Senior High School

DepED
DEPARTMENT OF EDUCATION

Physical Science

Quarter 1 – Module 6:

Stoichiometry: Magical but Real!

ALTERNATIVE DELIVERY MODE
ADM

Physical Science
Alternative Delivery Mode
Quarter 1 – Module 6: Stoichiometry: Magical but Real
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Quarter 1 – Module 6: Stoichiometry: Magical but Real!

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Introductory Message

For the facilitator:

Welcome to the Physical Science Grade 11 Alternative Delivery Mode (ADM) Module on Stoichiometry!

This module was collaboratively designed, developed and reviewed by educators both from public and private institutions to assist you, the teacher or facilitator in helping the learners meet the standards set by the K to 12 Curriculum while overcoming their personal, social, and economic constraints in schooling.

This learning resource hopes to engage the learners into guided and independent learning activities at their own pace and time. Furthermore, this also aims to help learners acquire the needed 21st century skills while taking into consideration their needs and circumstances.

In addition to the material in the main text, you will also see this box in the body of the module:

Notes to the Teacher

This contains helpful tips or strategies that will help you in guiding the learners.

As a facilitator you are expected to orient the learners on how to use this module. You also need to keep track of the learners' progress while allowing them to manage their own learning. Furthermore, you are expected to encourage and assist the learners as they do the tasks included in the module.

For the learner:

Welcome to the Physical Science Grade 11 Alternative Delivery Mode (ADM) Module on Stoichiometry!

The hand is one of the most symbolized part of the human body. It is often used to depict skill, action and purpose. Through our hands we may learn, create and accomplish. Hence, the hand in this learning resource signifies that you as a learner is capable and empowered to successfully achieve the relevant competencies and skills at your own pace and time. Your academic success lies in your own hands!

This module was designed to provide you with fun and meaningful opportunities for guided and independent learning at your own pace and time. You will be enabled to process the contents of the learning resource while being an active learner.

This module has the following parts and corresponding icons:

 ***What I Need to Know***	This will give you an idea of the skills or competencies you are expected to learn in the module.
 ***What I Know***	This part includes an activity that aims to check what you already know about the lesson to take. If you get all the answers correct (100%), you may decide to skip this module.
 ***What's In***	This is a brief drill or review to help you link the current lesson with the previous one.
 ***What's New***	In this portion, the new lesson will be introduced to you in various ways such as a story, a song, a poem, a problem opener, an activity or a situation.
 ***What is It***	This section provides a brief discussion of the lesson. This aims to help you discover and understand new concepts and skills.
 ***What's More***	This comprises activities for independent practice to solidify your understanding and skills of the topic. You may check the answers to the exercises using the Answer Key at the end of the module.
 ***What I Have Learned***	This includes questions or blank sentence/paragraph to be filled in to process what you learned from the lesson.
 ***What I Can Do***	This section provides an activity which will help you transfer your new knowledge or

	skill into real life situations or concerns.
 ***Assessment***	This is a task which aims to evaluate your level of mastery in achieving the learning competency.
 ***Additional Activities***	In this portion, another activity will be given to you to enrich your knowledge or skill of the lesson learned. This also tends retention of learned concepts.
 ***Answer Key***	This contains answers to all activities in the module.

At the end of this module you will also find:

References	This is a list of all sources used in developing this module.

The following are some reminders in using this module:

1. Use the module with care. Do not put unnecessary mark/s on any part of the module. Use a separate sheet of paper in answering the exercises.
2. Don't forget to answer *What I Know* before moving on to the other activities included in the module.
3. Read the instruction carefully before doing each task.
4. Observe honesty and integrity in doing the tasks and checking your answers.
5. Finish the task at hand before proceeding to the next.
6. Return this module to your teacher/facilitator once you are through with it.

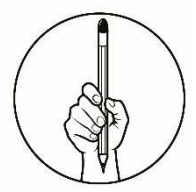
If you encounter any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator. Always bear in mind that you are not alone.

We hope that through this material, you will experience meaningful learning and gain deep understanding of the relevant competencies. You can do it!

What I Need to Know

This module is all about stoichiometry: a topic that is necessary in order to master more advanced topics in chemistry. In order to master stoichiometry, you need to achieve the following objectives:

- Define what stoichiometry is;
- Balance chemical equations correctly;
- Convert mass to mole and vice versa;
- Compute for the mass or mole of the reactants or products using stoichiometric ratio;
- Identify the limiting or excess reagent in a chemical reaction.



