

MATHEMATICS

Quarter 2-Module 7: Converse, Inverse and Contrapositive of an If-then Statement



AIRs - LM

MATHEMATICS 8

Quarter 2 - Module 7: Converse, Inverse and Contrapositive of an If-then Statement Second Edition, 2021

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Region I

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MATHEMATICS

Quarter 2-Module 7: Converse, Inverse and Contrapositive of an If-then Statement

Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.



Target

Conditional statements or if-then statements imply a cause-and-effect relationship and can be tremendously useful in Geometry. Mathematicians and scientists like if- then statements because of the relationship between the two events. They know that if they see the first event happening, then the second event will follow. Knowing about if -then statements enable mathematicians and scientists to make predictions about the future

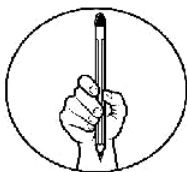
Before we start, let us consider first the most essential learning competencies.

1. Determines the inverse, converse, and contrapositive of an if-then statement. **(M8GE-IIg-1)**
2. Illustrates the equivalences of: (a) the statement and its contrapositive and (b) the converse and inverse of a statement. **(M8GE-IIg-2)**

After going through this module, you are expected to:

1. Transform conditional statement to its if-then form;
2. Illustrate the converse, inverse and contrapositive of an if – then statement;
3. Determine the negation of an statement;
4. Show the equivalences of: (a) the statement and its contrapositive, and (b) the converse and inverse of a statement.

Before going on, check how much you know about this topic. Answer the pretest on the next page in a separate sheet of paper.



Pre-Assessment

Directions: Choose the letter of the correct answer. Write your answer on a separate sheet of paper.

1. What is the if-then form of the statement, "Parallel lines never intersect."
A. If two lines intersect, then they are parallel.
B. If two lines are not parallel, then they intersect.
C. If two lines intersect, then they are not parallel.
D. If two lines are parallel, then they never intersect.
2. Given the statement, "Covid – 19 virus is dangerous.", transform into an if- then statement.
A. If it is Covid-19 virus, then it is dangerous.
B. If it is dangerous, then it is Covid- 19 virus.
C. If it is not Covid-19 virus, then it is not dangerous.
D. If it is not dangerous, then it is not Covid-19 virus.
3. What is form of an if-then statement if the hypothesis and the conclusion are interchanged?
A. Contrapositive B. Converse C. Inverse D. Negation
4. What form of an if-then statement in which the hypothesis and conclusion are both negated?
A. Contrapositive B. Converse C. Inverse D. Negation
5. Which of the following is the negation of the statement: "The sky is blue."?
A. The sky is red. B. The sky is blue.
C. The sky is not red. D. The sky is not blue.
6. Which is the converse of the statement, "If you are in love, then you are inspired."?
A. If you are inspired, then you are in love.
B. If you are in love, then you are not inspired.
C. If you are not in love, then you are not inspired.
D. If you are not inspired, then you are not in love.
7. What is the inverse of the statement: "If the number is divisible by 2 and 3, then it is divisible by 6."
A. If the number is divisible by 6, then it is divisible by 2 and 3.
B. If the number is not divisible by 2 and 3, then it is not divisible by 6.
C. If the number is not divisible by 6, then it is not divisible by 2 and 3.
D. If the number is divisible by a and 3, then the number is not divisible by 6.
8. Which is the contrapositive of the statement, "If winter comes, then spring is not far behind."?
A. If spring is far behind, then winter comes.
B. If spring is not far behind, then winter comes.
C. If spring is far behind, then winter does not come.
D. If spring is not far behind, then winter does not come.

