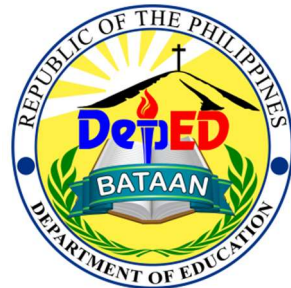


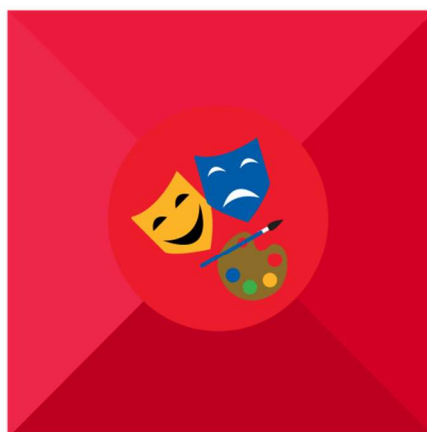
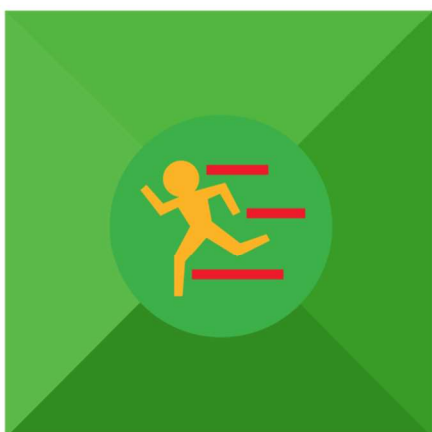
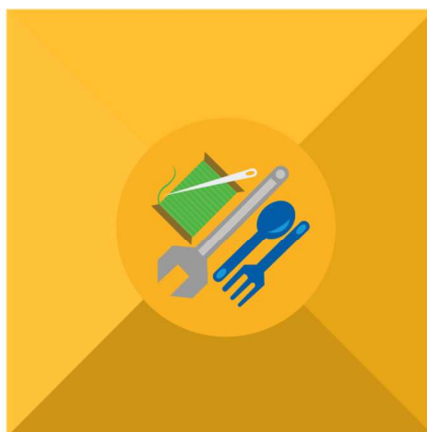
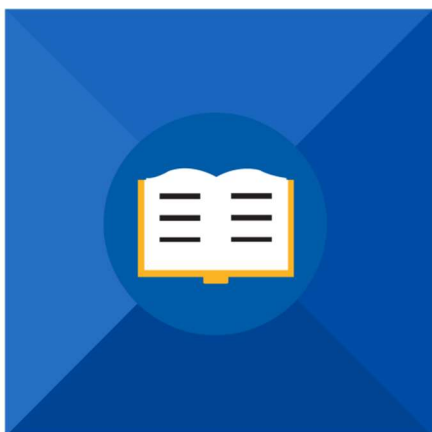
Senior High School



Physical Science

Quarter 1 – Module 6:

Limiting and Excess Reactants



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Alternative Delivery Mode
Quarter 1 – Module 6: Limiting and Excess Reactants
First Edition, 2020

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Senior High School

Physical Science
Quarter 1 – Module 6:
Limiting and Excess Reactants

Introductory Message

For the facilitator:

Welcome to the Physical Science – Grade 11 Alternative Delivery Mode (ADM) Module on Limiting and Excess Reactants!

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.

With this module, it will help you to understand the about the limiting reactant and excess reactant in a chemical reaction. To further enhance your learning toward the concepts of limiting reactant and excess reactant, different learning activities are provided. Learners may use extra sheet of paper upon answering the different activities included in this learning material.

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 learning module will help the learners to determine and understand the limiting and excess reactant in a chemical reaction. Furthermore, several learning activities are provided to deepen the learners' understanding about calculating amount of product formed during the chemical reaction process.

For the learner:

Welcome to the Physical Science – Grade 11 Alternative Delivery Mode (ADM) Module on Limiting and Excess Reactants!

