General Stoichiometry Notes

STOICHIOMETRY: tells relative amts of reactants & products in a chemical reaction

- Given an amount of a substance involved in a chemical reaction, we can figure out the amount of the other substances are needed or produced
- Always compare the number of moles, molecules, or atoms! Usually MOLES!
- Given the balanced equation: $N_2 + 3\ H_2 \rightarrow 2\ NH_3$
- For every molecule of N_2, I need ___ molecules of H_2 in order to produce ___ molecules of NH_3.
- So… if I have 2 molecules of N_2, then I need ___ molecules of H_2 in order to produce ___ molecules of NH_3.
- Comparison of coefficients = MOLE RATIO

To solve stoichiometry problems… ALWAYS!!!!!!!!!!

**** WRITE BALANCED EQUATION AND GIVEN & UNKNOWN INFORMATION! ****

1.) Find moles of given element or compound.

*** Use molar mass (from Periodic Table) of given substance if problem gives you grams.**

*** Use 6.022×10^{23} if problem gives you molecules.**

2.) Use mole ratio (coefficients) from balanced equation.

$$\frac{\text{\# (from problem or step1) moles given}}{\text{coefficient of given substance}} = \frac{\text{x moles unknown}}{\text{coefficient of unknown}}$$

3.) Find answer.

*** Use molar mass (from Periodic Table) of unknown substance if question asks for grams.**

*** Use 6.022×10^{23} if question asks for molecules.**

Here's an example:

How many moles of ammonia (NH_3) can be produced by the complete reaction of 3.25 moles of hydrogen?

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

3.25 moles ? moles

1.) DONE!!!

2.) $\frac{3.25 \text{ moles } H_2}{3} = \frac{x \text{ moles } NH_3}{2}$ $3x = 6.5$ $x = 2.17$ moles NH_3

3.) NOT NECESSARY!!! Question asked for moles of NH_3, so answer is 2.17 moles NH_3.

Example 2:

What mass of NaOH is produced when 6.21 moles $Ca(OH)_2$ reacts completely with Na_2CO_3?

$Na_2CO_3 + Ca(OH)_2 \rightarrow \underline{2}\ NaOH + CaCO_3$

6.21 moles ? g

1.) Step 1 is already done for you! The number of moles is given in the problem! YAY!

2.) $\frac{6.21 \text{ moles } Ca(OH)_2}{1} = \frac{x \text{ moles NaOH}}{2}$ $x = 12.42$ moles NaOH

3.) $12.42 \text{ moles NaOH} \times \frac{39.998 \text{ grams}}{1 \text{ mole}} = 497 \text{ g NaOH}$

Na = 1 x 22.99 = 22.99
O = 1 x 16.00 = 16.00
H = 1 x 1.008 = 1.008
39.998

Example 3:

If 34.32 grams of acetylene (C_2H_2) are burned in air, how many moles of CO_2 can be formed?

$\underline{2}\ C_2H_2 + \underline{5}\ O_2 \rightarrow \underline{4}\ CO_2 + \underline{2}\ H_2O$

34.32 g ? moles

1.) $\underline{34.32\text{ g } C_2H_2} \times \underline{1\text{ mole } C_2H_2} = 1.318\text{ moles } C_2H_2$
26.036 grams

C: 2 x 12.01 = 24.02
H: 2 x 1.008 = 2.016 +
26.036

2.) $\underline{1.32\text{ moles } C_2H_2} = \underline{x\text{ moles } CO_2}$
$2 \qquad 4$

$2x = 5.28$
$x = 2.64\text{ moles } CO_2$

Problem asked for moles of CO_2, so that is your answer. Be sure to round for significant figures. Answer should be reported as 2.640 moles CO_2

Example 4:

How many molecules of oxygen gas are required to completely react with 85.0 grams of propane (C_3H_8)?

$C_3H_8 + \underline{5}\ O_2 \rightarrow \underline{3}\ CO_2 + \underline{4}\ H_2O$

85.0 g ? mcs

1.) $\underline{85.0\text{ g } C_3H_8} \times \underline{1\text{ mole}} = 1.93\text{ moles } C_3H_8$
44.094 g

C: 3 x 12.01 = 36.03
H: 8 x 1.008 = 8.064 +
44.094

2.) $\underline{1.93\text{ moles } C_3H_8} = \underline{x\text{ moles } O_2}$
$1 \qquad 5$

$x = 9.65\text{ moles } O_2$

3.) $\underline{9.65\text{ moles}} \ \underline{6.022 \times 10^{23}\text{ mcs}} = 5.81 \times 10^{24}\text{ mcs } O_2$
1 mole

Example 5:

If 27.8 grams of Na_2SO_4 are reacted with excess $Al_2(CO_3)_3$, how many grams of $Al_2(SO_4)_3$ will be formed?

