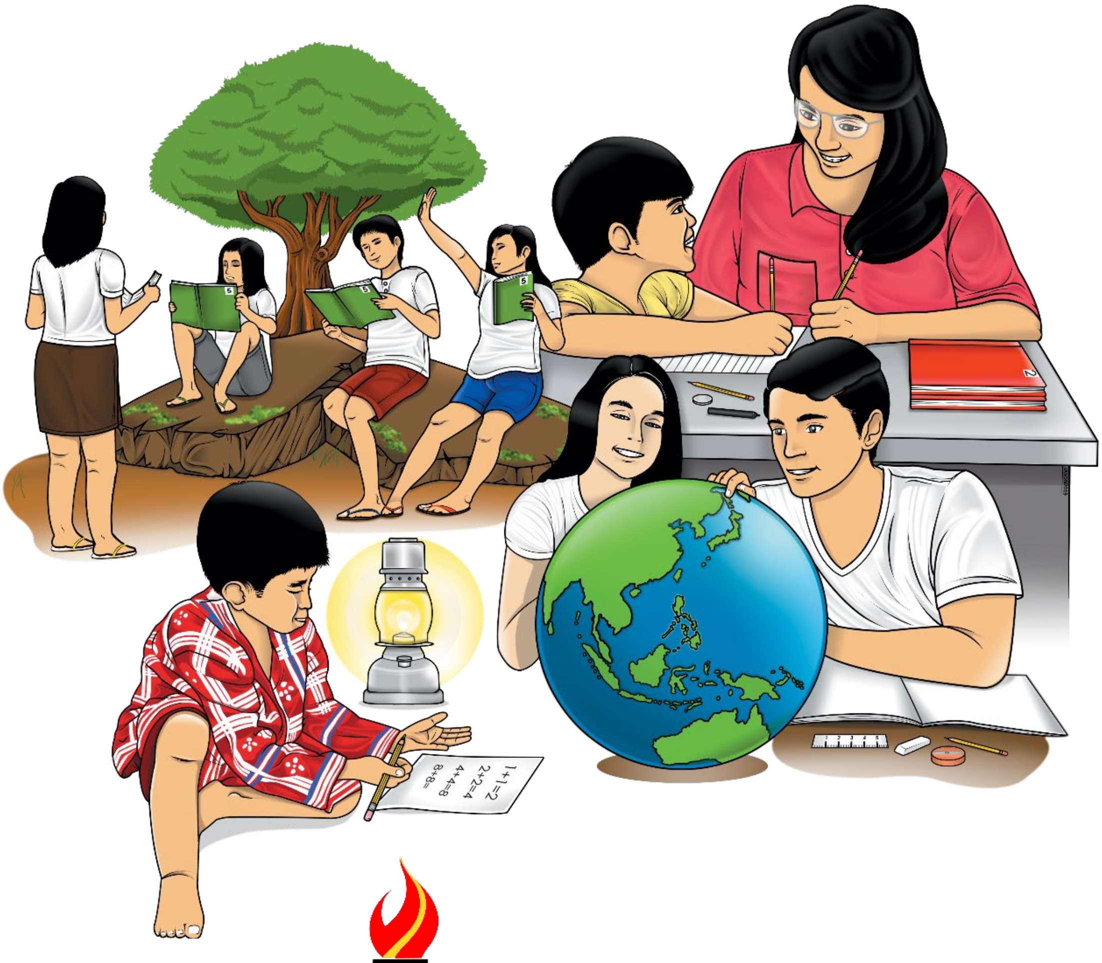
Senior High School

DepED
DEPARTMENT OF EDUCATION

General Mathematics
Quarter 2 – Module 18:
Tautologies and Fallacies



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Senior High School

General Mathematics

Quarter 2 – Module 18:
Tautologies and Fallacies

DEPARTMENT OF EDUCATION

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.

What I Need to Know

A proposition is defined earlier as a declarative sentence that is either true or false. You also learned that we can combine propositions using logical connectors. Are these compound propositions always true or always false? Think of a sentence that could never be false? How about a sentence that could never be true? To answer these questions, this module will help you identify statements that are always true or always false. This module is written for you to help you understand more, the different logical statements.

