EXTRA PRACTICE: Stoichiometry/Limiting (L.R.) & Excess Reactants (E.R.)/Percent Yield

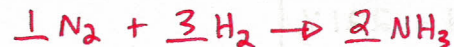### STOICHIOMETRY:

1. If 124 grams of sodium oxide is reacted with excess water, how many grams of sodium hydroxide are produced?

$$\underline{1}\ Na_2O + \underline{1}\ H_2O \rightarrow \underline{2}\ NaOH$$

$$\boxed{160\ g\ NaOH}$$

2. What mass of ammonia is produced if 25.0 grams of nitrogen gas is reacted with an excess of hydrogen gas?

$$\underline{1}\ N_2 + \underline{3}\ H_2 \rightarrow \underline{2}\ NH_3$$

$$\boxed{30.4\ g\ NH_3}$$

3. If 5.00 grams of potassium chlorate is decomposed into potassium chloride and oxygen, how many moles of oxygen gas are produced?

$$\underline{2}\ KClO_3 \rightarrow \underline{2}\ KCl + \underline{3}\ O_2$$

$$\boxed{0.0612\ mol\ O_2}$$

4. How many moles of iron (III) oxide are produced in a synthesis reaction of 5.99 moles of iron metal and oxygen gas?

$$\underline{4}\ Fe + \underline{3}\ O_2 \rightarrow \underline{2}\ Fe_2O_3$$

$$\boxed{3.00\ mol\ Fe_2O_3}$$

5. What mass of hydrogen gas is produced when 2.50 grams of zinc metal reacts with an excess of hydrochloric acid to produce zinc chloride and hydrogen?

$$\underline{1}\ Zn + \underline{2}\ HCl \rightarrow \underline{1}\ ZnCl_2 + \underline{1}\ H_2$$

$$\boxed{0.0771\ g\ H_2}$$

6. What is the mass of mercury produced from the decomposition of 1.25 grams of mercury (II) oxide into liquid mercury and oxygen gas?

$$\underline{2}\ HgO \rightarrow \underline{2}\ Hg + \underline{1}\ O_2$$

$$\boxed{1.16\ g\ Hg}$$

7. How many moles of sodium chlorate are produced from the synthesis of 4.60 moles of sodium chloride and oxygen gas?

$$\underline{2}\ NaCl + \underline{3}\ O_2 \rightarrow \underline{2}\ NaClO_3$$

$$\boxed{4.60\ mol\ NaClO_3}$$

LIMITING (L.R.) & EXCESS REACTANTS (E.R.):

1. What mass of sulfur trioxide is produced from the reaction between 12.4 grams of sulfur dioxide and 3.45 grams oxygen?

$$\underline{2}\ SO_2 + \underline{1}\ O_2 \rightarrow \underline{2}\ SO_3$$

L.R.= SO_2
E.R.= O_2 $\boxed{15.5\ g\ SO_3}$

2. If 1.64 grams of water and 6.58 grams of sulfur trioxide react in a synthesis reaction, how many grams of sulfuric acid, H_2SO_4, are produced?

$$\underline{1}\ H_2O + \underline{1}\ SO_3 \rightarrow \underline{1}\ H_2SO_4$$

L.R.= SO_3
E.R.= H_2O $\boxed{8.06\ g\ H_2SO_4}$

3. If 21.4 grams of aluminum metal is reacted with 91.3 grams of iron (III) oxide, how many grams of iron metal are produced in this single replacement reaction?

$$\underline{2}\ Al + \underline{1}\ Fe_2O_3 \rightarrow \underline{1}\ Al_2O_3 + \underline{2}\ Fe$$

L.R.= Al
E.R.= Fe_2O_3 $\boxed{44.3\ g\ Fe}$

4. What mass of sodium chloride will be produced by the reaction of 29.4 grams of chlorine gas and 58.7 grams of sodium iodide in this single replacement reaction?

$$\underline{1}\ Cl_2 + \underline{2}\ NaI \rightarrow \underline{2}\ NaCl + \underline{1}\ I_2$$

L.R.= NaI
E.R.= Cl_2 $\boxed{22.9\ g\ NaCl}$

5. How many grams of magnesium chloride are produced if 50.6 grams of magnesium hydroxide and 45.0 grams of hydrochloric acid react together? Products produced are magnesium chloride and water.
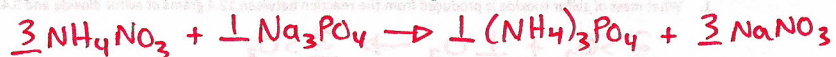
$$\underline{1}\ Mg(OH)_2 + \underline{2}\ HCl \rightarrow \underline{1}\ MgCl_2 + \underline{2}\ H_2O$$

