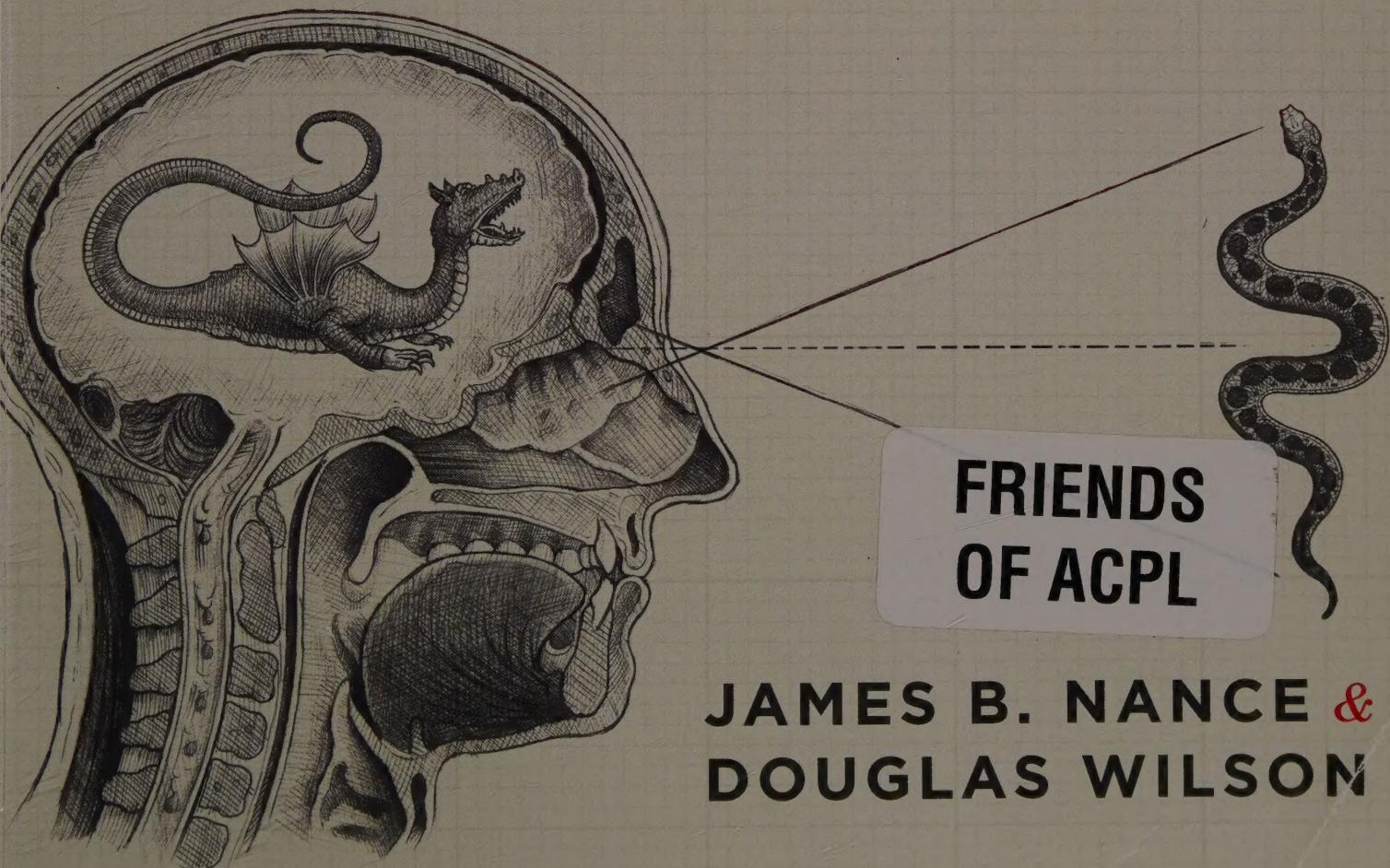


INTRODUCTORY LOGIC

The Fundamentals of Thinking Well



JAMES B. NANCE &
DOUGLAS WILSON

Introductory Logic

STUDENT

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A NOTE TO THE TEACHER | STUDENT EDITION

INTRODUCTORY LOGIC

The Fundamentals of Thinking Well

STUDENT: FIFTH EDITION

James B. Nance | Douglas Wilson



A NOTE to the TEACHER for the FIFTH EDITION

Logic is the science and art of reasoning well. We reason as we draw conclusions from other information by means of logical arguments. Arguments are made up of premises and conclusions, which are types of statements. Statements are sentences that are true or false. Categorical statements predicate something of a subject, and thus connect subject and predicate terms. A term is the verbal expression of a concept. Consequently, in order to follow logical arguments as we reason, we must know how to determine the truth of statements, and to understand statements, we need to be able to define the terms that make up those statements.

In this text we begin with terms. Your students will learn how to define terms and how to relate terms to other terms in genus and species charts. They will then study statements, discovering ways to determine the truth of a given statement, and will examine how statements relate to each other. Next, they will learn how to put statements together into arguments, and gather strategies for distinguishing valid arguments from invalid ones. They will do this first in the tightly controlled, artificial environment of categorical syllogisms. You will then lead them into the real world as they take the tools they have mastered and learn how to apply them to arguments in normal English. Once they have gained the skills of analyzing the arguments of others, they will take a brief foray into constructing arguments to establish conclusions of their own. They will then finish this course by learning to detect the fallacies that litter arguments in daily life.

This logic course thus follows the program outlined by Dorothy Sayers in “The Lost Tools of Learning.” In that seminal essay, she outlined for us the course of study for the medieval logic student, who learned “how to use language: how to define his terms and make accurate statements; how to construct an argument and how to detect fallacies in argument.” Terms, statements, arguments, fallacies—these are concepts that will become familiar to your students in this study of *Introductory Logic: The Fundamentals of Thinking Well*.

James B. Nance

April 2014

INTRODUCTORY LOGIC

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LOGIC: ITS NATURE AND PURPOSE

God created man with the ability to reason: “Come now, and let us reason together, saith the Lord” (Is. 1:18). He did this so that we could communicate with Him and with one another. This enables us to love and obey Him. Reasoning means drawing proper conclusions from other information. A proper use of reason allows us to form rational statements, and to understand the statements that are made by others. It allows us, for example, to take universal statements such as “God has commanded all men everywhere to repent” and to apply them, first to ourselves and then to our neighbor: “We are men, therefore we must repent.” Without the ability to reason, we would be unable to discuss, preach, read, hear the gospel, or follow God’s commands. In other words, proper reasoning opens the mind so that it can close upon truth.

Some have assumed that this ability to reason is what constitutes man being created in the image of God. But there are several problems with this assumption. First, there are other creatures (like angels and cherubim) who have an ability to reason, but who do not bear the image of God the same way that man does. Another problem is that it implies that humans who are very young (e.g., a fertilized human ovum) or who are severely retarded cannot bear God’s image, or that they do so imperfectly. Rather than treating reason as the image of God in man, it would be far better to treat reason as a gift that God gives (out of His own nature and character) to all intelligent creatures. The more He gives, the greater our responsibility to love Him, as Scripture says, “with all our minds.”

Formal logic is the science and art of reasoning well. As a science, logic includes discovering and identifying the patterns or rules by which we reason. As an art, logic teaches how to follow those rules, without abusing them in a wooden (and unreasonable) way. About sixteen centuries ago, Augustine said this about the science of logic:



KEY POINT

Reason opens our minds so that they can close upon truth. Reason is a gift from God; it is *not* the single, essential aspect of bearing God’s image.



DEFINITION

Logic is the science and art of reasoning well.

And yet the validity of logical sequences is not a thing devised by men, but is observed and noted by them that they may be able to learn and teach it; for it exists eternally in the reason of things, and has its origin with God. For as the man who narrates the order of events does not himself create that order; and as he who describes the situations of places, or the natures of animals, or roots, or minerals, does not describe arrangements of man; and as he who points out the stars and their movements does not point out anything that he himself or any other man has ordained; in the same way, he who says, “When the consequent is false, the antecedent must also be false,” says what is most true; but he does not himself make it so, he only points out that it is so. (*On Christian Doctrine*, book II, chapter 32)



KEY POINT

Logic is not created by God or man; rather, it is an attribute of God. It is not over God or independent of Him.

Logic is not devised by man, but neither is it created by God, like maple trees and dwarf stars are. Rather, it is an “attribute” of God which is reflected in creation. We need to be careful here, because it is not an attribute of God that is stated directly in Scripture, as His holiness, love, and righteousness are. But it is a characteristic of God that we see assumed everywhere in Scripture. We do not believe that logic is independent of God and over Him, which would mean that the triune God is not the sovereign God of the Bible. But neither do we believe that God could have created a nonsensical world where He was both the creator of it and not the creator of it. This leaves us with the assumption that all things are ultimately defined by God Himself, rather than by “rules.” Since we want to learn how to reason as faithful Christians, we begin by assuming that all faithful thinking and reasoning is somehow sharing in this characteristic of God. So when we study logic faithfully, we are studying some of the divine reflection in the world around us.

The Laws of Thought

Keeping all of this in mind, we must be careful when dealing with “rules” and “laws” of logic. In order to reason well, we have to assume

certain very basic things that never show up as particular items in our argument. They are simply (and quietly) assumed. For example, if you were putting together an argument about light bulbs or tricycles, it is very important that they not turn into something else (like toaster ovens or catcher's mitts) halfway through the argument. If they did, the argument would just have to lie down in the corner and sob quietly. It could never get anything done.

Traditionally, these assumptions have been called the “laws of thought.” There is nothing wrong with the *contents* of these assumptions, but there is a significant problem with *another* deeper assumption lying beneath them. That assumption is that you can have laws without a lawgiver, and that ultimately, you can have reason apart from the triune God of Scripture. All you need to do, it is thought, is postulate some laws of thought and off you go.

Because this is the case, we want to begin by showing how the laws of thought are actually grounded in the nature of the triune God, revealed in Jesus Christ. After we have done that, we will be able to discuss the traditional terminology. The reason for doing this is that many modernists have been guilty of thinking that impersonal “laws” have authority in themselves, which of course they do not.

Let’s start with the basic Christian confession that *Jesus is Lord*. When God reveals Himself in Christ, the decision that must be made is whether to believe it or not. These are the only two options: faith or unbelief. This means that the statement *Jesus is Lord* must either be true or false. A faithful person confesses that it is true. An unfaithful person denies it as false. God does not leave open the option of saying something like, “I believe that the higher reality of the lordship of Christ cannot be contained in our paltry categories of true and false, and so I cannot say whether I believe in Him or not.” Such a response is simple dishonesty masquerading as humility.

The fact that *any statement is either true or false* is one of the three traditional laws of thought, upon which much of the science of logic is based. This law of thought is called the **Law of Excluded Middle**, because it excludes the possibility of a truth value falling somewhere in the middle between true and false. Statements are either one or the other. If a statement is not true, then it is false, and vice versa.



DEFINITION

The Law of Excluded Middle: Any statement is either true or false.



DEFINITION

The Law of Identity: If a statement is true, then it is true.



DEFINITION

The Law of Noncontradiction: A statement cannot be both true and false.

As Christians we confess that God is triune. If asked, we would say, “Yes, that is true. God is triune.” Now if it is true that God is triune, *then it must be true that God is triune*. This is an application of **The Law of Identity**, which simply states that *if a statement is true then it is true*. For ordinary people in ordinary conversation, such rules are not thought to be necessary. But when people are fleeing from God, they will often take refuge in any folly, arguing that the truth of a statement can change in the middle of an argument. This law may be employed to answer the unbeliever who says, “Christianity may be true for you, but not for me.” No. If the Christian faith is true, then it is true.

The third law says that *a statement cannot be both true and false*. This is called the **Law of Noncontradiction**. Without this law, we could not argue for the exclusive truth of any statement that we hold. We could try to assert, for example, that “Jesus is Lord.” But our opponents could respond, “Oh, I agree that what you say is true. But it is also false.” We see that if we deny these laws, we lose the possibility of all rational discourse.

Think for a moment what would happen to our faith if we were to allow someone to deny these fundamental assumptions. If we confess “God in three Persons, blessed Trinity,” someone who denied the Law of Excluded Middle could say that this wonderful confession is not true, and it is not false. It is just wonderful, and perhaps even a little inspiring. One who denied the law of identity could say, “Yes, it is true that God is a Father for you, but it is *my* truth that She is a Mother.” And one who denied the Law of Noncontradiction could say that God is our Father, and also, in the same way and in the same respect, He is not our Father. In other words, denial of these bedrock assumptions would make a hash out of the simplest Christian confession like the Apostles’ Creed.

Having said all this, there is an important warning. The Bible does assume that the Father is the Father, and not the Son. The Spirit is the Spirit and not the Father. The Father is not “not the Father.” At the same time, the Bible *also* teaches that the Father perfectly indwells the Son, the Son indwells the Father, and both with the Spirit are one God. Statements about the Father are not independent from statements about

the Son. Jesus said, "Anyone who has seen me has seen the Father." These truths do not deny the laws of thought but rather support them.

Through a wooden application of these laws, some logicians have gotten to the point where they cannot understand or appreciate poetry, metaphor, sacraments, or marriage. The world is full of "indwelling" and mutual partaking, because this is *also* what our God is like. In our study of logic, we must always leave room for mystery. We know that the Father is Father, and no one else. We know as well that the Father is not the Son. But we should also know that the Father reveals Himself perfectly in the Son.

The Scope of This Book

The subject of logic may be divided into two main branches: **formal** and **informal**. Formal logic deals directly with reasoning, by considering the means of distinguishing between proper and improper modes of reasoning. Informal logic deals with operations of thinking that are indirectly related to reasoning, such as defining terms, relating terms to each other, and determining relationships between statements. Because informal fallacies are not formal methods of reasoning, they are also included under the branch of informal logic.

Formal logic itself may be divided into two main branches, **induction** and **deduction**. Induction deals with arguments of likelihood and probability. By induction we draw conclusions from facts or experience, conclusions which go beyond those facts. Inductive conclusions are never certain, but only probable. As such, they can be considered strong or weak, depending on how well experience supports the conclusion. They may also be strengthened by further experience. You can see that induction is the logic of the experimental sciences.

Whereas induction deals with arguments that are strong or weak, deduction deals with arguments that are valid or invalid. If valid, the conclusion follows from the premises, and it does so with certainty. A valid conclusion is one that is contained within the premises: if the premises of a valid argument are true, then the conclusion must be true. There are many branches of deductive reasoning. Two main branches are **categorical logic** and **propositional logic**. To the best of our knowledge, categorical logic was first developed as a science by



KEY POINT

Logic must always give way to mystery. For example, we understand many things in terms of poetry, or sacraments, or the indwelling of the Trinity.



DEFINITIONS

Formal logic deals with the proper modes of reasoning. **Informal logic** deals with operations of thinking that are indirectly related to reasoning.

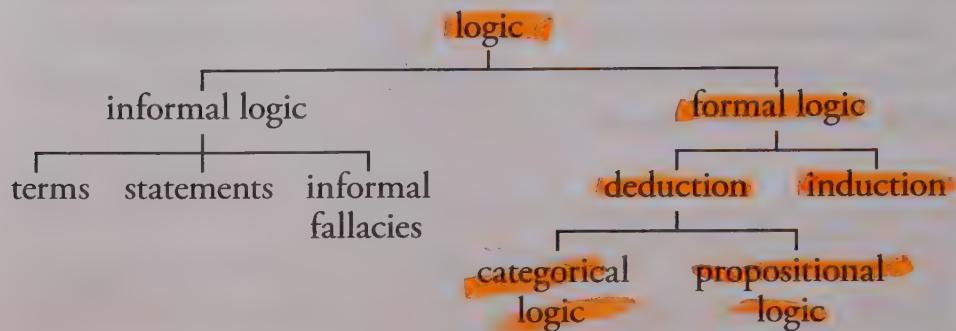


DEFINITIONS

Induction is reasoning with probability from examples or experience to general rules. **Deduction** is reasoning with certainty from premises to conclusions.

the Greek philosopher Aristotle (384–322 B.C.). Categorical logic deals with the **syllogism**, which is a type of deductive argument in which the conclusion connects one category (or term) with another, hence the name *categorical logic*. Propositional logic connects entire *propositions* together in arguments.

These branches of logic can be arranged as seen in the chart below:



This book is an introduction to the informal and categorical branches of logic. The next book in this series, *Intermediate Logic*, deals with the propositional branch of deduction. The point of all of this is to encourage students to begin the process of carefully “thinking God’s thoughts after Him.” The point of this book is *not* to teach us how to be quarrelsome with one another, nor to bring students to the false idea that the world is governed by some impersonal deity named Rules of Inference.

UNIT 1

TERMS AND DEFINITIONS

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THE PURPOSES AND TYPES OF DEFINITIONS

A term is a concept with a precise meaning expressed by one or more words. A single term can be expressed by many different words. Words that are exact synonyms represent the same term. The English word *girl* and the Latin word *puella* represent the same term. Similarly, a single word can represent different terms. For example, the word *mad* can mean either “angry” or “insane.”

A definition is a statement that gives the meaning of a term. The ability to define terms accurately is a valuable skill. Lawyers must continually define their terms, and may use precise, technical language to do so. The same is true for teachers, scientists, philosophers, theologians, and most other professionals. To demonstrate the value of this skill, let us consider some of the purposes that definitions serve.

- Definitions show relationships.** When a term is defined properly, the definition often gives some idea of the relationships which that term has with other terms. For example, if you were to define man as “a rational animal,” your definition implies both that man has some relationship to other rational beings, such as angels and demons, and to other animals—bears, whales, and lizards. Or if bald is defined as “having no hair,” its contradictory relationship with the term hairy is immediately apparent.

- Definitions remove ambiguity.** Words are ambiguous when they have more than one possible meaning. Commonly, in a discussion or a debate, ambiguous words are used without the participants being aware of the ambiguity. The result is a verbal disagreement that may be cleared up by defining terms. For instance, some people believe that Jesus’ command to love your enemies is an absurd requirement because they are defining *love* to mean “believe the other to be a nice person,” when in fact they know



DEFINITIONS

A term is a concept that is expressed precisely in words. A definition is a statement that gives the meaning of a term.



KEY POINT

Note the difference between a term and a word: one word can carry the meaning of many terms; the same term can be expressed with different words.



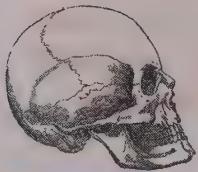
CAUTION

It is extremely important to define your terms at the beginning of any debate. You want to argue about substance, not words.



DEFINITIONS

An **ambiguous** word has more than one definition. A **vague** word is one whose extent is unclear.



CAUTION

A precising definition is very dependent on the situation in which it is used.



KEY POINT

Defining terms is a key way of communicating knowledge.

their enemies to be quite wicked and depraved. But biblically, *love* means ‘to treat the other person lawfully from the heart,’ which is to be our behavior toward all men. If this definition is made clear, the people may still think that the command is impossible, but at least they no longer should see it as absurd.

A definition that shows relationships or reduces ambiguity by providing a single, established meaning of a term is called a **lexical definition**. This is the sort of definition one would find in a dictionary.

3. **Definitions reduce vagueness.** A problem similar to ambiguity is vagueness. A term is vague when its extent is unclear. The term itself may have a single, understood meaning, but there are “gray areas” where it is uncertain if the given term applies. This is a common problem in descriptive terms, such as *old, dark, tall, mature*. If a father tells his children it must be warm outside before they can swim in the lake, the children often immediately want vagueness reduced: “How warm?” If the father responds, “At least eighty degrees Fahrenheit,” the issue is made clear. Or if you are asked to give a small donation for a gift for the secretary, you may want a definition to reduce the vagueness of the term *small*, like, “By small I mean five dollars.” This type of definition is a **precising definition**, because it seeks to make more precise what was previously vague or fuzzy. Note that precising definitions would not be found in a dictionary; they apply only to the situation in which they are used.

4. **Definitions increase vocabulary.** One of the most important elements of education is learning the meaning of unfamiliar terms. An increase in vocabulary means an increase in knowledge, which is why in English class students are taught “vocabulary words” and their definitions. In this very lesson you may have learned the definitions of terms like ambiguity and vagueness. Knowing these definitions helps us to make subtle distinctions and otherwise use language properly.

When a new word is invented, or an existing word is applied in a new way, it is given a **stipulative definition**. Such definitions, if widely accepted, increase the vocabulary of the language to which they are added. New words are continually adopted into English, such as words resulting from new inventions (*laptop*, added in

1985), from sports (*screwball*, 1928), from other languages (*macho* from Spanish, also 1928), or coined out of someone's imagination (*boondoggle*, from an American scoutmaster, 1957).

5. **Definitions can explain concepts theoretically.** Sometimes definitions are given for terms, not because the word itself is unfamiliar, but because the term is not understood. Such concepts require theoretical definitions, which are often scientific or philosophical in nature. For example, when your chemistry teacher defines water by its chemical formula H₂O, he is not trying to increase your vocabulary (you already knew the term *water*), but to explain its atomic structure.

Accepting a **theoretical definition** is like accepting a theory about the term being defined. If you define spirit as "the life-giving principle of physical organisms," you are inviting others to accept the idea that life is somehow a spiritual product.

6. **Definitions can influence attitudes.** Often terms are defined, not necessarily for the purpose of clarifying their meaning, but in order to influence the attitudes and emotions of an audience. Abortion has been defined as "the slaughter of innocent children" on the one hand, "the right of a woman to control her own body" on the other, or even the non-emotional "termination of a pregnancy." All these definitions aim at persuading the listener one way or another toward the term being defined, and as such are called **persuasive definitions**. Examples abound. Is democracy "mob rule" or "government by the people"? Is marriage "the institutionalized slavery of women by men" or "the blessed union of man and wife"? You can see the capacity of persuasive definitions for good or ill.



KEY POINT

Definitions may seem dry and logical, but they can be used persuasively. Knowing how to define terms well is a great advantage in debate.

SUMMARY

Definitions give meanings for terms. Definitions can show relationships between terms, remove ambiguity, reduce vagueness, increase vocabulary, explain concepts theoretically, and influence attitudes. Along with these purposes are the five types of definitions: lexical, precising, stipulative, theoretical, and persuasive.



EXERCISE 1 (16 points)

1. Write lexical definitions of the words *child* and *adult* that show the relationship between them.

adult, grown ups, children, infant, child

2. The word *grace* is an ambiguous word. Write two lexical definitions for the word *grace*, giving two of its different meanings.

A title of an archbishop.

A short prayer of thanks for a meal.

3. Write a precising definition of the word *soon* to clarify the vagueness in the sentence "I will be home soon."

I will be home in 10 minutes.

4. Invent a stipulative definition for the word *ploff*.

A soft or fluffy object.

5. Write a persuasive definition of the word *television* from the point of view of a mother who thinks her children watch too much of it.

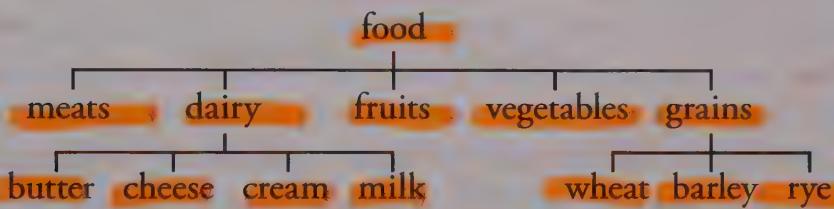
Television is a addictive source of media.

6. Write a short, imaginary dialogue between two people having a verbal dispute about the word *believe*. Then introduce a third person who settles the dispute by presenting lexical definitions for the word that eliminate the ambiguity. (Continue on the back if needed.)

John: I believe that the word believe should only be used in the life. Bill: Why the word believe can be used in any sentence its called freedom of speech.

GENUS AND SPECIES

Terms are often defined by being placed among a higher category, or **genus**. The genus of a term is more general, broad, or abstract than the term itself. The term under a genus is called the **species**, which is a type, kind, or example of the term. The species is more specific, narrow, or concrete than the genus. Terms can be placed in a **genus and species hierarchy**, thus clearly showing the relationships between them. For example, consider the hierarchy below:



Here we see the **genus food**, and under it some of the species of the term food: meats, dairy products, fruits, vegetables, and grains. Of these, the terms **dairy products** and **grains** are shown to be genera (the plural of genus) for the species under them. The genus **dairy products** is broader than any of its species, such as butter, because dairy products includes not only butter but cheese, cream, milk, and any other species that could be placed under it. The chart also shows that the term **grains** is the genus of wheat, barley, and rye. Of course, many other terms could be included as species of grains. Can you think of any?

The words **genus** and **species** are relative terms. Each term can be both a genus and a species—a genus of the terms below it, and a species of the term above it. Thus **grains** is both a species of food and a genus of wheat. This process can continue (although not indefinitely) both downward and upward. **Cheese** could be the genus for different varieties of cheese, such as Swiss, Parmesan, and Cheddar.



DEFINITIONS

A **genus** of a term is a term that is more general, broad, or abstract than the original term and includes it.

A **species** of a term is a term that is more specific, narrow, or concrete than the original term and is included by it.



KEY POINT

Genus and **species** are relative terms. Each term can be both a genus and a species.

**CAUTION**

Even though *genus* and *species* are biological terms, logical hierarchies are very different from biological ones.

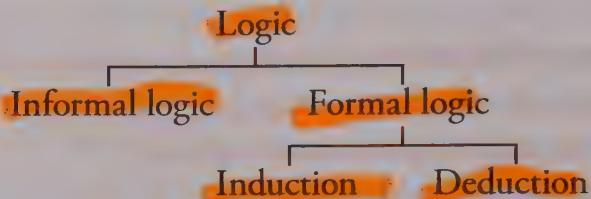
**KEY POINT**

Genus and species charts can be drawn very differently depending on the principle used to divide and categorize terms.

Food can be considered a species of *material* (if it is defined as “edible material”), and so on.

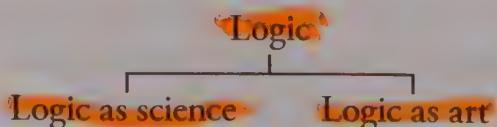
One caution: do not confuse the genus and species hierarchies of logic with the similar hierarchy you may have learned in biology. In logic, there are no levels other than genus and species—no family, order, class, phylum, or kingdom.

Now look at the genus and species hierarchy for the term *logic*.



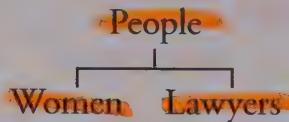
Two types of logic are identified as species: informal and formal. These species are **mutually exclusive**—they do not overlap. No branch of logic is both formal and informal. They are also **exhaustive**—no other types of logic exist. Theoretically, every genus can be divided into species that are both mutually exclusive and exhaustive. And while the species must be mutually exclusive, in practice they are rarely exhaustive. Are induction and deduction an exhaustive list of the types of formal logic?