The module is composed of only one lesson:

- Lesson 1 – Tautologies and Fallacies

After going through this module, you are expected to:

1. illustrate different types of tautologies and fallacies; and
2. apply tautologies and fallacies to real-life situations.

What I Know

Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

1. What is a proposition statement that is always true?
   a. negation b. tautology c. fallacy d. absolute

2. What is a proposition statement that is always false?
   a. negation b. tautology c. fallacy d. absolute

3. Which of the following is **NOT** a tautology?
   a. Merida is brave, or she is not brave.
   b. Either you will pass the test, or you will fail on the test.
   c. Today is a lucky day and tomorrow is not a lucky day.
   d. John loves Math or he does not love Math.

4. Which of the following is a tautology?
   a. p and q are both true, thus $p \wedge q$ is true.
   b. p is true and proposition q is false, thus $p \wedge q$ is true.
   c. p is false and proposition q is true, thus $p \wedge q$ is true.
   d. propositions p and q are both false, thus $p \wedge q$ is true.

5. Which of the following is a tautology?
   a. It is a sunny day or it is not both hot and sunny day.
   b. It is a sunny day or it is hot and sunny day.
   c. It is a sunny day and it is not both hot and sunny day.
   d. It is not hot and sunny day.

6. Which of the following statements is represented by the logical symbol of the tautology $p \wedge \sim (p \vee q)$?
   a. Beth likes Mathematics but she does not like Math and English
   b. Beth likes Mathematics but she does not like Math or English
   c. Beth likes Mathematics but she does not like either Math or English
   d. Beth likes Mathematics nor she does not like Math or English.

7. Let p, and q, be the propositions:
   p: Annie has a stomach ache.
   q: Annie misses the exam.
   Which of the following illustrate the tautology $p \vee \sim (p \wedge q)$?
   a. Annie has a stomach ache or she misses the exam.
   b. Annie has a stomach ache and she misses the exam.
   c. Annie has a stomach ache or she is not both missing the exam and has a stomach ache.
   d. Annie has a stomach ache and she is either missing the exam or has a stomach ache.

8. Which of the following is a tautology?
   a. $[(p \rightarrow q) \wedge p] \rightarrow p$
   b. $[(p \rightarrow q) \wedge p] \rightarrow q$
   c. $[\sim(p \wedge q) \wedge (\sim p)] \rightarrow q$
   d. $[(p \vee q) \wedge p] \rightarrow (\sim q)$

9. Which of the following statements is a fallacy?
   a. The dog is either brown, or the dog is not brown.
   b. Today is a rainy day or a sunny day.
   c. If today is a rainy day, then today is a hot day.
   d. Today is a hot day if and only if it is a sunny day.

10. When does $p \leftrightarrow q$, become false?
   a. when both p and q are true
   b. when both p and q are false
   c. when p is true and q is false
   d. cannot be determined

11. Which of the following truth table shows that the proposition $p \rightarrow (p \vee q)$ is a tautology?

a.

p	q	$p \vee q$	$p \rightarrow (p \vee q)$
T	T	T	T
T	F	F	T
F	T	T	T
F	F	F	T

b.

p	q	$p \vee q$	$p \rightarrow (p \vee q)$
T	T	F	T
T	F	F	T
F	T	T	T
F	F	F	T

c.

p	q	$p \vee q$	$p \rightarrow (p \vee q)$
T	T	T	T
T	F	T	T
F	T	T	T
F	F	F	T

d.

p	q	$p \vee q$	$p \rightarrow (p \vee q)$
T	T	F	T
T	F	F	T
F	T	F	T
F	F	T	T

12. Which of the following truth table shows that the proposition $(p \wedge (\sim q)) \wedge (p \wedge q)$ is a fallacy?

a.

p	q	$\sim q$	$(p \wedge (\sim q)$	$p \wedge q$	$(p \wedge (\sim q)) \wedge (p \wedge q)$
T	T	F	F	T	F
T	F	T	T	F	F
F	T	F	F	F	F
F	F	T	F	F	F

b.

p	q	$\sim q$	$(p \wedge (\sim q)$	$p \wedge q$	$(p \wedge (\sim q)) \wedge (p \wedge q)$
T	T	F	F	T	F
T	F	F	F	F	F
F	T	F	T	T	F
F	F	T	F	F	F

c.

p	q	$\sim q$	$(p \wedge (\sim q)$	$p \wedge q$	$(p \wedge (\sim q)) \wedge (p \wedge q)$
T	T	F	T	F	F
T	F	F	F	F	F
F	T	F	T	T	F
F	F	T	F	T	F

d.

p	q	$\sim q$	$(p \wedge (\sim q)$	$p \wedge q$	$(p \wedge (\sim q)) \wedge (p \wedge q)$
T	T	F	T	F	F
T	F	T	T	F	F
F	T	F	T	T	F
F	F	T	F	T	F

For items 13-14, refer to this statement: Charles loves both English and Mathematics, but he loves neither English nor Filipino.