L.R.= HCl
E.R.= $Mg(OH)_2$ $\boxed{58.8\ g\ MgCl_2}$

6. In a double replacement reaction of 30.0 grams of ammonium nitrate and 50.0 grams of sodium phosphate, how many grams of ammonium phosphate are produced from the limiting reactant?

$$3 NH_4NO_3 + 1 Na_3PO_4 \rightarrow 1 (NH_4)_3PO_4 + 3 NaNO_3$$

L.R = NH_4NO_3

E.R. = Na_3PO_4

$$\boxed{18.6 g \ (NH_4)_3PO_4}$$

7. If 100.0 grams of calcium carbonate reacts with 45.0 grams of iron (III) phosphate, how many grams of calcium phosphate are produced from the limiting reactant in this double replacement reaction?

$$3 CaCO_3 + 2 FePO_4 \rightarrow 1 Ca_3(PO_4)_2 + 1 Fe_2(CO_3)_3$$

L.R.= $FePO_4$

E.R.= $CaCO_3$

$$\boxed{46.3 g \ Ca_3(PO_4)_2}$$

8. If 15.0 grams of copper (II) chloride react with 20.0 grams of sodium nitrate, what mass of sodium chloride can be formed from the limiting reactant?
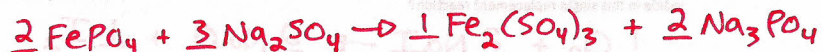
$$1 CuCl_2 + 2 NaNO_3 \rightarrow 1 Cu(NO_3)_2 + 2 NaCl$$

L.R.= $CuCl_2$

E.R.= $NaNO_3$

$$\boxed{13.0 g \ NaCl}$$

9. In a reaction of 25.0 grams of iron (III) phosphate and 15.0 grams of sodium sulfate, how many grams of iron (III) sulfate can be produced?
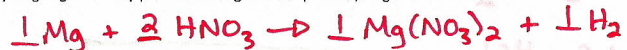
$$2 FePO_4 + 3 Na_2SO_4 \rightarrow 1 Fe_2(SO_4)_3 + 2 Na_3PO_4$$

L.R.= Na_2SO_4

E.R.= $FePO_4$

$$\boxed{14.1 g \ Fe_2(SO_4)_3}$$

PERCENT YIELD:

1. In an S-R reaction of 40.0 grams of magnesium and an excess of nitric acid, HNO_3, what is the percent yield of 1.70 grams of hydrogen gas actually produced along with the product, magnesium nitrate?
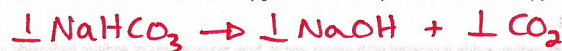
$$1 Mg + 2 HNO_3 \rightarrow 1 Mg(NO_3)_2 + 1 H_2$$

L.R.= Mg

Theor Yield = $3.32 g \ H_2$ $\boxed{\% \ Yield = 51.2 \%}$

2. If 25.0 grams of carbon dioxide gas is produced in a decomposition reaction of sodium bicarbonate, $NaHCO_3$, into sodium hydroxide and carbon dioxide, how many grams of sodium hydroxide is theoretically produced?

$$1 NaHCO_3 \rightarrow 1 NaOH + 1 CO_2$$

$$\boxed{22.7 g \ NaOH}$$

a. If 50.0 grams of sodium hydroxide are actually produced, what is the percent yield of this product?

$$\boxed{\% \ Yield = 221 \%}$$

b. Is this percent yield reasonable? Why or why not?

Not a reasonable percent yield because it does not satisfy the Law of Conservation of mass

c. In any reaction where the percent yield exceeds 100%, what may account for this result?

There may be impurities in the reaction that exceeds % yield over 100%.

3. Determine the percent yield for the reaction between 15.8 grams of ammonia gas and excess oxygen gas to produce 21.8 grams of nitrogen monoxide gas and water experimentally.
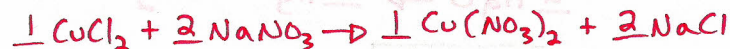
$$4 NH_3 + 5 O_2 \rightarrow 4 NO + 6 H_2O$$

L.R.= Mg

Theor Yield = $27.8 g \ NO$ $\boxed{\% \ Yield = 78.4 \%}$

4. If 15.0 grams of copper (II) chloride reacts with 20.0 grams of sodium nitrate, what is the percent yield of this reaction if 11.3 grams of sodium chloride are experimentally produced in this reaction?

$$1 CuCl_2 + 2 NaNO_3 \rightarrow 1 Cu(NO_3)_2 + 2 NaCl$$

L.R.= $CuCl_2$

E.R.= $NaNO_3$ $\boxed{\% \ Yield = 86.9 \%}$

Theor Yield = $13.0 g \ NaCl$