In the chart above, logic is divided into *formal* and *informal* logic. The dividing principle there is, “How directly related to reasoning is the term?” Logic that deals directly with reasoning is formal, while logic that is more indirectly related to reasoning is informal. Other dividing principles could have been used which would result in a different chart, such as “What is the product or goal of the term?” In one case, for logic, the goal might be to discover and classify the rules of reasoning. In this case we would be considering the *science* of logic. In another case, the goal might be to produce persuasive arguments, which would mean we are considering the *art* of logic. Thus the chart would be:



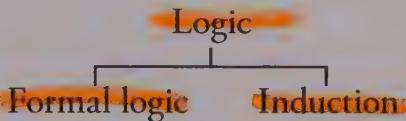


There are several types of errors which we need to avoid while constructing genus and species charts. The first error was already mentioned: species which overlap, meaning that they are not mutually exclusive. Such an error exists in this chart:



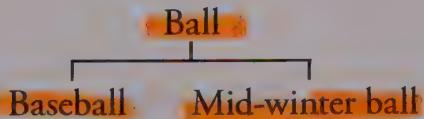
This is an error because the species overlap: some women are lawyers. The error was caused by using two different dividing principles for the term *people*: division by gender and division by profession.

A similar error would occur when a term appears at the wrong level in the chart, such as in this example:

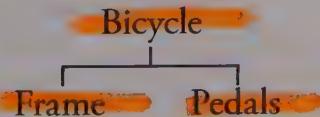


Here the species overlap because induction itself is a species of formal logic, and thus should appear beneath it.

Another error can occur if a chart is being produced for an ambiguous word, with two different definitions in mind for the same word. For example, consider the word *ball*. This word could be taken in two senses: as a round toy, or as a kind of formal dance. This ambiguity could result in the following faulty chart:



Finally, remember that a species is not a part of the genus, but rather a type or kind of that genus. The species of the genus *bicycle* may include *mountain bike*, but not *handlebars*. So when asked to make a genus and species chart, do not make a “whole to parts” chart like this:



THINKING DEEPER.

If the process of finding a further genus for any genus cannot continue indefinitely, it is reasonable to ask, What is the highest possible genus? If the genus of food is material, what is the genus of material? Possibilities include matter, substance, being, and so on. All of these are things created. But anything not created is God, since God alone is uncreated. Thus we are led to what theologians call the “Creator/creature distinction”: all things are either Creator, or something created by the Creator. These are the highest genera of things. More could be said about the highest genus of abstractions (like *logic*), verbs (like *to run*), and so on.



CAUTION

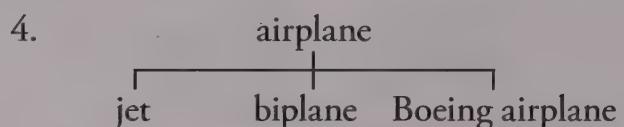
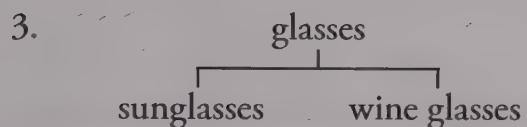
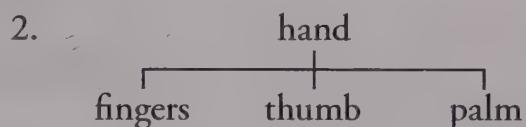
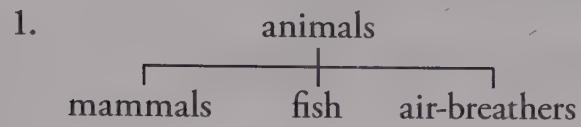
Watch out for these basic errors when drawing genus/species charts: overlapping species, ambiguous terms, and confusing genus/species with part/whole.

SUMMARY

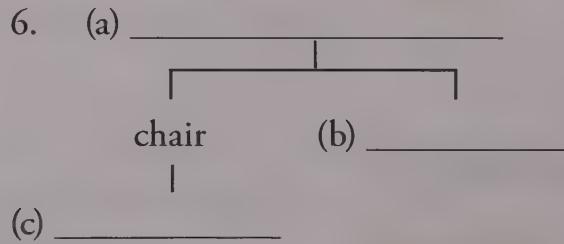
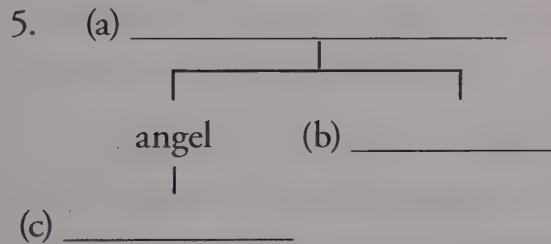
Terms can be organized into genus and species charts. A genus is a category into which a given term fits. A species is a type, kind, or example of a given term. Species should be mutually exclusive, and may be an exhaustive list.

Exercise 2 (20 points)

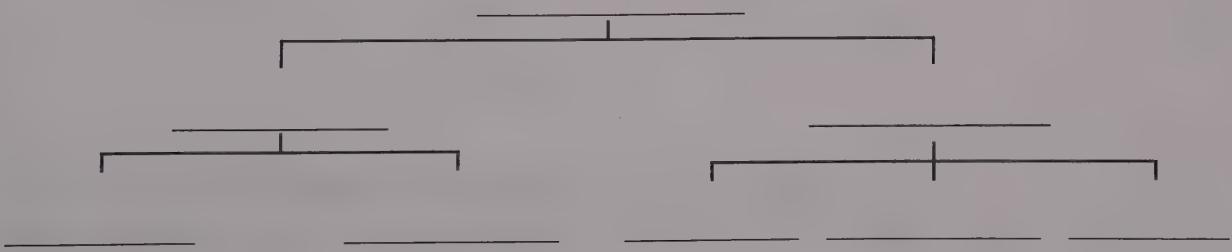
Explain the error or problem with each genus and species hierarchy shown.



Fill in the genus and species hierarchy for each term given, identifying a) a genus for the term, b) another species under that genus, and c) a species of the term.



7. Draw a genus and species hierarchy that includes the following terms: ALGEBRA, BIOLOGY, CHEMISTRY, GEOMETRY, MATH, PHYSICS, SCIENCE, SUBJECT

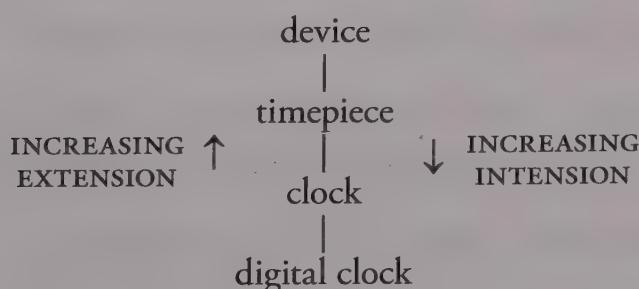


EXTENSION AND INTENSION

Two concepts closely associated with genus and species charts are extension and intension. The **extension** of a term is the sum of all the individual objects to which the term applies. Thus the extension of the term *book* is the set of all books—all novels, dictionaries, textbooks, manuals, etc. The extension of the term *helmet* would include every football helmet, bicycle helmet, space-suit helmet, and any other helmet imaginable.

All the objects included in the extension of a term have certain attributes in common. If they did not, we could not identify them with one term. The sum of the common attributes of a term is the **intension** of the term. Thus the intension of *book* would include attributes such as: having pages, on which words are written, which are bound together by some means. The intension of *helmet* would include these attributes: fitting on the head, resisting impact, made of protective material, and so on.

Extension and intension are inversely related. Given almost any genus and species chart, as you work your way up the chart, the extension of each term is greater than the previous terms, but the intension is smaller. Consider the hierarchy shown below:



The term *clock* has a greater extension than the term *digital clock*—that is, there are more clocks than there are digital clocks, because



DEFINITIONS

The **extension** of a term is the sum of all the individual objects described by it.

The **intension** of a term is the sum of all the common attributes denoted by the term.



KEY POINT

Extension and intension are inversely related.



THINKING DEEPER

It is possible to increase intension without simultaneously decreasing extension. For example, if we added the attribute *material* to *digital clock*, we have increased intension, but the extension has remained the same, since all digital clocks are material digital clocks. Similarly, since all digital clocks are *less than one mile in height*, adding this attribute would not change the extension. Is it possible to change extension without changing intension?



KEY POINTS

Greater extension means more abstraction; greater intension means more concreteness.

Understanding extension and intension will help you grasp various relationships among terms.

clock not only includes all digital clocks, but all other types of clocks as well. Similarly, there are more timepieces than there are clocks (can you name some?), so the extension of *timepiece* is greater than the extension of *clock*. As you go up a hierarchy, extension increases. However, intension *decreases* as you go up the chart, and increases as you go down. Timepieces have more attributes in common (i.e., a greater intension) than devices, clocks have more attributes in common than timepieces, and so on.

Increasing extension is parallel to increasing abstraction. The more abstract a term is, the greater its extent. *Device* is more abstract than *timepiece*. *To think* is more abstract than *to reason*, and thus would be higher on the genus and species chart, having a greater extension (though applying extension and intension to verbs tends to be more difficult than applying them to nouns).

Similarly, an increase in intension is accompanied by an increase in concreteness. The more attributes a term has, the more concrete it is. *Digital clock* is more concrete than *clock*, which is more concrete than *timepiece*.

The ability to list terms in order of increasing (or decreasing) extension (or intension) is a great help in understanding the relationships among them. Here we have in alphabetical order a number of terms from a genus and species hierarchy:

ANIMAL, APE, GORILLA, LIVING BEING, MAMMAL

Arranged in order of increasing extension (and decreasing intension), this list would look like this:

GORILLA, APE, MAMMAL, ANIMAL, LIVING BEING

Rearranged in order of increasing intension (that is, decreasing extension), the list would simply be placed in reverse order:

LIVING BEING, ANIMAL, MAMMAL, APE, GORILLA

The extension of a term is the sum of all the individual things to which a term applies. The intension of a term is the sum of the common attributes of the term. Extension and intension are inversely related; as extension increases, intension decreases, and vice versa.



Exercise 3 (15 points)

1. Arrange in order of increasing extension:

FIGURE, PLANE FIGURE, POLYGON, RECTANGLE, SQUARE

Figure, plane figure, polygon, rectangle

2. Arrange in order of decreasing extension:

INSTRUMENT, SCIMITAR, CURVED SWORD, SWORD, WEAPON

Scimitar, curved sword, sword, weapon, instrument

3. Arrange in order of increasing intension:

ANCIENT LANGUAGE, CLASSICAL LATIN, COMMUNICATION, LANGUAGE, LATIN

Ancient language, classical Latin, language, Latin, communication

4. Arrange in order of decreasing intension:

BAPTIST, CHRISTIAN, PROTESTANT, RELIGIOUS PERSON, SOUTHERN BAPTIST

Baptist, Southern Baptist, protestant, Christian, Religious person

5. Determine the attribute or characteristic that distinguishes the term from the genus given in parentheses after the term.

TIMEPIECE (DEVICE) Tell time.

CLOCK (TIMEPIECE) clock.

DIGITAL CLOCK (CLOCK) LED display

METHODS OF DEFINING

There are many methods of defining (giving a meaning of) a term. One of these methods, defining by genus and difference, directly relates to the genus and species hierarchies of the last two sections. Before we examine that method, however, we will consider two others that are commonly used.

1. Defining by synonym. When you look in the dictionary for the definition of a word, you often find a synonym (a word with the same meaning) of the word listed. This can be helpful, but only if you already understand the meaning of the synonym. For example, look up *progeny* and you will probably find that it is a synonym of *descendants* or *children*. This is helpful, since you know what these words mean. However, it may not help you to find out that *vicissitude* means *mutability*. We all learned the meanings of words by this method when we were young. “Daddy, what’s *essential* mean?” “Son, *essential* means *necessary* or *important*.”

One limitation of defining by synonym is that many words do not have exact synonyms (indeed, some would argue that no two words mean exactly the same thing). For example, the word *oxygen* has no real synonym, and is best defined by some other method. The same could be said for the terms *bone*, *breakfast*, and *triangle*.

2. Defining by example. Another way children (and adults) are taught the meanings of words is by being given examples of them. A child, upon asking her mother what money is, may be given a penny or shown a dollar bill. My children all learned the meaning of the word *cow* by having cows pointed out to them as we were driving by a field. “Jamie, look at all the cows!”



KEY POINT

There are several methods you can use to define a term. The best method to use may depend on the term and the circumstances.



HISTORY

Though we consider only three, the great Cassiodorus Senator (c. 480–575), in his book *An Introduction to Divine and Human Readings*, identifies no less than fifteen methods of defining terms. In addition to the three this text considers, Cassiodorus lists and explains the following methods: notional, qualitative, descriptive, distinguishing, metaphorical, negation of the opposite, use of image, statement of what is lacking, by way of praise or blame, proportional, relational, and causational.

**CAUTION**

When defining by example, include several differing terms to ensure your definition is complete enough.

**KEY POINT**

Using genus and difference is usually the best way to define a term.

Similarly, one can define words by example by using species of the term. We may define *noble gas* by listing helium, neon, argon, krypton, xenon, and radon. This would be a complete definition. Often, representative samples can give partial (though adequate) definitions. Defining *sickness* by giving chicken pox and the flu as examples will probably meet the need. In general, when defining by example, be sure to include several differing terms.

This method also has some limitations. When a child is shown a typewriter and calls it a computer, he demonstrates the ambiguity of this method. When shown a computer, the child is uncertain as to what part is the meaning of the word *computer*—the keyboard, the screen, or something else. Despite this and similar problems, giving examples is a common means of defining.

3. Defining by genus and difference. This is often the clearest method (though perhaps the most difficult) for defining terms, not being subject to the limitations of defining by synonym or example. In this method, a term is defined by naming its **genus**, and then adding descriptive words that distinguish that term from every other species under that genus—that is, by providing the **difference**. For example, the term *backpack* may be defined as “a bag carried on the back.” The genus is *bag*, the difference is *carried on the back*. The term *logic* has been defined as “the science of reasoning.” The genus is *science*, the difference is *of reasoning*. This difference distinguishes logic from other sciences, such as biology, chemistry, and physics.

To choose a genus, try to determine what kind of thing the term is. What kind of thing is a computer? Is it a tool? A machine? A box? Also, remember that you are not defining words *per se*, which are often ambiguous, but you are defining *terms*, the concepts behind words. When defining *church*, for example, you need to determine if you are considering the body of believers or the building where they meet before you develop a definition. When asked to define a term, only one definition is necessary.

When choosing the difference, remember that you are trying to distinguish the term from every other species under the genus. The difference should *exclude* species that the term does not *include*, and

vice versa. Consider this definition of *battle*: “a hostile encounter between two armies.” The difference “between two armies” excludes battles between ships at sea, among other things, and is thus too narrow. Also note that the difference should be an essential one. A painting is not “a picture drawn on canvas,” but “a picture drawn by means of paint.”

The difference need not come after the genus. “Three-sided polygon” is a good definition of *triangle* by method of genus and difference, even though the difference (*three-sided*) is given first.

You can see that this method of defining is particularly appropriate when the purpose is to show relationships between terms. The examples given in that section were examples of defining by genus and difference.

SUMMARY

Terms may be defined by synonym, by example, or by genus and difference. Terms are defined by genus and difference by stating the genus of the term along with words distinguishing that term from every other species under the genus.



Exercise 4 (24 points)

Define the following terms by listing three examples of each.

1. nation

Egypt
Iraq
United States

2. board game

RISK
Titanic
chess

3. candy

caramel
candy cane
Walgreens

Define these terms by identifying a synonym of each.

4. happy

joyful

5. job

work

6. dinner

supper

Define the following words by genus and difference.

7. brother

male, sibling

8. doe

female, deer

9. whisker

long, cat

10. queen

lady, monarch

11. quiz

short, test

12. idol

Faulsety, God

RULES FOR DEFINING BY GENUS AND DIFFERENCE

Up to this point, we have considered several methods of defining, and you have had some practice defining words by genus and difference. In order to use this method well, we need to keep a few rules in mind.

1. A definition should state the essential attributes of the term.

For any given term, some attributes are essential, while others can be considered merely accidental or superficial. Essential means necessary; i.e., without that attribute, the term would cease to be what it otherwise is. For example, an essential attribute of the term *oven* is its ability to heat. If a device could not heat, it would not be an *oven*. But the fact that ovens are usually shaped like a box is merely accidental (it is possible to have a round oven), and thus this attribute should not be part of the definition of the term.

How can you tell the difference between essential and accidental attributes? First ask, “Would this term cease to be what it is if this attribute were somehow changed or removed?” If changing the attribute would destroy the meaning of the term, that attribute is essential. Secondly, essential attributes tend to be the cause of accidental attributes. Consider the term *shin*. Which attribute is essential: “located on the front of the leg below the knee,” or “often injured in soccer games”? The former is the essential attribute, since it is one cause of the latter.

Also, note that this rule implies that a definition should avoid redundancy. For example, consider this definition of a triangle: “A polygon with three straight sides and three angles.” This definition is redundant in two places: all polygons have straight sides, and any polygon with three sides necessarily has three angles. A better definition for triangle is simply “A polygon with three sides.”



KEY POINT

Using only essential attributes in a definition conveys the most relevant information about the term and avoids redundancy.

**CAUTION**

Avoid using synonyms in definitions that use genus and difference.

**THINKING DEEPER**

We must be careful not to think that once we have produced a proper genus and difference definition we have somehow gotten to the *essence* of the thing defined. This analytic method has value in making our thoughts clear and distinct, but a more synthetic or poetic approach should be considered when we are seeking to fully learn what something is. For example, an analytic definition of *the Word of God* might be “God’s powerful, meaningful self-expression.” But how does the Bible describe the Word of God? Consider Psalm 19: “The law of the Lord is perfect, converting the soul: the testimony of the Lord is sure, making wise the simple....More to be desired are they than gold, yea, than much fine gold: sweeter also than honey and the honeycomb.”

2. A definition should not be circular. The word being defined should not be used as part of the definition. The difficulty this rule seeks to prevent is that circular definitions go nowhere. If a student defines *logic* as “the study of logic,” he hasn’t really given the meaning at all.

This rule is not necessarily broken when part of a word is used in its definition. The definition of *polar bear* as “a white bear that inhabits the arctic regions” is not circular, even though the word “bear” appears in both parts.

This rule generally excludes the use of synonyms. If synonyms are allowed, then define the word by synonym, not by genus and difference.

3. A definition should not be too broad nor too narrow. This rule is violated when a definition includes what it should exclude, or excludes what it should include. Consider this definition for the term *table*: “a piece of furniture consisting of a flat slab of wood fixed on legs.” The problem is that this definition excludes tables made of metal or other material. Its extension is too small. A definition for table that *includes* too much is “a piece of furniture with legs.” This would include chairs, couches, and other things which are not tables.

To check if the extensions of a term and its definition are equivalent, look for counterexamples. Is a *baby* a newborn person? What about a six-month-old baby? Is logic the science of thinking, or are some types of thinking outside the scope of logic?

4. A definition should not be unclear or figurative. Definitions can be unclear for a variety of reasons. A definition may be unclear because it uses words that are ambiguous, vague, or obscure. If you define *ray* as “a light beam,” your definition is ambiguous. Light has several meanings, and so does beam. However, simply rearranging the words in the definition to be “a beam of light” helps to clarify these ambiguities. Defining *year* as “a long period of time” breaks this rule, because the definition is vague. Defining *man* as “a ratiocinative hominid” breaks this rule because both “ratiocinative” and “hominid” are too obscure for most people.

Definitions also may be unclear when the language of the definition is figurative or metaphorical. “*Ray*: a drop of golden sun” is a

figurative definition. Such definitions may be poetic, but they often do not provide a clear meaning for the term.

5. A definition should be stated positively, if possible. Sometimes when trying to define a term we are tempted to say what it *is not*, when we should say what it *is*. Such definitions by process of elimination break this rule. The term *magazine* should not be defined as “a periodical that is not a newspaper.” To define an *isosceles triangle* as “a triangle that is neither equilateral nor scalene” breaks this rule, even though the term and its definition have exactly the same extension.

Some terms are necessarily negative, such as *bald*, *empty*, and *penniless*. The definitions of these would be awkward if written positively, and thus they may be negative without really breaking the rule.

6. A definition should be of the same part of speech as the term. If the term being defined is a noun, then the definition should be a noun. Similarly for the other main parts of speech: verbs, adjectives, and so on. This rule is broken, for example, when *to run* is defined as “faster than walking.” The term is a verb, the given definition is not. Defining *to sew* as “a needle pulling thread” breaks this rule as well—*to sew* is a verb, “a needle pulling thread” is a noun.

A similar error occurs in this definition of *to run*: “when you go faster than walking.” Is *to run* a time? Of course not, so don’t use the word *when*. Similar problems often crop up when the words *who*, *what*, *where*, *why* and *how* appear in definitions. These are best avoided, if possible.



KEY POINT

Try to avoid negative definitions, but recognize that they are sometimes necessary.



CAUTION

The use of words like *where* and *when* in a definition usually signals a problem with the definition.

SUMMARY

When terms are defined by genus and difference, certain rules should be followed. A definition should 1) state the essential attributes of the term, 2) not be circular, 3) not be too broad or too narrow, 4) not be unclear or figurative, 5) be stated positively if possible, and 6) be of the same part of speech as the term.



Exercise 5 (54 points)

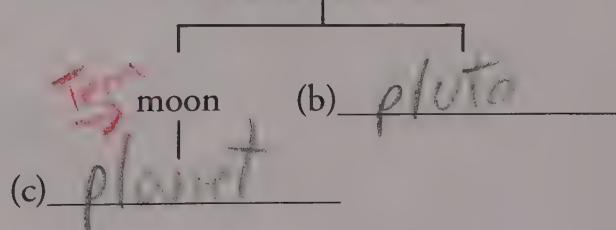
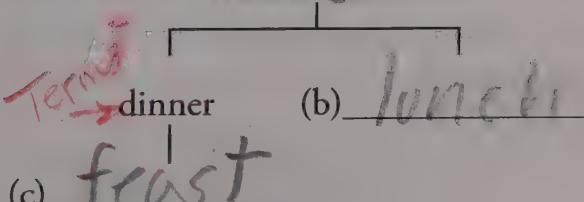
Identify the rule(s) broken by circling the correct number(s). Use the numbers in the following list: **A definition should** (1) *State the essential attributes of the term*, (2) *Not be circular*, (3) *Not be too broad or too narrow*, (4) *Not be unclear or figurative*, (5) *Be stated positively if possible*, and (6) *Be of the same part of speech as the term*.

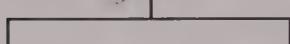
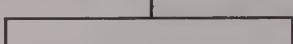
DEFINITION1. *Mountain*: A natural object bigger than a hill.**RULE #S BROKEN**1 2 **3** 4 5 62. *Wife*: Adam's rib.(1) 2 3 **4** 5 63. *Brick*: Dried clay shaped into a brick.1 **2** 3 4 5 64. *Rectangle*: The shape of a typical textbook.

(1) 2 3 4 5 6

5. *Headache*: When your head hurts.1 2 **3** 4 5 66. *Capitalist*: A person who is not a socialist.1 2 **3** 4 **5** 67. *To hate*: How you feel when you don't like something.(1) 2 **3** 4 5 68. *Carpet*: Floor covering.(1) 2 **3** **4** 5 69. *To float*: To hover.(1) 2 **3** 4 5 610. *Bag*: A pliant repository.1 2 3 **4** 5 611. *Large*: Something that is not small.1 2 3 4 **5** **6**12. *Life*: A roller coaster that we all ride.(1) 2 3 **4** 5 6

Fill in the genus and species hierarchy for each term given, identifying a) a genus for the term, b) another species under that genus, and c) a species of the term.

13. (a) Meal14. (a) Satellite

15. (a) Time telling devicewristwatch (b) wall clock(c) Rolex watch16. (a) furniturebed (b) couch(c) King size bed17. (a) to giveto teach (b) to feed(c) to tutor18. (a) to talkto pray (b) to whisper(c) to meditate

Define the following terms by genus and difference, using the same genus from any corresponding terms in the charts above. Be careful not break any of the rules!

19. dinner A feast at the end of the day.20. moon A satellite that orbits around the earth.21. wristwatch A time teller that fits on your wrist.22. bed A piece of furniture with a mattress on it.23. to teach To give knowledge to students.24. to pray To talk to God in secret.

REVIEW QUESTIONS

Answers can be found in the lesson under which the questions are listed.

Introduction

1. What is reasoning?
2. Why has God given men the ability to reason?
3. What is formal logic? In what way is logic an “attribute” of God?
4. What is the Law of Excluded Middle?
5. What is the Law of Identity?
6. What is the Law of Non-contradiction?
7. How does formal logic differ from informal logic?
8. What are some of the topics dealt with under informal logic?
9. What are the two branches of formal logic?
10. What are some differences between *induction* and *deduction*?
11. What are two branches of deduction?
12. Who first developed categorical logic, and when did he live?
13. What is one difference between *categorical logic* and *propositional logic*?
14. What are the branches of logic dealt with in this book?

Lesson 1: The Purposes and Types of Definitions,

1. What is a term?
2. What is the connection between a *term* and a *word*?
3. What does it mean to define a term?
4. What are six purposes for defining terms?
5. What are the five types of definitions?
6. Which types would you likely find in a dictionary?
7. What is an ambiguous word?
8. What is a vague word?
9. What is a lexical definition?
10. What is a precising definition?
11. What is a stipulative definition?

12. What is a theoretical definition?
13. What is a persuasive definition?

Lesson 2: Genus and Species

1. What is a genus?
2. What is a species?
3. Can a term be both the *genus* of one term and the *species* of another?
4. What are some of the common errors made in constructing genus and species charts?

Lesson 3: Extension and Intension

1. What is the extension of a term?
2. What is the intension of a term?
3. How are *extension* and *intension* related in any given genus and species chart?

Lesson 4: Methods of Defining

1. What are three methods of defining terms?
2. Do other methods exist?
3. What are some limitations of defining by synonym?
4. What are some rules for defining by example?
5. How is a term defined by genus and difference?

Lesson 5: Rules for Defining by Genus and Difference

1. What are the six rules for defining by genus and difference?
2. Can you restate these rules in your own words?
3. What is the difference between an *essential* and an *accidental* attribute?
4. What are three ways that a definition can be unclear?

UNIT 1 REVIEW

REVIEW EXERCISES

Students may do these exercises for further review of this unit.

Lesson 1: Additional Exercises

1. Write (or find) lexical definitions for the following pairs of words that will show the relationship between them. Explain the relationship: How are the words similar? How are they different?

a) brother: _____

sister: _____

relationship: _____

b) circle: _____

sphere: _____

relationship: _____

c) newspaper: _____

magazine _____

relationship: _____

- d) breakfast: _____
dinner: _____
relationship: _____

- e) blind: _____
deaf: _____
relationship: _____

- f) huge: _____
tiny: _____
relationship: _____

- g) to punch: _____
to slap: _____
relationship: _____

- h) to walk: _____
to run: _____
relationship: _____

Questions 2–5: Identify the type of definition used for the underlined word in the paragraph.