This learning module deals with the determining and understanding the limiting reactant and excess reactant in a chemical reaction. Different learning tasks are provided to deepen your learning about this topic. Problem solving is also included in this module for you to assess your own learning by calculating the amount of product formed during the chemical reaction process.

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 learning module was designed to help the students to learn the key concepts of chemical reaction focus on limiting and excess reactants. In this learning module, it deals determining the limiting, excess reactants and the amount of product formed in a chemical reaction. To further enhance the students' learning different learning activities are provided in this module. The lesson is presented in an easy way to address the learning difficulties of the students by using language level on their comprehension. Based on the recent study, students learn more if they are actively engaged in the textbook they are using. Through this learning module, it can help to improve the student's academic achievement in this subject. With this learning module, students can work in less supervision of the teacher.

The module is contained one lesson.

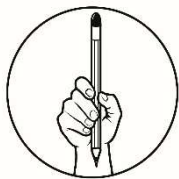
- Lesson 1 – Limiting and Excess Reactants

The most essential learning competency for this module.

Determine the limiting reactant in a reaction and calculate the amount of product formed (S11/12PS-IIIh-27)

After going through this module, you are specifically expected to:

1. Determine the limiting reactant/reagent in a chemical reaction,
2. Understand the excess reactant/reagent in a chemical reaction, and
3. Calculate the amount of product/s formed in a chemical reaction.;



What I Know

Identify the key term referred in each statement. Write your answer on a separate sheet of paper.

_____ 1. Substances originally present in a chemical reaction that are used to produce products after the reaction.

_____ 2. Substance produced in the chemical reaction.

_____ 3. A written chemical symbol to represent the process of chemical reaction.

_____ 4. In a chemical reaction, it limits the amount of substance that may be produced.

_____ 5. A reactant which is not used up after the chemical reaction is done.

Lesson

1

Limiting and Excess Reactants

It has been assumed that all the reactants involved in a reaction have been transformed into output or product but that is not the case in any chemical reaction. In other words, one may choose one reactant then calculate how many moles in that reaction and measure how many grams in that of the other reaction might be needed to complete the chemical reaction process. Two things you will recognize, either you have an excess in the first reaction or in the second reaction. Therefore, the excess amount in the reaction referred to as excess reactant on the other hand, the substance that limits in the reaction is called limiting reactant.



What's In



You and your friends planned to have a beach picnic. They assigned you to bring barbeque on your picnic day. You decided that each stick of barbeque has 3 slices of pork. If you have 36 slices of pork and 10 barbeque sticks, how many barbeques can be made?

From 36 slices of pork and 10 barbeque sticks, you can make 10 pork barbeques because there are 3 slices of pork in every stick. Although you can make more barbeques from the remaining slices of pork, only 10 pork barbeques are possible due to the limited number of sticks available. In this scenario, sticks are the limiting reactant since they are all used up in the process. While, specifically 6 slices of pork are excess, this is referred to as excess reactant, simply means not used up or left over in the entire process.



Notes to the Teacher

This learning module will help the learners to determine and understand the limiting and excess reactant in a chemical reaction. Furthermore, several learning activities are provided to deepen the learners' understanding about calculating amount of product formed during the chemical reaction process.



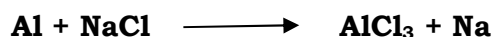
What's New

Limiting Reactant

In a given chemical reaction there is a limiting reagent or reactant which determines how many products are to be produced. Limiting reactant is a substance which was first used in a chemical reaction. This reaction always serves as the basis for calculating the quantity of chemically formed products. How can we determine a chemical reaction with the limiting reactant?

So let us try this!

In an experiment, suppose you have 4.5 g of Al and 2.25 g of NaCl are initially present, find:

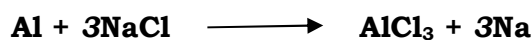


- the limiting reactant?
- the excess reactant remains after the reaction?
- the grams of AlCl_3 are formed?