What I Know

DIRECTIONS: Read the questions very carefully and write the letter of the correct answer on the space provided before each number.

_____1. Stoichiometry is defined as the quantitative study of_____in a chemical reaction.

A. moles and mass
B. elements and compounds
C. reactants and products
D. matter and energy

_____2. What is the first step in solving stoichiometric problems?

A. convert mass of the given substance to mole
B. determine the mole ratio of the involved substance
C. convert the moles of the wanted substance to the desired unit
D. balance the chemical equation

_____3. In the reaction, $2Al + 6HCl \rightarrow 2\ AlCl_3 + 3\ H_2$, the mass of aluminum was given and you were asked to compute how much H_2 will be produced. What stoichiometric ratio are you going to use?

A. $\frac{3\ NtH\ t}{t\ NtA\ h}$ B. $\frac{t\ NtH\ t}{3\ NtA\ h}$ C. $\frac{t\ NtA\ h}{3\ NtH\ t}$ D. $\frac{3\ NtA\ h\ t}{NtH\ t}$

_____4. What are the correct coefficients to balance the equation below?

___KClO3 →___KCl +___O2

A. 2-2-3 B. 2-3-2 C. 1-2-3 D. 3-2-2

For questions 5-10:

Nitric acid is formed from the reaction of nitrogen dioxide and water as shown in the equation, $3NO_2 + H_2O \rightarrow 2HNO_3 + NO$. Initially, you were given 10 grams of NO_2 and 10 grams of H_2O.

_____5. How many moles of NO_2 are there in the actual reaction?

A. 0.19 mol B. 0.20 mol C. 0.21 mol D. 0.22 mol

_____6. How many moles of H_2O are there in the actual reaction?

A. 0.53 mol B. 0.55 mol C. 0.57 mol D. 0.59mol

_____7. Which of the reactants is in excess?

A. NO_2 B. H_2O C. HNO_3 D. NO

_____8. Which of the reactants is limited in amount?

A. NO_2 B. H_2O C. HNO_3 D. NO

_____9. If you were asked to look for the amount of HNO_3, what stoichiometric ratio are you going to use?

A. $\frac{3\ NH_3}{4\ NH_4NO_3}$ B. $\frac{3\ NH_4NO_3}{4\ NH_3}$ C. $\frac{3\ NH_3}{4\ HNO_3}$ D. $\frac{3\ NH_4NO_3}{4\ H_2O}$

_____10. How many moles of HNO_3 will be produced in this chemical reaction?

A. 0.13 mol B. 0.15 mol C. 0.17 mol D. 0.19 mol

_____11. Which statement below is **false** when 10 g of nitrogen reacts with 5.0 g of hydrogen to produce ammonia?

$$N_2\,(g) + 3\,H_2\,(g) \rightarrow 2\,NH_3\,(g)$$

A. Hydrogen is the excess reactant.

B. Nitrogen is the limiting reactant.

C. 2.8 grams of hydrogen are left over.

D. The theoretical yield of ammonia is 15 g.

_____12. Which of these interpretations of the following balanced equation is **TRUE**?

$$2S_{(s)} + 3O_{2\,(g)} \rightarrow 2SO_{3\,(g)}$$

A. 2 atoms of S and 3 atoms of O_2 form 2 atoms of SO_3

B. 2 grams of S and 3 grams of O_2 form 2 grams of SO_3

C. 2 moles of S and 3 moles of O_2 form 2 moles of SO_3

D. 2 L of S and 3 L of O_2 form 2 L of SO_3

_____13. Which of the following quantities is conserved in *every* chemical reaction?

A. Mass

B. Moles

C. Molecules

D. Formula units

_____14. Which type of stoichiometric calculation does not involve the gram formula mass?

A. Mass-mass problems

B. Mass-volume problems

C. Mass-particle problems

D. Volume-volume problems

_____15. An excess amount of Zn (s) is added to 500 mL of 0.800 M HCl. What mass in grams of H_2 (g) is produced?

A. 0.100 g B. 0.200 g C. 0.400 g D. 0.600 g

Lesson 1

Stoichiometry

As the saying goes, "Chemistry is like cooking, just don't lick the spoon", we *cook* different substances at certain proportions to form desired results. These proportions are strictly followed in obedience to the Law of Conservation of Mass and Law of Definite Proportions.

Just by looking at the ingredients, we know how much of the other ingredients we will be needing in order to cook the dish well or how much final product we are going to make. Same goes with chemistry. This area of study in chemistry, which is very much related to cooking, is called **stoichiometry** (stoy·kee·aa·muh·tree): the quantitative study of reactants and products in a chemical reaction. The term came from the Greek words *stoicheion*, meaning "element", and *metron* meaning "measure".