2. Consider the following description of Noah's ark: "Noah's ark was big. What do I mean by big, you ask? Well, the ark had a volume of about one and a half million cubic feet!"

3. Rabbits were introduced to a small, populated island where they had no natural predators, and they rapidly overran the town there. In a letter to the editor, one citizen argued for their elimination, saying that "a rabbit is just a fuzzy rat!"

4. In the book *The Structure of Scientific Revolutions*, the author Thomas Kuhn writes, "In this essay, 'normal science' means research firmly based upon one or more past scientific achievements, achievements that some particular scientific community acknowledges for a time as supplying the foundation for its further practice."

5. In an editorial to the *London Times* titled "What is Relativity?" (November 28, 1919), Albert Einstein wrote, "The most important upshot of the special theory of relativity concerned the inert mass of corporeal systems. It turned out that the inertia of a system necessarily depends upon its energy-content, and this led straight to the notion that inert mass is simply latent energy."

6. Read the short story "The Most Dangerous Game" by Richard Connell (if you do not have a copy, you may be able to find it on the Internet). In the title, the word *game* is purposely ambiguous. Write your own lexical definitions for both meanings.

7. Consider the following ambiguous words. Think of at least three different meanings or definitions (including different parts of speech) for each.

age _____

check _____

class _____

date _____

face _____

fair _____

fine _____

head _____

light _____

UNIT ONE: TERMS AND DEFINITIONS

mean

point

race

round

scale

top

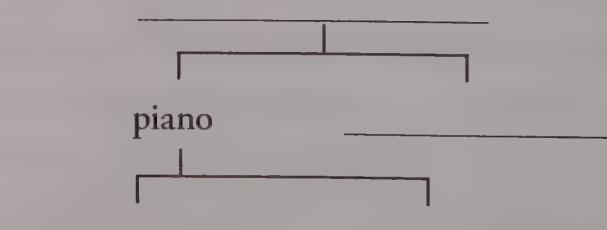
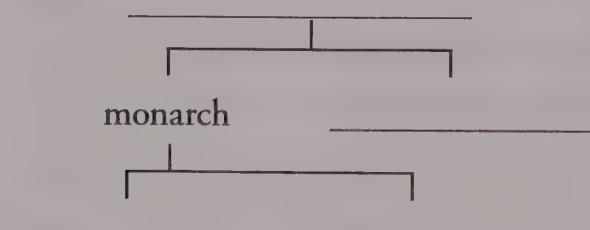
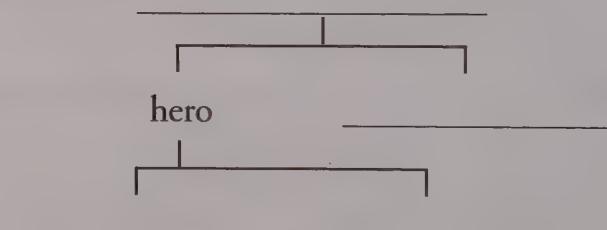
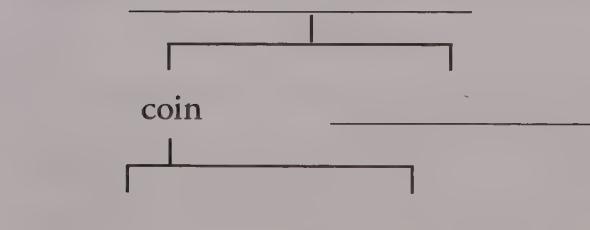
3. Can you think of some words that have only *one* meaning?

9. Do some research, either in a new dictionary or on the Internet, and discover some words that have recently been adopted into standard English. Where did the words originate?

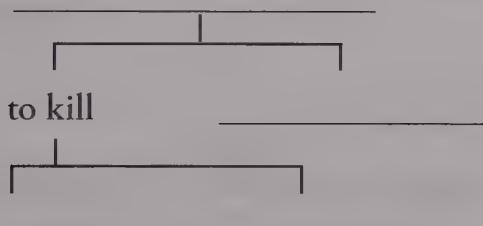
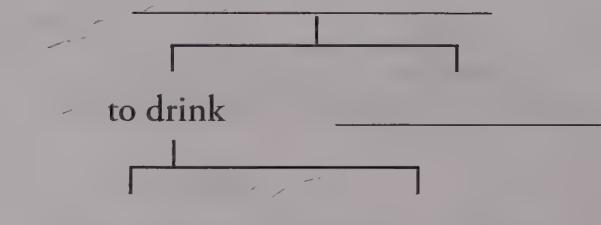
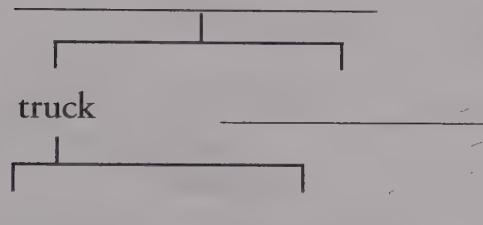
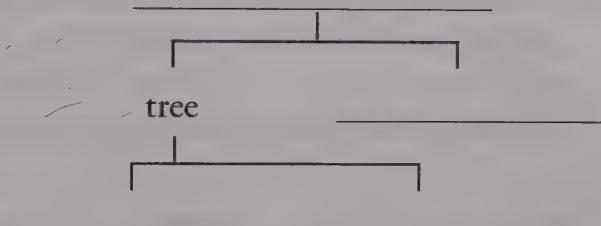
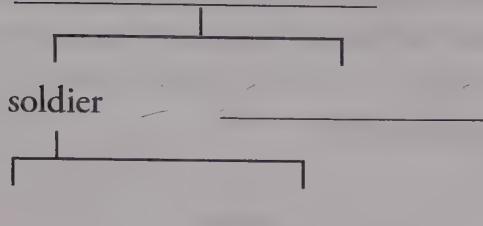
Lesson 2: Additional Exercises

1. Explain how the words *genus* and *species* are related to the words *general* and *specific*.

2. Create genus and species charts for the following terms. Include a genus for the given term, another species under that genus, and two species for the given term.



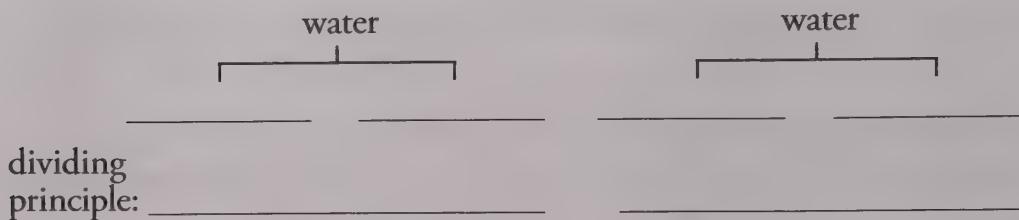
UNIT ONE: TERMS AND DEFINITIONS



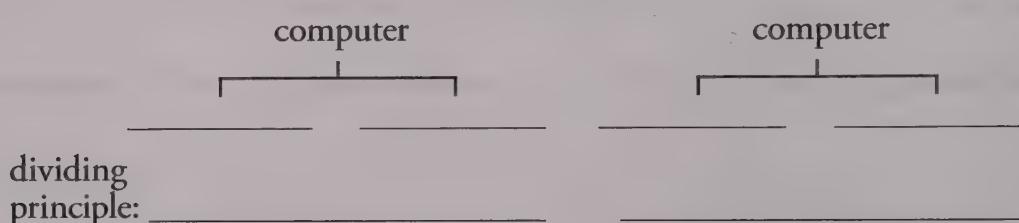
3. Consider the examples of proper genus and species charts in Lesson 2 and Exercise 2. In the space below, expand one of these charts by 1) introducing a new, higher genus, 2) introducing new, lower species, and 3) including more species to broaden the chart. For more practice, create additional charts on blank paper.

4. In a genus and species chart, different species may be produced for a given term depending on the dividing principle being used (as the species of logic could be *formal* and *informal*, or *art* and *science*). For each of the given terms, produce two sets of species, and identify what dividing principle you are using.

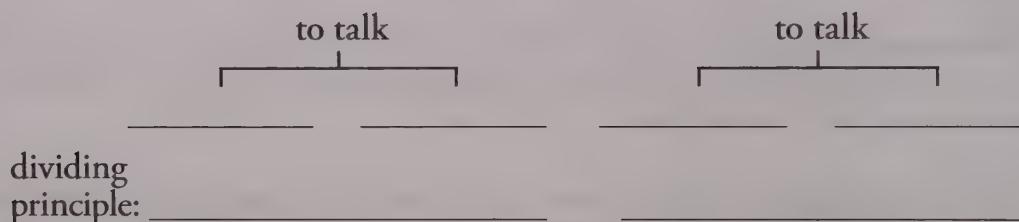
a)



b)



b)



5. Create a genus and species chart that includes the following terms (and additional terms as needed): *book of the Bible*, *epistle*, *Genesis*, *Gospel*, *Hebrews*, *Jonah*, *Luke*, *Matthew*, *New Testament book*, *Romans*.

What term or terms did you need to introduce to complete this chart? Do the terms at a given level “line up” properly?

Lesson 3: Additional Exercises

1. Arrange these terms in order of increasing extension: *banquet, dinner, formal dinner, meal, wedding banquet.*

2. Arrange these terms in order of increasing intension: *brother, child, human, sibling, twin brother.*

3. Arrange these terms in order of decreasing extension: *airplane, fighter, jet, F-14, vehicle.*

4. Arrange these terms in order of decreasing intension: *body, celestial body, gas giant, Jupiter, planet.*

5. Consider the term *gas giant* from the above list. Would adding the adjective *ringed* (i.e., *ringed gas giant*) change the extension? Would it change the intension?

6. For each of the following, determine the attribute or characteristic that distinguishes the term from the genus of the term given in parentheses: *term (word), idol (god), whisker (hair), fang (tooth), nightmare (dream), to accelerate (to move).*

term (word) _____

idol (god) _____

whisker (hair) _____

fang (tooth) _____

nightmare (dream) _____

to accelerate (to move) _____

7. Consider the second chapter of the epistle of James. What distinguishes *saving faith* from mere *belief*?
-
8. Develop a list of four verbs arranged in order of increasing intension.
-

Lesson 4: Additional Exercises

1. Define each of the following terms by synonym, example, and genus and difference. Limit your synonyms to only one word, and include a variety when defining by example.

a) father synonym: dad
 examples: Bill is Ken's father.
 John Kenneth Nichols is James' father.
 genus & difference: male & parent

b) ghost synonym: spirit
 examples: The ghost of Christmas past showed him the past.
 The ghost of Christmas future showed him
 genus & difference: _____

UNIT ONE: TERMS AND DEFINITIONS

c) house synonym: _____
examples: _____

genus & difference: _____

d) human synonym: _____
examples: _____

genus & difference: _____

e) monarchy synonym: _____
examples: _____

genus & difference: _____

f) hoop synonym: _____
examples: _____

genus & difference: _____

2. Another common method of defining terms is by etymology, in which the original language root of the word is used to clarify the meaning. For example, *monarchy* comes from the Greek *mon + arche*, meaning “one ruler.”

architect _____

manuscript _____

peninsula _____

submarine _____

telegram _____

translucent _____

3. Be attentive to words being defined by your teachers or parents, in the books that you read, or in sermons that you listen to. What other methods of defining terms, if any, do they use?
-
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Lesson 5: Additional Exercises

1. What is the primary rule broken by each of the following definitions?

Chair: a four-legged piece of furniture. _____

Chess: a game played on a checkered board. _____

Chick: juvenile poultry. _____

Salad: not a main dish and not a dessert. _____

To shake: a rapid back and forth motion. _____

To think: to think about something. _____

Variety: the spice of life. _____

Wood: hard material burned in fireplaces. _____

2. Write proper genus and difference definitions for the following terms:

chair _____

coin _____

to drink _____

pebble _____

salad _____

to snore _____

to throw _____

wood _____

year _____

3. The following terms are rather “negative.” Write genus and difference definitions for each of them. Can you define them positively?

absence _____

death _____

empty _____

ignorance _____

infinite _____

sin _____

4. Consider the song “Do, Re, Mi” from the movie *The Sound of Music*. If the definitions given in the song were considered serious, which would be good definitions by genus and difference? Of those which would be improper definitions, which rules are broken?

do (doe), “a female deer”: _____

re (ray), “a drop of golden sun”: _____

mi (me), “a name I call myself”: _____

fa (far), “a long, long way to run”: _____

so (sew), “a needle pulling thread”: _____

la, “a note to follow ‘so’”: _____

ti (tea), “a drink with jam and bread”: _____

5. Read the children’s book *A Hole is to Dig*. What primary rule is broken by most of the definitions in that book?
-

6. In Galatians 5:22–23, Paul lists the fruit of the Spirit. Do the terms have a common genus? Write a genus and difference definition of each term that clarifies the distinctions between them.

genus: _____

love: _____

joy: _____

peace: _____

patience: _____

kindness: _____

goodness: _____

faithfulness: _____

gentleness: _____

self-control: _____

7. Can *God* be defined by a genus and difference definition? Consider the answer to question 4 in the Westminster Shorter Catechism, “What is God?”: “God is a Spirit, infinite, eternal, and unchangeable, in his being, wisdom, power, holiness, justice, goodness, and truth.” Compare this to how the Bible defines or describes God.
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UNIT 2

STATEMENTS AND THEIR RELATIONSHIPS

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STATEMENTS

A **statement** is a particular kind of sentence that brings a message that can be said to be either true or false. Here is an example of a true statement:

The apostle Paul wrote the book of Galatians.



DEFINITION

A *statement* is a sentence that is either true or false.

But statements can also be false. Here is an example:

The apostle Paul wrote the book of Isaiah.

In evaluating statements, we should be looking for their truth value. The first statement above has a **true** truth value. The second sentence is said to have a **false** truth value. If a sentence has no truth value, then it is not a statement at all. The following are *not* statements:

Who wrote the book of 1 Timothy?

Husbands, love your wives as Christ loved the church.

The first sentence is a **question**, and consequently has no truth value. It is neither true nor false, and therefore is not a statement. The second sentence is a **command**. It also has no truth value, and is not a statement.

There is another kind of sentence that requires a little more care. It has the form of a statement, but it is not a real statement. Again, the instrument used to determine this is whether the sentence has a truth value. For example:

The round square sweetly kicked the green yesterday.



KEY POINT

Questions, commands, and nonsense sentences are not statements because they do not have a truth value.



FURTHER STUDY

What we call nonsense here—"This statement is false"—has a long history. It is also known as "The Liar Paradox." For a more detailed discussion of this paradox, read Keith Devlin's book *Goodbye, Descartes* (published by John Wiley & Sons).

This looks like a statement, but it cannot even be said to be false. It doesn't refer to anything. It is best described as **nonsense**.

Another example of nonsense is this:

This sentence is false.

Is this true? Then it is false, and therefore true. Is it false? It is therefore true, and consequently false. Again, there is no real truth value here. This sentence cannot be identified as either true or false. It is therefore not a statement, at least not the kind of statement that we can legitimately use in logic.

One caution: ridiculously false statements, such as "The queen is a man" or "Dogs grow two heads when tickled" are *not* nonsense. They have a truth value—false—so they are statements.

SUMMARY



A statement is a sentence that is either true or false. Other kinds of sentences that have no truth value—such as questions, commands, and nonsense—are not statements.

Exercise 6 (12 points)

Examine the following sentences and determine whether or not they are statements. In the space provided, write down *true statement*, *false statement*, *question*, *command*, or *nonsense*. Be careful.

1. Jesus healed blind men. _____
2. King David was the first king of Israel. _____
3. The tongues of flame at Pentecost were water. _____
4. Who wrote the book of Hebrews? _____
5. Children, obey your parents. _____
6. The Bible is the Word of God. _____
7. The Great Pyramid is six feet high. _____
8. Who said slaves should obey their masters? _____
9. How old was Jesus when He was baptized? _____
10. The slithy toves did gyre and gimble. _____
11. Believe the good news. _____
12. The United States has fifty states. _____

Challenge: Write a nonsense sentence that uses correct grammar.

SELF-SUPPORTING STATEMENTS

Once we have determined that a sentence is a statement, a further distinction can be made between **self-supporting statements** and **supported statements**. This distinction depends upon the means by which the truth value of the statement is determined. We will begin with self-supporting statements, which are statements that have immediately apparent truth values. We do not need to consider information outside of the statements to determine their truth values. Self-supporting statements can be divided into three categories:

1. Self-reports. A self-report is a statement by a person concerning his or her own desires, beliefs, or feelings. We usually do the charitable thing and take such a statement as true. For example,

I believe that Jesus is the Son of God.

The statement refers to the belief of the speaker; it does not primarily refer to whether Jesus is in fact the Son of God. In other words, the statement could be taken as true, even if Christianity were false. An atheist can acknowledge that it is true that the speaker believes that Jesus is the Son of God.

2. Statements that are true or false by logical structure. This is a statement that can be seen to be true or false by how the sentence is put together. For example,

Jesus is the Son of God, or He is not the Son of God.

This statement is necessarily true. It cannot be false, because it covers all the possibilities. A statement which is true by logical structure is called a **tautology**. Other statements are necessarily false. For example,



DEFINITION

A *self-supporting* statement is a statement whose truth value can be determined from the statement itself.



DEFINITION

A *tautology* is a statement that is always true by logical structure.



DEFINITION

A *self-contradiction* is a statement that is false due to its logical structure.

Jesus is the Son of God, and He is not the Son of God.

This is an example of a **self-contradiction**, a statement that is false by logical structure.

3. Statements that are true or false by definition. Some statements are necessarily true or false because of the definitions of the words in the sentence. For example,

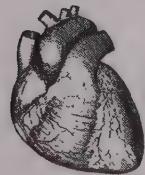
All triangles are three-sided figures.

This is necessarily true—it is true by definition. The following example is a statement that is false by definition.

This triangle is an octagon.

According to the definitions of *triangle* and *octagon*, the statement is necessarily false.

SUMMARY



Self-supporting statements are statements for which we need no outside evidence to determine their truth value. There are three types: self-reports, statements that are true or false by logical structure, and statements that are true or false by definition.

Exercise 7 (25 points)

1. List below five examples of a phrase that would introduce a self-report, such as, “It is my opinion that . . .”

2. List below five statements of your own that are true or false by logical structure. Include at least one tautology and one self-contradiction.

3. List below five statements that are true or false by definition. Include at least one true statement and one false statement.

SUPPORTED STATEMENTS

The other kind of statement is called a **supported statement**. A supported statement does not stand or fall by itself. It requires evidence from outside investigation before it can be declared true or false. Below are three examples of supported statements.

*Solomon had a treaty with Hiram.
It is raining outside.
The leaning tower will fall down.*

These are obviously statements; they are not questions or commands, and they can be said to be either true or false. But in order to determine the truth value of any of these statements, it is necessary to go outside the statement. We must gather some information before declaring them to be either true or false.

One source of this information is **authority**. How do we know if Solomon had a treaty with Hiram? Because we cannot travel back in time, we would have to look to some trustworthy, authoritative source, such as the Scriptures. Many of the truths we learn in school are supported by authority. Can you think of others?

A second source of information is **experience** or **observation**. Consider the statement “It is raining outside.” Is that statement true or false? The way to find out is to look outside in order to increase your experience. When we determine the truth value of statements by experience, we are trusting not an outside source but our own senses: sight, touch, taste, smell, or hearing.

A third way to determine the truth value of a supported statement is by **deduction**, in which we reason to some conclusion based on other statements. How do we know that the leaning tower will fall down? We might reason this way: “All man-made structures will



DEFINITION

A *supported statement* is a statement whose truth value depends on evidence or information from outside itself.



KEY POINT

Some ways to determine a supported statement’s truth value include authority, experience, and deduction.

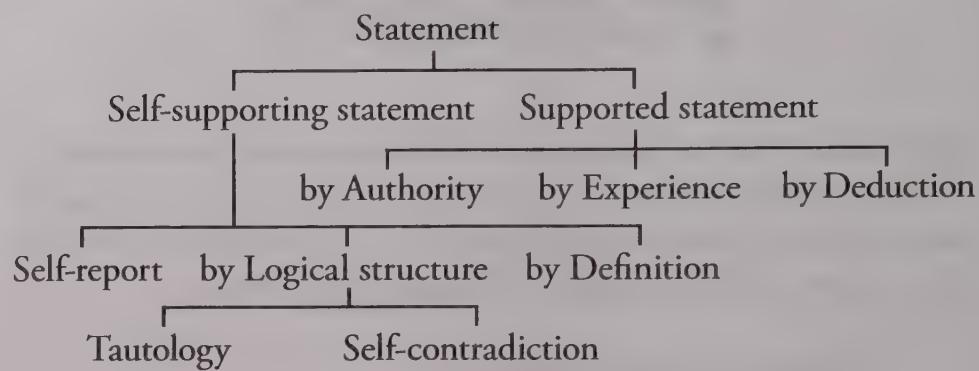


FURTHER STUDY

In his text *Logic*, the hymn writer and logician Isaac Watts identifies and describes six methods “whereby truth is let into the mind.” These are: 1) the evidence of the senses (that is, by experience), 2) inward consciousness (similar to self-report), 3) intelligence (knowledge of self-evident propositions), 4) reasoning, 5) evidence of faith (that is, by authority), and 6) direct inspiration by God.

eventually fall down. The leaning tower is a man-made structure, so the leaning tower will fall down.”

All the different types of statements we have studied so far can thus be organized into the following chart.



SUMMARY



Supported statements require one to collect information in order to determine their truth value. Such information can be collected in one of several ways, including looking to authority, experience, or deductive reasoning.

Exercise 8 (15 points)

Examine each of the following statements. In the blank at the right, enter the type of statement you believe it to be. Your options are *self-report*, *tautology*, *self-contradiction*, *true by definition*, *false by definition*, and *supported*. If the answer is supported, give the method used to support it.

1. The snow is deep.
2. I think Socrates was a wise man.
3. Paul was an apostle, and he wasn't.
4. Jericho fell to the invading Israelites.
5. I believe Paris really loved Helen.
6. A square has five sides.
7. The book of Genesis has fifty chapters.
8. Jesus is God, or He is not God.
9. Jesus is God, and He is man.
10. I think the snow is deeper than last year.
11. Jeremiah was a reluctant prophet.
12. My mother is a woman.
13. It either works, or it doesn't.
14. Dante was a poet.
15. The New Testament was written in Greek.

RELATIONSHIPS BETWEEN STATEMENTS

We now need to examine some relationships between statements. Self-supporting statements and supported statements both can be related to other statements in many different ways. There are four major relationships with which we are concerned.

1. Consistency. When two statements can be true at the same time, we say they are **consistent**. For example, these two statements are consistent.

Paul was an apostle.

The apostle Paul was never in Germany.

These statements are consistent because there is no conflict between them. Consequently, they can both be true at the same time. If there is a conflict between the statements, then they are **inconsistent**.

For an example of inconsistency, we may consider these:

The apostle Paul was never in Germany.

The apostle Paul spent his life in Germany.

It is not possible for both these statements to be true. If he was never in Germany, then he could not have spent his life there. The statements are therefore inconsistent.

2. Implication. Two statements are related by **implication** when the truth of the first requires or necessitates the truth of the second. If statement P implies statement Q, and if statement P is true, then statement Q must also be true. The following is an example of an implication.

P: All Christians are followers of Jesus Christ.

Q: Some Christians are followers of Jesus Christ.



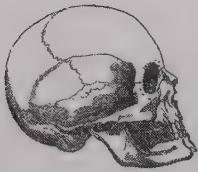
DEFINITION

Two statements are *consistent* if they can both be true at the same time.



DEFINITION

Two statements are related by *implication* if the truth of one requires the truth of the other.



CAUTION

In logic, “Some S is P” does not imply that “Some S is not P.”



DEFINITION

Two statements are *logically equivalent* if they imply one another.

He who says *P* must also say *Q*. This is because *P* implies *Q*. It would not be possible for someone to maintain that all Christians were followers of Christ, but that on the other hand some were not.

Many students of logic get confused over the use here of the word *some*. In common conversation, we tend to contrast “*some*” with “*others*.” That is, to say that *some Christians are followers of Jesus Christ* implies (we think) that *other Christians are not followers of Jesus Christ*. But in logic, when we say that *some S are P*, we are saying nothing about whether other *S* are *P*.

Notice that, if two statements are related by implication, then they are also necessarily consistent.

3. Logical equivalence. If two statements are **logically equivalent**, then the first must imply the second, and the second must imply the first. If they are logically equivalent, then both statements must be true, or they must both be false. It is not possible for one to be true and the other false. For an example, we may look at these:

P: No Christians are Buddhists.

Q: No Buddhists are Christians.

If *P* is true, then *Q* must also be true. And if *Q* is true, then *P* must be true. They both imply the other. In this case, they are both true. If we substituted the word *Americans* for *Buddhists*, then both statements would have been false. It is false that no Americans are Christians, and it must also be false that no Christians are Americans.

Similarly, these two statements are logically equivalent:

P: Some mammals are egg-layers.

Q: Some egg-layers are mammals.

Statements either of the form *No S is P* or of the form *Some S is P* are equivalent to the statements produced when the subject and predicate of each are reversed. We will consider these and other types of equivalent statements in more detail later.

4. Independence. If the truth or falsity of one statement has nothing at all to do with the truth or falsity of another statement, we say

they are **independent**. There are two indications we may use to help determine if statements are independent: first, neither statement can imply the other, and second, the statements must be consistent.

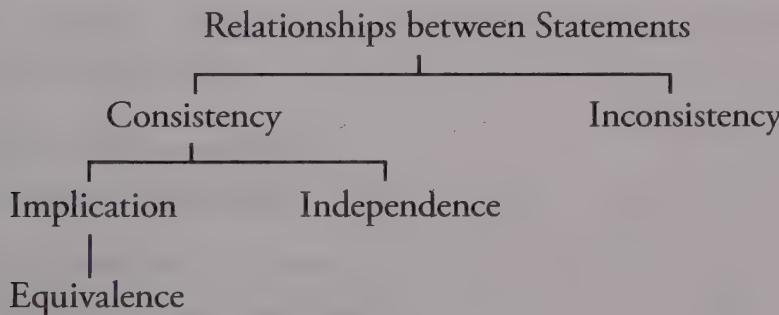
In other words, neither statement can necessitate the truth of the other statement (implication), and neither statement can necessitate the falsity of the other (inconsistency). Here are two statements that are independent.

All Christians have had their sins forgiven.

All tricycles have three wheels.

If one statement implies another, then the two are not independent. If one statement contradicts another, then the two are not independent. In this case, neither statement implies the other, and neither statement conflicts with the other. The truth value of one has no impact on the truth value of the other; hence these statements are independent of each other.