Solutions

First Step

Balanced the chemical equation.



Second Step

Calculate the molar mass (m.m) of the reactants.

$$\begin{aligned}
 \text{m.m Al} &= 27 \text{ g/mole} \\
 \text{m.m NaCl} &= 58 \text{ g/mole} \\
 \text{Na} &= 1 \times 23 = 23 \\
 \text{Cl} &= 1 \times 35 = \underline{35} \\
 &58 \text{ g/moles of NaCl}
 \end{aligned}$$

Third Step

Divide the calculated molar mass of the given element or compound from the given mass. Then afterward, the number of moles are divided by the coefficient indicated in the balanced chemical equation.

$$\text{Al} = \frac{4.5 \text{ g}}{27 \text{ g/moles}} = 0.167 \text{ mol}$$

$$\text{NaCl} = \frac{2.25 \text{ g}}{58 \text{ g/moles}} = 0.039 \text{ mol}$$

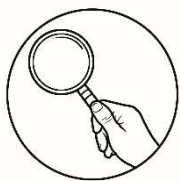
$$\text{For Al} = \frac{0.167 \text{ mol}}{1} = 0.167 \text{ mol}$$

$$\text{For NaCl} = \frac{0.039 \text{ mol}}{3} = 0.013 \text{ mol}$$

The limiting reactant is **NaCl**, since the calculated value is 0.013 lesser than Al. While, aluminum (Al) shows calculated value of 0.167. Therefore, it is concluded that **aluminum** (Al) is the **excess reactant**, since there is more than enough of it to react with the sodium chloride (NaCl).

For letter c, at the end of the reaction, how many grams of AlCl_3 are formed? Take note that the m.m of AlCl_3 is 132 g/moles.

$$\text{g of AlCl}_3 = 2.5 \text{ g NaCl} \times \frac{1 \text{ mol NaCl}}{58 \text{ g NaCl}} \times \frac{1 \text{ mol AlCl}_3}{3 \text{ mol NaCl}} \times \frac{132 \text{ g AlCl}_3}{1 \text{ mol AlCl}_3} = \mathbf{1.90 \text{ g of AlCl}_3}$$

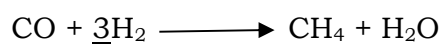


What is It

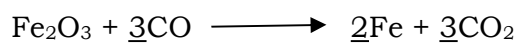
After reading the text in *What's new*. Let see how far you have learned about this topic.

Answer the following questions. Use separate sheet of paper for your solution and answer.

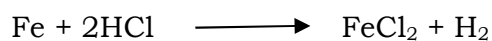
1. When 15 g CO and 8 g H₂ are reacted, what is the limiting reactant?

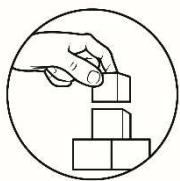


2. If 100 g Fe₂O₃ and 100 g CO are reacted, how much Fe are formed?



3. What is the excess reactant, when 22 g Fe reacts with 13 g of HCl?

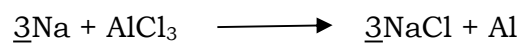




What's More

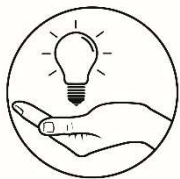
Calculate what is being asked. Use separate paper for your solution and answer.

Using this chemical equation.



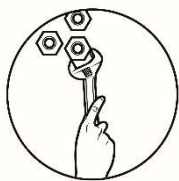
If 16 g Na and 8 g AlCl_3 are allowed to react, find

- the limiting reactant
- the excess reactant
- the grams of Al are formed in the chemical reaction.



What I Have Learned

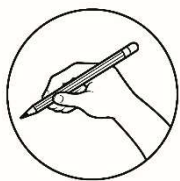
1. Limiting reactant is a reactant that limits the reaction.
2. Excess reactant is a reactant that contains one or more needed to react with limiting reactant.
3. Product is a substance that formed during the chemical reaction.