9. Which is the converse of "If a polygon is a rectangle, then its area does not equal to $l \cdot w \cdot h$."?
- If the area of a rectangle is $l \cdot w \cdot h$, then it is a polygon.
 - If a polygon has area that equals $l \cdot w \cdot h$, then it is a rectangle.
 - If a polygon is not a rectangle, then its area does not equal to $l \cdot w \cdot h$.
 - If a polygon has an area that does not equal to $l \cdot w \cdot h$, then it is a rectangle.
10. What is the inverse of the converse of an if-then statement?
- Contrapositive
 - Converse
 - Inverse
 - Negation
11. Given the statement, "If it does not rain, then we will have practice.". What is, "If it rains today, then we will have no practice." called?
- Contrapositive
 - Converse
 - Inverse
 - Negation
12. What is the contrapositive of: If I have a Siberian Husky, then I have a dog.
- If I have a dog, then I have a Siberian Husky.
 - If I have a dog, then I do not have a Siberian Husky.
 - If I do not have a Siberian Husky, then I do not have a dog.
 - If I do not have a dog, then I do not have a Siberian Husky.
13. "If JM loves Mathematics, then he loves Geometry.", what is its inverse form?
- If JM loves Geometry, then he loves Mathematics.
 - If JM loves Mathematics, then he loves Geometry.
 - If JM does not love Mathematics, then he does not love Geometry.
 - If JM does not love Geometry, then he does not love Mathematics.
14. If the contrapositive of a statement is, "If the sidewalk is not wet, then it did not rain last night.", which of the following statement is its equivalent?
- If it rained last night, then the sidewalk is wet.
 - If the sidewalk is not wet, then it rained last night.
 - If it did not rain last night, then the sidewalk is not wet.
 - If the sidewalk is not wet, then it did not rain last night.
15. Which form of if-then statement is equivalent to its inverse?
- Converse of the if-then statement
 - Contrapositive of if-then statement
 - Negation of the if-then statement
 - The original if-then statement



Jumpstart

*For you to understand the lesson well, do the following activities.
Have fun and good luck!*

Activity 1: Look for My Parts

Directions: Identify the hypothesis and conclusion of each if-then statement.

1. If today is Friday, then tomorrow is Saturday.
Hypothesis: _____
Conclusion: _____
2. If a man is honest, then he does not steal.
Hypothesis: _____
Conclusion: _____
3. If a number is an even, then it is divisible by 2.
Hypothesis: _____
Conclusion: _____
4. If Julia doesn't water the plants, then the plants will die.
Hypothesis: _____
Conclusion: _____
5. If Douglas does well in college, then he will apply to medical school.
Hypothesis: _____
Conclusion: _____

Questions:

1. How did you identify the hypothesis? _____
2. How did you identify the conclusion? _____
3. What can you say about the if-then statement? _____

Activity 2: Table Time

Directions: Rewrite each statement to its equivalent if - then form then identify the hypothesis and conclusion. Number 1 is done for you.

Conditional Statement	If-then form	Hypothesis	Conclusion
1. A triangle has three sides.	If a polygon is a triangle, then it has three sides.	A polygon is a triangle.	It has three sides.
2. Vertical angles are congruent.			
3. A rectangle has four right angles.			
4. Filipinos are God-fearing people.			
5. A diligent child is loved by his parents.			

Activity 3: Take My Opposite

Directions: Determine the negative or opposite form of each of the given statements.

Example:

Statement: The isosceles triangle is equilateral.

Opposite: The isosceles triangle is not equilateral.

- Statement: The sky is blue.
Opposite: _____
- Statement: The sum of the measures of complementary angles is 90° .
Opposite: _____
- Statement: A quadrilateral has four sides.
Opposite: _____
- Statement: Collinear points lie on the line.
Opposite: _____
- Statement: Good citizens obey rules and regulations.
Opposite: _____

Now that you are well-versed in converting conditional statements to if-then form and can easily identify the hypothesis and the conclusion. And you were able to take the negative or opposite of a statement. You are now ready to our lesson.



Discover

Converse, Inverse and Contrapositive of an If-then Statement

Conditional statements or if-then statements make appearances everywhere. If-then statements are indeed important. What is also important are statements that are related to the if-then statement by changing the position of the hypothesis and conclusion, and the negation of a statement. Starting with an original statement, we end up with three new if-then statements that are named: the converse, the inverse and the contrapositive.

