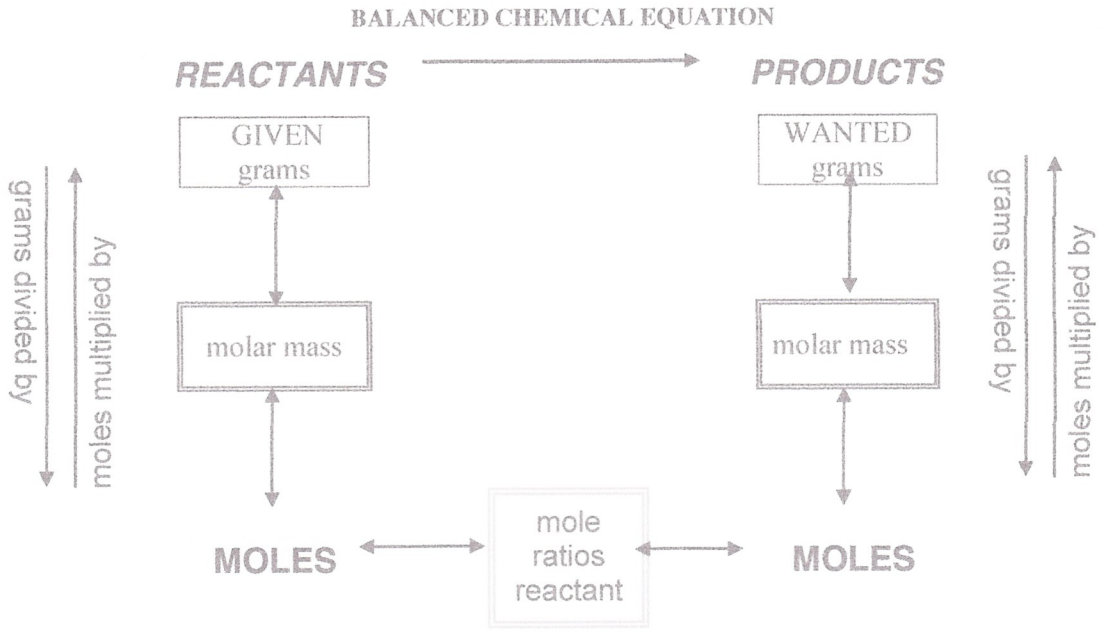
STOICHIOMETRY MAP FOR CHEMICAL REACTIONS

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



$$xA \longrightarrow yB + zC$$

GIVEN: **WANTED:**

$$\text{Grams A} \times \underbrace{\frac{1 \text{ mole A}}{g \text{ A}}}_{\text{molar mass A}} \times \underbrace{\frac{y \text{ mole B}}{x \text{ mole A}}}_{\substack{\text{mole ratio from} \\ \text{the balanced equation}}} \times \underbrace{\frac{g \text{ B}}{1 \text{ mole B}}}_{\text{molar mass B}} = \text{Gram B}$$

Stoichiometric Calculations

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

$$4\ Na_{(s)} + O_{2(g)} \rightarrow 2\ Na_2O_{(g)}$$

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?

$$\square\ g\ Na \times \frac{1\ mol\ Na}{\square\ g\ Na} \times \frac{\square\ mol\ O_2}{\square\ mol\ Na} = \square\ mol\ O_2$$

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

$$12.5\ g\ Na_2O \times \frac{1\ mol\ Na_2O}{62.0\ g\ Na_2O} \times \frac{mol\ Na \times}{mol\ Na_2O} \frac{g\ Na}{mol\ Na} =$$

2. Acetylene gas C_2H_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.

$$C_2H_{2(g)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}$$

(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 CO_2 are produced?

Stoichiometry Practice Worksheet

Balancing Equations and Simple Stoichiometry

Balance the following equations:

1) ___ N_2 + ___ F_2 → ___ NF_3

2) ___ C_6H_{10} + ___ O_2 → ___ CO_2 + ___ H_2O

3) ___ HBr + ___ $KHCO_3$ → ___ H_2O + ___ KBr + ___ CO_2

4) ___ $GaBr_3$ + ___ Na_2SO_3 → ___ $Ga_2(SO_3)_3$ + ___ NaBr

5) ___ SnO + ___ NF_3 → ___ SnF_2 + ___ N_2O_3

Solve the following stoichiometry grams-grams problems:

6) Using the following equation:

$$2\ NaOH + H_2SO_4 \rightarrow 2\ H_2O + Na_2SO_4$$

How many grams of sodium sulfate will be formed if you start with 200 grams of sodium hydroxide and you have an excess of sulfuric acid?

7) Using the following equation:

$$Pb(SO_4)_2 + 4\ LiNO_3 \rightarrow Pb(NO_3)_4 + 2\ Li_2SO_4$$

How many grams of lithium nitrate will be needed to make 250 grams of lithium sulfate, assuming that you have an adequate amount of lead (IV) sulfate to do the reaction?