$\underline{3}\ Na_2SO_4 + Al_2(CO_3)_3 \rightarrow Al_2(SO_4)_3 + \underline{3}\ Na_2CO_3$

27.8 g ? g

1.) $\underline{27.8\text{ g } Na_2SO_4} \times \underline{1\text{ mole } Na_2SO_4} = 0.196\text{ moles } Na_2SO_4$
142.05 grams

Na: 2 x 22.99 = 45.98
S: 1 x 32.07 = 32.07
O: 4 x 16.00 = 64.00 +
142.05

2.) $\underline{0.196\text{ moles } Na_2SO_4} = \underline{x\text{ mole } Al_2(SO_4)_3}$
$3 \qquad 1$

$3x = 0.196$
$x = 0.0653\text{ moles } Al_2(SO_4)_3$

Al: 2 x 26.98 = 53.96
S: 3 x 32.07 = 96.21

3.) $\underline{0.0653\text{ mole } Al_2(SO_4)_3} \times \underline{342.17\text{ g } Al_2(SO_4)_3} = 22.3\text{ g } Al_2(SO_4)_3$
$1\text{ mole } Al_2(SO_4)_3$

O: 12 x 16.0 = 192.00 +
342.17

Practice Problem:

How many grams of iron are formed when 57.9 grams of iron (III) nitrate react with excess calcium according to the following equation?

$\_\_\ Ca + \_\_\ Fe(NO_3)_3 \rightarrow \_\_\ Ca(NO_3)_2 + \_\_\ Fe$

Stoichiometry Problems 1 Worksheet

1. When lead (II) sulfide is burned in air, lead (II) oxide and sulfur dioxide are produced. If 0.890 moles of sulfur dioxide were produced, how many moles of oxygen gas were required to react with the lead (II) sulfide? ___ PbS + ___ O_2 → ___ PbO + ___ SO_2

2. In the synthesis reaction of aluminum and oxygen to produce aluminum oxide, how many grams of aluminum are required to react with 0.223 moles of oxygen?
   ___ Al + ___ O_2 → ___ Al_2O_3

3. Calculate the number of grams of oxygen produced if 2.50 grams of potassium chlorate are decomposed completely by heating.
   ___ $KClO_3$ → ___ KCl + ___ O_2

4. How many moles of oxygen are needed for the complete combustion of 3.0 moles of methane (CH_4)? ___ CH_4 + ___ O_2 → ___ CO_2 + ___ H_2O

5. Using the same equation from #4, how many grams of carbon dioxide are formed when 8.0 grams of methane react? ___ CH_4 + ___ O_2 → ___ CO_2 + ___ H_2O

6. When elemental sulfur combines with oxygen gas, sulfur dioxide is formed. What is the total number of grams of oxygen needed to react completely with 2.0 moles of sulfur?
   ___ S + ___ O_2 → ___ SO_2

7. In the synthesis of water from its elements, what is the total number of grams of oxygen gas needed to produce 54 grams of water? ___ H_2 + ___ O_2 → ___ H_2O

8. How many moles of aluminum oxide will be formed when 27 grams of aluminum react completely with excess oxygen gas? ___ Al + ___ O_2 → ___ Al_2O_3

9. What mass (in grams) of sodium oxide is produced by the reaction of 1.44 grams of sodium with excess oxygen? $\_\_ Na + \_\_ O_2 \rightarrow \_\_ Na_2O$

10. What mass (in grams) of water will be given off when 1.92×10^{22} molecules of octane (C_8H_{18}) are burned completely in air? $\_\_ C_8H_{18} + \_\_ O_2 \rightarrow \_\_ CO_2 + \_\_ H_2O$

11. How many grams of $Al_2(SO_4)_3$ are need to react with KCl in order to produce 1.245 moles of K_2SO_4?
$\_\_ Al_2(SO_4)_3 + \_\_ KCl \rightarrow \_\_ AlCl_3 + \_\_ K_2SO_4$

12. Hydrogen gas can be produced through the following unbalanced reaction.
$\_\_ Mg + \_\_ HCl \rightarrow \_\_ MgCl_2 + \_\_ H_2$

(A) What mass of HCl is consumed by the reaction of 2.50 moles of magnesium?