Negation

Before we define the converse, inverse and contrapositive of an if-then statement, we need to examine the topic of negation. Sometimes in mathematics, it's important to determine what the opposite of a given mathematical statement is. This is usually referred to as negating a statement.

The negation of a statement is stating the opposite meaning of the original statement. The negation of a statement simply involves the insertion of the word not or no at the proper part of the statement. The addition of the word not or no is done so that it changes the truth status of the statement.

Let us consider the following illustrative examples:

1. Statement: Today is Wednesday.
Negation: Today is not Wednesday.
2. Statement: A triangle has three angles.
Negation: A triangle has no three angles.
3. Statement: Jenny rides the bus.
Negation: Jenny does not ride the bus.

We can also negate a negation, by omitting the word not or no.

Example:

- | | |
|------------|--|
| Statement: | A prime number has no other factors except 1 and itself. |
| Negation: | A prime number has other factors except 1 and itself. |

We will examine this idea in a more abstract setting. When the statement P is true, the statement “not P ” is false. Similarly, if P is false, its negation “not P ” is true. Negations are commonly denoted with a tilde \sim . So instead of writing “not P ” we can write $\sim P$.

Now we can define the converse, the inverse and the contrapositive of an if-then statement.

- The **converse** of the if-then statement is created when the hypothesis and conclusion are reversed or interchanged.
- The **inverse** of the if-then statement is when both the hypothesis and conclusion are negated.

- The **contrapositive** of the if-then statement is a combination of the converse and the inverse. The contrapositive is determined by reversing the negation of both hypothesis and conclusion.

In symbols, if the *if-then statement* is referred to as, *If P, then Q*:

- The *converse* is referred to as, *If Q, then P*.
- The *inverse* is referred to as, *If $\sim P$, then $\sim Q$* .
- The *contrapositive* is referred to as, *If $\sim Q$, then $\sim P$* .

Examples:

1. *If- Then Statement:* If the weather is nice, then I will wash the car.
Converse: If I will wash the car, then the weather is nice.
Inverse: If the weather is not nice, then I will not wash the car.
Contrapositive: If I will not wash the car, then the weather is not nice.
2. *If- Then Statement:* If you take yoga, then you are relaxed.
Converse: If you are relaxed, then you take yoga.
Inverse: If you did not take yoga, then you are not relaxed.
Contrapositive: If you are not relaxed, then you did not take yoga.
3. *If- Then Statement:* If a triangle has three congruent sides, then it is equilateral.
Converse: If a triangle is equilateral, then it has three congruent sides.
Inverse: If a triangle has no three congruent sides, then it is not equilateral.
Contrapositive: If a triangle is not equilateral, then it has no three congruent sides.
4. *If- Then Statement:* Scalene triangle has no two equal sides.
If-then Form: If a triangle is scalene, then it has no two equal sides.
Converse: If a triangle has no two equal sides, then it is scalene.
Inverse: If a triangle is not scalene, then it has two equal sides.
Contrapositive: If a triangle has two equal sides, then it is not scalene.
5. *If- Then Statement:* Two intersecting lines lie in one plane.
If-then Form: If two lines are intersecting, then they lie in one plane.
Converse: If two lines lie in one plane, then they are intersecting.
Inverse: If two lines are not intersecting, then they do not lie in one plane.
Contrapositive: If two lines do not lie in one plane, then they are not intersecting.

Logical Equivalence

We may wonder why it is important to form these other forms of if-then statements from the original one.

Consider this example:

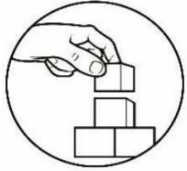
- Statement: If it rained last night, then the ground is wet.
- Converse: If the ground is wet, then it rained last night.
- Inverse: If it did not rain last night, then the ground is not wet.
- Contrapositive: If the ground is not wet, then it did not rain last night.

A careful look at the above example reveals something. Suppose that the original statement “If it rained last night, then the ground is wet” is true. Which of the other statements have to be true as well?