All these relationships can be organized as shown:



We will expand this chart as we learn about other relationships.



DEFINITION

Two statements are *independent* if the truth or falsity of one has no effect on the truth or falsity of the other.

SUMMARY

Four basic relationships between statements are consistency, implication, logical equivalence, and independence. Any two statements can be examined in order to determine whether these relationships apply.



Exercise 9 (20 points)

With the following five sets of statements, circle Y if the statements are consistent, and circle N if they are not consistent.

1. The sun is hot.
The moon is white. Y N
2. Paul was the author of Romans.
Peter was the author of Romans. Y N
3. Sally told a lie once.
Sally usually tells the truth. Y N
4. All fish have fins.
Some fish do not have fins. Y N
5. God knows all things.
God does not know all things. Y N

For the next five sets of statements, circle Y if the first sentence implies the second, and circle N if it does not.

6. God created everything.
God created porcupines. Y N
7. All watermelons are green.
Some watermelons are green. Y N
8. Honey is sweet.
I hate honey. Y N
9. The Bible is the Word of God.
Ecclesiastes is the Word of God. Y N
10. Some trees are tall.
All trees are tall. Y N

Continued on next page.

Now seek to determine whether the statements in these sets are logically equivalent. If they are equivalent, circle Y; if not, circle N.

11. No Baptists are Americans.
No Americans are Baptists. Y N

12. All dogs are four-legged animals.
All four-legged animals are dogs. Y N

13. No apples are oranges.
No oranges are bananas. Y N

14. Some apostles were Scripture-writers.
Some Scripture-writers were apostles. Y N

15. No windmills are giants.
No giants are windmills. Y N

Lastly, examine these sets to determine independency. Circle Y if the statements are independent; circle N if they are not independent.

16. The typewriter is broken.
Obadiah is my favorite book. Y N

17. Logic is hard.
Spanish is hard. Y N

18. God created all the stars.
God created this star. Y N

19. Some triangles are yellow.
Some tricycles are red. Y N

20. Alan wrote this poem.
Alan has written no poems. Y N

Continued on next page.

Challenge: Consider these two statements: *Some soldiers are painters.* *Some soldiers are not painters.* Answer the following questions, explaining your answers.

Are these statements consistent?

Does the first imply the second?

Are they equivalent?

Are they independent?

CONSISTENCY AND DISAGREEMENT

Sometimes the consistency of statements is difficult to determine. Two statements may appear to be inconsistent, but upon close examination they turn out to be consistent. When there appears to be inconsistency, we have a **disagreement**. There are three kinds of disagreements that concern us here.

1. Real disagreements. This is an actual inconsistency. Both statements cannot be true at the same time. For example:

*Jesus is the Son of God.
Jesus is not the Son of God.*

Between these two statements there is real disagreement. Jesus cannot be both the Son of God and not the Son of God.

2. Apparent disagreement. Apparent disagreements are frequently the result of differences of opinion or perception. For example:

*SMITH: I think logic is easy.
JONES: I think logic is the hardest course I have ever taken.*

Of course there is no true disagreement here. Both statements are self-reports, and both can therefore be taken as true without contradiction: it can be true that Smith thinks logic is easy at the same time that Jones thinks logic is hard. There is a difference of opinion, but there is no logical contradiction.

3. Verbal disagreement. When different definitions are used for the same words (that is, when words are vague or ambiguous), verbal disagreements can result. This does not necessarily mean that there is true inconsistency. For example:



KEY POINT

Sometimes statements may seem inconsistent but actually are not.



DEFINITIONS

A *real disagreement* is an actual inconsistency between two statements: they cannot both be true at the same time.

An *apparent disagreement* is a difference of opinion or perception.

A *verbal disagreement* is a misunderstanding due to differing definitions for one or more words.

MURPHY: *One fifth of all high school graduates are illiterate.*

JOHNSON: *One third of all high school graduates are illiterate.*

This difference between Murphy and Johnson certainly looks like an inconsistency. But the key question here concerns the possible definitions of the word *illiterate*. Suppose Murphy intends the word to mean those who cannot read at all, and Johnson means those who cannot read past a second grade level. If they are not careful, they might find themselves in a forty-five minute debate before realizing that they don't really disagree.

Because of the possibility of verbal disagreements, it is extremely important to define terms in the first part of any debate. You want to argue about substance, not just words. Consider the following question: "If a tree falls down in the forest, and nobody hears it, does it make a sound?" Some would say yes, and others would say no. But their disagreement would almost certainly be based upon how they are defining the word *sound*.

SUMMARY



We have considered three common types of disagreements. Real disagreements are an actual inconsistency between the statements. Apparent disagreements are differences in opinion or perception. Verbal disagreements result from differences in definition.

Exercise 10 (12 points)

Give examples of the three types of disagreements. (Even though the names are historical, your answers need not be.)

Real disagreement

1. Luther: _____
Erasmus: _____

2. Lee: _____
Grant: _____

Apparent disagreement

3. Peter: _____
Paul: _____

4. Homer: _____
Virgil: _____

Verbal disagreement (circle the word being defined differently)

5. William: _____
Robert: _____

6. Write two statements that are consistent but not independent.

Start studying Lessons 4, 5

Right the flash cards

THE ONE BASIC VERB

With the approach to statements and categorical logic we are taking in this text, there is only one verb that needs to be mastered. This is the verb of being—that is, *is*, *are*, *was*, *were*, *will be*, and so on. Although it may seem awkward at first, this is done to help us analyze statements more easily. Instead of saying *No cows eat meat*, we would change the verb and say *No cows are meat-eaters*. Another example:

John will run swiftly.
John will be a swift runner.

As statements are placed into arguments, it is helpful to avoid the verbs of ordinary conversation. This makes analysis of the argument simpler, but it does not mean that there are no pitfalls. Even the word *is* can carry different definitions. Consider the following:

God is love.
Love is blind.
Ray Charles is blind.
Therefore Ray Charles is God.

There is obviously a problem here. But where is it? The argument is fallacious because it treats each usage of the word *is* as though it were an equal sign ($A = B$, $B = C$, $D = C$, therefore $D = A$). But *is* does not always have this meaning, as we see here. What does *is* mean in each of those statements?

Here is another ordinary statement: *My little brother throws rocks*. To change statements like this into standard form, use the following procedure:



KEY POINT

To analyze statements using categorical logic, translate them into a form that uses the verb of being.



CAUTION

In ordinary English, the verb of being can have different meanings—be careful you don't mix them.

**CAUTION**

Maintain the tense of verbs (past, present, future) when translating statements to standard form.

- 1. Identify and write down the entire subject.** In our example, the entire subject is “My little brother.”
- 2. Choose the proper “to be” verb.** Consider the number (singular or plural) of the subject and the tense (past, present, future) of the verb. *My little brother* is singular, and the verb *throws* is present tense. So the proper “to be” verb is *is*.
- 3. Rewrite the entire predicate as a predicate nominative (i.e., a noun).** In this case, the predicate *throws rocks* becomes *a rock-thrower*. So the whole proposition becomes *My little brother is a rock-thrower*.

Here is an example that is slightly more awkward.

The Apostle Paul rebuked Peter at Antioch.
The Apostle Paul was a Peter-at-Antioch-rebuker.

Note that, in the above example, the tense of the verb is reflected in the verb of being; the original statement is in the past tense so the verb *was* is used. As you translate the sentences in the exercises, try to maintain the tense.

And now we go right into practical application. *The logic student works on Exercise 11* would become . . . ?

SUMMARY

In order to help us analyze statements in arguments, we must translate the statements so that they only use the verb of being (*is, are, was, were, will be*, etc). To do this, you should 1) identify and write down the entire subject, 2) choose the “to be” verb that matches the subject and predicate, and 3) rewrite the entire predicate as a predicate nominative.

Exercise 11 (20 points)

Rewrite each sentence using no verbs but the verb of being.

1. John eats turnips.

John is a turnip eater.

2. Rebekah reads her Bible daily.
-

3. Paul resisted Peter and Barnabas.
-

4. Susan works hard to resist temptation.
-

5. Faith produces fruit.
-

6. The works of the sinful nature lead to death.
-

7. The donkey rebuked the prophet.
-

8. The man will sing loudly.
-

9. Absalom rebelled against King David.
-

10. God created heaven and earth.
-

STANDARD CATEGORICAL STATEMENTS

Categorical statements are statements that affirm or deny something about a given subject. Every categorical statement can be translated into one of four forms. The forms are as follows:

1. *All S are P.*
2. *No S are P.*
3. *Some S are P.*
4. *Some S are not P.*

Now how can a statement be translated into one of these forms? Let us take a sentence that could occur in everyday conversation.

Nobody shuts the door.

First we change the verb, as in the previous lesson, and the sentence becomes this:

Nobody is a door-shutter.

Then the sentence can be put into one of our four forms.

No person is a door-shutter.

Statements have two parts—a **subject** and a **predicate**. The subject is usually symbolized by the letter *S*, and the predicate is symbolized by the letter *P*. In a categorical statement, a relationship is expressed between two classes of objects, the subject class and the predicate class, e.g., *people* on the one hand and *door-shutters* on the other.

Each statement also has quantity and quality. The **quantity** identifies whether the statement is universal (*all* and *no*) or particular (*some*



DEFINITION

A **categorical statement** is a statement that affirms or denies something about a given subject.



KEY POINT

Every categorical statement can be put into one of four basic forms.



DEFINITIONS

The **subject** of a statement is the term being described, or about which something is asserted. The **predicate** is the term that describes or asserts something about the subject.



DEFINITIONS

The **quantity** of a statement is the scope of its claim about the extension of the subject: universal (entire extension) or particular (partial).

The **quality** of a statement is the positive or negative nature of its claim about the subject: affirmative (asserts something) or negative (denies something).

and *some . . . not*). A statement is universal when it makes a claim about the entire extension of the subject. A statement is particular when it makes a claim about part of the extension of the subject. The **quality** identifies whether the statement is affirmative (*all* and *some*), or negative (*no* and *some...not*). A statement is affirmative when it affirms something of the subject. It is negative when it denies something of the subject. There are four combinations of quantity and quality, which give us our four standard categorical statements:

Statement	Quantity	Quality
<i>All S are P</i>	Universal	Affirmative
<i>No S are P</i>	Universal	Negative
<i>Some S are P</i>	Particular	Affirmative
<i>Some S are not P</i>	Particular	Negative

In developing a formal argument, the statements must be put into one of these standard forms. The rules for translating categorical statements into standard categorical form are as follows:

1. The statements must begin with the words *all*, *no*, or *some*.
2. The verb must be the verb of being: *is*, *are*, *was*, *were*, *will be*, etc.
3. Both the subject and the predicate must be a noun or a noun phrase.



CAUTION

Both the subject and predicate of a standard categorical statement must be a noun or noun phrase.

All dogs are brown.

Instead, the proper form would be

All dogs are brown animals.

This is because *brown* is a mere adjective, whereas *brown animals* gives us the noun we need. Another example should suffice.

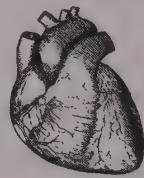
Some houses are big.
Some houses are big structures.

Then, to better understand and analyze our arguments, abbreviations are used for the sake of convenience. Consequently, the above statement changes to

Some H are B.

SUMMARY

There are four types of categorical statements: universal affirmative, universal negative, particular affirmative, and particular negative. These may be translated into standard categorical form: *All S is P*, *No S is P*, *Some S is P*, and *Some S is not P*, respectively. In each of these, a relationship is expressed between the subject S and the predicate P.



Exercise 12 (22 points)

In the following exercise, analyze each statement. In the blank at the right, put down what sort of categorical statement it is, i.e., universal affirmative, universal negative, particular affirmative, or particular negative.

1. Some cowboys are intellectuals. _____
2. All Scripture is God-breathed writing. _____
3. Some children are not students. _____
4. No Christians are Hindus. _____
5. Some books are fiction. _____
6. Some writers are not poets. _____
7. All dogs are carnivores. _____
8. No Trojans are Greeks. _____
9. Some soldiers are not brave men. _____
10. All men are mortals. _____

Translate the following sentences into one of the four standard forms.

11. Christians will not be condemned.

12. Every false teacher attacks the authority of Scripture.

13. A few churches allow divorce too easily.

14. Many people do not believe in the devil.

THE SQUARE OF OPPOSITION

We have already considered some relationships between statements. Now that we have a grasp of the four categorical statement forms, we will consider some new relationships. These relationships result from comparing statements with the same subject and predicate in a special arrangement called the **square of opposition**.

Universal affirmative statements are also called **A statements**. Below is the translation of an A statement:

1. *Everyone who goes to our church believes in God.*
2. *All our church-goers believe in God.*
3. *All our church-goers are God-believers.*
4. *All C are G.*

Universal negative statements are also known as **E statements**. Notice below the transformation of an E statement:

1. *None of my friends understands Algebra.*
2. *No friends of mine understand Algebra.*
3. *No friends of mine are Algebra-understanders.*
4. *No F are A.*

Particular affirmative statements, or **I statements**, are translated thus:

1. *Many Christians know a lot about the Bible.*
2. *Some Christians know a lot about the Bible.*
3. *Some Christians are Bible-knowers.*
4. *Some C are B.*



DEFINITION

The *square of opposition* is a diagram of the basic relationships between categorical statements with the same subject and predicate.



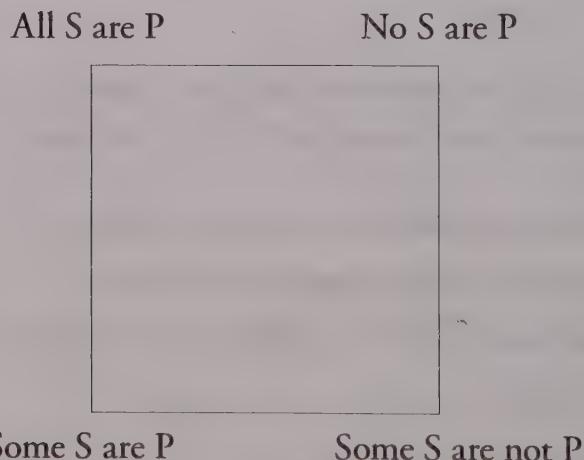
KEY POINT

We abbreviate the four basic categorical statements using the letters A, E, I, and O.

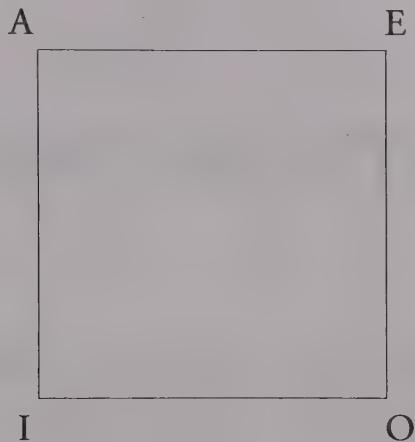
And finally, we have particular negative statements, or **O statements**:

1. *Many books in the Bible do not have a reference to Satan in them.*
2. *Some books in the Bible do not have a reference to Satan in them.*
3. *Some Bible books are not Satan-referencers.*
4. *Some B are not S.*

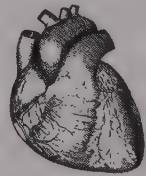
Now the four types of categorical statements are related to one another; they are not independent (provided they contain the same subject and predicate). There is a simple way to diagram the various relationships which is called the **square of opposition**. The square of opposition demonstrates how A, E, I and O statements are related. Each one of the statements is located at a different corner of the square. The universals are placed at the top and the particulars at the bottom. The affirmatives are on the left and the negatives on the right. It looks like this:



If we substitute our abbreviations for the categorical statements, it then looks like this:

**SUMMARY**

The four categorical statements can be abbreviated using the letters *A*, *E*, *I* and *O*. These can be placed into the corners of the square of opposition, which will allow us to analyze the relationships between the statements.



CONTRADICTION

The square of opposition presents five different relationships between categorical statements. They are (1) contradiction, (2) contrariety, (3) subcontrariety, (4) subimplication, and (5) superimplication.

We will consider contradiction first. **Contradiction** is the relationship between A and O statements, and I and E statements. We will first look at A and O.

An A statement would be: *All S are P*

An O statement would be: *Some S are not P*.

Between the two statements there is obvious contradiction. The contradiction remains obvious if we substitute actual terms for the abbreviations.

All Christians are forgiven sinners.

Some Christians are not forgiven sinners.

A contradiction also exists between I and E statements.

An I statement would be: *Some S are P*

An E statement would be: *No S are P*.

Again, the situation is unchanged if we substitute real terms for S and P:

Some Christians are forgiven sinners.

No Christians are forgiven sinners.

This contradiction means that the statements cannot both be true. It is also not possible for both to be false. If one statement is true, the



KEY POINT

An A statement always contradicts the O statement with the same subject and predicate. The same is true for E and I statements.



DEFINITION

Two statements are in **contradiction** if and only if they always have opposite truth values.



HISTORY

Aristotle was the first to expound the relationships between categorical statements in his book *On Interpretation*. They were presented for the first time in what is now the standard Square of Opposition in a commentary on Aristotle's book by the Roman philosopher Apuleius (c. AD 124–170).

other must be false, and vice versa. This can be illustrated with the example given above. If it is true that some Christians are forgiven sinners, then it must be false that none are. If it is false that some Christians are forgiven sinners, then it must be true that none are. This also means that contradictory statements do not have the relationship of consistency, which we discussed earlier. Consistent statements were statements that could both be true.

In the square of opposition, contradiction is represented by the diagonal lines that are drawn from one corner to another. A line can be drawn from A to O, or from I to E. These lines, which form an X, represent contradiction.

SUMMARY

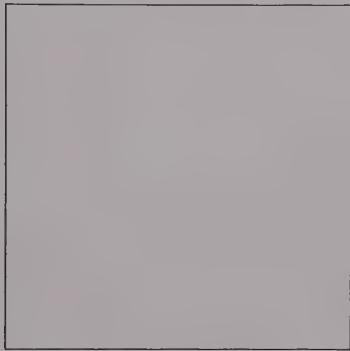


In the square of opposition, the statements in the opposite corner are contradictory statements. If one is true, the other one must be false. This relationship exists between A and O statements, and I and E statements.

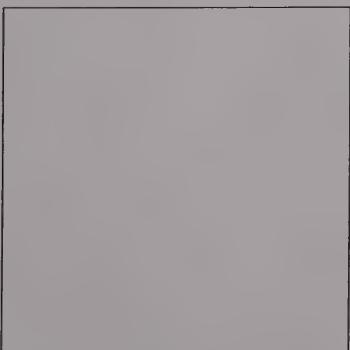
Exercise 13 (12 points)

Draw six squares of opposition using the instructions provided.

1. Place the four categorical statements at each corner, using the abbreviations *S* and *P*.
2. Place A, E, I or O at the appropriate corner.



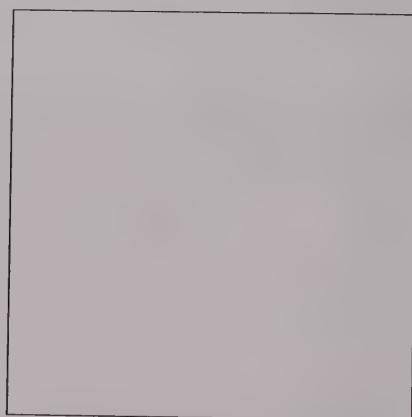
3. Enter the letters again, and draw in the appropriate lines of contradiction.
4. Use *dogs* as the subject and *cats* as the predicate (so the upper left-hand corner would say *All dogs are cats*).



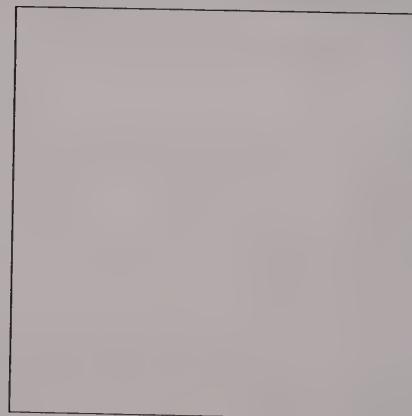
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For the last two squares, make up categorical statements of your own and place them in the appropriate corners, making sure that for each square the four statements have the same subject and the same predicate.

5.



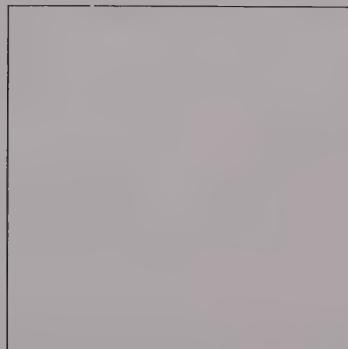
6.



Exercise 14 (8 points)

Analyze the following arguments. Each of them contains two contradictory statements. Isolate those statements (ignoring the others), translate them into categorical statements with the same subject and predicate, and diagram where they are located on the square of opposition. Show all your work.

1. All logic students can see the problem here. However, some of them cannot see the problem (but they might if they think about it).



2. There is no good reason to believe that the Bible is the Word of God; it is simply the word of men. I admit that prophecies that were fulfilled is one good reason to believe it, though I am still unconvinced.



CONTRARIETY

A **contrary** relationship is that which exists between the universal statements A and E. In this relationship, it is not possible for both statements to be true. It is possible, however, for both to be false.

For example, here are two contrary statements:

All astronauts are men.

No astronauts are men.

These statements can be abbreviated:

All A are M.

No A are M.

It is not possible for both these statements to be true. If all astronauts are men, then it is false that none are. If none are men, then it is false that all are. At the same time, it is possible for both to be false. Consider the fact that some space shuttle astronauts were women, and others were men. In such a situation, both statements are clearly false.

It is important to remember the distinction between contradiction and contrariety. Contradictory statements cannot both be true at the same time, and cannot both be false at the same time. With contrariety, both cannot be true simultaneously, but both can be false at the same time.

The relationship of contrariety is represented by the top horizontal line of the square of opposition. When the terms are the same, all A and E statements are contrary. Here is another example:

All snakes are green reptiles.

No snakes are green reptiles.



KEY POINT

Only A and E statements can be contrary.



DEFINITION

Two statements are **contrary** if and only if they can both be false but cannot both be true.



CAUTION

Do not confuse contrariety with contradiction: contradictory truth values are always opposite; contrary ones can both be false.

We would abbreviate these as follows:

All S are G.
No S are G.

You should be able to see that, while both of these statements may be false, they cannot both be true.

We will now turn to an attempt to identify the relationship in a discussion between two Christians who differ on the mode of baptism. Jones argued vigorously, “I maintain that all the baptisms in the New Testament were by immersion.” Smith was not at all daunted and said, “And I maintain that nobody in the New Testament was baptized by immersion.” How should we understand this dispute? Is it a contradiction, or is it a clash of contrary statements? Let’s break their assertions down.



KEY POINT

In any argument that involves contrary claims, remember that it is possible for *both* claims to be false—there may be a third option.

JONES: *All the baptisms in the New Testament were by immersion.*

All New Testament baptisms were immersions.

All B were I.

SMITH: *Nobody in the New Testament was baptized by immersion.*

No New Testament baptisms were immersions.

No B were I.

Now we place both statements on the square of opposition and see that the first is an A statement and the second an E statement. This means, necessarily, that Smith and Jones cannot both be correct; the two positions exclude one another. It is possible, however, for both to be wrong. What if the New Testament teaches that two modes of baptism are used? (This is not an assertion that it does so, but rather a reminder that the logical possibility exists.) Then both Smith and Jones would be wrong.

What would the situation be if Smith maintained that some baptisms were not immersions? His statement would then be *Some B were not I.* This would be a relationship of contradiction. If *All B are I* is true, then *Some B were not I* is false. If *Some B were not I* is true, then *All B were I* is false. In this case, either Jones or Smith must be correct; both could not be wrong.

It may seem initially that the clash of *all* and *no* is more fundamental than the clash of *all* and *some . . . not*. This is not the case. In a clash between *all* and *no*, both can share a claim to falsehood. But between *all* and *some . . . not*, one of them must be true and the other must be false.

Consider one more example. Sally is saying that all the girls in the high school are stuck up and proud (*All G are P*). Jane thinks that Sally is confused and that none of them are (*No G are P*). But if it is true that only some of the girls are proud, then both Sally and Jane are wrong. Both cannot be right, but both can be wrong.

SUMMARY

A and E statements have a relationship of contrariety. Both cannot be true, but both can be false. This should not be confused with the relationship of contradiction, where both cannot be true, and both cannot be false.



SUBCONTRARIETY

Subcontrariety is the relationship that exists between I statements and O statements. It is represented by a horizontal line on the bottom of the square of opposition. It is possible for both an I statement and an O statement to be true. But it is not possible for both to be false. The relationship of subcontrariety is the opposite of contrariety, as seen by comparing them side by side:

Contrariety: *Both statements cannot be true, but they can both be false.*

Subcontrariety: *Both statements can be true, but they cannot both be false.*

For example, here are an I statement and an O statement respectively:

Some preachers are boring speakers.

Some preachers are not boring speakers.

Think about this for a moment. Is it possible for both of these statements to be true? Is the world big enough to contain preachers who are not boring, as well as those who are? Certainly. Pastor Jones, for example, may be as boring as they come, while Pastor Smith is not at all boring. But is it possible for both statements to be false at the same time? No, it is not. Think for a moment. If it is false that some preachers are boring, this is the same thing as saying that no preachers are boring. And if no preachers are boring, then certainly some preachers are not boring—because all preachers are not boring.

Consider another example:



KEY POINT

Only I and O statements can have the relationship of subcontrariety.



DEFINITION

Two statements are **subcontraries** if and only if both can be true but both cannot be false.

Some students are intelligent.
Some students are not intelligent.

To see that both of these can be true is not difficult. There will perhaps be more difficulty in understanding why both cannot be false. It may help to draw the statements on the square of opposition, then follow through this argument step by step:

1. If it is false that some students are not intelligent, that is the same as saying that all students are intelligent (by contradiction).
2. If all students are intelligent, then it must be true that some students are intelligent (by implication).
3. And if it is true that some students are intelligent, then it cannot be false that some are (by the laws of thought).
4. Thus they cannot both be false.

SUMMARY



On the square of opposition, particular statements of different qualities are related by subcontrariety. I statements are subcontrary to O statements, and O statements are subcontrary to I statements. The relationship of subcontrariety means that both statements can be true, but they cannot both be false.

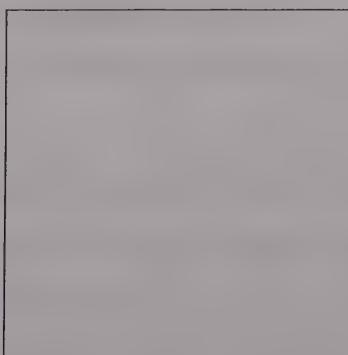
Exercise 15 (12 points)

Analyze the following paragraphs, isolate the related statements, and put them into categorical form. Assign abbreviations to the terms, place them on the square of opposition, and determine their relationship. One will show the relationship of contradiction, one the relationship of contrariety, and one subcontrariety. Show your work.

