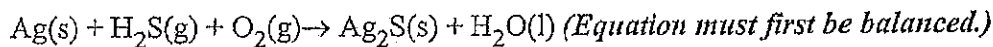


If you start with 20.grams of hydrochloric acid, how many grams of sulfuric acid will be produced?

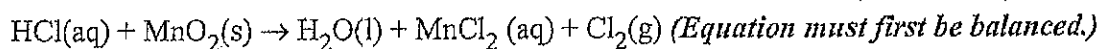
## Stoichiometry Worksheet

Go to solutions

1. Silver sulfide ( $\text{Ag}_2\text{S}$ ) is the common tarnish on silver objects. What weight of silver sulfide can be made from 1.23 mg of hydrogen sulfide ( $\text{H}_2\text{S}$ ) obtained from a rotten egg? The reaction of formation of silver sulfide is given below:



2. A somewhat antiquated method for preparing chlorine gas involves heating hydrochloric acid with pyrolusite (manganese dioxide), a common manganese ore. (Reaction given below.) How many kg of HCl react with 5.69 kg of manganese dioxide?



3. Given the following equation:  $2 \text{C}_4\text{H}_{10} + 13 \text{O}_2 \rightarrow 8 \text{CO}_2 + 10 \text{H}_2\text{O}$ , show what the following molar ratios should be.

- a.  $\text{C}_4\text{H}_{10} / \text{O}_2$  b.  $\text{O}_2 / \text{CO}_2$  c.  $\text{O}_2 / \text{H}_2\text{O}$   
d.  $\text{C}_4\text{H}_{10} / \text{CO}_2$  e.  $\text{C}_4\text{H}_{10} / \text{H}_2\text{O}$

4. Given the following equation:  $2 \text{KClO}_3 \rightarrow 2 \text{KCl} + 3 \text{O}_2$

How many moles of  $\text{O}_2$  can be produced by letting 12.00 moles of  $\text{KClO}_3$  react?

5. Given the following equation:  $2 \text{K} + \text{Cl}_2 \rightarrow 2 \text{KCl}$

How many grams of KCl is produced from 2.50 g of K and excess  $\text{Cl}_2$ . From 1.00 g of  $\text{Cl}_2$  and excess K?

6. Given the following equation:  $\text{Na}_2\text{O} + \text{H}_2\text{O} \rightarrow 2 \text{NaOH}$

How many grams of NaOH is produced from  $1.20 \times 10^2$  grams of  $\text{Na}_2\text{O}$ ? How many grams of  $\text{Na}_2\text{O}$  are required to produce  $1.60 \times 10^2$  grams of NaOH?

7. Given the following equation:  $8 \text{Fe} + \text{S}_8 \rightarrow 8 \text{FeS}$

What mass of iron is needed to react with 16.0 grams of sulfur? How many grams of FeS are produced?

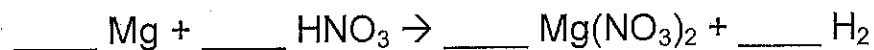
8. Given the following equation:  $2 \text{NaClO}_3 \rightarrow 2 \text{NaCl} + 3 \text{O}_2$

12.00 moles of  $\text{NaClO}_3$  will produce how many grams of  $\text{O}_2$ ? How many grams of NaCl are

*produced when 80.0 grams of  $\text{O}_2$  are produced?*

## Percent Yield Calculations

- 1) Balance this equation and state which of the six types of reaction is taking place:



Type of reaction: \_\_\_\_\_

- 2) If I start this reaction with 40 grams of magnesium and an excess of nitric acid, how many grams of hydrogen gas will I produce?
- 3) If 1.7 grams of hydrogen is actually produced, what was my percent yield of hydrogen?
- 

- 4) Balance this equation and state what type of reaction is taking place:



Type of reaction: \_\_\_\_\_

- 5) If 25 grams of carbon dioxide gas is produced in this reaction, how many grams of sodium hydroxide should be produced?
- 6) If 50 grams of sodium hydroxide are actually produced, what was my percent yield?

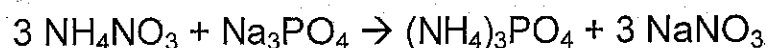


## Limiting Reagent Worksheet

For the following reactions, find the following:

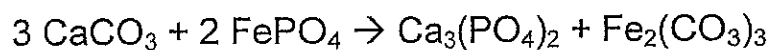
- a) Which of the reagents is the limiting reagent?
- b) What is the maximum amount of each product that can be formed?
- c) How much of the other reagent is left over after the reaction is complete?

- 1) Consider the following reaction:



Answer the questions above, assuming we started with 30 grams of ammonium nitrate and 50 grams of sodium phosphate.

- 2) Consider the following reaction:



Answer the questions at the top of this sheet, assuming we start with 100 grams of calcium carbonate and 45 grams of iron (III) phosphate.