What I Can Do

Answer the given word problems. Use another sheet of paper for your answer.

1. Write the balanced chemical equation, when magnesium is reacted with silver nitrate forming magnesium nitrate and silver.
2. If 18 g of magnesium reacts with 33 g of silver nitrate, determine the limiting reactant.
3. Find the excess reactant in the given reaction.
4. How much silver can be formed from the above chemical reaction?



Assessment

Multiple Choice. Read and analyze each question. Write the letter that corresponds to your answer on a separate sheet of paper.

1. Suppose your classmates will be visiting you. You decided to make burger for their snack. You have 20 burger patties and 17 burger buns, how many burgers you can make?

- a. 20
- b. 17
- c. 3
- d. 37

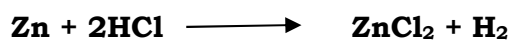
2. Based on problem 1, what is the limiting reactant?

- a. burger buns
- b. burger patties
- c. your classmates
- d. your budget

3. Based on problem 1, how many burger patties are extra after your preparation for snack?

- a. 0
- b. 37
- c. 17
- d. 3

For numbers 4-10. If 68 g of Zn reacts with 27.5 g of HCl. Use the chemical equation to answer the following questions below.



4. What is the molar mass of Zn?

- a. 65 g/mol
- b. 30 g/mol
- c. 27 g/mol
- d. 68 g/mol

5. What is the molar mass of HCl?

- a. 2 g/mol
- b. 16 g/mol
- c. 36 g/mol
- d. 68 g/mol

6. What coefficient is indicated in HCl?

- a. 2
- b. 3
- c. 4
- d. 5

7. Which substance is limiting reactant?

- a. ZnCl_2
- b. HCl
- c. Zn
- d. H_2

8. Which substance is excess reactant?

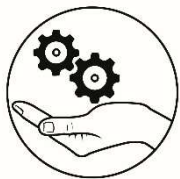
- a. HCl
- b. H_2
- c. ZnCl_2
- d. Zn

9. What is the molar mass of ZnCl_2 ?

- a. 135 g/mol
- b. 65 g/mol
- c. 70 g/mol
- d. 35 g/mol

10. How many grams of H_2 will be produced?

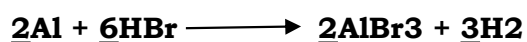
- a. 0.76 g
- b. 72 g
- c. 55 g
- d. 27.5 g



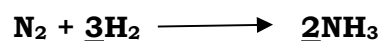
Additional Activities

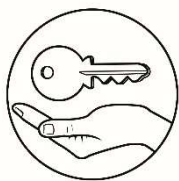
Answer the given problem. Use another sheet of paper for your answer and solution.

1. Determine the limiting reactant and excess reactant, when 36 g of Al and 28.5 g of HBr are reacted and how many grams of H₂ gas are formed?



2. When 10 g of N₂ and 7 g H₂ are allowed to react. Determine the limiting reactant and excess reactant in this reaction.





Answer Key

What I Know:

1. Reactant
2. Product
3. Chemical equation
4. Limiting reactant
5. Excess reactant

What's In

How many barbeque can be made? Ans. 10 barbeque

What is It:

1. CO
2. 70 g Fe
3. HCl

What's more:

- a. AlCl_3
- b. Na
- c. 1.64 g Al

What can I Do:

1. $\text{Mg} + 2\text{AgNO}_3 \rightarrow \text{Mg}(\text{NO}_3)_2 + 2\text{Ag}$
2. AgNO_3
3. Mg
4. 20.96 g Ag

Assessment:

1. B
2. A
3. D
4. A
5. C
6. A
7. B
8. D
9. B
10. A

Additional activities:

1. Limiting reactant = HBr
- Excess reactant = Al
- $\text{H}_2 = 0.352 \text{ g H}_2$
2. Limiting reactant = N_2
- Excess reactant = H_2

What's New:

- a. Limiting reactant = NaCl
- b. Excess reactant = Al
- c. 1.90 g of AlCl_3

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