What's In

Almost everything around you involves chemistry. From the things you eat to the clothes you wear, the air you breathe and the ground you walk on, even the emotions from a heart break: all of these things involve chemistry. But to better appreciate chemistry lessons, you need to follow some simple rules:

1. Read the directions very carefully and follow the directions indicated in every activity.
2. Create a *mental image* of the concepts that are being discussed. This will help you better understand abstract concepts in chemistry.
3. Perform all of the activities in this module in the correct sequence. Doing this will help you scaffold your way up to more challenging tasks.

4. Imagine your answer and compare it with the mental image of the concept you just learned. This will help you check your own work. If your imagination fails, you may use the answer key card in assessing your work, with the help of your facilitator or guardian.
5. Look for real-world examples of the concepts you have learned. This will make chemistry concepts more real to you and will also help you appreciate it more.
6. Have fun learning chemistry!

Notes to the Teacher

A simple exercise on how to balance chemical equations will be given to the learners as an essential skill in learning how to solve stoichiometric problems.

In your Grade 10 Science, you learned how to balance chemical equations. This skill is essential in learning how to solve stoichiometric problems. To refresh your memories, try to balance the following equations below.

1. ___$KClO_3$ → ___KCl +___O_2
2. ___Al +___O_2 → ___Al_2O_3
3. ___U +___$F_{2=}$ → ___UF_6
4. ___$FeCl_2$ +___Na_3PO_4 → ___$Fe_3(PO_4)_2$ +___NaCl
5. ___Na_2CO_3 +___$Ca(OH)_2$ → ___NaOH +___$CaCO_3$
6. ___Mg +___HNO_3 → ___H_2 +___$Mg(NO_3)_2$
7. ___CaC_2 +___H_2O → ___$Ca(OH)_2$ +___C_2H_2
8. ___S +___O_2 → ___SO_3
9. ___UO_2 +___HF → ___UF_4 +___H_2O
10. ___H_2SO_4 +___LiOH → ___Li_2SO_4 +___H_2O

What's New

Activity 1: Chicken Adobo ala Chem

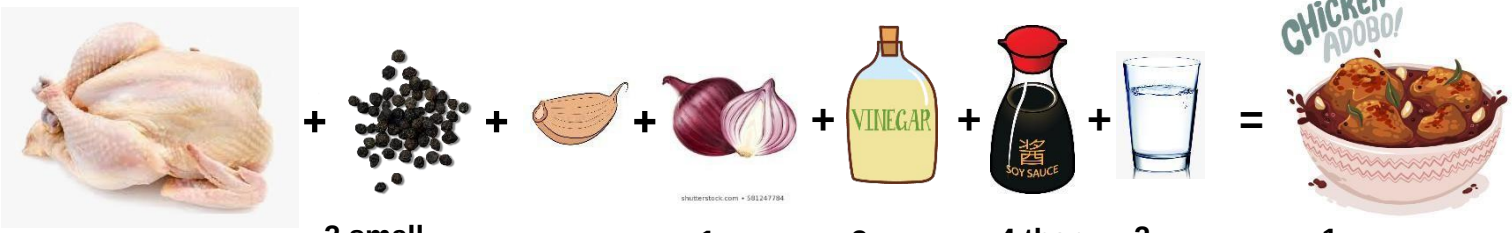
To better understand the relationship of chemistry (stoichiometry) and cooking, let us use the cooking of adobo as an analogy.

Objectives:

- Relate stoichiometry to cooking
- Demonstrate the relationship between a reactant with another reactant/s, a reactant to a product, and vice versa

Procedure:

- Observe and strictly follow the "adobo equation"
- Identify the amount of ingredients or product (adobo) that will be needed/produced using the given quantities
- Write your answer on the space provided



1 pound chicken packs + **2 small Pepper corns** + **5 garlic cloves** + **1 piece onion** + **3 tbsp vinegar** + **4 tbsp Soy sauce** + **2 cups water** = **1 casserole Chicken adobo**

4 pounds chicken	=	____casserole C.A.	3 pounds chicken	=	_____tbsp soy sauce
15 tbsp vinegar	=	____pcs onion	4 pcs onion	=	_____cloves garlic
4 cups water	=	____cloves garlic	12 cups water	=	_____tbsp vinegar
10 packs pepper corn	=	____casserole C.A.	10 tbsp soy sauce	=	_____pounds chicken

Guide Questions:

1. What will happen to your chicken adobo if you were only given the ingredients but not the exact measurement? Why?

   _____

   _____

   _____

2. How did you know how to compute for the amount of the other ingredients in the activity? _____

   _____

   _____

All chemicals that react together and the products they form are found in a chemical equation. But knowing the substances is not enough. You need to know the exact amount that you will need to react to form the products. Like in cooking, you need to the know exact amount of the ingredients so that nothing will be wasted and you get the desired results. This can be done by balancing the chemical equation, which is the *first step* in solving stoichiometric problems.