13. Express the statement to mathematical symbol.
    a. $(p \wedge q) \wedge (q \wedge r)$ b. $(\sim p \wedge \sim q) \wedge (q \wedge r)$
    c. $(p \wedge \sim p) \wedge (\sim q \wedge r)$ d. $(p \wedge q) \wedge (\sim q \wedge \sim r)$

14. The given statement is a:
    a. tautology b. fallacy
    c. both tautology and fallacyd. neither tautology nor fallacy

15. Which of the following is an example of a fallacy of affirming the conclusion?
    a. If I will not take a bath, then I cannot go to school.
    b. If I will love you, then you will love me too.
    c. Assuming that I will not study my lesson, then I will not pass the test.
    d. Since I cannot buy a new laptop, then I will not attend online classes.

Lesson 1 Tautologies and Fallacies

Honesty is a value that everyone should possess but we cannot deny the fact that everything that we say is not always true, sometimes we also say false statements. In the same manner, not everything that we hear is true, and so we should analyze first what we heard before we believe it. Mathematics also plays an important role in analyzing statements, through truth tables we can check whether a statement is always true (tautology) or always false (fallacy).

You have already learned in module 16 the term tautology, which is true for every value of the two or more given statements. The contradiction is just the opposite of tautology or you can contradict the tautology statement. Finding the truth values of propositions will give you the idea if it is a tautology or a fallacy. In previous modules, you learned how to construct the truth tables of given propositions or arguments, while on this module your previous knowledge will be intensified as it applied to real-life situations. Also, in the previous module, a statement that is always false is called a contradiction, but since in other sources it is also called a fallacy, we will be using the word fallacy this time since contradiction is an example of logical fallacy. Also, the word fallacy will be used in module 20 to find the validity of the arguments. It is hoped that this module will help identify true statements or analyze statements before you accept them as true or false.

What's In

Determine the truth value of each of the following propositions. Show the truth table of each as well.

1. $\sim p \wedge q$ where p and q are both true propositions
2. $p \vee \sim q$ where p and q are both false propositions
3. $p \rightarrow q$ where p is true and q is false
4. $p \leftrightarrow q$ where p is false and q is true
5. $(p \rightarrow q) \wedge (q \rightarrow p)$ where p and q are both true propositions
6. $(p \leftrightarrow q) \vee q$ where p and q are both false
7. $\sim(q \vee p) \wedge p$ where p and q are both true
8. $p \wedge (p \leftrightarrow q)$ where p is true and q is false
9. $p \rightarrow (q \vee q)$ where p and q are both false
10. $\sim p \wedge (p \rightarrow q)$ where p is false and q is true.

What's New

Now, that you already know how to perform different types of operations on propositions, I am confident that you are now ready for the new lesson.

Activity 1:

Determine whether the given statements are always true or just a mistaken belief (false statement). Write <u>**T**</u> if the statement is always true or <u>**MB**</u> if it is a mistaken belief.

1. Today is Monday or today is not Monday.
2. Either Nicco is smart, or he is not smart.
3. If you buy a book then you will read it daily.
4. Assuming that If I plant cactus, then I will get my hands dirty. Since I didn't get my hands dirty, therefore I didn't plant a cactus.
5. If I will study my lessons every day then I will have a passing grade. But, I study my lessons every day then I will have a passing grade.
6. I love you or I don't love you.
7. Since I like you, then you will like me too.
9. I can comprehend the writings that I read or I cannot comprehend the writings that I read.

Activity 2:

Explain whether the given statement is true or false.

1. If I study hard, then I will get an academic award but I will study hard. Therefore, I will get an academic award.
2. Blessy loves both swimming and running, but she loves neither swimming nor running.