- The converse “If the ground is wet, then it rained last night” is not necessarily true. The ground could be wet for other reasons.
- The inverse “If it did not rain last night, then the ground is not wet” is not necessarily true. Again, just because it did not rain does not mean that the ground is not wet.
- The contrapositive “If the ground is not wet, then it did not rain last night” is a true statement

What we see from this example (and what can be proved mathematically) is that the original if-then statement has the same truth value as its contrapositive. We can say that these two statements are logically equivalent. We also see that the original if-then statement is not logically equivalent to its converse and inverse. The converse and inverse of the if-then statement are logically equivalent.

Now that you have learned about the converse, inverse and contrapositive of an if-then statement, so you can proceed to the next activities.



Explore

Here are some enrichment activities for you to work on to master and strengthen the basic concepts you have learned from this lesson.

Activity 4: Give Me in Symbol

Directions: Identify the converse, inverse and contrapositive of the following.

If-then Statement

Converse

Inverse

Contrapositive

1. If M, then G.
2. If $\sim M$, then G.
3. If P, then $\sim Q$.
4. If $\sim Q$, then $\sim P$.
5. If $\sim Q$, then P.

Great job! In the next activity, you are going to check the converse, inverse and contrapositive of the if-then statement.

Activity 5: Check Me Out

A. **Directions:** Tell whether the converse of each if-then statement true or false.

1. Statement: If you do your homework, then you can watch TV.
Converse: If you will watch TV, then you will do your homework.
2. Statement: If today is Wednesday, then yesterday was Tuesday.
Converse: If yesterday was Tuesday, then today is Wednesday.
3. Statement: If the angle is right, then it measures 90° .
Converse: If the angle measures 90° , then it is right.
4. Statement: If you are a Filipino, then you are hospitable.
Inverse: If you are not hospitable, then you are not a Filipino.
5. Statement: If a plane figure has 4 sides, then it is a quadrilateral.
Inverse: If a figure is not a quadrilateral, then it has no 4 sides
6. Statement: If I win the game, then I'll get a prize.
Inverse: If I will not win the game, then I will not get a prize.

7. Statement: If I say bad words, then I will be punished.
Inverse: If I will not say bad words, then I will not be punished.
8. Statement: If it is a cheese, then it contains calcium.
Contrapositive: If it is not a cheese, then it contains calcium.
9. Statement: If segments are congruent, then they have the same length.
Contrapositive: If segments do not have the same length, then they are not congruent.
10. Statement: If the sides of a rectangle are opposite, then they are parallel.
Contrapositive: If the sides of a rectangle are not parallel, then they are not opposite.

Excellent! Now that you are already familiar on the concepts of converse, inverse and contrapositive of the “if-then statement”, brace yourself because more challenging activities await you.

Activity 6: Complete Me

Directions: Transform each statement to its equivalent if-then form, then determine its converse, inverse and contrapositive.

- Statement Vertical angles are congruent.

If-then Form

Converse

Inverse

Contrapositive
- Statement A square has four right angles.

If-then Form

Converse

Inverse

Contrapositive
- Statement A regular polygon is equilateral.

If-then Form

Converse

Inverse

Contrapositive

4.

Statement
If-then Form
Converse
Inverse
Contrapositive

Perpendicular lines intersect.

5.

Statement
If-then Form
Converse
Inverse
Contrapositive

Filipinos are a peace-loving people.



Deepen

Activity 7: Picture Me

Directions: Observe the set of pictures. Describe the pictures using if-then statements, then rewrite into its converse, inverse and contrapositive of statements.



Source: <https://busyteacher.org/24007-first-conditional-speaking-practice.html>

Excellent! Now that you can identify the hypothesis and the conclusion of the “if-then statement” and were able to form its converse, inverse and contrapositive, you are now ready to study the kinds of reasoning in the next lesson.



Gauge

Post Test

Directions: Carefully read each item. Use separate sheet for your answers. Write only the letter of the best answer for each test item.