In a balanced chemical equation like $N_2 + 3H_2 \rightarrow 2NH_3$, the coefficients written before the chemical symbol are molar quantity or moles. Since there are no device that can measure the molar quantity of a substance, we need to convert the mole of a substance into mass (normally, in grams). In the case of the reaction of nitrogen gas and hydrogen gas to form ammonia, to convert mole to mass, we use a **conversion factor** using the molar mass of the substance:

REACTANTS	**PRODUCT**
$1 \text{ mol } N_2 \frac{28.02 \text{ g } N_2}{1 \text{ mol } N_2} = 28.02 \text{ g } N_2$	$2 \text{ mol } NH_3 \frac{17.04 \text{ g } NH_3}{1 \text{ mol } NH_3} = 34.08 \text{ g } NH_3$
$3 \text{ mol } H_2 \frac{2.02 \text{ g } H_2}{1 \text{ mol } H_2} = 6.06 \text{ g } H_2$	
Total mass of reactants = 34.08 g	

Law of Conservation of Mass and Stoichiometry

Notice that the total mass of the reactants and the mass of the product are equal. This shouldn't be surprising since we know that the number of elements on both side of the equation are the same. As the Law of Conservation of Mass states, *"in an ordinary chemical reaction, mass is neither created nor destroyed".*

Looking back at the adobo "equation", we know that if we double the pounds of chicken, you also double the quantity of all other ingredients, including the product to get the desired result. If we triple the tablespoons of vinegar, you also have to triple the cloves of garlic. If we put it in a mathematical expression, we say that:

$$\frac{3\ \text{tbsp vinegar}}{5\ \text{cloves garlic}} = 1 \text{ (the desired effect)}$$

If we triple the quantity of vinegar, you also have to triple the quantity of the cloves of garlic:

$$3\left(\frac{3\ \text{tbsp vinegar}}{5\ \text{cloves garlic}}\right) = \frac{9\ \text{tbsp vinegar}}{15\ \text{cloves garlic}} \qquad \frac{(3)3\ \text{tbsp vinegar}}{(3)5\ \text{cloves garlic}} = 1 \text{(the desired effect)}$$

Likewise, in a balanced chemical equation like $N_2 + 3H_2 \rightarrow 2NH_3$, we can say that 1 mol of N_2 is "stoichiometrically equivalent" to 3 mol H_2 since:

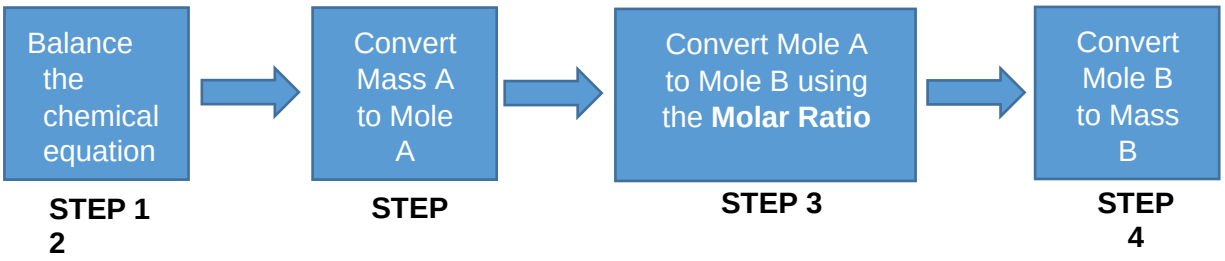
$$\frac{1\ \text{mol}\ N_2}{3\ \text{mol}\ H_2} = 1 \qquad \text{and} \qquad \frac{(3)1\ \text{mol}\ N_2}{(3)3\ \text{mol}\ H_2} = 1$$

Inverting the ratio will still get the same result:

$$\frac{3\ \text{mol}\ H_2}{1\ \text{mol}\ N_2} = 1 \qquad \text{and} \qquad \frac{(3)3\ \text{mol}\ H_2}{(3)1\ \text{mol}\ N_2} = 1$$

Using this **molar ratio** and a **balanced chemical equation**, we can compute for the quantity of another substance involved in the reaction. A mole ration is the ratio of moles of reactants and products according to the coefficients in the balanced chemical equation.