(B) What mass of each product is produced in part (A)?

13. Acetylene gas, C_2H_2, used in welding, produces an extremely hot flame when it burns in pure oxygen according to the following unbalanced reaction.
$\_\_ C_2H_2 + \_\_ O_2 \rightarrow \_\_ CO_2 + \_\_ H_2O$
How many molecules of CO_2 are produced when 2.50×10^4 grams of C_2H_2 burn completely?

PERCENT YIELD NOTES

~ compares the actual amount of product that you made (in an experiment) to the amount of product you should have made (according to calculations)

~ ACTUAL YIELD: amount of product that you made in an experiment; when given in the problem, the amount (grams, atoms/molecules, moles) given will be associated with a product of the reaction

~ THEORETICAL YIELD: amount of product that you should have made (according to calculations); amount given with a reactant should be used to calculate theoretical yield

~ $\% \text{ YIELD} = \frac{\text{ACTUAL YIELD}}{\text{THEORETICAL YIELD}} \times 100$

EXAMPLE

(A) What is the theoretical yield of carbon dioxide if 9.5 grams of aluminum bicarbonate are completely decomposed? (B) If a student makes 5.2 grams of CO_2 in an experiment, what is the % yield?

__ $Al(HCO_3)_3$ → __ Al_2O_3 + __ CO_2 + __ H_2O

ANSWER:

Al = 1 x 26.98 = 26.98
H = 3 x 1.008 = 3.024
C = 3 x 12.01 = 36.03
O = 9 x 16.00 = 144.00
210.034

2 $Al(HCO_3)_3$ → __ Al_2O_3 + 6 CO_2 + 3 H_2O
9.5 g ? g

1.) 9.5 g $Al(HCO_3)_3$ x $\frac{1 \text{ mole } Al(HCO_3)_3}{210.034 \text{ grams}}$ = 0.0452 moles $Al(HCO_3)_3$

2.) $\frac{0.0452 \text{ moles } Al(HCO_3)_3}{2} = \frac{x \text{ moles } CO_2}{6}$ 2 x = 0.2712
x = 0.1356 moles CO_2

C = 1 x 12.01 = 12.01
O = 1 x 16.00 = 16.00
44.01

3.) 0.1356 moles CO_2 x $\frac{44.01 \text{ g } CO_2}{1 \text{ mole}}$ = 6.0 g CO_2 is the theoretical yield.

(B) % yield = $\frac{5.2 \text{ g}}{6.0 \text{ g}}$ x 100 = 87 %

PRACTICE PROBLEM

(A) What is the theoretical yield of water if 7.5 grams of oxygen are reacted with excess hydrogen?
(B) If a student produces 7.0 grams of water, what is the student's % yield?

__ H_2 + __ O_2 → __ H_2O

PERCENT YIELD WORKSHEET

1. Use the following information to answer the questions. In the following reaction, 41.0 grams of lead (II) chloride are reacted with excess sodium chromate.

__ $PbCl_2$ + __ Na_2CrO_4 → __ $PbCrO_4$ + __ NaCl

(A) What is the theoretical yield (in grams) of sodium chloride in this reaction?

(B) If a student performed this experiment and recovered 16.5 grams of sodium chloride, what is the student's percent yield?

2. Use the following information to answer the questions. In the following reaction, 1.70 moles of zinc nitrate are reacted with excess chromium (II) phosphide.

$$\_\_\ Zn(NO_3)_2 + \_\_\ Cr_3P_2 \rightarrow \_\_\ Zn_3P_2 + \_\_\ Cr(NO_3)_2$$

(A) What is the theoretical yield (in grams) of zinc phosphide?

(B) If a student performed this experiment and recovered 149 grams of zinc phosphide, what is the student's percent yield?

3. Use the following information to answer the questions. In the following reaction, 10.0 grams of copper (II) sulfate are reacted with excess iron (III) phosphate.

$$\_\_\ CuSO_4 + \_\_\ FePO_4 \rightarrow \_\_\ Cu_3(PO_4)_2 + \_\_\ Fe_2(SO_4)_3$$

(A) How many grams of copper (II) phosphate can be produced?

(B) If a student performed this experiment and recovered 6.70 grams of copper (II) phosphate, what is the student's percent yield?