- What is the if-then form of the statement, “Two points determine a line.”?
A. If points determine a line, then there are two.
B. If there are two points, then they determine a line.
C. If there are no two points, then they do not determine a line.
D. If points do not determine a line, then there are no two points.
- Given the statement, “Politicians are busy preparing for the coming election.”, transform into an if- then statement.
A. If you are busy preparing for the election, then you are a politician.
B. If you are not busy preparing for the election, then you are not a politician.
C. If you are a politician, then you are busy preparing for the coming election.
D. If you are not a politician, then you are not busy preparing for the coming election.
- When taking the converse of a statement, what will you do to the hypothesis and the conclusion?
A. Highlight B. Negate C. Reverse D. Reverse and Negate
- If the statement is “If it does not rain, then we will have practice”, what is “If it rains today, then we will not have a practice.” called?
A. Contrapositive B. Converse C. Inverse D. Negation
- Which is equivalent to the converse of the original if-then statement?
A. Contrapositive B. Converse C. Inverse D. Negation
- If the if-then statement is true, which form of if-then statement is also logically true?
A. Contrapositive B. Converse C. Inverse D. Negation
- If P , then Q , what is If $\sim P$, then $\sim Q$ called?
1. Contrapositive B. Converse C. Inverse D. Negation
- Given the statement, “If angles are congruent, then the measures are equal”, what is its contrapositive?
A. If the measures of the angles are equal, then the angles are congruent.
B. If the angles are not congruent, then the measures of the angles are equal.

- C. If the measures of the angles are not equal, then the angles are not congruent.
 - D. If the angles are not congruent, then the measures of the angles are not equal.
9. What is the converse of the statement in item number 8?
- A. If the measures of the angles are equal, then the angles are congruent.
 - B. If the angles are not congruent, then the measures of the angles are equal.
 - C. If the measures of the angles are not equal, then the angles are not congruent.
 - D. If the angles are not congruent, then the measures of the angles are not equal.
10. What is the contrapositive of the statement, "If R, then S." in symbols?
- A. If S, then R. B. If $\sim R$, then $\sim S$. C. If $\sim S$, then $\sim R$. D. If R, then $\sim S$.

For items number 11-13, refer on the if-then statement:

If the animal is an adult insect, then it has six legs.

11. What is the converse of the statement?
- A. If the animal has six legs, then it is an adult insect.
 - B. If the animal is an adult insect, then it has six legs.
 - C. If the animal does not have six legs, then it is not an adult insect.
 - D. If the animal is not an adult insect, then it does not have six legs.
12. What is the inverse of the statement?
- A. If the animal has six legs, then it is an adult insect.
 - B. If the animal is an adult insect, then it has six legs.
 - C. If the animal does not have six legs, then it is not an adult insect.
 - D. If the animal is not an adult insect, then it does not have six legs.
13. What is the contrapositive of the statement?
- A. If the animal has six legs, then it is an adult insect.
 - B. If the animal is an adult insect, then it has six legs.
 - C. If the animal does not have six legs, then it is not an adult insect.
 - D. If the animal is not an adult insect, then it does not have six legs.
14. What is the inverse of this statement: If the table top is rectangular, then its diagonals are congruent?
- A. If the table top is rectangular, then its diagonals are congruent.
 - B. If the diagonals of a table top are congruent, then it is rectangular.
 - C. If the table top is not rectangular, then its diagonals are not congruent.
 - D. If the diagonals of the table top are not congruent, then it is not rectangular.
15. What is the contrapositive of this statement: If the table top is rectangular, then its diagonals are congruent?
- A. If the table top is rectangular, then its diagonals are congruent.
 - B. If the diagonals of a table top are congruent, then it is rectangular.
 - C. If the table top is not rectangular, then its diagonals are not congruent.
 - D. If the diagonals of the table top are not congruent, then it is not rectangular.

Congratulations! You are almost done with this module.

Additional Activity

Activity 8: If-the Statement is Real

1. Cite 5 examples of if-then statements that you have encountered or experienced in your daily lives.
- 2.
3. Determine the converse, inverse and contrapositive of each statement.

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