1. Johnny sneered at Billy, “All third-graders are stupid!” Billy shouted back, ineffectively countering Johnny’s point, “That’s not true! None of them are!”

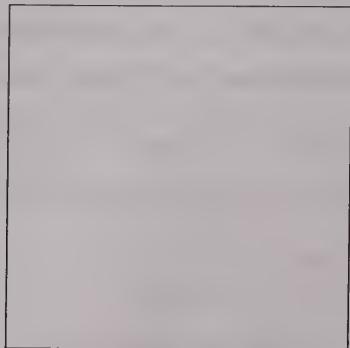


2. Smith said, “Pro-lifers don’t care about children who are already born. All they care about is their stupid political agenda.” Jones disagreed by saying, “No, there are many pro-lifers who are involved in caring for children.”



Continued on next page.

3. Some people I know are always complaining about their jobs; they never seem to quit.
Of course, not everyone complains.



SUBIMPLICATION

In the relationship of subimplication, the truth of a particular statement can be inferred from the truth of the universal with the same quality. Given the truth of a universal A statement, the truth of the corresponding particular statement (in this case, an I statement) is implied. The same can be said of the other universal/particular relationship (which is E to O).

If an A statement is true, then its corresponding I statement must be true. If an E statement is true, then its corresponding O statement must be true. What follows is an example of subimplication.

A statement: *All Christians are God's children.*

I statement: *Some Christians are God's children.*

If it is true that all Christians are God's children, then it must be true that some of them are. It cannot be false that some Christians are God's children if all of them are.

Here is an example of subimplication between an E and O.

E statement: *No logicians are poets.*

O statement: *Some logicians are not poets.*

If it is true that no logicians are poets, then it must be true that some are not poets. It is not possible for this O statement to be false. If the E statement is true, then the O statement must also be true.

On the square of opposition, the relationship of subimplication can be pictured with two arrows on either side of the square, going from top to bottom. The relationship of subimplication has nothing to do with falsity. It is concerned solely with the implication of truth. The truth of particular statements is inferred from the truth of the



KEY POINT

Subimplication can only exist between pairs of A and I statements and pairs of E and O statements.

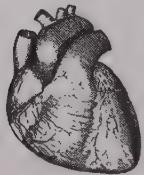


DEFINITION

Subimplication is the relationship between a universal and particular statement of the same quality, in which the truth of the universal necessitates the truth of the particular.

corresponding universal statement. So now you can recognize that the examples of implication given earlier in the text were actually more specifically examples of *sub*implication.

SUMMARY



Subimplication is the relationship from A to I statements, and E to O statements. In this relationship, the truth of the universal affirmative implies the truth of the particular affirmative, and in the same way, the truth of the universal negative implies the truth of the particular negative.

SUPERIMPLICATION

As we have learned, subimplication is the implication of truth for one statement on the basis of the truth of another. In contrast to this, **superimplication** is the implication of falsity. With subimplication, the inference is from a universal statement to a particular statement of the same quality (A to I, or E to O). This relationship was pictured by vertical arrows on either side of the square of opposition, going from top to bottom. In the relationship of superimplication, the arrows go up the other way (from I to A, or O to E). In superimplication, given the falsity of a particular statement, the falsity of its corresponding universal is implied. In other words, the falsity of an A statement can be inferred from the falsity of an I statement. In the same way, the falsity of an E statement can be inferred from the falsity of an O statement.

For example:

I statement: *Some Christians are atheists.*

A statement: *All Christians are atheists.*

This is straightforward. If it is false that some Christians are atheists, then it must be false that all of them are. Understanding the relationship between O and E statements is perhaps a little more difficult.

O statement: *Some dogs are not mammals.*

E statement: *No dogs are mammals.*

If it is false that some dogs are not mammals, then it must be false that no dogs are mammals. Work through this carefully again using the square of opposition:



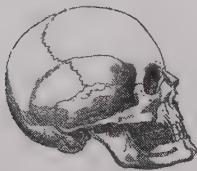
KEY POINT

Superimplication can only exist between pairs of I and A statements and pairs of O and E statements.



DEFINITION

Superimplication is the relationship between a universal and particular statement of the same quality, in which the falsity of the particular necessitates the falsity of the universal.



CAUTION

Subimplication and superimplication only work in one direction. Subimplication carries truth from universal to particular, while superimplication carries falsity from particular to universal.



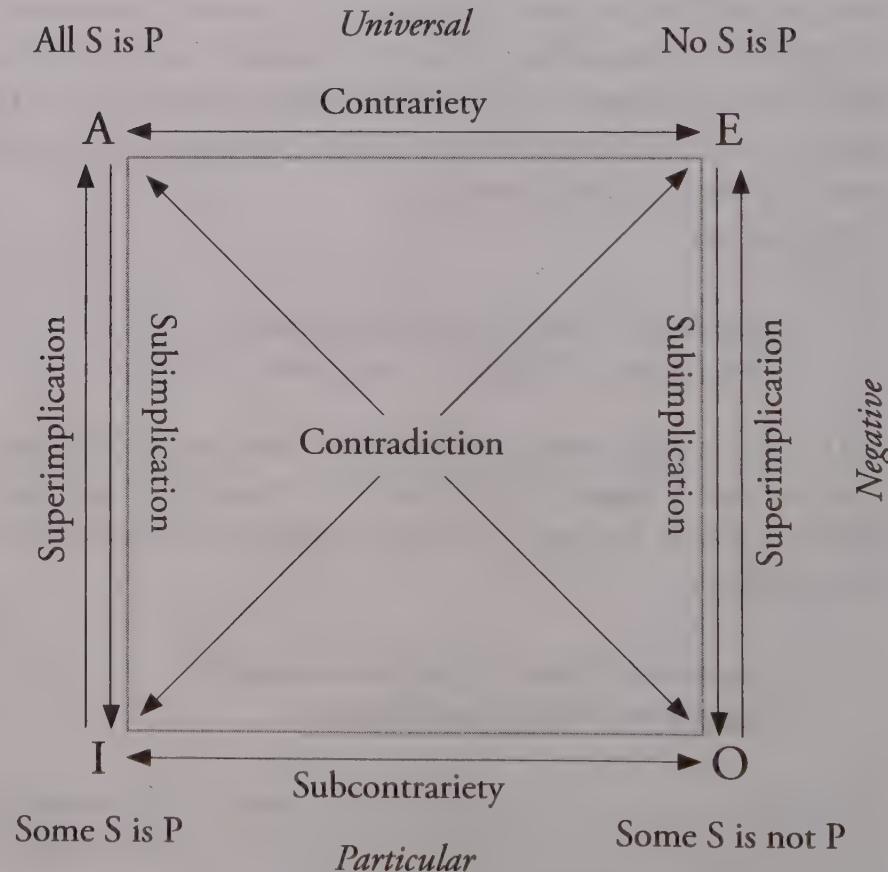
THINKING DEEPER

Relationships from the square of opposition hold even for statements that do not have the same subject and predicate. For example, consider the fact that “I have a son” implies that “I am a father.” Place “I have a son” in the position of the *A* statement, “I am a father” in the *I* position, “I am not a father” in the *E* position, and “I do not have a son” in the *O* position. You can verify that contradiction, contrariety, subcontrariety, subimplication, and superimplication still apply to these statements.

1. If it is false that some dogs are not mammals, then it must be true that all of them are mammals (by contradiction).
2. If all of them are mammals, then it must be false that none are mammals (by contrariety).

Remember that between *A* and *I* statements, and *E* and *O* statements, we can distinguish two relationships—subimplication and superimplication. With the relationships previously studied, the arrow between the letters should be understood as a two-way street. *A* to *O* and *O* to *A* have the same relationship—contradiction. But with either subimplication or superimplication, the arrow goes only one way.

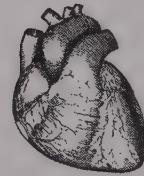
We can now draw the complete square of opposition, including all of the relationship lines.



Note that Appendix A shows the complete square of opposition with a description of each of the relationships.

SUMMARY

A relationship of superimplication exists from I to A statements, and from O to E statements. In this relationship, if the particular statement is false, then the universal statement of the same quality is false. This completes the relationships on the square of opposition.



Exercise 16 (12 points)

In the following exercise, write the relationship that exists between the two given statements in the blank at right. Their order does matter.

1. All cowboys are rough men.
Some cowboys are not rough men. _____
2. Some ladies are not rude women.
No ladies are rude women. _____
3. All Christians are forgiven sinners.
Some Christians are forgiven sinners. _____
4. No Christians are Muslims.
Some Christians are not Muslims. _____
5. All french fries are greasy food.
No french fries are greasy food. _____
6. Some pictures are beautiful art.
Some pictures are not beautiful art. _____
7. Some atheists are irrational men.
No atheists are irrational men. _____
8. All eighth graders are brilliant logicians.
Some eighth graders are brilliant logicians. _____
9. All violinists are right-handed players.
Some violinists are not right-handed players. _____
10. Some feminists are feminine.
All feminists are feminine. _____
11. All Democrats are Republicans.
Some Democrats are not Republicans. _____
12. All bards are story-tellers.
Some bards are story-tellers. _____

Exercise 17 (32 points)

1. Draw the square of opposition, including all the arrows and relationships. Include the abbreviated categorical statements in the corners, using S and P.

In the following problems, assume that the first statement in each set is true. Then determine the truth value of each remaining statement in the set. Circle T if it is true, F if it is false, and ? if the truth value cannot be determined.

2. *All students are young people.*

No students are young people. T F ?

Some students are young people. T F ?

3. *No angels are demons.*

Some angels are demons. T F ?

Some angels are not demons. T F ?

4. *Some computers are word processors.*

All computers are word processors. T F ?

No computers are word processors. T F ?

Continued on next page.

5. *Some laws are not biblical laws.*

All laws are biblical laws.

T F ?

No laws are biblical laws.

T F ?

On the first line, translate the statement into standard categorical form. Do not abbreviate. On the second line, write the categorical statement that has the given relationship to the statement translated above it.

6. Students never eat frog legs.

Standard form: _____

Contradiction: _____

7. Many children make mud pies.

Standard form: _____

Subcontrariety: _____

8. Everybody here has eaten.

Standard form: _____

Contrariety: _____

9. A few of the meals were not appetizing.

Standard form: _____

Superimplication: _____

Challenge: Expand the “Relationships between Statements” chart in Lesson 9 (page 71) to include the relationships from the square of opposition.

UNIT 2

REVIEW QUESTIONS

Answers can be found in the lesson under which the questions are listed.

Lesson 6: Statements

1. What is a statement?
2. What are the possible truth values of a statement?
3. What are the types of sentences that are not statements?

Lesson 7: Self-supporting Statements

1. What is a self-supporting statement?
2. What are the three types of self-supporting statements?
3. Give an example of a self-report.
4. What is the difference between a *tautology* and a *self-contradiction*?
5. Give an example of a statement that is false by definition.

Lesson 8: Supported Statements

1. What is the difference between a *supported* statement and a *self-supporting* statement?
2. What are three methods of determining the truth value of supported statements?
3. Do any other methods exist?

Lesson 9: Relationships between Statements

1. What does it mean that two statements are consistent?
2. What does it mean that one statement implies another?
3. What are logically equivalent statements?
4. What does it mean that two statements are independent?
5. Can two statements be consistent yet *not* be related by implication or independence?

Lesson 10: Consistency and Disagreement

1. What is another term for a real disagreement?
2. What is the difference between an *apparent* disagreement and a *verbal* disagreement?

Lesson 11: The One Basic Verb

1. What are the different verbs of being?
2. What is the procedure for rewriting statements into statements that use only verbs of being?

Lesson 12: Standard Categorical Statements

1. What are the two main parts of a categorical statement?
2. What is the quantity of a statement?
3. What is the quality of a statement?
4. What are the four types of categorical statements expressed in terms of their quantity and quality?
5. What are the four types of categorical statements expressed in terms of *S* and *P*?

Lesson 13: The Square of Opposition

1. What are the four types of categorical statements abbreviated by one letter?
2. Draw the square of opposition using these abbreviations.

Lesson 14: Contradiction

1. What two pairs of statement types contradict each other?
2. What does contradiction mean in terms of the truth value of the pair of statements?
3. How is contradiction diagrammed on the square of opposition?

Lesson 15: Contrariety

1. What pair of statement types are contraries?
2. What does contrariety mean in terms of truth value?
3. How is contrariety diagrammed on the square of opposition?
4. What do *contradiction* and *contrariety* have in common?
5. How do they differ?

Lesson 16: Subcontrariety

1. What pair of statement types are subcontraries?
2. What does subcontrariety mean in terms of truth value?
3. How is subcontrariety diagrammed on the square of opposition?
4. How do *contrariety* and *subcontrariety* differ?

Lesson 17: Subimplication

1. What two pairs of statement types are related by subimplication?
2. What does subimplication mean in terms of truth value?
3. How is subimplication diagrammed on the square of opposition?

Lesson 18: Superimplication

1. What two pairs of statement types are related by superimplication?
2. What does superimplication mean in terms of truth value?
3. How is superimplication diagrammed on the square of opposition?
4. What do *subimplication* and *superimplication* have in common?
5. How do they differ?
6. Draw the complete square of opposition, including all the relationships.

REVIEW EXERCISES

Students may do these exercises for further review of this unit.

Additional Exercises for Lesson 6

1. The text says that statements are always either true or false. How would you respond to a scoffer who tried to deny this by claiming that there are no absolutely true statements?

2. If statements are always either true or false, how are we to understand statements for which we do not know the truth value? Consider this claim: “Somewhere in the infinite decimal expansion of the number pi ($\pi = 3.14159 \dots$) the digits 1234567890 appear in that order.” No man knows if this is true or false. Is it a statement? Who does know the truth value?

3. There is a classic riddle of a missionary being threatened by natives in this way: “We will let you decide how you will die. If you say something true, you will be burned at the stake. If you say something false, you will be boiled in oil.” The missionary escaped this dilemma by saying, “I will be boiled in oil.” Was this sentence true, false, or nonsense? Explain.

4. When something is truly authoritative, you are required to respond to it submissively. The ultimate authority for Christians is the Bible. The Bible contains the types of sentences considered in this lesson. The submissive response to a command, such as Romans 12:1–2, is to obey it. What is a submissive response to a statement, such as Romans 5:8? What is a submissive response to questions, such as Romans 8:31–35? What type of sentence is Romans 11:33? What would be a submissive response to it?

5. Consider Titus 1:12, in which Paul quotes a Cretan who said that Cretans are always liars. Should the Cretan's claim be considered nonsense? Why or why not?

Additional Exercises for Lesson 7

1. Why do we usually consider self-reports to be true? Is there ever a situation in which we should challenge someone who makes a claim about his own desires, beliefs, or feelings? If so, give an example.

2. A tautology is true by logical structure and can take the form p or $\text{not } p$. Can you think of an example of a tautology in this form that someone might use in ordinary conversation?

3. A self-contradiction is a statement that is false by logical structure. Is there ever an appropriate use of a self-contradiction?

4. Consider Esther's statement in Esther 4:16, "If I perish, I perish." Is this a tautology?

5. What is the truth value of the statement *Unicorns have one horn*?

6. Which of the types of statements considered in this lesson should we understand this to be: *I think that triangles have three sides* or *I do not think that triangles have three sides*?

Additional Exercises for Lesson 8

1. Consider the following supported statements. Explain how one would determine the truth value of each statement. Your options are *by authority*, *by experience*, or *by deductive reasoning*.

a. Most teenage boys like to argue.

b. The capital city of Japan is Tokyo.

c. If you are reading this sentence then you can see.

d. It's nine o'clock on a Saturday.

e. The product of two odd numbers is an odd number.

f. It is easier for a camel to go through a needle's eye, than for a rich man to enter into the kingdom of God.

2. Is it possible that all three methods (authority, experience, and deduction) may be used to determine the truth value of a given statement? Consider this claim: "In the absence of air, two different masses will fall toward the earth at the same rate." How might different people know that this is true?

3. Consider this claim: "Unicorns do not exist." Can the truth value of such a statement be determined by experience? If not, is there any way to determine the truth value of such statements?

4. Consider this claim: "California will probably experience a major earthquake within the next twenty years." Such a statement is supported by the *inductive* reasoning of experts. How does this method differ from the method of *experience*? of *deductive* reasoning? Can you think of other statements that are known to be true by inductive reasoning?

Additional Exercises for Lesson 9

1. The text says that when two statements can be true at the same time, they are consistent. Can two statements that happen to be *false* at the same time still be consistent? Consider these two false statements: “The apostle Paul spent his life in Germany” and “The apostle Peter was never married.” Which relationships do these statements have with each other?

2. The text says that two statements are related by implication when the truth of the first requires the truth of the second. Can one false statement imply another false statement? For example, does “No dogs are mammals” imply that “Some dogs are not mammals”?

3. Can a false statement imply a true statement? For example, does “All mammals are dogs” imply that “Some mammals are dogs”?

4. Is a statement equivalent to itself? If so, how else is a statement related to itself?

5. *No S is P* is equivalent to *No P is S*, and *Some S is P* is equivalent to *Some P is S* (when *S* and *P* are the same terms). Are statements of the form *All S is P* equivalent to *All P is S*? Are statements of the form *Some S is not P* equivalent to *Some P is not S*? If not, give examples of such pairs of statements that differ in truth value.

6. Can two statements with the same subject be logically independent?

7. Give an example of consistent statements that are neither independent nor related by implication.

8. Identify every relationship that exists between each of the following pairs of statements.

This is a green apple.

Pluto is the ninth planet.

All roads lead to Rome.

Route 66 leads to Rome.

Some people like chocolate.

Everybody likes chocolate.

No captains are cowards.

No cowards are captains.

This is question 7.

This is question 8.

Some frogs are princes.

Some princes are frogs.

The Bible is God's Word.

The Koran is not God's Word.

Additional Exercises for Lesson 10

1. Consider two people having an apparent disagreement (a difference in opinion). How could such a dispute change into a real disagreement?
-
-

2. Why is it so important to define terms at the beginning of a debate?
-
-

3. Romans 4 seems to disagree with James 2:14–26 regarding faith and works in the justification of Abraham. Given that the infallible Scripture cannot contradict itself, what sort of disagreement might this be? Consider doing some further study on this issue.
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Additional Exercises for Lesson 11

Translate the following statements so that they only use the verb of being.

1. The *Eagle* [Apollo 11 spacecraft] has landed.
-

2. A prudent man conceals knowledge.
-

3. Gentlemen in England now abed shall think themselves accursed they were not here.
-

4. Seventy-six trombones led the big parade.
-

5. The forests will echo with laughter.
-

6. We who have believed do enter that rest.
-

7. Angels we have heard on high.
-

8. The great fish moved silently through the night water.
-

Additional Exercises for Lesson 12

Translate the following statements into standard categorical form, and identify the quantity and quality of each.

1. In all labor there is a profit.
-

2. Most of the Trojans fell before Diomed's onslaught.

3. The natural man does not receive the things of the Spirit of God.

4. Many brave souls went hurrying down to Hades.

5. There is none righteous.

6. A few names in Sardis have not defiled their garments.

7. The Argives held their peace as Hector spoke.

8. None of the Greeks approaching Troy spoke a word.

Additional Exercises for Lesson 13

1. Fill in the blanks of the following chart.

No S is P

Particular affirmative

O

Universal affirmative

E

Some S is P

Some S is not P

A

2. Why do you suppose the vowels A, E, I, and O are used to represent the four categorical statements? What type of statement could we represent by the letter U?

3. Select any two of the following terms: *cats, dogs, reptiles, mammals*. Put the two terms you have selected as the subject and predicate of the four categorical statements, and put them in the square of opposition. Which statements are true? Which are false? How many true statements and how many false statements appear in every square of opposition?

Additional Exercises for Lesson 14

Write the contradiction of the given statements. Which is the true statement: the given one, or its contradiction?

1. All men are sinners. _____

2. No pleasures are lawful activities. _____

3. Some Christians are Jews. _____

4. Some worshiped beings are not idols. _____

Additional Exercises for Lesson 15

1. Give an example of contrary statements that are both false, and then give an example of contrary statements, one being true and the other false.

2. If someone is making a claim that you want to deny, which type of statement should you choose so that at least one of you is correct: the contradiction, or the contrary?

3. Consider these two inconsistent statements: *Pluto is a planet*. *Pluto is not a planet*. Are these statements related by contradiction or contrariety? Explain.

4. Can contrary statements both be true? What if the subject does not exist? For example, could “All Martian scientists are people eaters” and “No Martian scientists are people eaters” both be considered true, since there are no Martian scientists?

Additional Exercises for Lesson 16

1. Give an example of subcontrary statements that are both true. Then give an example of subcontrary statements, one being true and the other false.

2. Without looking back at the text, restate the argument given as to why two statements related by subcontrariety cannot both be false.

3. Could subcontrary statements be considered false if the subject does not exist, e.g., "Some Martian scientists are people eaters" and "Some Martian scientists are not people eaters"?

4. If a given universal statement is true, can you figure out the truth value of the remaining statements on the square of opposition using only contradiction, contrariety, and subcontrariety? Can you do the same for a given false particular statement?

Additional Exercises for Lesson 17

1. Find all the examples of subimplication that appear in the text prior to lesson 17.

2. Some logicians translate *All S is P* as “If a thing is *S* then it is *P*” and *Some S is P* as “There exists an *S* which is *P*.” Translated this way, a universal statement does not claim that the subject exists, but a particular statement does claim that something exists. How would this affect the relationship of subimplication? How would it affect the rest of the square of opposition? Does *All Martian scientists are people eaters* imply that *Some Martian scientists are people eaters*?
-
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Additional Exercises for Lesson 18

1. Some logic texts consider subimplication and superimplication as two ways of looking at the same relationship, called *subalternation*. Thus, the square of opposition would only have one arrow on each side pointing both up and down. With this understanding, draw a genus and species chart that includes the following terms: *consistency*, *contradiction*, *contrariety*, *equivalence*, *implication*, *inconsistency*, *independence*, *relationship between statements*, *subalternation*, *subcontrariety*, *subimplication*, *superimplication*.

For items 2–7, identify the relationship that exists between the first and second statements.

2. All czars are dukes. Some czars are dukes. _____
3. Some spiders are insects. No spiders are insects. _____
4. All meats are desserts. No meats are desserts. _____
5. Some peptides are not acids. No peptides are acids. _____
6. Some castles are not palaces. All castles are palaces. _____
7. Some spies are touts. Some spies are not touts. _____

For items 8–12, name the square of opposition relationship being described.

8. If a statement is true, the statement of a different quantity and quality is false.

9. If a particular statement is false, the universal of the same quality must be false.

10. Both statements of the same quantity can be true, but they cannot both be false.

11. If a universal statement is true, the particular of the same quality must be true.

12. Both statements of the same quantity can be false, but they cannot both be true.

For items 13–16, assume that the first statement in each set is false. Then determine the truth value of each remaining statement in the set. Circle *T* if it is true, *F* if it is false, and *?* if the truth value cannot be determined.

13. All caps are derbies.

No caps are derbies.	T	F	?
Some caps are derbies.	T	F	?
Some caps are not derbies.	T	F	?

14. No newts are salamanders.

Some newts are salamanders. T F ?

Some newts are not salamanders. T F ?

All newts are salamanders. T F ?

15. Some emus are ostriches.

All emus are ostriches T F ?

No emus are ostriches T F ?

Some emus are not ostriches. T F ?

16. Some swamis are not Punjabis.

All swamis are Punjabis. T F ?

No swamis are Punjabis. T F ?

Some swamis are Punjabis. T F ?

UNIT 3

SYLLOGISMS AND VALIDITY

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ARGUMENTS

Having completed the units on terms and statements, we now begin the study of formal logic by considering logical arguments.

Many people think an argument is nothing more than a quarrelsome disagreement. But as the word is used in logic, it means nothing of the kind. A quarrel occurs when people are irritated or angry with each other. In formal logic, an **argument** is simply a set of statements, one of which appears to be implied or supported by the others.

There are two types of statements in an argument. The first type is called a **premise**. The second is called a **conclusion**. The conclusion is the point or terminus of the argument, the statement that appears to be implied or supported by the others. The premises are those statements that support or imply the conclusion.

An argument will never contain more than one conclusion. It can contain more than one premise. When you hear words like *therefore*, *thus*, *so*, and *consequently*, there is reason to believe that you are about to hear the conclusion of an argument. Common words that indicate premises are *since*, *because*, *for*, and *given that*. If a statement in an argument is immediately followed by words indicating a premise, it is probably the conclusion. This statement you are now reading must be a conclusion, because it is followed by the word *because*.

The following is an example of a formal argument, written in informal language.

The Bible is the Word of God, and the book of Jonah is definitely in the Bible. We must therefore conclude that the book of Jonah is the Word of God.

There are two premises here. The first is that the Bible is the Word of God. The second is that the book of Jonah is in the Bible. The



DEFINITION

An **argument** is a set of statements, one of which appears to be implied or supported by the others.



DEFINITION

The **conclusion** of an argument is the statement that appears to be implied by the other statements in the argument, which are called **premises**.

**CAUTION**

We formally evaluate arguments not by the truth of the conclusion but by whether the conclusion follows logically from the premises.

conclusion, which follows from this, is that the book of Jonah is the Word of God.

Here is an argument which is similar in form, but in which the conclusion does not follow from the premises.

The Bible is the Word of God, and the Book of Mormon is definitely not in the Bible. We must therefore conclude that the Book of Mormon is not the Word of God.

Christians must take special care in situations like this. Just because you agree with the conclusion (*the Book of Mormon is not the Word of God*) does not mean the argument is a good one. The question is not whether the conclusion is true, but whether it follows from the premises. In this case it does not. The premises contain no information about whether the Bible is the only word from God. If the premise had said that the Bible was the sole Word of God, then the conclusion would have been warranted. Look at a similar argument where the error is a little more obvious.

Given that the Iliad was written by Homer, and that the Odyssey is definitely not in the Iliad, we must therefore conclude that Homer did not write the Odyssey.

The problem should be obvious. For the conclusion to follow, the premises would need to tell us that the *Iliad* was the only thing that Homer ever wrote.

SUMMARY

An argument is a set of statements, one of which (the conclusion) appears to be implied by the others (the premises). Arguments contain only one conclusion, which usually starts with *therefore, thus, so, or in conclusion*. Arguments may contain more than one premise. Premises usually start with *because, since, for, or given that*. In a good argument, the conclusion is supported or implied by the premises.

Exercise 18 (10 points)

Underline the conclusion in each of the following arguments.