Limiting Reactant Notes

Limiting Reactant: reactant that will be consumed (used up) first; limits the amount of product that can be made (produced)

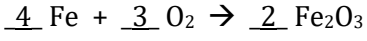
Excess Reactant: reactant that will not be completely consumed by reacting with all of the limiting reactant; there will be some of this reactant left over after the reaction is complete

How is a limiting reactant problem different from a regular stoichiometry problem? There are amounts (grams, atoms/molecules, moles) given with both of the reactants.

How are the calculations different from regular stoichiometry problems? Once you determine the limiting reactant, the calculations are exactly the same.

How can I determine which is the limiting reactant? Find the number of moles of each reactant. Divide the number of moles by its coefficient from the balanced equation. The smaller of these two numbers is the limiting reactant. Use the number and unit associated with the limiting reactant to solve the problem.

EX: (A) How many grams of Fe_2O_3 can be produced from the reaction of 20.0 grams of Fe with 20.0 grams of O_2? (B) How many grams of excess reactant remains after reaction is complete?



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

(A) STEP 1: determine the limiting reactant

Fe: $20.0\ g\ Fe \times \frac{1\ mole\ Fe}{55.85\ g\ Fe} = 0.358\ moles\ Fe$

Fe: $\frac{0.358}{4} = 0.0895$

O_2: $20.0\ g\ O_2 \times \frac{1\ mole\ O_2}{32.00\ g\ O_2} = 0.625\ moles\ O_2$

O_2: $\frac{0.625}{3} = 0.208$

So, Fe is limiting reactant. **Use the information given for Fe to solve the problem.**

$\frac{0.358 \text{ moles Fe}}{4} = \frac{x \text{ moles } Fe_2O_3}{2}$ $\quad 4x = 0.716$

$x = 0.179$ moles Fe_2O_3

$0.179 \text{ moles } Fe_2O_3 \times \frac{159.7 \text{ g } Fe_2O_3}{1 \text{ mole } Fe_2O_3} = 28.6 \text{ grams } Fe_2O_3$

(B) STEP 1: Using limiting reactant information, determine the amount of excess reactant used.

$\frac{0.358 \text{ moles Fe}}{4} = \frac{x \text{ moles } O_2}{3}$ $\quad 4x = 1.074$

$x = 0.2685$ moles O_2 used

$0.2685 \text{ moles } O_2 \times \frac{32 \text{ g } O_2}{1 \text{ mole}} = 8.59 \text{ g } O_2$ used

STEP 2: Subtract number of grams of excess (O_2) used from the original amount given in the problem.

20.0 g – 8.59 g = 11.41 g O_2 remain

On your own… if 25.00 grams of aluminum sulfate reacted with 25.00 grams of zinc chloride, how many grams of aluminum chloride could be produced? How many grams of excess reactant remains after reaction is complete?

$$\_\_ Al_2(SO_4)_3 + \_\_ ZnCl_2 \rightarrow \_\_ AlCl_3 + \_\_ ZnSO_4$$

LIMITING REACTANTS WORKSHEET

1. The coating you see on a corroded iron object that has been left in moist conditions is black iron oxide (Fe_3O_4). This substance can also be made in the laboratory by the reaction between iron and steam, according to the following equation: $Fe + H_2O \rightarrow Fe_3O_4 + H_2$
   (A) When 36.0 grams of H_2O react with 167 grams of Fe, which is the limiting reactant?
   (B) What mass (in grams) of black iron oxide is produced?
   (C) How much of the excess reactant is left over when the reaction is completed?

2. Zinc and sulfur react to form zinc sulfide according to the following equation:

$Zn + S_8 \rightarrow ZnS$

(A) If 23.0 grams of Zn are heated with 19.3 grams of S_8, which is the limiting reactant?
(B) How many grams of product are formed?
(C) How many grams of excess reactant remain after the reaction is completed?

3. Carbon reacts with steam under certain conditions to produce hydrogen and carbon monoxide.

$C + H_2O \rightarrow H_2 + CO$

(A) If 2.40 grams of carbon react with 3.10 grams of steam, which is the limiting reactant?
(B) How many moles of each product are formed?
(C) How many grams of each product are formed?

4. Aluminum reacts with hydrochloric acid according to the following equation:

$Al + HCl \rightarrow AlCl_3 + H_2$

(A) If 18 grams of aluminum are combined with 75 grams of HCl, which is the limiting reactant?
(B) What mass of each product is formed?