Use the following equation to answer questions 8-11:

$$2\ C_6H_{10} + 17\ O_2 \rightarrow 12\ CO_2 + 10\ H_2O$$

8) If I do this reaction with 35 grams of C_6H_{10} and 45 grams of oxygen, how many grams of carbon dioxide will be formed?

9) What is the limiting reagent for problem 6? _____

10) How much of the excess reagent is left over after the reaction from problem 6 is finished?

11) If 35 grams of carbon dioxide are actually formed from the reaction in problem 6, what is the percent yield of this reaction?

Answer the following stoichiometry-related questions:

12) Write the balanced equation for the reaction of acetic acid with aluminum hydroxide to form water and aluminum acetate:

13) Using the equation from problem #12, determine the mass of aluminum acetate that can be made if I do this reaction with 125 grams of acetic acid and 275 grams of aluminum hydroxide.

14) What is the limiting reagent in problem #13?

15) How much of the excess reagent will be left over in problem #13 after the reaction is complete?

Percent Yield Worksheet (1)

1) Write the equation for the reaction of iron (III) phosphate with sodium sulfate to make iron (III) sulfate and sodium phosphate.

2) If I perform this reaction with 25 grams of iron (III) phosphate and an excess of sodium sulfate, how many grams of iron (III) sulfate can I make?

3) If 18.5 grams of iron (III) sulfate are actually made when I do this reaction, what is my percent yield?

4) Is the answer from problem #3 reasonable? Explain.

5) If I do this reaction with 15 grams of sodium sulfate and get a 65.0% yield, how many grams of sodium phosphate will I make?

Worksheet: Percent Yield (2) Name_____

1. Chlorobenzene, C_6H_5Cl, is used in the production of chemicals such as aspirin and dyes. One way that chlorobenzene is prepared is by reacting benzene, C_6H_6, with chlorine gas according to the following BALANCED equation.

$$C_6H_6\ (l) + Cl_2\ (g) \rightarrow C_6H_5Cl\ (s) + HCl\ (g)$$

   a. What is the theoretical yield if 45.6 g of benzene react?

   b. If the actual yield is 63.7 g of chlorobenzene, calculate the percent yield.

2. When carbon disulfide burns in the presence of oxygen, sulfur dioxide and carbon dioxide are produced according to the following equation.

$$CS_2\ (l) + 3\ O_2\ (g) \rightarrow CO_2\ (g) + 2\ SO_2\ (g)$$

   a. What is the percent yield of sulfur dioxide if the burning of 25.0 g of carbon disulfide produces 40.5 g of sulfur dioxide?

   b. What is the percent yield of carbon dioxide if 2.5 mol of oxygen react and 32.4 g of carbon dioxide are produced?

Worksheet: Limiting Reactants (1) Name_____

1. BALANCE the equation first. $FeCl_3 + O_2 \rightarrow Fe_2O_3 + Cl_2$

   a. How many moles of chlorine gas can be produced if 4 moles of $FeCl_3$ react with 4 moles of O_2? SHOW ALL WORK!

   b. What is the limiting reactant?

   c. What is the excess reactant?

2. Use the following BALANCED equation.

   $2\ C_2H_6 + 7\ O_2 \rightarrow 4\ CO_2 + 6\ H_2O$

   a. If 15 g of C_2H_6 react with 45 g of O_2, how many grams of water will be produced?

   b. What is the limiting reactant?

   c. What is the excess reactant?

Limiting Reactant Worksheet (2) **Stoichiometry #6**

Name _____

1. In the following reaction, how many grams of iron(III) chloride can be made from 23.67 grams of chlorine and an excess of iron?

$$2\ Fe_{(s)} + 3\ Cl_{2\,(g)} \rightarrow 2\ FeCl_{3\,(s)}$$

2. How many grams of aluminum oxide would be needed along with 98.7 grams of calcium?

$$3\ Ca_{(s)} + Al_2O_{3\,(s)} \rightarrow 3\ CaO_{(s)} + Al_{(s)}$$

3. In the situation in problem #1, a group of students measured their production of iron(III) chloride and found that they had made only 29.5 grams of iron(III) chloride. What is the percent yield for these students?

4. What is the percent yield in a reaction if students expect to produce 197.5 grams of copper(II) sulfate but recover only 157 grams?

5. 234.56 g of octane (C_8H_{18}) are burned in an excess of oxygen, and 310.5 g of water are collected. What is the percent yield in this experiment?

6. What is the theoretical yield of sodium carbonate when 15.2 g hydrogen carbonate reacts with 0.23 mol sodium hydroxide?

7. The thermite reaction is a rare reaction that involves two solids in a single replacement reaction between iron (III) oxide and aluminum powders. If 45.98 g of iron (III) oxide reacts with 24.73 g of aluminum, what is the limiting reactant?

