# Lesson 3.3: Deductive Reasoning

Tuesday, October 25, 2022 10:54 AM

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3.3
Deductive

## Lesson 3.3 Deductive Reasoning

## Workbook Pages 145-148

***You can take notes in your workbook, on your own paper, on peardeck powerpoint, or even on the textbook website – interactive workbook**



## Florida's B.E.S.T. Standards for Mathematics

**Content Objective**
Students apply the Laws of Detachment and Syllogism.

**MA.912.LT.4.10**
Judge the validity of arguments and give counterexamples to disprove statements.

**MA.K12.MTR.1.1**
Actively participate in effortful learning both individually and collectively.

**MA.K12.MTR.5.1**
Use patterns and structure to help understand and connect mathematical concepts.





## Learn

## The Law of Detachment

Unlike inductive reasoning, which uses a specific pattern of examples or observations to make a general conclusion, **deductive reasoning** uses general facts, rules, definitions, or properties to reach specific *valid* conclusions from given statements. An argument is **valid** if it is impossible for all the premises, or supporting statements, of the argument to be true and for its conclusion to be false. One law related to deductive reasoning is the Law of Detachment.





## Learn
The Law of Detachment

**Key Concept: Law of Detachment**

| | |
|---|---|
| **Words** | If $p \rightarrow q$ is a true statement and $p$ is true, then $q$ is true. |
| **Example** | Given: If a car is out of gas, then it will not start.<br>Sarah's car is out of gas.<br>Valid Conclusion: Sarah's car will not start. |





## Example 1
Inductive and Deductive Reasoning

**Determine whether each conclusion is based on *inductive* or *deductive* reasoning.**

**a. If a student is late returning a library book, then he or she will be charged a $2 late fee. Chang returned a library book late, so he concludes that he will be charged a $2 late fee.**

Deductive (Facts)

**b. Every time Tamika has worn her favorite jersey to a football game, her school's team has won the game.**

Patterns

Tamika is wearing her favorite jersey to the football game tonight, so she concludes that her school's team will win the game.

Inductive

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## Example 1
Inductive and Deductive Reasoning

**a. If a student is late returning a library book, then he or she will be charged a $2 late fee. Chang returned a library book late, so he concludes that he will be charged a $2 late fee.**

Chang is basing his conclusion on the library's policies, so he is using deductive reasoning.





## Example 1
Inductive and Deductive Reasoning

**b. Every time Tamika has worn her favorite jersey to a football game, her school's team has won the game. Tamika is wearing her favorite jersey to the football game tonight, so she concludes that her school's team will win the game.**

Tamika is basing her conclusion on a specific pattern of observations, so she is using inductive reasoning.





## Example 1
Inductive and Deductive Reasoning

**Check**

Determine whether each conclusion is based on *inductive* or *deductive* reasoning.

a. Newton's first law of motion states that an object at rest will remain at rest unless acted on by an unbalanced force. Elisa watches a soccer ball roll across the field. She concludes that an unbalanced force has acted upon the soccer ball. Facts Deductive

b. Mrs. Jackson notices that her family's data usage is increasing by approximately 2500 megabytes of data every month. So, she concludes that her family's data usage next month will be 2500 megabytes greater than this month's data usage. Pattern Inductive

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## Example 1

Inductive and Deductive Reasoning

**Check**

Determine whether each conclusion is based on *inductive* or *deductive* reasoning.

a. Newton's first law of motion states that an object at rest will remain at rest unless acted on by an unbalanced force. Elisa watches a soccer ball roll across the field. She concludes that an unbalanced force has acted upon the soccer ball. deductive

b. Mrs. Jackson notices that her family's data usage is increasing by approximately 2500 megabytes of data every month. So, she concludes that her family's data usage next month will be 2500 megabytes greater than this month's data usage. inductive





## Example 2

The Law of Detachment

**Determine whether each conclusion is valid based on the given information. Write *valid* or *invalid*. Explain your reasoning.**

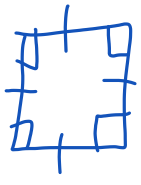
**a. Given: To go on the field trip, a student must turn in a permission slip. Mariana turned in her permission slip.**

**Conclusion: Mariana can go on the field trip.** P Q VALID

**b. Given: If a figure is a square, then it is a polygon.**

**Figure *A* is a polygon.**

**Conclusion: Figure *A* is a square.** NOT Always False



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## Example 2
The Law of Detachment

**a. Given: To go on the field trip, a student must turn in a permission slip. Mariana turned in her permission slip.**

**Conclusion: Mariana can go on the field trip.**

**Step 1 Identify the hypothesis and conclusion.**

Because a student must turn in a permission slip to go on the field trip, the phrase *a student must turn in a permission slip* is the hypothesis of the conditional statement.

*p*: A student turns in a permission slip.

*q*: The student can go on the field trip.




## Example 2
The Law of Detachment

**Step 2 Analyze the conclusion.**

The given statement *Mariana turned in her permission slip* satisfies the hypothesis, so *p* is true. By the Law of Detachment, *Mariana can go on the field trip,* which matches *q,* is a true or valid conclusion.




## Example 2
The Law of Detachment

**b. Given: If a figure is a square, then it is a polygon. Figure *A* is a polygon.**

**Conclusion: Figure *A* is a square.**

**Step 1 Identify the hypothesis and conclusion.**

*p*: A figure is a square.

*q*: It is a polygon

q: it is a polygon.