1. All theology is a study in infinity, so all calculus problems are theology, because all calculus problems are a study in infinity.
2. All space stations are important technology, but some space stations are not a product of American ingenuity. Therefore some important technology is not a product of American ingenuity.
3. Some pagans are idolaters, because no pagans are Christians, and no Christians are idolaters.
4. All objects in free fall are weightless, and all meteoroids are objects in free fall. Therefore all meteoroids are weightless.
5. All marsupials are pouched animals, and some marsupials are not Australian mammals. Consequently, some Australian mammals are not pouched animals.
6. Some Socratic sages are not perspicacious people, since some Socratic sages are metaphorical masters, and some perspicacious people are also metaphorical masters.
7. All murderers are criminals, and some heroes of the faith are murderers, from which it follows that some criminals are heroes of the faith.
8. No street legal vehicles are stock cars. Thus no racing car is street legal, since all stock cars are racing cars.
9. Some conclusions are not easily located statements, for all easily located statements are sentences at the end of arguments, and some sentences at the end of arguments are not conclusions.
10. Given that some pagan literature is great writing, and no great writing is worthless instructional material, we must conclude that some pagan literature is not worthless instructional material.

THE SYLLOGISM

The **syllogism** is a particular form for organizing categorical statements into an argument. A **categorical syllogism** is made up of three categorical statements. The first two statements are the premises, and the last is the conclusion. What follows is an example of a syllogism.

*All red plants are living things.
All roses are red plants.
Therefore, all roses are living things.*

If we abbreviate, our syllogism looks like this (note that the symbol \therefore means *therefore*):

*All M are P
All S are M
 \therefore All S are P*

All syllogisms contain three terms. The terms in the above syllogism are *S*, *P*, and *M*. In order to structure an argument properly, it is necessary to have a good understanding of these terms. The terms are called, respectively, the minor term (*S*), the major term (*P*), and the middle term (*M*).

The **minor term** is the subject term of the conclusion. The minor term above was *roses*, or *S*. The **major term** is the predicate term of the conclusion. In our syllogism, the major term was *living things*, or *P*. The **middle term** is the term that is in both premises but is not in the conclusion at all. It is called the middle term because it connects the premises together. In our example, the middle term was *red plants*, or *M*. As you might suspect, the **major premise** is



DEFINITIONS

A **syllogism** is a deductive argument with two premises and three terms.

A **categorical syllogism** is a syllogism consisting of three statements in categorical form.



DEFINITIONS

The **major term** of a syllogism is the predicate of the conclusion and is used in one premise. The **minor term** is the subject of the conclusion and is used in the other premise. The **middle term** is found once in each premise.



DEFINITIONS

The **major premise** of a syllogism is the premise containing the major term. The **minor premise** contains the minor term.



HISTORY

Aristotle introduced most of the key terms in this section—including *syllogism*, *premise*, and *major*, *minor*, and *middle term*—in his book *Prior Analytics*. He was not always as precise as many would expect or prefer. For example, his definition for syllogism is too broad: “A syllogism is a discourse in which, certain things being stated, something other than what is stated follows of necessity from their being so.”



KEY POINT

The standard order for statements in a syllogism is (1) major premise, (2) minor premise, and (3) conclusion. This order is assumed in the following lessons as we analyze syllogisms.

the premise that contains the major term. Traditionally, the major premise is the first premise in the argument. The **minor premise** is the premise that contains the minor term. There is no middle premise, only a middle term.

In our example above, the major premise was *All red plants are living things* (it contains the major term—*living things*). The minor premise was *All roses are red plants* (it contains the minor term—*roses*). The conclusion follows because the argument is valid. If the premises were true, the conclusion would necessarily have to be true. (Note that the minor premise happens to be false, but this does not affect the validity of the syllogism.)

Consider the following syllogism:

All ringed planets are gas giants, so no inner planets are ringed planets, since no inner planets are gas giants.

This syllogism is not in the traditional order for standard categorical syllogisms. To put it into standard form, this procedure should be followed:

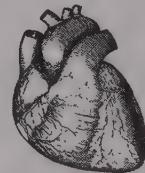
1. **Find the conclusion.** In our example, the conclusion is *No inner planets are ringed planets*. We know this because it starts with the word *so* and precedes the word *since*.
2. **Find the major term.** The major term is the predicate of the conclusion. The major term of the example is *ringed planets*.
3. **Find the major premise.** The major premise is the premise containing the major term. Since the major term is *ringed planets*, the major premise is *All ringed planets are gas giants*.
4. **Find the minor premise.** The minor premise contains the minor term. Obviously, it is also the statement that is neither the major premise nor the conclusion. In the example above, the minor premise is *No inner planets are gas giants*. To check, we see that this does contain the minor term, *inner planets*.

5. Write the syllogism out in standard order. Standard order is major premise, minor premise, conclusion. Thus the example syllogism in standard order looks like this:

*All ringed planets are gas giants.
No inner planets are gas giants.
Therefore, no inner planets are ringed planets.*

SUMMARY

A syllogism is a deductive argument with two premises and three terms. The minor term is the subject of the conclusion, the major term is the predicate of the conclusion, the middle term is not in the conclusion, but it is in both premises. The major premise is the premise containing the major term. The minor premise is the premise containing the minor term. The standard order for categorical syllogisms is: major premise, minor premise, conclusion.



Exercise 19 (35 points)

Identify the major, minor and middle terms for each syllogism. The syllogisms are not necessarily in standard order.

1. All theology is a study in infinity, so all calculus problems are theology, because all calculus problems are a study in infinity.

Major term: _____

Minor term: _____

Middle term: _____

2. All space stations are important technology, but some space stations are not a product of American ingenuity. Therefore some important technology is not a product of American ingenuity.

Major term: _____

Minor term: _____

Middle term: _____

3. Some pagans are idolaters, because no pagans are Christians, and no Christians are idolaters.

Major term: _____

Minor term: _____

Middle term: _____

4. All objects in free fall are weightless, and all meteoroids are objects in free fall. Therefore all meteoroids are weightless.

Major term: _____

Minor term: _____

Middle term: _____

5. All marsupials are pouched animals, and some marsupials are not Australian mammals. Consequently, some Australian mammals are not pouched animals.

Major term: _____

Minor term: _____

Middle term: _____

Continued on next page.

Rewrite the following arguments into standard order for categorical syllogisms.

6. Some Socratic sages are not perspicacious people, since some Socratic sages are metaphorical masters, and some perspicacious people are also metaphorical masters.

7. All murderers are criminals, and some heroes of the faith were murderers, from which it follows that some criminals are heroes of the faith.

8. No street legal vehicles are stock cars. Thus no racing car is street legal, since all stock cars are racing cars.

9. Some conclusions are not easily located statements, for all easily located statements are sentences at the end of arguments, and some sentences at the end of arguments are not conclusions.

10. Given that some pagan literature is great writing, and no great writing is worthless instructional material, we must conclude that some pagan literature is not worthless instructional material.

THE MOOD OF SYLLOGISMS

Because the syllogism is composed of categorical statements, the syllogism can be abbreviated following the same rules concerning the substitution of letters for terms. In this book, we will have a standard substitution for the various terms. *S* will represent the minor term, *P* will represent the major term, and *M* will represent the middle term, as in the previous lesson.

Notice how the following syllogism is transformed:

Some black cars are fast cars.
All Model T cars are black cars.
Therefore, some Model T cars are fast cars.

This syllogism is invalid; the conclusion does not follow from the premises. Nevertheless, we may still abbreviate it in order to analyze it readily. When abbreviated, it looks like this:

Some M are P
All S are M
∴ Some S are P

When a syllogism is arranged in standard order, with the standard abbreviations for the terms, we call this arrangement a **schema**. If two arguments follow the same logical form, we can say that they have the same schema. For example, an argument that substituted *dogs* for *Model T cars*, *brown animals* for *black cars*, and *slow animals* for *fast cars*, would have the same schema as the argument above. In other words, the abbreviations for the two arguments would be identical.

We now come to what is called the **mood** of the syllogism. The mood refers to the various possible combinations of A, E, I and O



KEY POINT

We can work with syllogisms more easily if we abbreviate the terms in the statements.



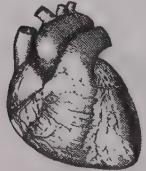
DEFINITIONS

The **schema** of a syllogism is a representation of it, having statements in standard order with standard abbreviations of its terms.

The **mood** of a syllogism is a three-letter description of the types of categorical statements it contains when arranged in standard order.

statements that make up the syllogism. It tells you what kinds of statements the syllogism contains when arranged in standard order. The mood of our syllogism above is IAI, because the major premise is an I statement, *Some M are P*, the minor premise is an A statement, *All S are M*, and the conclusion is an I statement, *Some S are P*.

SUMMARY



Terms in a syllogism may be abbreviated in just the same way as they are in a categorical statement: *P* is the major term, *S* is the minor term, *M* is the middle term. A schema represents the structure of the syllogism in standard form using these abbreviations. The mood of a syllogism shows the types of its various statements in standard order.

THE FIGURE OF SYLLOGISMS

The **figure** of a syllogism is a number identifying the placement of the middle term in the argument. There are four possible ways the middle term can be arranged in the two premises. In a **figure 1** syllogism, the middle term is the subject of the major premise and the predicate of the minor premise. In **figure 2**, the middle term is the predicate of both premises. In **figure 3**, the middle term is the subject of both premises. In **figure 4**, the middle term is the predicate of the major premise and the subject of the minor premise. The four figures can thus be diagrammed as shown (*all/no/some/not* are removed for clarity):



DEFINITION

The **figure** of a syllogism is a number from 1 to 4 identifying the placement of its middle term.

	<i>Fig. 1</i>	<i>Fig. 2</i>	<i>Fig. 3</i>	<i>Fig. 4</i>
Major premise:	M is P	P is M	M is P	P is M
Minor premise:	S is M	S is M	M is S	M is S

Consider the following syllogism, and note how the middle term is arranged according to the pattern of figure 1.

*No Hindus are Christians.
Some Indians are Hindus.
Therefore, some Indians are not Christians.*

The middle term is *Hindus*, because it occurs in both premises but not in the conclusion. In the major premise, *Hindus* is the subject. In the minor premise it is the predicate. If you look again at figure 1, you will see that this is the pattern for the figure 1 syllogism.

Now we will **schematize** the syllogism (i.e., set out its schema):

*No M is P.
Some S is M.
. Some S is not P.*



DEFINITION

The **form** of a syllogism is the mood and figure of the syllogism.

The mood of this syllogism is EIO. That is, the major premise is an E statement, the minor premise is an I statement, and the conclusion is an O statement. As we have already pointed out, it is also a figure 1. We can therefore describe the syllogism as an EIO-1.

When the mood and the figure of the syllogism are listed together this way, we are describing the **form** of the syllogism. The form is the mood plus the figure.

Below are examples of schemas having figures 2, 3 and 4, all with the same mood, EIO.

<i>Figure 2</i>	<i>Figure 3</i>	<i>Figure 4</i>
No P is M	No M is P	No P is M
Some S is M	Some M is S	Some M is S
. . . Some S is not P	. . . Some S is not P	. . . Some S is not P

Given that there are four possible types of categorical statements for each premise and the conclusion, and four possible figures, there are $4 \times 4 \times 4 \times 4$ possible combinations of mood and figure—that is, 256 forms of syllogisms. These are all shown in Appendix B.

SUMMARY



The figure of a syllogism is a number identifying the placement of the middle term in the premises. The middle term may be the subject or predicate of each premise. There are four possible combinations. When this figure is listed after the mood, it is a description of the syllogism's form.

Exercise 20 (26 points)

Write the form (mood and figure) of the following syllogisms on the blank to the right. The syllogisms are in standard order.

1. All Bibles are books.
Some periodicals are not books.
Therefore, some periodicals are not Bibles. _____
2. Some speeches are sermons.
No sermons are short events.
Thus some short events are not speeches. _____
3. All students are geniuses.
Some blondes are students.
Consequently, some blondes are geniuses. _____
4. No fish are mammals.
No fish are snakes.
So no snakes are mammals. _____

Rewrite these syllogisms in standard order and give their mood and figure.

5. All combatants are fighters, so all Spartans are fighters, since all Spartans are combatants.

Mood and figure: _____

6. Some sailors are not poets, because all sailors are mariners, but some poets are not mariners.

Mood and figure: _____

Continued on next page.

7. All books are paper, and some plaques are not paper. Hence, some books are not plaques.
-
-
-

Mood and figure: _____

Exercise 21 (32 points)

Write out the schemas for the given forms.

1. EIO-1 _____ 3. AOO-3 _____

2. IAI-2 _____ 4. OIO-4 _____

Now develop your own syllogisms to meet the requirements of the given form. Make sure your syllogisms are in standard order.

5. AEE-1

6. EAO-2

7. AII-3

8. EAE-4

TRUTH AND VALIDITY

When you examine a syllogism, the first thing you should look for is **validity**. We say that a syllogism is **valid** if the conclusion is necessarily true given that the premises are true. In other words, if the premises are true, and the syllogism is valid, then the conclusion has to be true. If a syllogism has true premises and a false conclusion, we know it is **invalid**. In a valid syllogism, the premises may be false. But if they were true, the conclusion would have to be true also. This is because validity depends on the form of the argument only, not the truth of the statements. Here is an example of a valid syllogism; one of the premises happens to be false, but the syllogism remains valid:

*All dogs are brown animals.
All poodles are dogs.
Therefore, all poodles are brown animals.*

If it were in fact true that all dogs were brown, then all poodles would *necessarily* be brown. The problem with the syllogism is the falsehood of the first premise, not the structure of the argument. To test for validity, grant provisional “truth” to the premises, and then see if the conclusion would have to be true.

Here is an example of an invalid syllogism, with all true premises and a true conclusion.

*All dogs are mammals.
All dogs are canines.
Therefore, all canines are mammals.*

Both of the above premises are true, and the conclusion is also true. But if you examine the syllogism carefully, as you will learn



DEFINITION

A syllogism is **valid** if and only if the premises imply the conclusion.



CAUTION

Validity depends only on the form of the argument, not on the meaning or truth of the individual statements.



DEFINITION

A **sound syllogism** is valid and has true premises.



CAUTION

Know the difference between truth and validity. Statements are true or false, arguments are valid or invalid.

how to do in the next few lessons, you will see that the conclusion is not implied by the premises (substituting the word *animals* for *canines* makes this clear). It is this lack of implication that makes the syllogism invalid.

Once a syllogism has been examined for validity (and it is found to be valid), it may then be examined with a view toward the truth or falsehood of the conclusion. If the syllogism is invalid, then there is no reason to proceed further. But if it is found to be valid, it is still necessary to examine the truth of the premises. If they are found to be true, then the conclusion must be true as well.

If a syllogism is valid and the premises are true, it is said to be **sound**. You should realize, then, that the conclusion of a sound syllogism must be true.

Do not confuse truth with validity! Once we learn the basic rules of formal logic, it is easy to see how prevalent this confusion is. In public debate, the applause is frequently reserved not for those who reason well but for those with whom the audience agrees.

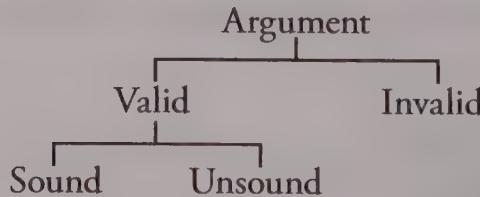
Here is a final example where the premises are true and the conclusion is necessarily true.

All dogs are mammals.

All poodles are dogs.

Therefore, all poodles are mammals..

This syllogism is valid and the premises are true, so the conclusion is also true. This is a sound syllogism. The different types of syllogisms with respect to validity and truth can thus be arranged as shown.



You can see from the chart that there are two ways for a syllogism to be spurious: first, it can simply be invalid; second, it can be valid but unsound.

SUMMARY

A syllogism is valid if the truth of the conclusion follows from the truth of the premises. If a syllogism has true premises and a false conclusion, it is invalid. The validity of a syllogism is not the same thing as the truth of the conclusion. A syllogism may be valid and have a false conclusion. It may be invalid and have a true conclusion. Or, as in a sound syllogism, it may be valid and have a true conclusion. Validity depends only on the form of the argument.



TESTING SYLLOGISMS BY COUNTEREXAMPLE

The validity of a syllogism is determined solely by the form. Validity is not determined by the meanings of the individual statements. Certain forms are always valid, and the other forms are invalid. There are many ways to test the validity of a syllogism. The two this text are concerned with are testing by **counterexamples** and testing by **rules**. We will begin our testing of syllogisms with counterexamples. How can you test a syllogism by counterexample? This is accomplished through the substitution of terms. Suppose someone has presented an argument like this:

*Some Christians are not critical thinkers.
Some humanists are not critical thinkers.
Therefore, some humanists are Christians.*

The syllogism is invalid. This can be shown by recalling the definition of validity. We said that *a syllogism with true premises and a false conclusion is necessarily invalid*. If we were to substitute terms in this syllogism such that the premises were obviously true and the conclusion obviously false, we would show the syllogism to be invalid. For example, let us substitute *women*, *men*, and *lawyers* for *Christians*, *humanists*, and *critical thinkers*. The syllogism would then look like this:

*Some women are not lawyers.
Some men are not lawyers.
Therefore, some men are women.*

Both syllogisms have the same form (OOI-2), and are therefore both valid, or both invalid. The second has an obviously absurd conclusion though both premises are true. Some women are not lawyers,



KEY POINT

The validity of syllogisms depends solely on their form. Certain forms are always valid; other forms are always invalid.



DEFINITION

A **counterexample** to a syllogism is a syllogism of the same form as the original, but with obviously true premises and an obviously false conclusion, in order to show the original to be invalid.

and some men are not. If both premises are true (and they are), and the conclusion is false (which it is) then the problem has to be with the form of the syllogism. That is, it is invalid. Let's consider another example (and counterexample).

No man is immortal.

Some angels are not men.

Therefore, some angels are immortal.



CAUTION

Do not assume a syllogism is valid if you cannot think of a counterexample to it. You may just need to be more creative.

To test with a counterexample, we want to construct a syllogism with the same form (EOI-1), but with true premises and a false conclusion. We could do this:

No dogs are horses.

Some cats are not dogs.

Therefore, some cats are horses.

It is much easier to see the problem with the second syllogism than with the first. Nevertheless, both have the same form, and stand or fall together. If the second is invalid, then so is the first—of necessity.

Note that if you were testing an argument for validity but were unable to develop a counterexample, there is one of two possibilities. Either the argument is valid, so no counterexample is possible, or you are not being creative enough. If you suspect an argument is invalid, but you have not been able to think of a counterexample, try starting with just a false conclusion. Invent major and minor terms that when substituted make the conclusion false. Then write these terms in the premises, leaving the middle term blank. To finish the counterexample, you simply need to find a middle term that makes both the premises true. For example, suppose you wanted to write a counterexample for this argument:

All Paul's writings are first-century compositions.

Some epistles are not Paul's writings.

Therefore some epistles are not first-century compositions.



KEY POINT

When developing counter-examples, try starting with a false conclusion, then find a middle term that results in true premises.

To write a counterexample, we start by making the conclusion false. If we substitute *students* for *epistles*, and *people* for *first-century compositions*, we get

All _____ are people.

Some students are not _____.

Therefore some students are not people.

The conclusion is false (since all students are people), so we simply need to find a middle term to make the premises true. Many terms would work, so we will leave it up to you to finish.

SUMMARY

An invalid argument may be exposed through the use of a counterexample. A counterexample is a syllogism of the same form as the original argument, but with obviously true premises and an obviously false conclusion.



Exercise 22 (27 points)

Test the following syllogisms by counterexample. If no counterexample is possible, write "valid."

1. Some cherubim are not angels.

Some angels are not seraphim.

Therefore, all seraphim are cherubim.

2. No wind instruments are guitars.

All wind instruments are expensive instruments.

Therefore, no expensive instrument is a guitar.

3. All NIV Bibles are Zondervan publications.

Some KJV Bibles are not Zondervan publications.

Therefore, no KJV Bible is an NIV Bible.

4. Some Baptists are not Presbyterians.

No Nazarene is a Baptist.

Therefore, all Nazarenes are Presbyterians.

Continued on next page.

5. All Calvinists are predestinarians.
No predestinarian is an Arminian.
Therefore, some Arminians are not Calvinists.
-
-
-

6. Some colds are not fatal diseases.
All cancers are fatal diseases.
Therefore, some cancers are not colds.
-
-
-

Challenge: Work through the 256 forms of syllogisms in Appendix B, using counterexamples to determine validity. There are 232 invalid forms and 24 valid ones. As you work through them, remember that if you cannot figure out a counterexample, it is either valid or you need to be more creative. Also, you would be greatly assisted in working through them more quickly if you recall what you learned about the relationships between statements. Good luck!

DISTRIBUTED TERMS

We have seen that counterexamples are one method for determining the invalidity of syllogisms. You may also have realized that the method of counterexamples is not very helpful when the syllogism happens to be valid. Because of this, we need another method for testing syllogisms for validity.

This method involves the use of rules. Because these rules depend upon an understanding of distributed terms, we will define them first. The terms in a syllogism are said to be either distributed or undistributed. By **distributed term**, we mean that the term refers to all members of its category. We can tell if a term is distributed or not simply by its placement in a categorical statement. We will look at each categorical statement in turn.

All S are P—Here *S* is distributed and *P* is undistributed. The *S* refers to all of its class, the *P* does not. The statement *All dogs are mammals* says something about all members of the subject class, all dogs, but it does not refer to all members of its predicate class. It does not say anything about all mammals. It only says that some of them are dogs.

No S are P—Both *S* and *P* are distributed. The *S* refers to all of its class, and so does the *P*. For example, the statement *No dogs are cats* makes a claim about all dogs (they are not cats) and about all cats (they are not dogs).

Some S are P—Both *S* and *P* are undistributed. No claim is being made about every *S* or every *P*. It only says that some of the *S* are *P*, and that some of the *P* are *S*.



KEY POINT

Counterexamples can only show a syllogism to be invalid—they cannot show a syllogism to be valid.



DEFINITION

A **distributed term** is a term that, within a statement, refers to all members of its category.



KEY POINT

The subjects of universal statements and the predicates of negative statements are distributed.

Some S are not P—S is undistributed and P is distributed. Consider the O statement *Some astronauts are not men*. This statement says nothing about all astronauts. It only says that some of them are not men. However, it does make a claim about all men. This claim is that all men are not those astronauts being referred to in the subject (namely, female astronauts).

It may help you to remember that the subjects of universal statements are distributed (by definition of “universal”) and the predicates of negative statements are also distributed. The rules for testing a syllogism are explained in the next section. You will quickly see why it is necessary to understand what a distributed term is.

SUMMARY



A distributed term is a term that refers to all members of its category. Universal statements distribute the subject; negative statements distribute the predicate.

Exercise 23 (15 points)

1. What is a *distributed* term?

Underline the distributed terms in the following statements.

2. Some athletes are not honors students.
3. No clear liquid is a solid object.
4. Some politicians are corrupt men.
5. All chefs are contented people.
6. No Bible reader is an ignorant person.
7. Some millionaires are not lazy men.
8. Some Baptists are immersionists.

Underline the distributed terms in the following syllogisms.

9. No wind instruments are guitars.
All wind instruments are expensive instruments.
Therefore, no expensive instrument is a guitar.
10. Some colds are not fatal diseases.
All cancers are fatal diseases.
Therefore, some cancers are not colds.

TESTING SYLLOGISMS BY RULES

There are five rules for testing the validity of syllogisms. If any of these rules are violated, then a syllogism is invalid. If the syllogism passes all five, then it is valid. The rules are the following:

1. In at least one premise, the middle term must be distributed.
2. If a term is distributed in the conclusion, it must also be distributed in its premise.
3. A valid syllogism cannot have two negative premises.
4. A valid syllogism cannot have a negative premise and an affirmative conclusion.
5. A valid syllogism cannot have two affirmative premises and a negative conclusion.



KEY POINT

To establish the validity of a syllogism beyond doubt, test it with the five rules of validity.

Compare the last three rules. If you give them some thought, you should recognize an implication of rules 3 and 5: If a syllogism has a negative conclusion, then one premise must be affirmative and the other negative. You should also see from rule 4 that if a syllogism has an affirmative conclusion, then it must have two affirmative premises. So, these last three rules can be combined even more briefly into this denser “rule”: *The number of negative conclusions in a syllogism must equal the number of negative premises.* If a syllogism has zero negative conclusions (i.e., an affirmative conclusion), then it must have zero negative premises. If it has one negative conclusion, then it must have exactly one negative premise. We will now discuss each of the rules in more detail.

Rule 1: In at least one premise, the middle term must be distributed. This means that the middle term must be either the subject

of an A statement, the subject or predicate of an E statement, or the predicate of an O statement. Below is a small paradigm showing which terms are distributed or undistributed in categorical statements.

	S	P
A	D	U
E	D	D
I	U	U
O	U	D

When you are examining a syllogism, the first rule is applied by looking at what types of statements the middle term is in. For example, consider the following syllogism:

*All men are mortals.
No mortals are angels.
Therefore, some angels are not men.*

The middle term is *mortals* because it appears in both premises. The middle term occurs in two types of statements, an A and an E. Now the middle term is not distributed in the A statement, because it is the predicate. It is distributed in the E statement, because both terms are distributed in an E statement. The syllogism therefore passes its first test.

When this rule is broken, it is known as the **Fallacy of the Undistributed Middle**. Here is an example in which this fallacy is made:

*All men are created beings.
Some created beings are angels.
Therefore, some angels are men.*

The middle term, *created beings*, is not distributed in either premise. Thus, this syllogism is invalid; it has an undistributed middle. The reasoning behind this rule is that the middle term “connects” the two premises. If the middle term is undistributed in both, meaning that in neither premise does it refer to all of its members, then



KEY POINT

Having an undistributed middle term basically means that a syllogism is making no necessary connection between its premises.

no necessary connection is being made between the premises. In the example, the *created beings* of the major premise is a separate class from the *created beings* of the minor premise. The only way a connection is necessarily made between the two premises is for the middle term to be distributed in at least one of them.

Rule 2: If a term is distributed in the conclusion, it must also be distributed in its premise. This rule is a result of the more general rule that, in a valid syllogism, the conclusion cannot go beyond the premises. If a term in the conclusion refers to all members of a particular class (i.e., the term is distributed), then the term in its premise must refer to all members of its class. This rule can be illustrated by looking again at the first example under rule 1. The conclusion is an O statement. By looking at our paradigm, we can see the predicate of an O statement is distributed. That term must therefore be distributed in the premise in which it occurs. That happens to be the major premise. The term is *men*. The term *men* is distributed in the premise, as we can see by looking at the paradigm again.

When this rule is broken it can have one of two names. If the major term is distributed in the conclusion, but not in the premise, it is known as the **Fallacy of an Illicit Major**. Predictably enough, if the minor term is distributed in the conclusion, but not in the premise, it is known as the **Fallacy of an Illicit Minor**. Here is an example of an illicit major:

*Some rocks are granite.
No granite is a sandstone.
Therefore some sandstones are not rocks.*

You see that the major term, *rocks*, is distributed in the conclusion, but it is not distributed in its premise. So this syllogism is invalid.