If you are given a specific mass of substance, how do you know how much of the other reactants are you going to use? Can you also know the amount of product that you are going to form? To solve this, you need to follow the steps in solving stoichiometric problems:



For example, in the reaction $Mg + HNO_3 \rightarrow H_2 + Mg(NO_3)_2$, you were given 10 grams of Mg, how much HNO_3 are going to use and how much H_2 and $Mg(NO_3)_2$ will be formed?

STEP 1: Balance the chemical equation.

The balanced chemical equation is $Mg + 2HNO_3 \rightarrow H_2 + Mg(NO_3)_2$

STEP 2: Convert Mass of Mg to Mole

$$10\ g\ Mg\left(\frac{1\ mol\ Mg}{24.3\ g\ Mg}\right) = 0.41\ mol\ Mg$$

STEP 3: Convert Mole of Mg to the Mole of the desired substance using Mole Ratio

(Based from the balanced chemical equation)

$$0.41\ mol\ Mg\left(\frac{2\ mol\ HNO_3}{1\ mol\ Mg}\right) = 0.82\ mol\ HNO_3$$

$$0.41\ mol\ Mg\left(\frac{1\ mol\ H_2}{1\ mol\ Mg}\right) = 0.41\ mol\ H_2$$

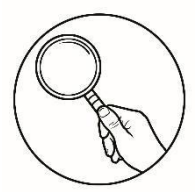
$$0.41\ mol\ Mg\left(\frac{1\ mol\ Mg(NO_3)_2}{1\ mol\ Mg}\right) = 0.41\ mol\ Mg(NO_3)_2$$

STEP 4: Convert Mole of the desired substance to Mass

$$0.82\ mol\ HNO_3\left(\frac{63.0\ g\ HNO_3}{1\ mol\ HNO_3}\right) = \mathbf{52\ g\ HNO_3}$$

$$0.41\ mol\ H_2\left(\frac{2.0\ g\ H_2}{1\ mol\ H_2}\right) = \mathbf{0.83\ g\ H_2}$$

$$0.41\ mol\ Mg(NO_3)_2\left(\frac{148.3\ g\ Mg(NO_3)_2}{1\ mol\ Mg(NO_3)_2}\right) = \mathbf{61\ g\ Mg(NO_3)_2}$$



What is It

Activity 2: Cook like a Chemist

Imagine you are a chemist. How do you know how much reactants you are going to use and how much products are going to be formed? Try solving these problems to practice your skills.

Objectives:

- Solve the following stoichiometric problems correctly; and
- Follow the steps in solving stoichiometric problems carefully

Procedure:

- Follow the four steps in solving stoichiometric problems to solve for what is being required.
- Write you final answer in the correct number of significant figures.

1. When baking soda ($NaHCO_3$) is heated, carbon dioxide (CO_2) is released. This makes bread, cookies and other pastries to rise. If 42.0 g of $NaHCO_3$ was used, how much CO_2 was released? ($NaHCO_3$ = 84.00 g/mol, CO_2 = 44.01, Na_2CO_3 = 105.99 g/mol, H_2O = 18.02 g/mol)

$$2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$$

2. How much potassium iodide (166.00 g/mol) is required to get 1.78 g of mercury(II) iodide precipitate (454.39 g/mol). The unbalanced chemical equation is:

$$KI + Hg(NO_3)_2 \rightarrow HgI_2 + KNO_3$$

3. Titanium (IV) oxide (TiO_2) is a pigment used for white paint. It is formed from the reaction of the mineral ilmenite ($FeTiO_3$) with sulfuric acid. How much TiO_2 will be produced if 1000.0 g of $FeTiO_3$ is reacted with sufficient amount of sulfuric acid?

($FeTiO_3$ = 151.71 g/mol, TiO_2 = 79.87 g/mol)

$$FeTiO_3 + H_2SO_4 \rightarrow TiO_2 + FeSO_4 + H_2O$$

There are times when the ingredients that we use when cooking dictates how much food we are going to make. In the case of our chicken adobo, if you have 10 pounds of chicken but you only have one onion, you will be forced to cook only one pound of chicken to avoid making your dish go bland. In the same manner, certain reactants with limited amount dictate the amount of product we are going to form. This is where the concept of limiting reagent and excess reagent comes in.

