

Chapter 2- Lesson 2

Logic Puzzles & Syllogisms

Lewis Carroll may have exaggerated a little, as math professors often do about the utility of their subject. Carroll is best known for his nonsensical books, including the infamous “Alice in Wonderland”, written for children of ages five to ninety; but his main line of work was as a professor of mathematics at Oxford University in England. He studied logic as a vocation, and he played with logic in his writings.



Alice and the Mock Turtle

As a teacher of logic and a lover of nonsense, Carroll designed entertaining puzzles to train people in systematic reasoning. In these puzzles he strings together a list of implications, purposefully inane so that the reader is not influenced by any preconceived opinions. The job of the reader is to use all the listed implica-

tions to arrive at an inescapable conclusion. You will get the general idea after a few examples.¹

Here is one of Lewis Carroll's simpler puzzles. See if you can figure it out.

- A. All babies are illogical.
- B. Nobody is despised who can manage crocodiles.
- C. Illogical persons are despised.

While the puzzles Carroll developed intentionally have no direct application, you will find that the ability to reason logically is of high value. The goal of this lesson is to help you develop some mathematical tools for solving logical puzzles. After the lesson you will get another chance at the puzzle above using these tools.



Lewis Carroll, cleaning a lens

Syllogism

A syllogism is a series of related premises that ultimately connect the original hypothesis and last conclusion together into a final conclusion.

¹ <http://www.math.hawaii.edu/~hile/math100/logice.htm>

Name _____

Date _____

Block _____

Puzzle 3— Popcorn Friends

- A. If you eat popcorn, then you will sneeze.
- B. If you don't go to the dance, you won't have any friends.
- C. If you are sick, you won't be able to go to the dance.
- D. If you sneeze, then you are sick.

Build your syllogism

Final Conclusion:

If _____, then _____.

Puzzle 4— On T.V.

- A. If a dog looks funny, then it will be popular.
- B. If something is popular, then it will be on T.V.
- C. If something is on T.V., then it is famous.
- D. If a dog is green, then it will look funny.

Build your syllogism

Final Conclusion:

If _____, then _____.

Name _____

Date _____

Block _____

Puzzle 5— For Want of a Nail²

- A. If the horseshoe is lost, then the horse will be lost.
- B. If the horse is lost, then the knight will be lost.
- C. If the horseshoe nail is lost, then the horseshoe will be lost.
- D. If the battle is lost, then the kingdom will be lost.
- E. If the knight is lost, then the battle will be lost.

Build your syllogism.

Final Conclusion:

If _____, then _____.

² Larson, etal. Geometry: An Integrated Approach

Puzzle 6— Going to the Movies

What *final conclusion* can you draw from the premises below? Use symbols to rewrite each premise and to build a syllogism.

- A. If it is hot, we will go to the movies.
- B. If it is not sunny, then it must be cloudy.
- C. If it is windy, there won't be clouds.
- D. If it is sunny, it will be hot.

Build your syllogism.

Final Conclusion:

If _____, then _____.

Puzzle 7 — Sunday Restaurant

Use symbols to build a syllogism, then rewrite your conclusion using words.

- A. It is Sunday if and only if I am working at the restaurant.
- B. If stores are open, then it is not Sunday.
- C. If the stores are closed, then I won't be able to buy cat food.
- D. If I can't buy cat food, my cat will not purr.

Build your syllogism.

Final Conclusion:

If _____, then _____.

**Switching Order
The Contrapositive**

The order of an implication, $p \rightarrow q$, can be switched to its contrapositive, $\sim q \rightarrow \sim p$ while preserving its truth value.

Biconditional Statements

A biconditional statement, or a “two-way implication” says that when a first situation occurs, so must a second, AND when the second situation occurs, so must the first.

Biconditional statements can be written in the forms:

If x, then y and if y, then x.
x if and only if y

Name _____

Date _____

Block _____

Puzzle 8— Illogical Babies

Let's return to the puzzle by Lewis Carroll. Probably the toughest thing about this, and other Carroll, puzzle is re-writing each premise as an implication.

- A. All babies are illogical.
- B. No person is despised who can manage crocodiles.
- C. Illogical persons are despised.

1. Re-write each premise as an implication.

2. Build your syllogism.

3. What is the final conclusion?

All and None

The words "all", "none" or "no" are called quantifiers. Quantifiers can be translated into implications as follows:

All x are y If x, then y.

No x are y If x, then not y.