Rule 3: A valid syllogism cannot have two negative premises. Any syllogism that has only E or O statements as premises is therefore invalid. This rule is an easy one to apply. The following combinations of premises are therefore invalid: OO, OE, EO, and EE. One of the



KEY POINT

A term distributed in the conclusion must be distributed in a premise, because a conclusion cannot “go beyond,” or make a more general statement than, its premises.



KEY POINT

A syllogism cannot be valid unless at least one premise affirms something.

premises must affirm something. If they are both negations, no valid conclusion can be drawn. Consider the following example:

*Some Turks are not Muslims.
No Hindus are Muslims.
Therefore, some Hindus are not Turks.*

If we apply our rule, we can immediately see that the syllogism violates it. The premises are O and E statements, respectively, which are both negative. If the rule is broken, we say that it is the **Fallacy of Two Negative Premises**.



KEY POINT

In syllogisms, affirmative conclusions require all affirmative premises.

Rule 4: A valid syllogism cannot have a negative premise and an affirmative conclusion. The first thing to do is determine the nature of the conclusion. If it is affirmative (A or I), then it cannot have an E or O statement in the premises. Consider this example:

*All Turks are Muslims.
No Hindus are Muslims.
Therefore, some Hindus are Turks.*

This syllogism breaks our fourth rule. The conclusion is affirmative (an I statement), and the minor premise is a negative premise (an E statement). In testing with this rule, look first at the conclusion. If it is affirmative, quickly scan the premises and determine if either is negative. If one is, then the syllogism is necessarily invalid. Any syllogism that breaks this rule may be said to commit the **Fallacy of a Negative Premise and an Affirmative Conclusion**.



KEY POINT

A negative conclusion in a syllogism requires one negative premise.

Rule 5: A valid syllogism cannot have two affirmative premises and a negative conclusion. With this rule, the means of testing is similar to the means with the fourth rule. If the conclusion is negative, then one of the premises must also be negative. For example:

*All whales are mammals.
No canaries are mammals.
Therefore, some canaries are not whales.*

We see right away that the conclusion is negative. This means that one of the premises has to be negative as well, which the minor premise is. Here is an example that breaks this rule:

All whales are sea creatures.
Some sea creatures are warm-blooded animals.
Therefore, no warm-blooded animals are whales.

When this rule is broken, the syllogism makes the **Fallacy of Two Affirmative Premises and a Negative Conclusion.**



THINKING DEEPER

Because of how they translate universals and particulars, many modern logicians include this sixth rule of validity: “A valid syllogism cannot have two universal premises and a particular conclusion.” The associated fallacy is the *Existential Fallacy*. They argue that a universal statement does not assume that the subject exists, but that a particular statement does (for why this is, see the additional exercises for Lesson 17). Consequently, if the premises are universal and the conclusion is particular, the conclusion goes beyond the premises and is therefore invalid.

SUMMARY



In testing by rule, there are five rules to keep in mind. If a syllogism breaks just one rule, it is invalid. If it passes all five, it is necessarily valid. There are two rules that involve distributed terms: the middle must be distributed in at least one premise, and if a term is distributed in the conclusion, then it must be distributed in the premise in which it occurs. The last three rules involve the quality of the statements. A valid syllogism cannot have two negative premises, it cannot have a negative premise with an affirmative conclusion, and it cannot have two affirmative premises and a negative conclusion.

Exercise 24 (26 points)

In the following exercise, analyze the syllogisms. Identify which rules are violated in the syllogism by writing the name of the fallacy or fallacies. If no fallacy is made, write "valid." The premises are *not* necessarily in standard order. (Hint: the first syllogism violates three rules.)

1. Some chefs are not fat people.

No fat person is a contented person.

Therefore, all chefs are contented people.

2. All water is clear liquid.

No clear liquid is a solid object.

Therefore, some water is not a solid object.

3. Some Christians are not Bible-readers.

No Bible-reader is an ignorant person.

Therefore, no ignorant person is a Christian.

4. All Muslims are Hindus.

All Hindus are Christians.

Therefore, some Christians are not Muslims.

5. No dog is a cat.

Some cats are female.

Therefore, some dogs are female.

6. Some politicians are corrupt men.

Some corrupt men are Mafia members.

Therefore, some politicians are Mafia members.

Continued on next page.

7. No honors students are rugby players.
 Some athletes are rugby players.
 Therefore, some athletes are not honors students.
-

8. Some challenging games are not fun games.
 Some fun games are not chess.
 Therefore, all challenging games are chess.
-

9. Some professionals are millionaires.
 Some millionaires are not lazy men.
 Therefore, no lazy men are professionals.
-

10. Some Baptists are immersionists.
 No Presbyterian is a Baptist.
 Therefore, some Presbyterians are not immersionists.
-

Challenge: For additional practice, find the fallacies made by syllogisms used in previous exercises.

Exercise 18

1. _____
2. _____
3. _____
5. _____
6. _____
8. _____
9. _____

Exercise 20

2. _____
4. _____
6. _____
7. _____

Continued on next page.

UNIT THREE: SYLLOGISMS AND VALIDITY

Exercise 21

2. _____
3. _____
4. _____
5. _____
8. _____

Exercise 22

1. _____
2. _____
3. _____
4. _____
6. _____

Exercise 23

9. _____
10. _____

Exercise 25 (15 points)

Write schemas of syllogisms that have the given fallacies.

1. Illicit major, illicit minor.

2. Two negative premises, undistributed middle.

3. Two negative premises, negative premise and affirmative conclusion.

4. Two affirmative premises and a negative conclusion, illicit major.

5. Illicit major, illicit minor, undistributed middle, and two affirmative premises and a negative conclusion.

REVIEW QUESTIONS

Answers can be found in the lesson under which the questions are listed.

Lesson 19: Arguments

1. What is a logical argument?
2. What is a premise?
3. What are some words that introduce a premise in an argument?
4. What is a conclusion?
5. What are some words that introduce a conclusion in an argument?
6. How else might a conclusion be identified in an argument?

Lesson 20: The Syllogism

1. Define *syllogism* by genus and difference.
2. What are the three terms in a syllogism?
3. Where is the major term found in a conclusion?
4. Where is the minor term found in a conclusion?
5. Where is the middle term found?
6. What is the standard order for the statements in a syllogism?
7. What is the procedure for arranging a syllogism into standard categorical form?

Lesson 21: Mood of Syllogisms

1. What is the schema of a syllogism?
2. What is the mood of a syllogism?

Lesson 22: Figure of Syllogisms

1. What does the figure of a syllogism identify?
2. How many different figures can a syllogism have?
3. What is the form of a syllogism?
4. How many different forms of syllogisms exist?

Lesson 23: Truth and Validity

1. What does it mean that a syllogism is valid?
2. Can the statements in a valid syllogism be false?
3. Can the statements in an invalid syllogism be true?
4. What is a sound syllogism?

Lesson 24: Testing Syllogisms by Counterexample

1. Does validity depend solely on the form of a syllogism?
2. What is a counterexample of a syllogism?
3. How does a counterexample show a syllogism to be invalid?
4. How many forms of syllogisms are valid, and how many are invalid?

Lesson 25: Distributed Terms

1. What is a distributed term?
2. Which types of statements distribute their subject?
3. Which types of statements distribute their predicate?

Lesson 26: Testing Syllogisms by Rules

1. List the five rules of validity.
2. Which rules depend on how terms are distributed in the statements?
3. Which rules depend on the quality of the statements in a syllogism?
4. Name the fallacy or fallacies associated with each rule.

REVIEW EXERCISES

Students may do these exercises for further review of this unit.

The following sample arguments will be used in all of the additional exercises in this unit.

- a) No true socialist is a millionaire, but some Russians are millionaires. Therefore, some Russians are not true socialists.
- b) All modern high-resolution images are digital pictures, so some photographs from satellites are modern high-resolution images, since some digital pictures are photographs from satellites.
- c) Some robots are not programmed humanoids, because some robots are androids, and all androids are programmed humanoids.
- d) All epic poems are works of great artistry. Hence, given that no nursery rhymes are works of great artistry, no nursery rhymes are epic poems.
- e) No tele-judges are Supreme Court justices, and some tele-judges are not public defenders. Thus, some Supreme Court justices are not public defenders.
- f) No high-school mathematics is advanced particle physics. Consequently, some advanced algebra must be advanced particle physics, for all advanced algebra is high-school mathematics.
- g) Some secret agents are not arrogant mothers, because some arrogant mothers are mid-management secretaries, but no mid-management secretaries are secret agents.
- h) Some chanting story-tellers are rap singers, so some bards are rap singers, since all chanting story-tellers are bards.
- i) All football games are sporting events, and all football games are physically exhausting activities. Clearly, all sporting events are physically exhausting activities.
- j) Some professional nurses are not licensed medical practitioners. Therefore all graduates of medical school are licensed medical practitioners, for some graduates of medical school are professional nurses.

Additional Exercises for Lesson 19

1. Underline the conclusion in each of the sample arguments above.
 2. How many of the sample arguments have conclusions as the final sentence?
-

Additional Exercises for Lesson 20

1. Locate the major term, minor term, and middle term for each of the sample arguments.

Major Term	Minor Term	Middle Term
a) _____	_____	_____
b) _____	_____	_____
c) _____	_____	_____
d) _____	_____	_____
e) _____	_____	_____
f) _____	_____	_____
g) _____	_____	_____
h) _____	_____	_____
i) _____	_____	_____
j) _____	_____	_____

2. Arrange the sample arguments into standard form syllogisms.

a)	_____

b)	_____

UNIT THREE: SYLLOGISMS AND VALIDITY

- c) _____

- d) _____

- e) _____

- f) _____

- g) _____

- h) _____

- i) _____

- j) _____

Additional Exercises for Lessons 21 and 22

1. Write out the schemas for the sample arguments.

a) _____

f) _____

b) _____

g) _____

c) _____

h) _____

d) _____

i) _____

e) _____

j) _____

2. Determine their mood and figure.

a) _____

f) _____

b) _____

g) _____

c) _____

h) _____

d) _____

i) _____

e) _____

j) _____

3. Write the schemas for each of the following moods and figures, and use those schemas to then write your own standard-form syllogisms:

AII-1 _____

IEO-2 _____

EAO-3	_____	_____
	_____	_____
	_____	_____
OAO-4	_____	_____
	_____	_____
	_____	_____

Additional Exercises for Lesson 23

1. Which of the sample arguments appear to be valid? Circle the corresponding letters:
a b c d e f g h i j
2. Of those, which appear to be sound and which do not? Why?

Additional Exercise for Lesson 24

Three of the sample arguments are valid. Identify them and write counterexamples for the seven invalid sample arguments.

a) _____

b) _____

- c) _____

- d) _____

- e) _____

- f) _____

- g) _____

- h) _____

- i) _____

- j) _____

Additional Exercises for Lessons 25 and 26

1. Underline the distributed terms in the sample arguments.

- a) No true socialist is a millionaire.
Some Russians are millionaires.
∴ Some Russians are not true socialists.

- b) All modern high-resolution images are digital pictures.
 Some digital pictures are photographs from satellites.
 ∴ Some photographs from satellites are modern high-resolution images.
- c) All androids are programmed humanoids.
 Some robots are androids.
 ∴ Some robots are not programmed humanoids.
- d) All epic poems are works of great artistry.
 No nursery rhymes are works of great artistry.
 ∴ No nursery rhymes are epic poems.
- e) Some tele-judges are not public defenders.
 No tele-judges are Supreme Court justices.
 ∴ Some Supreme Court justices are not public defenders.
- f) No high-school mathematics is advanced particle physics.
 All advanced algebra is high-school mathematics.
 ∴ Some advanced algebra is advanced particle physics.
- g) Some arrogant mothers are mid-management secretaries.
 No mid-management secretaries are secret agents.
 ∴ Some secret agents are not arrogant mothers.
- h) Some chanting story-tellers are rap singers.
 All chanting story-tellers are bards.
 ∴ Some bards are rap singers.
- i) All football games are physically exhausting activities.
 All football games are sporting events.
 ∴ All sporting events are physically exhausting activities.
- j) Some professional nurses are not licensed medical practitioners.
 Some graduates of medical school are professional nurses.
 ∴ All graduates of medical school are licensed medical practitioners.
2. Determine the formal fallacies made in each of the sample arguments.

- a) _____
- b) _____
- c) _____
- d) _____
- e) _____

INTRODUCTORY LOGIC

- f) _____
- g) _____
- h) _____
- i) _____
- j) _____

UNIT 4

ARGUMENTS IN NORMAL ENGLISH

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IMMEDIATE INFERENCES

We are now able to determine the validity of any standard-form categorical syllogism. However, most arguments we run into in daily life are expressed in normal English, rather than the more stilted categorical form. In order to make the skills we have learned more practical, we need to consider how to translate arguments in normal English into standard syllogisms. We will first look at translations resulting from **immediate inferences**.

An immediate inference is a statement that can be inferred directly from another statement. It resembles a syllogism with only one premise, and is related to the concepts of implication and equivalence. We have already mentioned a number of immediate inferences in this text. For example, from the square of opposition we know that *Some S is P* can be immediately inferred from *All S is P* by subimplication. We also learned in the section on logical equivalence that the statements in the following sets can be immediately inferred from each other:

$$\text{No } S \text{ is } P = \text{No } P \text{ is } S$$

$$\text{Some } S \text{ is } P = \text{Some } P \text{ is } S$$

The immediate inference that switches the subject and predicate of a statement like this is called the **converse**. The converse is only valid for E and I statements. A and O statements do not have a valid converse. *All S is P* does not imply that *All P is S*. If it did, then the fact that *All women are people* would imply that *All people are women*. Similarly, *Some dogs are not poodles* does not mean that *Some poodles are not dogs*.

Another type of immediate inference is the **obverse**. The obverse of a statement is obtained by changing the quality of the statement (*All* changes to *No*, *Some* to *Some . . . not*, and vice versa) and changing the predicate to its **complement** (*P* to *non-P*). Each of the four categorical statements has a valid obverse. They are translated as follows:



DEFINITION

An **immediate inference** is a statement that can be inferred directly from another statement.



DEFINITIONS

The **converse** of a statement is a statement that reverses the subject and predicate. It is only valid for E and I statements.

The **obverse** of a statement is a statement of the opposite quality with a negated predicate. It is valid for all statements.



DEFINITION

The **complement** of a term is the set of all terms not included in the given term. Thus the complement of the term *P* is *non-P*.



DEFINITION

The **contrapositive** of a statement is a statement that reverses and negates both the subject and predicate of the original. It is valid for A and O.

$$\text{All } S \text{ is } P = \text{No } S \text{ is non-}P.$$

So *All believers are Christians* is equivalent to *No believers are non-Christians*.

$$\text{No } S \text{ is } P = \text{All } S \text{ is non-}P.$$

Thus, *No demons are atheists* means the same as *All demons are non-atheists*.

$$\text{Some } S \text{ is } P = \text{Some } S \text{ is not non-}P.$$

So *Some incredible things are possible* implies that *Some incredible things are not impossible*.

And finally,

$$\text{Some } S \text{ is not } P = \text{Some } S \text{ is non-}P.$$

This is the most obvious. *Some Americans are not capitalists* is equivalent to *Some Americans are non-capitalists*.

The third type of immediate inference is called the **contrapositive**. The contrapositive switches the subject and predicate of A and O statements, like the converse, but it changes both subject and predicate of each to their complements. This can be derived from the other two immediate inferences. Follow the two translations closely:

$\text{All } S \text{ is } P$ \downarrow $\text{No } S \text{ is non-}P$ \downarrow $\text{No non-}P \text{ is } S$ \downarrow $\text{All non-}P \text{ is non-}S$	by obverse by converse by obverse	$\text{Some } S \text{ is not } P$ \downarrow $\text{Some } S \text{ is non-}P$ \downarrow $\text{Some non-}P \text{ is } S$ \downarrow $\text{Some non-}P \text{ is not non-}S$
--	--	--

Thus the statement *All saved people are believers* is equivalent to *All non-believers are unsaved people*. Similarly (though it is perhaps more awkward), *Some faithful people are not Buddhists* translates into its contrapositive, *Some non-Buddhists are not unfaithful people*. Notice that the contrapositive is not valid for E and I statements. You can prove this by trying to put either type of statement through

the translation procedure above. After the first obverse, you obtain statements that have no valid converse.

Now, consider the following argument. Is it valid or invalid?

All non-believers are unsaved people.

No believers are non-Christians.

Therefore, all Christians are saved people.

As it is written, this argument has six terms: *saved people*, *unsaved people*, *Christians*, *non-Christians*, *believers* and *non-believers*. It also looks as if it has a negative premise and an affirmative conclusion. But in order to analyze it for validity, we need to reduce the number of terms down to the standard three using the immediate inferences. The major premise is an A statement. Thus we can take its contrapositive and change it into *All saved people are believers*. The minor premise can be changed into its obverse, *All believers are Christians*. Thus the whole argument becomes

All saved people are believers.

All believers are Christians.

Therefore, all Christians are saved people.

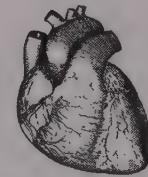
This argument can now be analyzed by the techniques already covered. We see that it is an AAA-4 syllogism, which is invalid, having an illicit minor term.



KEY POINT

Use immediate inferences to translate arguments with complementary terms into standard-form syllogisms for analysis.

SUMMARY



Immediate inferences are statements that can be inferred directly from other statements. There are three main types of equivalent immediate inferences. Converse switches the subject and predicate and is valid for E and I statements. Obverse changes both the quality of the statement and the predicate to its complement, and is valid for all statements. Contrapositive switches the subject and predicate of the statement and changes both to their complements; it is valid for A and O statements.

Exercise 26 (22 points)

Write two valid immediate inferences for each of the statements given. Identify the immediate inferences as either *converse*, *obverse*, or *contrapositive*.

1. All things that glitter are gold.

2. No emperors were philosophers.

3. Some prophets are pagans.

4. Some mathematicians are not teachers.

Write statements with the given criteria, which will show that the immediate inference given is not valid for the given type of statement.

5. A false A statement that has a true converse.

6. A true O statement that has a false converse.

7. A false I statement that has a true contrapositive.

Exercise 27 (31 points)

Translate the following arguments into standard-form categorical syllogisms. Note that they may not be in proper order. Also, find and identify the one invalid syllogism.

1. Some Christians are Calvinists, but no Christians are unbelievers. Therefore some Calvinists are believers.

2. All mumbling is murmuring, so all mumbling is nonsensical, since no murmuring is sensical.

3. All perfect beings are nonhuman, since all mortals are imperfect, and no humans are immortals.

4. All eighth graders are less than six feet tall, because all poor logicians are non-eighth graders, and nobody six feet tall or more is a good logician.

5. Some non-adults are not immature people, but no mature people are impatient people. We must conclude that some adults are patient people.

6. No things that glitter are non-gold, and all gold is expensive. Thus, nothing that glitters is inexpensive.
-
-
-

TRANSLATING ORDINARY STATEMENTS

Categorical statements are given in very formal language, but in everyday arguments they can be expressed in a wide variety of ways. You have already done some translation of ordinary statements into categorical form, but many more means of expressing statements need to be considered.

For example, we have already learned that categorical form requires verbs to be changed into nouns. Thus the ordinary statement *All roads lead to Rome* gets translated into *All roads are to-Rome leaders* or *All roads are roads that lead to Rome*. Similarly, we have seen that, for proper categorical form, adjectives must become nouns. *All toads are ugly* is not categorical form; it must be translated into something like *All toads are ugly amphibians*.

The assignments have also required you to recognize some synonyms to the words *all*, *no*, and *some*. The following are some examples:

All: every, any, as many as

No: none, all...not, never

Some: many, most, a few

Note that statements of the form *Not all S are P* should be translated *Some S are not P*, because the contradiction of an A statement is an O statement. Thus, *Not all students are bad* means *Some students are not bad people*.

Try translating the following ordinary statements into categorical form before reading on:

Everybody needs a friend.

Any number two pencil will work.

As many as saw the accident may testify.

None of the songs I heard were copyrighted.



KEY POINT

Most arguments you encounter will need to be translated into more formal, precise language in order to be analyzed more easily.



CAUTION

Statements of the form *Not all S are P* should be translated *Some S are not P*, not *No S is P*.

*All of the pianos in that room are not in tune.
 Toddlers never study calculus.
 Many soldiers visited the memorial.
 Most people like ice cream.
 A few people like spinach.
 Not all soldiers fight on the front lines.*



KEY POINT

Singular statements are best translated as universals.

We will now identify some additional statements in ordinary English which require more careful translation.

1. Singular statements. Statements often refer to a single person or thing. When they do, they are usually best translated as universals. Thus they would be changed like this:

*John is a mailman.
 All John is a mailman.*

Singular statements that are denials are translated in the same way. For example:

*You are not my people.
 No you are my people.*

Again, while this may sound awkward, it will allow us to analyze arguments more easily.

2. Indefinite statements. Some statements look very similar to singular statements, but the context requires them to be translated differently. For example, consider the sentence

Dogs ate my homework.

This statement should not be translated *All dogs were eaters of my homework*, since no doubt only a few dogs were involved. This is better changed to

Some dogs were eaters of my homework.



KEY POINT

Indefinite statements may be translated as universals or particulars, depending on the statement's meaning.

Translating indefinite statements requires the student to think about the meaning of the statements in the argument. Consider this argument:

Cats are mammals.

Cats sang outside my window.

Therefore mammals sang outside my window.

The first statement should be translated into a universal, *All cats are mammals*. The second, however, should be translated into the particular *Some cats were outside-my-window singers*. How would you translate the conclusion?

3. Hypothetical statements. Many statements use *if... then...* language. We will consider this in more detail in a later section, but for now we recognize that such statements can be translated into universals, such as

If you like chocolate, you will love this cake.

All chocolate likers will be lovers of this cake.



KEY POINT

Hypothetical statements should be translated as universals.

Similarly, negative hypotheticals can be translated into E statements:

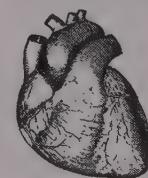
If it's a hard test then I won't pass.

No hard test is a test I will pass.

We will practice with these before we look at more difficult translations.

SUMMARY

Arguments with statements in normal English must first be translated into categorical form in order to be examined. This section has considered the translation of singular, indefinite, and hypothetical statements.



Exercise 28 (20 points)

Translate the following statements in normal English into standard categorical form.

1. God is good.

2. As many as are led by the Spirit of God, these are sons of God.

3. If you sin then you are a lawbreaker.

4. Not everybody will come.

5. A soft answer turns away wrath.

6. If anyone loves the world, the love of the Father is not in him.

7. Many antichrists have come.

8. I believe.

9. The Pharisees sit in Moses' seat.

10. The love of most will grow cold.

TRANSLATING INCLUSIVE & EXCLUSIVE STATEMENTS

There are two more broad types of statements in ordinary English that we need to learn how to translate into standard form: statements that employ what we might call inclusives and exclusives. Let us examine these further.

1. Inclusives. Some statements employ what we might call “inclusive” words. The words in this very general category, often relative pronouns and adverbs, all have the function of *including* a broad, unspecified range of things (or times) in the meaning of the sentence. Examples are words such as *whoever*, *whatever*, *wherever*, *whenever*, *however*, *always*, *never*, and other similar words. We might also call them “ever-words.” Let’s look at some examples.

First, consider how you would translate this sentence:

You should eat whatever your mother feeds you.

The function of the word *whatever* here is to include every type of food your mother might feed you, and so it is best translated “all things.” The words following the inclusive word usually make up the subject; the remainder of the statement becomes the predicate, as the following translation shows:

You should eat whatever your mother feeds you.

All things your mother feeds you are things you should eat.

Consider this use of the inclusive word *whenever*:

*Whenever two or more of you are gathered in my name,
there I shall be in the midst of you.*



DEFINITION

For our purposes, an **inclusive** is a word, often a relative pronoun or adverb, that refers to a broad range of things or times.



KEY POINT

The words following the inclusive usually make up the subject.

Depending on the rest of the argument, this can be translated in terms of time or place. We can translate it

*All times that two or more of you are gathered in my name
are times that I will be in the midst of you.*

You need to be very careful with time inclusives such as *always*. Sometimes the translation is easy:

*The poor you will always have with you.
All times are times the poor will be with you.*

But consider the translation of this statement:

Joe always wins at chess.

This should not be translated *All times are times Joe wins at chess*, because sometimes Joe is not playing chess. It is best translated this way:

All times Joe plays chess are times Joe wins at chess.

Never should be treated similarly. Note that though it is negative, it still refers inclusively to all times—just as an E statement distributes its terms.

Sometimes shorter versions of “ever-words” are used. They should be translated in the same way as their longer counterparts. In this example, the word *where* acts like the word *wherever*.

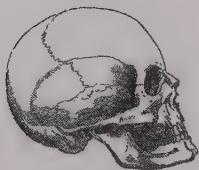
*I will go where you go.
All places you go are places I will go.*

Then, notice that even the word *that* can be used as an inclusive. Take this statement, for example:

All's well that ends well.

Here, the word *that* has the same function as *whatever*, so this is best translated

All things that end well are things that are well.



CAUTION

Some inclusive and exclusive time-words are tricky to translate correctly. Take care translating *always* and *never*.

2. Exclusives. Words that exclude—such as *only*, *unless*, and *except*—require special attention as well. Exclusives set boundaries by explicitly referring to a limited class of things. Though they may seem opposite to inclusives, they are still usually translated as universals, often affirmative. We will consider several examples to clarify. First, consider this statement:

Only the good die young.

What is the categorical form of this statement? Initially, you may want to translate it *All good people are people who die young*. But that is not the meaning of the statement, any more than *Only women are mothers* means *All women are mothers*. The statement is really this one:

All people who die young are good people.

The words *nobody but*, *nothing but*, and so on are all translated in this same way. For example:

Nobody but the Spartans could fight like that.

All people who could fight like that are the Spartans.

Now consider this statement:

The plants will die unless you water them.

This does not mean that *All the plants you water are plants that do not die*. The above statement could still be true, but if you faithfully water the plant, it will still eventually die. Rather, the statement should become

All the plants you do not water are the plants that die.

Or, by the contrapositive,

All the plants that do not die are the plants you water.

Finally, the word *except* must be considered. Statements that employ *except* often contain two independent statements, which should both be considered. For example:



DEFINITION

For our purposes, **exclusives** are words that set boundaries, referring only to a limited class of things.



KEY POINT

The words following an exclusive often make up the predicate.



KEY POINT

Statements that use *except* can contain two independent statements.



CAUTION

Some statements in ordinary English may be translated into more than one categorical statement.

Everyone was invited to the clubhouse except sisters.