A **limiting reagent** is the substance in a chemical reaction that controls or limits the maximum amount of product formed while an **excess reagent** is the reactant present in quantities greater than necessary to react with the quantity of the limiting reagent. In the example I gave earlier, the limiting reagent(ingredient) is the onion while the excess reagent(ingredient) are the chicken.

To identify which of the reactant is the limiting reagent and which one is the excess, you have to assume that one substance is limited, then compute for the required amount of the other reactant. Let's us use again the equation

$$N_2 + 3H_2 \rightarrow 2NH_3$$

10 g 10 g

If you have 10 grams each of N_2 and H_2, which one is the limiting reagent and which one is the excess reagent? To answer this, you have to assume on reactant to be a limiting reagent, then compute for the required amount of the other reactant to completely consume the other. Let us assume that N_2 is the limiting reagent. How much H_2 do you need to completely use up all the N_2?

Convert Mass A to Mole A	Convert Mole A to Mole B using Mole Ratio	Convert Mole B to Mass B

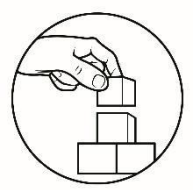
$$10\ g\ N_2 \frac{1\ mol\ N_2}{28\ g\ N_2} = 0.36\ mol\ N_2 \frac{3\ mol\ H_2}{1\ mol\ N_2} = 1.1\ mol\ H_2 \frac{2\ g\ H_2}{1\ mol\ H_2} = \boxed{2.2\ g\ H_2}$$

As you can see from the calculation, 10 grams of N_2 will only require 2.2 grams of H_2. Since you have 10 grams of H_2, it means that it is in excess while N_2 is in limited quantity. But what if you assumed that H_2 was the limiting reagent? How much N_2 do you need to consume all 10 grams of H_2?

Convert Mass A to Mole A	Convert Mole A to Mole B using Mole Ratio	Convert Mole B to Mass B

$$10\ g\ H_2 \frac{1\ mol\ H_2}{2\ g\ H_2} = 5.0\ mol\ H_2 \frac{1\ mol\ N_2}{3\ mol\ H_2} = 1.7\ mol\ N_2 \frac{28\ g\ N_2}{1\ mol\ N_2} = \boxed{48\ g\ N_2}$$

If all 10 grams of H_2 get used up in the reaction, you will be needing 48 grams of N_2. Since you only have 10 grams of N_2, it means that its quantity is limited and, therefore, H_2 is in excess.



What's More

Activity 3: Am I too much for you?

Objectives:

- Follow the steps in solving for the limiting and excess reagents carefully; and
- Identify the limiting and excess reagents.

Procedure:

- Solve the following problems to identify the limiting and excess reagent using a single thread of solution, just like in the example
- Report your answer in the correct number of significant figures

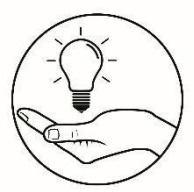
1. In the reaction $Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$, you were given 15 grams of $Mg(OH)_2$ and 25 grams of HCl. Which of the two reactants is the limiting reagent? How much $MgCl_2$ will be produced in the reaction? ($Mg(OH)_2$ = 58.32 g/mol, HCl = 36.46 g/mol, $MgCl_2$ = 95.32 g/mol)

2. Nitric oxide (NO) is a substance that can improve heart health and enhance your performance during exercise or workout. It can be formed through the reaction:

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

   If 25 g NH_3 is reacted with 20 g O_2, which of the two is the limiting reagent? How much NO will be formed in the reaction? (NH_3 = 17.03 g/mol, O_2 = 32.00 g/mol, NO = 30.01 g/mol)

3. Consider the reaction $MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$. If the both the reactants have a mass of 100 grams, which of the two will be used up first? How many grams of $MnCl_2$ will be produced after the reaction? (MnO_2 = 86.94 g/mol, HCl = 36.46 g/mol, $MnCl_2$ = 125.8 g/mol)



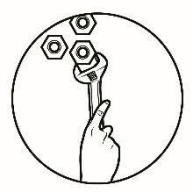
What I Have Learned

Stoichiometry - the quantitative study of reactants and products in a chemical reaction

Mole (molar) Ratio – the ratio of moles of reactants and products according to the coefficients in the balanced chemical equation.

Limiting reagent - the substance in a chemical reaction that controls or limits the maximum amount of product formed

Excess reagent - the reactant present in quantities greater than necessary to react with the quantity of the limiting reagent.