What is It

A **tautology** is a compound statement that is true for every value of the individual statements. The word tautology is derived from a Greek word where 'tauto' means 'same' and 'logy' means 'logic'.
The simple examples of tautology are:

- Either Mari will buy apples or Mari will not buy apples.
- My pet Yummy is healthy or he is not healthy
- A function is a polynomial function or it is not a polynomial function.

Some important tautologies are presented below:

Laws that illustrates tautologies	**Possible Statements**
Contraposition	$(p \to q) \leftrightarrow (\sim q \to \sim p)$
Reduction ad absurdum	$\sim(p \to q) \leftrightarrow (p \wedge \sim q)$
De Morgan's Laws	$\sim(p \wedge q) \leftrightarrow (\sim p \vee \sim q)$ $\sim(p \vee q) \leftrightarrow (\sim p \wedge \sim q)$
Modus Ponens	$[(p \to q) \wedge p] \to q$
Exportation	$[p \to (r \to q)] \leftrightarrow [(p \wedge r) \to q]$
Transitivity	$(p \to r) \wedge (r \to q) \to (p \to q)$
Deduction	$(p \to r) \wedge [(p \wedge r) \to q] \to (p \to q)$

To determine whether a given statement is a tautology, you can use the table of truth values.

Example:

If I follow the school rules and regulations, then I am a disciplined person, but I follow the school rules and regulations, therefore I am a disciplined person. Show that the given statement is a tautology.

Solution:

Step 1: Translate the given statement into symbols.

Let p: I follow school rules and regulation.

q: I am a discipline person.

The statement can be written in symbols as $[(p \to q) \wedge p] \to q$.

Step 2: Construct the truth table of the given statements.

p	q	$p \to q$	$(p \to q) \wedge p$	$[(p \to q) \wedge p] \to q$
T	T	T	T	T
T	F	F	F	T
F	T	T	F	T
F	F	T	F	T

Step 3: Make a conclusion.

Since the result is all true, it shows that the given statement is a tautology. Observe also, that the statement illustrates Modus Ponens.

Fallacy is a statement that is always false. (in previous modules it is also a *contradiction*)

Examples:

1. Twelve is an odd number.
2. Cats can fly.
3. A triangle has four sides.
4. $ab = b^2$
5. Today is Monday and Tuesday

Sometimes fallacy is also described as a mistaken idea based on unsound arguments. Some commonly used fallacies are as follows:

1. Affirming the conclusion – a fallacy of affirming the conclusion is incorrect reasoning in proving $p \rightarrow q$ by starting by assuming q and proving p.
   Example: Assuming that I smile to you, then I am happy to see you.
   If you answer all the assignments, then you will learn Math.

2. Denying the hypothesis – a fallacy of denying the hypothesis is incorrect reasoning in proving $p \rightarrow q$ by starting with assuming $\sim p$ and proving $\sim q$.
   Example: Assuming that I will not eat sweet foods, then I will not be a diabetic.
   Since I am not hungry, then I will not eat.

3. Circular reasoning – a fallacy in which the reasoner begins with what they are trying to end with.
   Example: A chicken must come from an egg.
   But, an egg cannot exist without a chicken laying it.
   But, a chicken must come from an egg…

Like tautology, truth table can be also used to show that a statement is a fallacy.

Example: Denise loves both singing and dancing, but she loves neither dancing nor acting.

Solution:

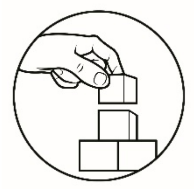
Step 1: Translate the given statement into symbols.
Let p: Denise loves singing.
q: Denise loves dancing.
r: Denise loves acting.

The statement can be written in symbols as $(\boldsymbol{p} \wedge \boldsymbol{q}) \wedge (\sim \boldsymbol{q} \wedge \sim \boldsymbol{r})$.

Step 2: Construct the truth table of the given statements.

p	q	r	$\sim q$	$\sim r$	$p \wedge q$	$\sim \boldsymbol{q} \wedge \sim \boldsymbol{r}$	$(\boldsymbol{p} \wedge \boldsymbol{q}) \wedge (\sim \boldsymbol{q} \wedge \sim \boldsymbol{r})$
T	T	T	F	F	T	F	F
T	T	F	F	T	T	F	F
T	F	T	T	F	F	F	F
T	F	F	T	T	F	T	F
F	T	T	F	F	F	F	F
F	T	F	F	T	F	F	F
F	F	T	T	F	F	F	F
F	F	F	T	T	F	T	F

Step 3: Make a conclusion.
Since the result is all false, it shows that the given statement is a fallacy.