## Example 2
The Law of Detachment

**Step 2 Analyze the conclusion.**

The given statement *Figure A is a polygon* satisfies the conclusion *q* of a true conditional. However, knowing that a conditional statement and its conclusion are true does not make the hypothesis true. Figure *A* could be a triangle. The conclusion is *invalid*.

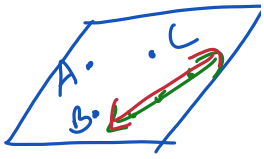




## Example 2
The Law of Detachment

**Check**

Determine whether the conclusion is valid based on the given information. Select the correct answer and justification.




Invalid

**a. Given:** If three points are noncollinear, then they determine a plane.
Points *A*, *B*, and *C* lie in plane $\mathcal{G}$.

**Conclusion:** Points *A*, *B*, and *C* are noncollinear.

A. Valid; points *A*, *B*, and *C* determine plane $\mathcal{G}$. Therefore, they are noncollinear.

B. Valid; because points *A*, *B*, and *C* are noncollinear, they determine plane $\mathcal{G}$.

C. Invalid; points *A*, *B*, and *C* determine plane $\mathcal{G}$. Therefore, they are noncollinear.

D. Invalid; points *A*, *B*, and *C* can be collinear and lie in plane $\mathcal{G}$.



## Example 2
The Law of Detachment

**Check**

Determine whether the conclusion is valid based on the given information. Select

the correct answer and justification.

**a. Given:** If three points are noncollinear, then they determine a plane.
Points $A$, $B$, and $C$ lie in plane $\mathcal{G}$.

**Conclusion:** Points $A$, $B$, and $C$ are noncollinear.

A. Valid; points $A$, $B$, and $C$ determine plane $\mathcal{G}$. Therefore, they are noncollinear.

B. Valid; because points $A$, $B$, and $C$ are noncollinear, they determine plane $\mathcal{G}$.

C. Invalid; points $A$, $B$, and $C$ determine plane $\mathcal{G}$. Therefore, they are noncollinear.

D. Invalid; points $A$, $B$, and $C$ can be collinear and lie in plane $\mathcal{G}$.

Students, select an option!

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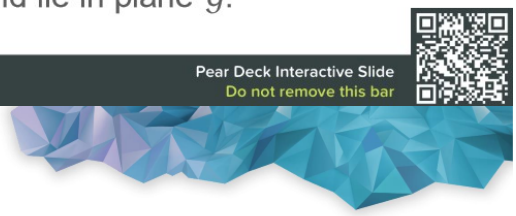

## Example 2
The Law of Detachment

### Check

Determine whether the conclusion is valid based on the given information. Select the correct answer and justification.

**a. Given:** If three points are noncollinear, then they determine a plane.
Points $A$, $B$, and $C$ lie in plane $\mathcal{G}$.

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A. Valid; points $A$, $B$, and $C$ determine plane $\mathcal{G}$. Therefore, they are noncollinear.

B. Valid; because points $A$, $B$, and $C$ are noncollinear, they determine plane $\mathcal{G}$.

C. Invalid; points $A$, $B$, and $C$ determine plane $\mathcal{G}$. Therefore, they are noncollinear.

D. Invalid; points $A$, $B$, and $C$ can be collinear and lie in plane $\mathcal{G}$.





## Example 2
The Law of Detachment

**b. Given:** If Dakota goes to the video game store, then he will buy a new game.
Dakota went to the video game store this afternoon.

**Conclusion:** Dakota bought a new game.

A. Invalid; because the statement *Dakota bought a new game* does not satisfy the hypothesis of the conditional statement, the conclusion is not true.

B. Valid; because the statement *Dakota went to the video game store this afternoon* satisfies the conclusion of the conditional statement, the hypothesis of the conditional is true.

C. Valid; because the statement *Dakota went to the video game store this afternoon* satisfies the hypothesis of the conditional statement, the conclusion is true.

D. Invalid; because the statement *Dakota went to the video game store this afternoon* satisfies only the hypothesis, the conclusion is not true.

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## Example 2

The Law of Detachment

**b. Given:** If Dakota goes to the video game store, then he will buy a new game.
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C. Valid; because the statement *Dakota went to the video game store this afternoon* satisfies the hypothesis of the conditional statement, the conclusion is true.

D. Invalid; because the statement *Dakota went to the video game store this afternoon* satisfies only the hypothesis, the conclusion is not true.



## Example 2

The Law of Detachment

**b. Given:** If Dakota goes to the video game store, then he will buy a new game.
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**Conclusion:** Dakota bought a new game. C

A. Invalid; because the statement *Dakota bought a new game* does not satisfy the hypothesis of the conditional statement, the conclusion is not true.

B. Valid; because the statement *Dakota went to the video game store this afternoon* satisfies the conclusion of the conditional statement, the hypothesis of the conditional is true.

C. Valid; because the statement *Dakota went to the video game store this afternoon* satisfies the hypothesis of the conditional statement, the conclusion is true.

D. Invalid; because the statement *Dakota went to the video game store this afternoon* satisfies only the hypothesis, the conclusion is not true.




## Learn

The Law of Syllogism

One law that is related to deductive reasoning is the Law of Syllogism. This law allows you to draw conclusions from two true conditional statements when the conclusion of one statement is the hypothesis of the other.

**Key Concept: Law of Syllogism**

| | |
|---|---|
| **Words** | If $p \rightarrow q$ and $q \rightarrow r$ are true statements, then |