What I Can Do

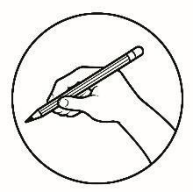
Fertilizers are one of the most important substances in the world since it is used to make food for 7.8 billion world population as of March 2020. Hundreds of millions of tons of fertilizer are made each year just to support our growing need for food. The most common material in making fertilizer is ammonia, which is made through the Haber–Bosch process, is synthesized through the following chemical reaction:

$$N_2 + 3H_2 \rightarrow 2NH_3$$

This ammonia is then used create other fertilizers, but sometimes, ammonia can be directly sprayed on to the soil or plant as seen in the picture above.

Guide Questions:

1. If you were to synthesize ammonia, how many grams of hydrogen gas are you going to need if you have 2500 grams of nitrogen gas?
2. How much ammonia can you produce from the given amount of nitrogen gas?



Assessment

DIRECTIONS: Read the questions very carefully and write the letter of the correct answer on the space provided before each number.

_____1. Stoichiometry is defined as the quantitative study of_____in a chemical reaction.

A. moles and mass
B. elements and compounds
C. reactants and products
D. matter and energy

_____2. What is the first step in solving stoichiometric problems?

A. convert mass of the given substance to mole
B. determine the mole ratio of the involved substance
C. convert the moles of the wanted substance to the desired unit
D. balance the chemical equation

_____3. In the reaction, $2Al + 6HCl \rightarrow 2\ AlCl_3 + 3\ H_2$, the mass of aluminum was given and you were asked to compute how much H_2 will be produced. What stoichiometric ratio are you going to use?

A. $\frac{3\ NtH\ t}{t\ NtAl}$ B. $\frac{t\ NtH\ t}{3\ NtAh}$ C. $\frac{t\ NtAh}{3\ NtH\ t}$ D. $\frac{3\ NtAh}{t\ NtH\ t}$

_____4. What are the correct coefficients to balance the equation below?

___KClO3 →___KCl +___O2

A. 2-2-3 B. 2-3-2 C. 1-2-3 D. 3-2-2

For questions 5-10:

Nitric acid is formed from the reaction of nitrogen dioxide and water as shown in the equation, $3NO_2 + H_2O \rightarrow 2HNO_3 + NO$. Initially, you were given 10 grams of NO_2 and 10 grams of H_2O.

_____5. How many moles of NO_2 are there in the actual reaction?

A. 0.19 mol B. 0.20 mol C. 0.21 mol D. 0.22 mol

_____6. How many moles of H_2O are there in the actual reaction?

A. 0.53 mol B. 0.55 mol C. 0.57 mol D. 0.59 mol

_____7. Which of the reactants is in excess?

A. NO_2 B. H_2O C. HNO_3 D. NO

_____8. Which of the reactants is limited in amount?

A. NO_2 B. H_2O C. HNO_3 D. NO

_____9. If you were asked to look for the amount of HNO_3, what stoichiometric ratio are you going to use?

A. $\frac{3\ mol\ NO}{4\ mol\ HNO_3}$ B. $\frac{3\ mol\ HNO_3}{2\ mol\ NO}$ C. $\frac{3\ mol\ H_2O}{4\ mol\ HNO_3}$ D. $\frac{3\ mol\ HNO_3}{1\ mol\ H_2O}$