What's More

Activity 1.1

Determine whether the statement is a tautology or fallacy.

1. If today is Saturday, then tomorrow is Monday
2. Assuming that I am a college degree, then I am a teacher.
3. Either Joshua will buy books or Joshua will not buy books.
4. If I will study hard, then I will pass the examination, but I studied hard, therefore I passed the examination
5. Aldrin loves both Math and Science, but he loves neither Science nor English

Activity 1.2

Construct a truth table for each of the following to determine whether the given is a tautology or a fallacy.

1. $(p \to q) \leftrightarrow (\sim q \to \sim p)$
2. $\sim(p \wedge q) \leftrightarrow (\sim p \vee \sim q)$
3. $\sim(p \to q) \leftrightarrow (p \wedge \sim q)$
4. $(p \wedge q) \leftrightarrow (p \to \sim q)$
5. $q \wedge \sim(p \vee q)$

What I Have Learned

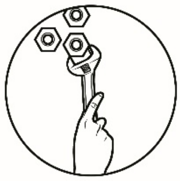
A. Fill in the blanks with the correct term or phrase to complete the sentence.

1. A ____________________ is a statement which is true for every value of the individual statements.
2. ________________ is statement which is always false.
3. _________________ is an incorrect reasoning in proving $p \to q$ by starting by assuming q and proving p.
4. _________________ is an incorrect reasoning in proving $p \to q$ by starting with assuming $\sim p$ and proving $\sim q$.
5. _________________ a fallacy in which the reasoner begins with what they are trying to end with.

B. How important is your knowledge about tautologies and fallacy in real-life situations?

____

____



What I Can Do

On your Own!

Make a compound statement which is either a tautology or a fallacy and write the statement in symbol. Then, construct a truth table to show that the statement given is a tautology or a fallacy.

The following rubric will be used to rate your work for each of the four problems:

Criteria	4	3	2	1
Translating the statements into symbols	The statement is translated into symbols with correct logical connectors.	One of the logical connectors used is incorrect	Two of the logical connectors used are incorrect	Three or more logical connectors used are incorrect
Accuracy of the truth table	The truth table has complete and accurate truth values	One of the values in the truth table is incorrect	Two of the values in the truth table are incorrect	Three or more of the values in the truth table are incorrect
Proof statement	Consistently logical; aids clear and easy understanding of the solution	Somewhat logical; somewhat aids clear or easy understanding of the solution	Somewhat illogical; tends to complicate the understanding of the solution	No textual explanation or table of values of solution or answer.

Assessment

Choose the letter of the best answer. Write the chosen letter on a separate sheet of paper.

1. Which of the following is a tautology?
   a. It is a compound statement that is always true.
   b. It is a compound statement that is not always true.
   c. It is a compound statement that is sometimes true.
   d. It is a compound statement that is neither true nor false.

2. Which of the following is a fallacy?
   a. It is a compound statement that is always true.
   b. It is a compound statement that is not always true.
   c. It is a compound statement that is sometimes true.
   d. It is a compound statement that is neither true nor false.

3. Which of the following is **NOT** a tautology?
   a. Maria is smart, or she is not smart.
   b. Either you will pass the interview, or you will fail in the interview.
   c. Anna loves Arts or she does not love Arts.
   d. Today is a not lucky day and tomorrow is a lucky day.

4. Which of the following is a tautology?
   a. $[(p \rightarrow q) \wedge p] \rightarrow p$
   b. $(p \rightarrow q) \leftrightarrow (\sim q \rightarrow p)$
   c. $[[p \rightarrow (r \rightarrow q)] \leftrightarrow [(p \wedge r) \rightarrow q]$
   d. $(p \rightarrow r) \wedge [(\boldsymbol{p} \leftrightarrow \boldsymbol{r}) \rightarrow q] \rightarrow (p \rightarrow q)$

5. Which of the following is a tautology?
   a. Michael is an artist or not an artist.
   b. Michael is an artist and a singer.
   c. It is not true that Michael is both an artist and a singer
   d. Michel is not a singer.