MORE PRACTICE PROBLEMS IF YOU NEED THEM…

1.) A reaction between methane and sulfur produces carbon disulfide (CS_2), a liquid often used in the production of cellophane.

$\_\_\_ CH_4 + \_\_\_ S_8 \rightarrow \_\_\_ CS_2 + \_\_\_ H_2S$

If 1.50 moles of S_8 are used, (A) how many moles of CS_2 are produced?
(B) How many moles of H_2S are produced?

2.) Lead (II) oxide is obtained by roasting galena, lead (II) sulfide, in air.

$\_\_\_ PbS + \_\_\_ O_2 \rightarrow \_\_\_ PbO + \_\_\_ SO_2$

(A) Determine the theoretical yield (in grams) of PbO if 200.0 grams of PbS are heated.
(B) What is the percent yield if 170.0 grams of PbO are obtained?

3.) Some rockets are fueled by the reaction of hydrazine (N_2H_2) and hydrogen peroxide (H_2O_2). How many moles of nitrogen gas can be produced by reacting 255 grams of hydrazine with excess hydrogen peroxide?

$\_\_\_ N_2H_2 + \_\_\_ H_2O_2 \rightarrow \_\_\_ N_2 + \_\_\_ H_2O$

4.) One in a series of reactions that inflate automobile air bags is the decomposition of sodium azide (NaN_3).

$\_\_ NaN_3 \rightarrow \_\_ Na + \_\_ N_2$

Determine the mass of N_2 produced if 100.0 grams of NaN_3 are decomposed.

5.) Titanium is a transition metal used in many alloys because it is extremely strong and lightweight. Titanium tetrachloride ($TiCl_4$) is extracted from titanium oxide using chlorine and carbon.

$\_\_\_ TiO_2 + \_\_\_ C + \_\_ Cl_2 \rightarrow \_\_\_ TiCl_4 + \_\_\_ CO_2$

If you begin with 1.25 moles of TiO_2, what mass of Cl_2 gas is needed?

6.) How many molecules of iodine can be produced by the complete reaction of 43.97 grams of KI?

$\_\_\_ CuCl_2 + \_\_\_ KI \rightarrow \_\_\_ CuI + \_\_\_ KCl + \_\_\_ I_2$

7.) What mass of ammonia (NH_3) is needed to react completely with oxygen to produce 3.54×10^{24} molecules of water?

$\_\_\_ NH_3 + \_\_\_ O_2 \rightarrow \_\_\_ NO + \_\_\_ H_2O$

UNITS 8 & 9 REVIEW WORKSHEET

1.) ___ $CaCl_2$ + ___ $AgNO_3$ → ___ $Ca(NO_3)_2$ + ___AgCl

(A) Type of reaction?

(B) If 50.0 grams of calcium chloride are reacted with excess silver nitrate, how many grams of silver chloride can be produced?

(C) What is the percent yield if a student makes 118 grams of silver chloride in this experiment?

2.) ___ $Fe(HCO_3)_3$ → ___ Fe_2O_3 + ___ H_2O + ___CO_2

(A) Type of reaction?

(B) A lab group decomposed 15.0 grams of $Fe(HCO_3)_3$. What is the theoretical yield of iron (III) oxide?

(C) If the lab group produced 4.63 grams of iron (III) oxide, what is their percent yield?

3.) ___ Au + ___HNO_3 + ___HCl → ___ $AuCl_3$ + ___NO + ___ H_2O

(A) How many grams of hydrochloric acid (HCl) are needed to completely react 1.25 moles of gold metal?

4.) ___ Fe + ___ $CuNO_3$ → ___ $Fe(NO_3)_2$ + ___ Cu

(A) How do we know that this reaction actually happens?

(B) When 3.7 moles of iron are reacted with excess copper (I) nitrate, how many moles of copper are produced?

5.) ___ $Ca_3(PO_4)_2$ + ___ SiO_2 + ___ C → ___ P + ___ $CaSiO_3$ + ___ CO

(A) How many moles of $CaSiO_3$ would be produced by the complete reaction of 225.5 grams of calcium phosphate?

6.) ___ Ca + ___ H_2O → ___ $Ca(OH)_2$ + ___ H_2

(A) How many molecules of water would be needed to react completely with 34.2 grams of calcium?

7.) ___ K_3PO_4 + ___ $MgCl_2$ → ___ $Mg_3(PO_4)_2$ + ___ KCl

(A) What is the theoretical yield of potassium chloride if 21.7 grams of magnesium chloride are reacted with 25.4 grams of potassium phosphate?