_____10. How many moles of HNO_3 will be produced in this chemical reaction?

A. 0.13 mol B. 0.15 mol C. 0.17 mol D. 0.19 mol

_____11. Which statement below is **false** when 10 g of nitrogen reacts with 5.0 g of hydrogen to produce ammonia?

$$N_2\,(g) + 3\,H_2\,(g) \rightarrow 2\,NH_3\,(g)$$

A. Hydrogen is the excess reactant.

B. Nitrogen is the limiting reactant.

C. 2.8 grams of hydrogen are left over.

D. The theoretical yield of ammonia is 15 g.

_____12. Which of these interpretations of the following balanced equation is **TRUE**?

$$2S_{(s)} + 3O_{2\,(g)} \rightarrow 2SO_{3\,(g)}$$

A. 2 atoms of S and 3 atoms of O_2 form 2 atoms of SO_3

B. 2 grams of S and 3 grams of O_2 form 2 grams of SO_3

C. 2 moles of S and 3 moles of O_2 form 2 moles of SO_3

D. 2 L of S and 3 L of O_2 form 2 L of SO_3

_____13. Which of the following quantities is conserved in *every* chemical reaction?

A. Mass

B. Moles

C. Molecules

D. Formula units

_____14. Which type of stoichiometric calculation does not involve the gram formula mass?

A. Mass-mass problems

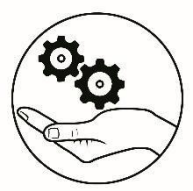
B. Mass-volume problems

C. Mass-particle problems

D. Volume-volume problems

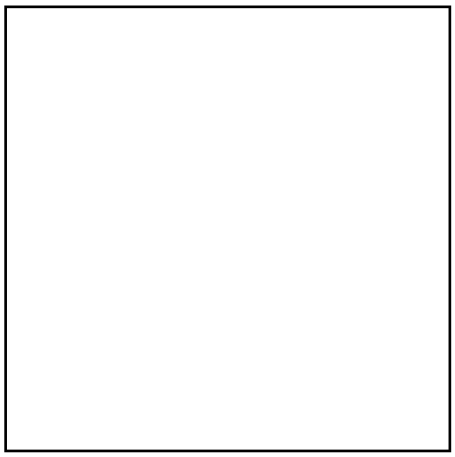
_____15. An excess amount of Zn (s) is added to 500 mL of 0.800 M HCl. What mass in grams of H_2 (g) is produced?

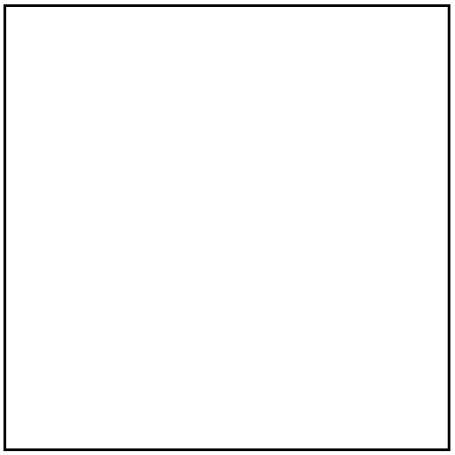
A. 0.100 g B. 0.200 g C. 0.400 g D. 0.600 g

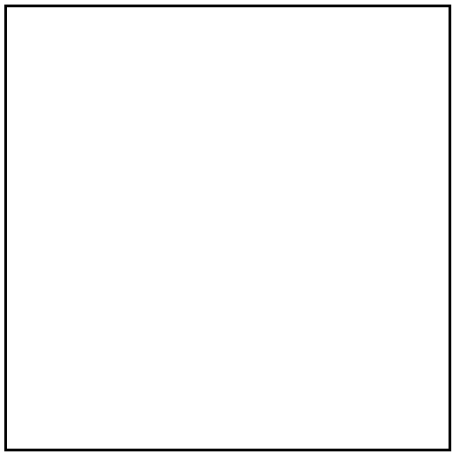


Additional Activities

How is the concept of stoichiometry applicable in your everyday life? List five (5) activities that you do in your house the applies the concept of stoichiometric problem solving and limiting and excess reagents. Take a picture and attach it below or draw these activities and explain how it relates to stoichiometric problem solving and limiting and excess reagents.







Answer Key

What I Know

1. C
2. D
3. C
4. A
5. C
6. B
7. B
8. A
9. A
10. B
11. D
12. C
13. A
14. D
15. C

Assessment

1. C
2. D
3. C
4. A
5. C
6. B
7. B
8. A
9. A
10. B
11. D
12. C
13. A
14. D
15. C

References

Chicken https://www.pngitem.com/pimgs/m/408-4084569_chicken-meat-png-background-image-raw-chicken-with.png

Pepper corn https://pngimg.com/uploads/black_pepper/black_pepper_PNG11.png

Garlic clove https://thumbs.dreamstime.com/b/peeled-garlic-clove-white-illustrations-background-83689303.jpg

Onion https://image.shutterstock.com/image-illustration/red-onion-on-white-background-260nw-581247784.jpg

Vinegar https://www.pinclipart.com/picdir/big/70-702159_cashier-clipart-casher-bottle-of-vinegar-clipart-png.png

Soy Sauce - https: // images. clipartlogo. com/ files/ istock/ previews/ 1043/ 104356229-soy-sauce.jpg

Cup of water - https://www.pngitem.com/pimgs/m/485-4852817_water-cup-png-graphic-royalty-free-stock-cup.png

Chicken adobo - https://i.pinimg.com/originals/8f/2c/a8/8f2ca87a34b58096b380dba06b104efd.png

Ammonia sprayed as fertilizer - https://l.hdnux.com/350x235p/s3-us-west-1.amazonaws.com/contentlab.studiod/getty/0936f3bdf8b34a739e7ddc34c3b0f80b.jpg

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