6. Which of the following statements is represented by the logical symbol of the tautology $p \wedge \sim (p \vee q)$?
   a. Jeff likes Music but he does not like Music and Arts
   b. Jeff likes Music but he does not like Music or Arts
   c. Jeff likes Music nor he does not like Music or Arts.
   d. Jeff likes Music but he does not like either Music or Arts

7. Let p, and q, be the propositions:
   p: Ivy was absent.
   q: Ivy misses the review.
   Which of the following illustrates the tautology $p \vee \sim (p \wedge q)$?
   a. Ivy was absent or she misses the review.
   b. Ivy was absent or she is not both missing the review and she was absent.
   c. Ivy was absent and she misses the review.
   d. Ivy was absent and she is either missing the review or she was absent

8. Which of the following is a **NOT** tautology?
   a. $[(p \rightarrow q) \wedge p] \rightarrow p$
   b. $(p \rightarrow q) \leftrightarrow (\sim q \rightarrow \sim p)$
   c. $[[p \rightarrow (r \rightarrow q)] \leftrightarrow [(p \wedge r) \rightarrow q]$
   d. $(p \rightarrow r) \wedge [(p \wedge r) \rightarrow q] \rightarrow (p \rightarrow q$

9. Which of the following statement is a fallacy?
   a. The dog is either brown, or the dog is not brown.
   b. Today is a rainy day or a sunny day.
   c. If tomorrow is Monday, then today is Saturday.
   d. Today is a hot day if and only if it is a sunny day.

10. Which of the following is a fallacy?

a. $(p \wedge q) \leftrightarrow (p \rightarrow \sim q)$
b. $(p \rightarrow q) \leftrightarrow (\sim q \rightarrow \sim p)$
c. $[[p \rightarrow (r \rightarrow q)] \leftrightarrow [(p \wedge r) \rightarrow q]$
d. $(p \rightarrow r) \wedge [(p \wedge r) \rightarrow q] \rightarrow (p \rightarrow q$

11. Which of the following truth table shows that the proposition $p \vee (q \rightarrow \sim p)$ is a tautology?

a.

p	q	$\sim p$	$q \rightarrow \sim p$	$p \vee (q \rightarrow \sim p)$
T	T	F	F	T
T	F	F	T	T
F	T	T	T	T
F	F	T	T	T

b.

p	q	$\sim p$	$q \rightarrow \sim p$	$p \vee (q \rightarrow \sim p)$
T	T	F	F	T
T	F	F	F	T
F	T	T	T	T
F	F	T	T	T

c.

p	q	$\sim p$	$q \rightarrow \sim p$	$p \vee (q \rightarrow \sim p)$
T	T	F	T	T
T	F	F	F	T
F	T	T	F	T
F	F	T	F	T

d.

p	q	$\sim p$	$q \rightarrow \sim p$	$p \vee (q \rightarrow \sim p)$
T	T	T	F	T
T	F	T	T	T
F	T	F	T	T
F	F	F	T	T

12. Which of the following truth table shows that the proposition $(p \wedge [(q \vee (\sim p)) \wedge (\sim q)]$ is a fallacy?

a.

p	q	$\sim p$	$\sim q$	$(q \vee (\sim p)$	$[(q \vee (\sim p)) \wedge (\sim q)]$	$(p \wedge [(q \vee (\sim p)) \wedge (\sim q)]$
T	T	F	F	F	F	F
T	F	F	T	F	F	F
F	T	T	F	F	F	F
F	F	T	T	T	T	F

b.

p	q	$\sim p$	$\sim q$	$(q \vee (\sim p)$	$[(q \vee (\sim p)) \wedge (\sim q)]$	$(p \wedge [(q \vee (\sim p)) \wedge (\sim q)]$
T	T	F	F	T	F	F
T	F	F	T	F	F	F
F	T	T	F	T	F	F
F	F	T	T	T	T	F

c.

p	q	$\sim p$	$\sim q$	$(q \vee (\sim p)$	$[(q \vee (\sim p)) \wedge (\sim q)]$	$(p \wedge [(q \vee (\sim p)) \wedge (\sim q)]$
T	T	T	F	T	F	F
T	F	T	T	F	F	F
F	T	F	F	T	F	F
F	F	F	T	T	T	F

d.