8. Suppose a vessel contains 0.120 mol NH_3 and 0.140 mol O_2. Which is the limiting reactant? How many moles of NO could be obtained?

$$4\,NH_3 + 5\,O_2 \Rightarrow 4\,NO + 6\,H_2O$$

9. In the reaction of sodium hydroxide with chlorine gas, sodium chloride , sodium hypochlorite, and water a reproduced. If 48.9g of chlorine gas is bubbled into a solution containing 54.2 g NaOH, how many grams of NaClO can eventually be produced?

$$2\,NaOH + Cl_2 \Rightarrow NaCl + NaClO + H_2O$$

PERIODIC CHART OF THE ELEMENTS

IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII	IB	IIB	IIIA	IVA	VA	VIA	VIIA	INERT GASES
1 H 1.00797														1 H 1.00797	2 He 4.0026
3 Li 6.939	4 Be 9.0122									5 B 10.811	6 C 12.0112	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.183
11 Na 22.9898	12 Mg 24.312									13 Al 26.9815	14 Si 28.086	15 P 30.9738	16 S 32.064	17 Cl 35.453	18 Ar 39.948
19 K 39.102	20 Ca 40.08	21 Sc 44.956	22 Ti 47.90	23 V 50.942	24 Cr 51.996	25 Mn 54.9380	26 Fe 55.847	27 Co 58.9332	28 Ni 58.71	29 Cu 63.54	30 Zn 65.37	31 Ga 69.72	32 Ge 72.59	33 As 74.9216	34 Se 78.96	35 Br 79.909	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.905	40 Zr 91.22	41 Nb 92.906	42 Mo 95.94	43 Tc [99]	44 Ru 101.07	45 Rh 102.905	46 Pd 106.4	47 Ag 107.870	48 Cd 112.40	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.904	54 Xe 131.30
55 Cs 132.905	56 Ba 137.34	+57 La 138.91	72 Hf 178.49	73 Ta 180.948	74 W 183.85	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.09	79 Au 196.967	80 Hg 200.59	81 Tl 204.37	82 Pb 207.19	83 Bi 208.980	84 Po [210]	85 At [210]	86 Rn [222]
87 Fr [223]	88 Ra [226]	‡89 Ac [227]	104 Rf [261]	105 Db [262]	106 Sg [266]	107 Bh [262]	108 Hs [265]	109 Mt [266]	110 ? [271]	111 ? [272]	112 ? [277]						

+ Lanthanide Series

58 Ce 140.12	59 Pr 140.907	60 Nd 144.24	61 Pm [147]	62 Sm 150.35	63 Eu 151.96	64 Gd 157.25	65 Tb 158.924	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04	71 Lu 174.97

‡ Actinide Series

90 Th 232.038	91 Pa [231]	92 U 238.03	93 Np [237]	94 Pu [242]	95 Am [243]	96 Cm [247]	97 Bk [247]	98 Cf [249]	99 Es [254]	100 Fm [253]	101 Md [256]	102 No [256]	103 Lr [257]

NAME_____ PER_____

Limiting Reactant and Percent Yield Worksheet

(Show your work)

1. Consider the following reaction: $2\ Al + 6\ HBr \rightarrow 2\ AlBr_3 + 3\ H_2$
   When 3.22 moles of Al reacts with 6.96 moles of HBr, what are the limiting and excess reactants?

2. Consider the following reaction: $4\ FeS_2 + 11\ O_2 \rightarrow 2\ Fe_2O_3 + 8\ SO_2$
   When 26.62 moles of FeS_2 reacts with 59.44 moles of O_2, what are the limiting and excess reactants?

3. Consider the following reaction: $3\ Si + 2\ N_2 \rightarrow Si_3N_4$
   When 600 g of Si reacts with 500 g of N_2, What are the limiting and excess reactants?

4. Given the following equation: $Al_2(SO_3)_3 + 6\ NaOH \rightarrow 3\ Na_2SO_3 + 2\ Al(OH)_3$
   If 10.0 g of $Al_2(SO_3)_3$ is reacted with 10.0 g of NaOH, determine the limiting and excess reactants.

NAME_____ PER_____

5. Given the following equation: $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$
   If I perform this reaction with 3.6 moles of C_3H_8 and an excess of oxygen gas, what is my theoretical yield of Water in moles? If I actually isolated 12 moles of water what is my percent yield?

6. Given the following equation: $2\ FePO_4 + 3\ Na_2SO_4 \rightarrow Fe_2(SO_4)_3 + 2\ Na_3PO_4$
   If I perform this reaction with 25 g of Iron (III) phosphate and an excess of Sodium sulfate, what is my theoretical yield in grams of Iron (III) sulfate? If I make 18.5 g of Iron (III) sulfate, what is my percent yield?

7. Given the following reaction: $2\ K_3PO_4 + Al_2(CO_3)_3 \rightarrow 3\ K_2CO_3 + 2\ AlPO_4$
   If I perform this reaction with 150 g of Potassium phosphate and 90 g of Aluminum carbonate, what is my theoretical yield in grams of Potassium carbonate? If the reaction results in 125 g of Potassium carbonate, what is my percent yield?