(B) How many grams of excess reactant remain after the reaction is complete?

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8.) Al + $NiCl_2$ →

9.) $Zn(NO_3)_2$ + Mg →

10.) Cu + K_2SO_4 →

11.) CsF + I_2 →

12.) Cl_2 + NaBr →

13.) $Pb(ClO_3)_2$ + K →

14.) Mn + LiOH →

HELP!! I'm still struggling with this stuff!

How do I know what steps to use and what steps to leave out?

If given:	**Asked for:**	**Use step(s):**
Moles	moles	2
Moles	grams or molecules	2 & 3
Grams or molecules	moles	1 & 2
Grams or molecules	grams or molecules	1, 2, & 3

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Step 1 – Find the number of moles of the substance you are given an amount of. (conversion)

$$\text{\# and unit given in problem} \times \frac{1 \text{ mole}}{\text{"\#" unit given}} = \text{answer to step 1}$$

If unit given is grams, then "#" should be the molar mass (from the Periodic Table).
If unit given is mcs, then "#" should be 6.022×10^{23}.

Step 2 – Use mole ratio (coefficients) from balanced equation.

$$\frac{\text{\# of moles of given substance*}}{\text{coefficient of given substance}} = \frac{\text{x moles unknown substance}}{\text{coefficient of unknown substance}}$$

Then, solve for x.
*The number you put here should be your answer from step 1 or the number of moles given in the problem.

Step 3 – Find the answer. (conversion)

$$\text{x moles of unknown substance**} \times \frac{\text{(\#) unknown unit}}{1 \text{ mole}} = \text{final answer}$$

If unknown unit is grams, (#) should be molar mass (from Periodic Table).
If unknown unit is mcs, (#) should be 6.022×10^{23}.
**The number you put here as the "x" is your answer from step 2.

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Stoichiometry Problems 1 wksht.
1.) 1.34 moles O_2 2.) 8.02 g Al 3.) 0.980 g O_2 4.) 6.0 moles O_2 5.) 22 g 6.) 64 g O_2 7.) 48 g O_2 8.) 0.50 moles Al_2O_3 9.) 1.94 g Na_2O 10.) 5.16 g H_2O 11.) 142.1 g $Al_2(SO_4)_3$ 12.) a) 183 g HCl b) 238 g $MgCl_2$; 5.00 g H_2 13.) 1.16×10^{27} mcs CO_2

Percent Yield wksht.
1.) (A) 17.2 g (B) 95.9 % 2.) (A) 146 g (B) 102 % 3.) (A) 7.95 g (B) 84.3 %

Limiting Reactants wksht.
1. (A) H_2O, (B) 116 g, (C) 83.7 g;
2. (A) Zn, (B) 34.3 g, (C) 8.0 g;
3. (A) H_2O, (B) 0.172 moles of each, (C) 4.82 g CO, 0.347 g H_2;
4. (A) Al, (B) 88.9 g $AlCl_3$, 2.02 g H_2

More Practice Problems.
1.) (A) 3.00 moles CS_2 (B) 6.00 moles H_2S 2.) (A) 186.6 g PbO (B) 91.10 % 3.) 8.50 moles N_2
4.) 64.60 g N_2 5.) 178 g Cl_2 6.) 3.988×10^{22} mcs I_2 7.) 66.6 g NH_3

UNITS 8 & 9 REVIEW WORKSHEET
1. (A) double replacement (B) 129 g (C) 91.5%
2. (A) decomposition (B) 5.01 g (C) 92.4%
3. (A) 137 g
4. (A) Fe is higher than Cu on Activity Series. (B) 7.4 moles
5. (A) 2.180 moles
6. (A) 1.03×10^{24} molecules
7. (A) 26.8 g (B) 4.6 g remain
8.) $2\ Al + 3\ NiCl_2 \rightarrow 3\ Ni + 2\ AlCl_3$
9.) $Zn(NO_3)_2 + Mg \rightarrow Zn + Mg(NO_3)_2$
10.) $Cu + K_2SO_4 \rightarrow$ no rxn.
11.) $CsF + I_2 \rightarrow$ no rxn.
12.) $Cl_2 + 2\ NaBr \rightarrow Br_2 + 2\ NaI$
13.) $Pb(ClO_3)_2 + 2\ K \rightarrow Pb + 2\ KClO_3$
14.) $Mn + LiOH \rightarrow$ no rxn.