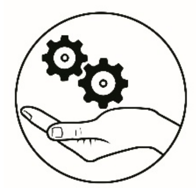
p	q	$\sim p$	$\sim q$	$(q \vee (\sim p)$	$[(q \vee (\sim p)) \wedge (\sim q)]$	$(p \wedge [(q \vee (\sim p)) \wedge (\sim q)]$
T	T	F	T	T	F	F
T	F	F	T	F	F	F
F	T	T	F	T	F	F
F	F	T	F	T	T	F

For items 13-14, refer to this statement: Carmela loves both Badminton and Volleyball, but she loves neither Badminton nor Tennis.

13. Express the statement to a mathematical symbol.
    a. $(p \wedge q) \wedge (q \wedge r)$
    b. $(p \wedge q) \wedge (\sim q \wedge \sim r)$
    c. $(p \wedge \sim p) \wedge (\sim q \wedge r)$
    d. $(\sim p \wedge \sim q) \wedge (q \wedge r)$

14. The given statement is a:
    a. tautology
    b. fallacy
    c. both tautology and fallacy
    d. neither tautology not fallacy

15. Which of the following is an example of a fallacy denying the hypothesis?
    a. If I will not take a bath, then I cannot go to school.
    b. If I will love you, then you will love me too.
    c. Assuming that I will study my lesson, then I will not pass the test.
    d. Assuming that I will not go to school every day, then I will not fail.



Additional Activities

Draw a conclusion!

1. If I pass the final exam, I will graduate. I graduated. Therefore…
2. I will go to La Union, I will eat "Halo-Halo" de Iloko. If I eat "Halo-Halo", I gain weight. Therefore,…
3. Rachel and Paulo will be at a concert. Rachel was at the concert. Therefore,…
4. If a person is an engineer, then that person has a college degree. Dennis does not have a college degree. Therefore,…
5. If I am irritated or angry, I cannot concentrate. I can concentrate. Therefore,…

Answer Key

What I Know

1. b
2. c
3. c
4. a
5. a
6. c
7. c
8. b
9. c
10. c
11. c
12. a
13. d
14. b
15. b

What's More

Activity 1.1

1. Fallacy 2. Fallacy 3. Tautology
4. Tautology 5. Fallacy

Activity 1.2

p	q	$p \to q$	$\sim p$	$\sim q$	$\sim q \to \sim p$	$(p \to q) \leftrightarrow (\sim q \to \sim p)$
T	T	T	F	F	T	T
T	F	F	F	T	F	T
F	T	T	T	F	T	T
F	F	T	T	T	T	T

Since the result is all true, it shows that the given statement is a tautology.

p	q	$p \wedge q$	$\sim(p \wedge q)$	$\sim p$	$\sim q$	$\sim p \vee \sim q$	$\sim(p \wedge q) \leftrightarrow (\sim p \vee \sim q)$
T	T	T	F	F	F	F	T
T	F	F	T	F	T	T	T
F	T	F	T	T	F	T	T
F	F	F	T	T	T	T	T

Since the result is all true, it shows that the given statement is a tautology.

p	q	$(p \to q)$	$\sim(p \to q)$	$\sim q$	$(p \wedge \sim q)$	$\sim(p \to q) \leftrightarrow (p \wedge \sim q)$
T	T	T	F	F	F	T
T	F	F	T	T	T	T
F	T	T	F	F	F	T
F	F	T	F	T	F	T

Since the result is all true, it shows that the given statement is a tautology.

p	q	$\sim q$	$(p \wedge q)$	$(p \to \sim q)$	$(p \wedge q) \leftrightarrow (p \to \sim q)$
T	T	F	T	F	F
T	F	T	F	T	F
F	T	F	F	T	F
F	F	T	F	T	F

Since the result is all false, it shows that the given statement is a fallacy.

p	q	$p \vee q$	$\sim(p \vee q)$	$q \wedge \sim(p \vee q)$
T	T	T	F	F
T	F	T	F	F
F	T	T	F	F
F	F	F	T	F

Since the result is all false, it shows that the given statement is a fallacy.

Assessment

1. a.
2. b
3. d
4. c
5. a
6. d
7. b
8. a
9. c
10. a
11. a
12. b
13. b
14. a
15. d

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