This clearly includes the statement *All non-sisters were clubhouse-invited people*, but it just as clearly includes the meaning of *No sisters were clubhouse-invited people*. Which translation you should use depends on how the statement is used in the argument.

Obviously, the translation of arguments that use the types of statements in these last two sections requires careful thought and practice. Often, the best approach is simply to ask, “What does this statement *really* mean?” If the meaning can be correctly carried across into the statements in categorical form, then the arguments can be examined for validity.

SUMMARY



Arguments with statements in normal English must first be translated into categorical form in order to be examined. This section has considered the translations of statements that employ inclusive and exclusive statements, which are generally translated using universals.

Exercise 29 (20 points)

Translate the following statements in normal English into standard categorical form.

1. Wherever you go, there you are.

2. You may prepare it however you like.

3. Unless you repent, you too will perish.

4. He never did anything wrong.

5. You will reap what you sow.

6. He gets sick whenever he drinks milk.

7. Righteousness is found only in the Lord.

8. God does whatever He pleases.

9. You always hurt the one you love.

10. Nobody leaves except those who have finished.

Exercise 30 (20 points)

Translate the following arguments into standard categorical form.

1. Happy is the land that has no history, and King Frank's land has no history. We must conclude that King Frank's land is happy.

2. None but the wise are truly happy, so Solomon was happy, since he was so wise.

3. Some people are not Christ's disciples, for whoever turns away cannot be His disciple, and many people turn away.

4. All sciences except logic study the tangible, and chemistry is not logic. Thus, chemistry is a study of the tangible.

5. Write a counterexample to the one invalid argument in this exercise.

ENTHYMEMES

We have come a long way toward being able to analyze arguments in normal English. Still, most of the arguments that you come across in daily life do not explicitly state all of the premises, and some even leave the conclusion unstated. Arguments in which a statement is left assumed are called **enthymemes**. We must now consider how to change enthymemes into complete, standard-form syllogisms.

We will work through some examples step-by-step. Here is an argument you might hear in everyday conversation:

You aren't invited to the party, because only eighth-graders are invited.

First, we locate the conclusion. In this argument, the conclusion is the first statement, *You aren't invited to the party*. Translating this into categorical form gives us

No you are invited persons.

Second, consider the other statement, *Only eighth-graders are invited*. If we put this in standard form we obtain

All invited persons are eighth-graders.

We see that this has the major term, *invited persons*, so it is the major premise. Put this into proper order, and leave a space for the missing premise:

All invited persons are eighth-graders.

()

∴ No you are invited persons.



DEFINITIONS

An **enthymeme** is an argument in which a statement is unstated and assumed. Specifically, it is a syllogism with one assumed statement.



CAUTION

Several different statements may fit as the assumed statement in an enthymeme. To fairly evaluate it, assume it is valid and choose possible statements accordingly.



FURTHER STUDY

An argument that has more than two premises is called a *sorites*. These can be analyzed for validity by breaking them down into syllogisms, with the conclusion of one syllogism becoming the premise of another until the conclusion is reached. Lewis Carroll, the author of *Alice in Wonderland* and other stories, describes a unique method of analyzing sorites, with many examples, in his book *Symbolic Logic* (available bound together with Carroll's *Game of Logic* from Dover Publications).

The missing premise must contain the terms that have been used only once, in this case *you* and *eighth-graders*. If the person is arguing validly, the missing premise must also be an E statement. (We know this because of the rules for validity.) Since an E statement is equivalent to its converse, it doesn't matter what order the terms are placed in. Thus the missing premise could be *No you are eighth-graders*, and the complete syllogism would then be

All invited persons are eighth-graders.
(No you are eighth-graders.)
∴ No you are invited persons.

The enthymeme has thus been translated into categorical form, with the assumed premise set in parentheses. It is an AEE-2 syllogism. We found the missing premise by considering which terms were used only once in the other statements, and by considering what the quality of the statement had to be, assuming the person was arguing validly.

Consider another example, this time from the Bible. In Matthew 27:4 Judas says:

I have sinned, for I have betrayed innocent blood.

What was Judas assuming in this enthymeme? First, we put the conclusion, *I have sinned*, into categorical form:

All I am a sinner.

The given premise contains the minor term *I*, so it is the minor premise. We put that into categorical form and obtain:

All I am an innocent-blood betrayer.

What is the assumed premise? It is the major premise, and must contain both the middle term *innocent-blood betrayer* and the major term *sinner*. Now, we should assume that he was arguing validly, if we can (sometimes no valid syllogism is possible). If so, the only valid syllogism that ends in a universal affirmative is AAA-1. Thus the complete argument is

(*All innocent-blood betrayers are sinners.*)

All I am an innocent-blood betrayer.

∴ *All I am a sinner.*

One more example should be sufficient, again from the Bible (Matt. 10:40). In this enthymeme the conclusion is left assumed:

He who receives you receives me, and he who receives me receives the one who sent me.

What does Jesus leave us to conclude? If we place the premises in categorical form, and in the proper order, we obtain

All receivers of me are receivers of the one who sent me.

All receivers of you are receivers of me.

(∴)

Obviously, Jesus wishes us to conclude that *He who receives you receives the one who sent me*. We can translate this into proper form and place it in the syllogism, and we obtain this as the final product:

All receivers of me are receivers of the one who sent me.

All receivers of you are receivers of me.

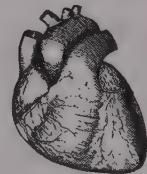
(∴ *All receivers of you are receivers of the one who sent me.*)



CAUTION

Remember that the assumed statement in an enthymeme might be the conclusion.

SUMMARY



Many arguments in daily life are expressed as enthymemes. An enthymeme is a syllogism in which one statement is left assumed. The assumed statement can be determined by considering which terms were used only once in the given statements, then considering the form of the assumed statement that would make the syllogism valid, if possible.

Exercise 31 (25 points)

Translate the following enthymemes into standard-form syllogisms. Assume the enthymeme is valid, and place parentheses around the assumed statement. Number 5 assumes the conclusion.

1. Tomorrow is not Tuesday, therefore tomorrow we will not have a test.

2. No enthymemes are complete, so some arguments are incomplete.

3. Some young people are not rebels, since not everyone rebels as a teenager.

4. Most Russians are not capitalists, because communists are not capitalists.

5. God does whatever He pleases, and He is pleased to save sinners. So

Exercise 32 (25 points)

Repeat the above exercise using these enthymemes, all taken from Scripture.

1. “This man is not from God, for he does not keep the Sabbath” (John 9:16).

2. “I will fear no evil, for you are with me” (Psalm 23:4).

3. “You are worthy, our Lord and God, to receive glory . . . for you created all things” (Rev. 4:11).

4. “The promise comes by faith, so that it may be by grace” (Rom. 4:16).

5. “Here are my mother and my brothers! For whoever does the will of my Father in heaven is my brother and sister and mother” (Mt. 12:49–50).

HYPOTHETICAL SYLLOGISMS

As mentioned earlier, many arguments in normal English are given in the form of hypotheticals, statements using *if . . . then . . .* language. At that time we learned that the statements could be translated into universal categorical statements (A or E), and the argument then treated like other categorical syllogisms. But hypothetical syllogisms can also be examined in a manner different from categorical syllogisms.

First, we will consider what may be called pure hypothetical syllogisms. This form of argument employs only hypotheticals, as follows:

If P then Q.
If Q then R.
Therefore, if P then R.

We can use the symbol \supset for *if . . . then*. When we do, the whole argument is symbolized like this:

$$\begin{aligned} P &\supset Q \\ Q &\supset R \\ \therefore P &\supset R \end{aligned}$$

This is a valid argument, which, in fact, could be translated into an AAA-1 categorical syllogism. Here is an example of a valid, pure hypothetical syllogism:

If I study, then I will get good grades.
If I get good grades, then my parents will be pleased.
Therefore, if I study then my parents will be pleased.

We see that hypothetical statements combine two categorical statements into one new *if . . . then* statement. The categorical statement after the *if* is called the **antecedent**, usually abbreviated *P*.



DEFINITION

A **hypothetical** is a statement that affirms an outcome based on a condition. It has the form *If P then Q*.



DEFINITION

A **pure hypothetical syllogism** is an argument that uses only hypothetical statements.



DEFINITION

The **antecedent** of a hypothetical statement is the condition, the part following the “if.” The **consequent** is the result of the condition, the part after the “then.”



DEFINITION

A **mixed hypothetical syllogism** is an argument that uses both hypothetical and categorical statements.

The statement after the *then* is called the **consequent**, abbreviated *Q*. The antecedent of the above conclusion is *I study*, and the consequent is *My parents will be pleased*.

Pure hypothetical syllogisms can also be invalid. Consider this argument:

If you are a woman, then you are a human.
If you are a man, then you are a human.
Therefore, if you are a woman, then you are a man.

The argument follows this form

<i>If P then Q</i>	$P \supset Q$
<i>If R then Q</i>	$R \supset Q$
<i>Therefore, if P then R</i>	$\therefore P \supset R$

Some syllogisms combine hypothetical and categorical statements. These are called **mixed hypothetical syllogisms**. We will consider two valid and two invalid forms of mixed hypothetical syllogisms.

The first form we will consider is called **modus ponens**. It looks like this:

If P then Q
P
Therefore, Q

If we put terms from real life into the argument, we could obtain this:

If I study, then I will get good grades.
I study.
Therefore, I will get good grades.

You can see that the first statement is a hypothetical statement, and the second is a categorical statement. If this is expressed with symbols only, we can clearly see the form of modus ponens:

$P \supset Q$
P
 $\therefore Q$

Here is another example of modus ponens:

*If something has a complex design, then it has a designer.
Living cells have a complex design.
Therefore, living cells have a designer.*

The second type of argument is called **modus tollens**. The form of argument is:

*If P then Q
Not Q
Therefore, not P*

With the same real terms we used above, the argument would be:

*If I study, then I will get good grades.
I did not get good grades.
Therefore, I did not study.*

In symbols, modus tollens would thus be:

$P \supset Q$
 $\sim Q$
 $\therefore \sim P$

Here is a second example of modus tollens:

*If a school is classical, then logic is taught in that school.
Logic is not taught in the public school.
Therefore, the public school is not classical.*

There are also two fallacies that take a similar form to the arguments presented above. The first is the fallacy of **affirming the consequent**, so named because the second premise affirms the consequent of the hypothetical statement. This is how it looks:

<i>If P then Q</i>	$P \supset Q$
<i>Q</i>	Q
<i>Therefore, P</i>	$\therefore P$



KEY POINT

Learn the two basic, valid, mixed hypothetical syllogisms: *modus ponens* and *modus tollens*.



FURTHER STUDY

Though they may be translated into categorical syllogisms, hypothetical syllogisms (as they are dealt with in this lesson) are more properly considered under *propositional logic*, rather than categorical. You can see this in the fact that the letters *P* and *Q* represent whole propositions, rather than categories or terms. The next book in this series, *Intermediate Logic: Mastering Propositional Arguments*, deals more fully with this branch of reasoning.



DEFINITION

Learn the two basic, *invalid*, mixed hypothetical syllogisms: *affirming the consequent* and *denying the antecedent*.



KEY POINT

The Latin phrase *non sequitur* means “it does not follow”; i.e., that an argument is invalid.

With terms from the real world inserted, we see a form of invalid argument which is all too familiar:

*If I study, then I will get good grades.
I got good grades.
Therefore, I studied.*

This is what is called a **non sequitur**, meaning “it does not follow.” The student may have gotten good grades some other way—cheating, for example. The initial statement does not say that studying is the only way to good grades. There is therefore no basis for the conclusion that studying must have been the way they were obtained. Here is a clearer counterexample:

*If you were a gorilla, then you would have two legs.
You have two legs.
Therefore, you must be a gorilla.*

You can see that the premises are true, but the conclusion is false. Thus affirming the consequent is invalid.

The other fallacy is called **denying the antecedent**, because the antecedent of the hypothetical statement is denied in the second premise.

$$\begin{array}{ll} \text{If } P \text{ then } Q & P \supset Q \\ \text{Not } P & \neg P \\ \text{Therefore, not } Q & \therefore \neg Q \end{array}$$

And the real life example is

*If I study, then I will get good grades.
I did not study.
Therefore, I will not get good grades.*

This is also a *non sequitur*. You might not study but still luck out and get good grades. Consider this more clear counterexample:

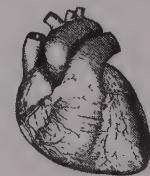
*If you were a gorilla, then you would have two legs.
You are not a gorilla.
Therefore, you do not have two legs.*

This clearly demonstrates that denying the antecedent is invalid. Here is a summary of the mixed hypothetical syllogisms:

VALID	<i>Modus Ponens</i> $P \supset Q$ P $\therefore Q$	<i>Modus Tollens</i> $P \supset Q$ $\sim Q$ $\therefore \sim P$
INVALID	<i>Affirming the Consequent</i> $P \supset Q$ Q $\therefore P$	<i>Denying the Antecedent</i> $P \supset Q$ $\sim P$ $\therefore \sim Q$

SUMMARY

Hypothetical syllogisms are very common arguments in normal English. Pure hypothetical syllogisms employ only *if... then* statements. Mixed hypothetical syllogisms employ hypotheticals and categoricals. There are two valid forms of mixed hypothetical syllogisms: modus ponens and modus tollens. There are also two invalid forms: affirming the consequent and denying the antecedent.



Exercise 33 (20 points)

Analyze each of the following arguments and write down its form in the blank provided: *pure hypothetical*, *modus ponens*, *modus tollens*, *affirming the consequent*, or *denying the antecedent*.

1. If you are lazy, then you will be poor. Henry is poor, and it follows that he is therefore lazy.
2. The Bible teaches that if a man is generous, then he will prosper. We know that Mike is not generous, and therefore he cannot prosper.
3. If you speak too much, sin will not be absent. If sin is not absent, then it is present. Thus if you speak too much, sin is present.
4. If a ministry is of God, then it will succeed. The Mormon church is successful. We can conclude that it is blessed by God.
5. If you are kind to the poor, then you are lending to the Lord. Paul is kind to the poor. He is therefore lending to the Lord.
6. If you visit your neighbor too much he will get sick of you. My neighbor is not sick of me, so I don't think I visit too much.
7. If you don't answer a fool according to his folly, then he will think that he is wise. Sharon did not answer him according to his folly. He must think he is wise.
8. If a country is rebellious, it has many rulers. Argentina has had many rulers; it must be a rebellious country.
9. If a man is lawless, even his prayers are detestable. Larry is not at all a lawless man. So his prayers must not be detestable.

Continued on next page.

10. "If you are willing, you can make me clean." "I am willing," Jesus said. "Be clean."

11. If recycling were necessary, then it would be profitable. Recycling is not yet profitable. So it must not be necessary.

12. If a man gives gifts, then everyone wants to be his friend. Everyone wants to be Gordon's friend. Gordon must give out a lot of gifts.

13. If they receive you they receive me. If they receive me, then they receive Him who sent me. So if they receive you, they receive Him who sent me.

14. If I kill you, then you will die. I promise that I will never kill you. Therefore, you will never die!

15. If you flog a mocker, then the simple will learn prudence. We don't flog mockers. That must be why we have so many imprudent people.

16. If you are rich, then many will want to be your friend. No one wants to be Jessica's friend. She must not be rich.

17. If you honor the Lord with your wealth, then He will bless you greatly. Mr. Spence has always honored the Lord this way. He will be blessed.

18. If you fear the Lord, then you will love wisdom. A man who hates wisdom must not fear the Lord.

19. If you are a Christian, then you will read your Bible. I know a man who reads the Bible. He must be a Christian.

20. If they had belonged to us, they would have remained with us. But they went out from us. This showed that they did not belong to us.

Exercise 34 (16 points)

Analyze the following paragraph. Separate the various arguments (there are four), and determine whether they are valid or not. Identify each argument by name.

If Paul went to Ephesus, then he wouldn't write the Ephesians a letter. But he did write them a letter, which means that he didn't go to Ephesus. But if Paul didn't go to Ephesus, then he would not have known the people there. We know, however, that Paul did go to Ephesus, therefore he did know the people there. If he knew the people in Ephesus, then he would have known the saints in Colossae too. But we know that he did not know the Christians in Colossae, which means that he didn't know the Ephesians. If Paul didn't know the Ephesians, then he would have written them a letter. He wrote them a letter, and this proves that he did not know them.

1.

Name _____ Valid? _____

2.

Name _____ Valid? _____

3.

Name _____ Valid? _____

4.

Name _____ Valid? _____

ESTABLISHING CONCLUSIONS

Up to this point this text has concentrated on analysis—determining the validity or invalidity of existing arguments. This is in keeping with what Dorothy Sayers states in her essay on classical education, “The Lost Tools of Learning.” She writes, “Indeed, the practical utility of Formal Logic today lies not so much in the establishment of positive conclusions as in the prompt detection and exposure of invalid inference.”

Still, there is a value in being able to establish positive conclusions, for example, when we need to prove the resolution in a debate. And now we have all the tools we need in order to do this. We can take a given statement, place it as the conclusion of an argument, and find a valid argument form that could be used to establish that conclusion.

As you may have discovered by now, there are twenty-four valid argument forms. Each figure has six valid moods, as follows:

AAA-1	AEE-2	AAI-3	AAI-4
AAI-1	AEO-2	AII-3	AEE-4
AII-1	AOO-2	EAO-3	AEO-4
EAE-1	EAE-2	EIO-3	EAO-4
EAO-1	EAO-2	IAI-3	EIO-4
EIO-1	EIO-2	OAO-3	IAI-4

Any of these forms may be used to establish a valid conclusion. Take, for example, the claim that “Angels have limited knowledge.” Imagine that you wanted to prove this claim in debate. The following procedure could be followed:

1. Put the statement to be established into categorical form. The given statement would become something like this: *All angels are*



KEY POINT

You can use logical techniques to construct syllogisms as well as analyze them.



KEY POINT

There are 24 valid forms of syllogisms—six moods for each of the four figures.



HISTORY

As logic developed as a science, various logicians recognized different syllogism forms as valid. In his *Prior Analytics*, Aristotle identified 16 valid forms, omitting AAI-1, EAO-1, AEO-2, EAO-2, AAI-4, AEE-4, AEO-4, and IAI-4. Later, AAI-4, AEE-4, and IAI-4 were recognized as valid.

Peter of Spain named the 19 valid forms using vowels to represent the corresponding mood (e.g., AAA-1 was named Barbara, OAO-3 was named Bocardo). Interestingly, the five remaining rejected forms can be shown to be equivalent to AAI-4 (called Bramantip). Cassiodorus Senator added AAI-1 to the list of valid forms.

Other logicians, up to and including Isaac Watts, called the fourth figure “useless,” and thus ended up with only 14 valid forms. Finally, many modern logicians reject the nine forms of mood and figure that have universal premises and a particular conclusion. The 24 forms given here as valid can be shown to be derived (using the immediate inferences) from four basic forms: AAA-1, AII-1, AAI-3, and AAI-4.

beings with limited knowledge. This is a universal affirmative, or an A statement.

2. Find a valid argument form (mood and figure) which has that type of statement as the conclusion. The only argument form that has an A statement as a conclusion is AAA-1, so we must use this form for our argument.

3. Place the statement as the conclusion of the selected form of syllogism, and fill in the known terms, leaving the middle term blank. The argument would then look something like this (note that it is in AAA-1 form, and the conclusion is in categorical form from step 1):

All _____ are beings with limited knowledge.

All angels are _____.

Therefore, all angels are beings with limited knowledge.

4. Find a middle term that makes the premises true, thus completing the argument. What is something that all angels are, and at the same time is a being that has limited knowledge? It could be argued that, since only God has unlimited knowledge, then any being which is not God—that is, any created being—has limited knowledge. And since all angels are created beings, the term “created being” works as our middle term. So our final argument is

All created beings are beings with limited knowledge.

All angels are created beings.

Therefore, all angels are beings with limited knowledge.

Let’s work through another example. Suppose you wanted to prove the following resolution: “Not all killing of another person is murder.” Our first step is to put the statement into categorical form, e.g., *Some killing of a person is not murder.* Write that down. This is an O statement, and there are many valid syllogism forms that have that type of statement as their conclusion. Consequently, we might

find it easier to jump to the next step and consider a middle term that might work, in this case, a killing that is not murder.

What type of killing is not murder? Well, murder is defined as unlawful killing, so we need to think of an example of killing that is not unlawful. What about the lawful execution of a criminal?

With this in mind, we must think of true statements that connect the execution of a criminal to the two terms in the conclusion: the killing of a person, and murder. Clearly, every execution of a criminal is the killing of a person, and at least some executions are not murder. This gives us an O statement as the major premise, *Some executions are not murder* (we know it's the major premise because it has the major term: *murder*), and an A statement as the minor premise, *All executions are the killing of a person*. This gives us the following argument:

Some executions are not murder.

All executions are the killing of a person.

Therefore, some killing of a person is not murder.

This is an OAO-3, which is a valid form. Thus, as long as the premises are both true, we have an argument that establishes the desired conclusion.

SUMMARY

To establish the truth of a statement, we follow this procedure: 1) Put the statement into categorical form. 2) Find a valid argument form that has that type of statement as a conclusion. 3) Place the statement as the conclusion of the selected form of syllogism, and fill in the known terms. Then 4) find a middle term that makes the premises both true and completes the argument. The steps need not be followed in this exact order.



Exercise 35 (40 points)

Develop sound syllogisms that establish the given statements as conclusions, using the suggested mood and figure in parentheses.

- Everyone in heaven is happy. (AAA-1)

- Bats aren't bugs. (EAE-2)

- Many spirits are demons. (IAI-3)

- Some people will not be saved. (EIO-2)

For the following problems, develop sound syllogisms that establish the given statements as conclusions, using whatever syllogism form you like. (4 each)

- Socrates is mortal.

Continued on next page.

6. Whoever turns away from Christ cannot be his disciple.

7. Some teachers are fathers.

8. Not all roads lead to Rome.

9. Logic is an art.

10. Some problems are not hard to solve.

REVIEW QUESTIONS

Answers can be found in the lesson under which the questions are listed.

Lesson 27: Immediate Inferences

1. What is an immediate inference?
2. What are the three types of immediate inference that result in equivalent statements?
3. How is the converse of a statement produced?
4. How is the obverse of a statement produced?
5. How is the contrapositive of a statement produced?
6. Which immediate inferences are valid for each of the four types of categorical statements?
7. How can the contrapositive of a statement be derived using obverse and converse?

Lesson 28: Translating Ordinary Statements

1. What is a singular statement?
2. When translating singular statements into categorical form, what quantity should the translation probably have?
3. What is an indefinite statement?
4. What needs to be considered in translating indefinite statements into categorical form?
5. What is a hypothetical statement?
6. How are hypothetical statements translated into categorical form?

Lesson 29: Translating Inclusive and Exclusive Statements

1. List several inclusives or “ever-words.”
2. How should the following words be translated: *whoever, whatever, wherever, whenever, however, always, never*?
3. What are exclusives?
4. Give examples of statements using *only, unless, and except* along with their translations.

Lesson 30: Enthymemes

1. What is an enthymeme?

2. When determining the missing statement in an enthymeme, what must be assumed about the enthymeme's validity?

Lesson 31: Hypothetical Syllogisms

1. What is the difference between *pure* and *mixed* hypothetical syllogisms?
2. What are the two valid forms of mixed hypothetical syllogisms?
3. What are the two invalid forms?
4. What does *non sequitur* mean?
5. How does *modus ponens* differ from *affirming the consequent*?
6. How does *modus tollens* differ from *denying the antecedent*?

Lesson 32: Establishing Conclusions

1. How many valid moods exist for each of the four figures?
2. What is the general procedure for establishing the truth of a given statement?
3. Does that procedure need to be followed strictly?

REVIEW EXERCISES

Students may do these exercises for further review of this unit.

Additional Exercises for Lesson 27

1. The immediate inferences learned in this lesson are species of what genus? Expand the “relationships between statements” genus and species chart to include *converse*, *obverse*, and *contrapositive*.
2. The converse is the only immediate inference that does not use the complement. What is unique about the obverse? the contrapositive?

3. Give an example of a false E statement that has a true contrapositive.

Write two equivalent immediate inferences for each of the following statements.

4. All exothermic reactions are energy releasers.

5. No large democracy is an effective government.

6. Some pagan myths are profitable reading.

7. Some friendly neighbors are not Christians.

8. All impossible events are improbable events.

9. No penguins are non-swimmers.

10. Some exercises are unhealthy activities.

11. Some defendants are not nonresponsive witnesses.

Translate the following arguments into standard-form categorical syllogisms, and determine their validity.

12. No fantasy is non-fiction. Thus, much fiction is interesting stuff, for no uninteresting stuff is fantasy.

13. All non-Olets are progressive wardens, because all obstructionists are non-progressive wardens, and no Olets are non-obstructionists.

14. No dinosaurs were mammals, but most non-apatosaurus were non-mammals. Therefore, many dinosaurs were not apatosaurus.

15. Some good sleepers are non-pacifists, for snipers are never pacifists, but a few good sleepers are not non-snipers.

Additional Exercises for Lesson 28

Translate the following statements into standard categorical form.

1. Paris is beautiful in the springtime.
-

2. Scotty is not a miracle worker.

3. Elephant bellows can travel six miles.

4. Gangsters do not obey the law of the land.

5. If Satan casts out Satan, then his kingdom cannot stand.

6. You could be a musician if you could make sounds loud or mellow.

Translate the following arguments into standard categorical syllogisms, and determine their validity.

7. Toddlers never study calculus. So Sammy is not a calculus student, since he is still a toddler.

8. Some of the days in Genesis chapter one are not ordinary days, because ordinary days are caused by the sun, and not all of the days in Genesis chapter one were caused by the sun.

9. Children were singing in the park, and anyone who sings in the park entertains me. Therefore, some children entertained me.

10. If you don't have a brain then you can't talk. But the scarecrow could talk. So he must have had a brain.
-
-
-

Additional Exercises for Lesson 29

Translate the following arguments into standard categorical syllogisms, and determine their validity.

1. Whatever is undeserved is unjust. Therefore, giving extra credit is not just, since giving extra credit is undeserved.
-
-
-

2. The boy squeals whenever he hears that song, and once during church he heard that song. So once during church he squealed.
-
-
-

3. Rocks are not food, because only food can be digested, and rocks are indigestible.
-
-
-

4. The boys will dunk whoever gets too close to the pool. So some people won't get dunked, since some people won't get too close to the pool.
-
-
-

5. Allah is an idol, for anything that is worshiped is an idol except for the true God, and Allah is a false god that is worshiped.
-
-
- ∴
-
-

6. You may eat whichever piece you like. You would like the biggest piece. So you may eat the biggest piece.
-
-
-

7. He wins the game unless he makes a mistake. Some times he doesn't make a mistake are still not perfect games. Thus, not every time he wins is a perfect game.
-
-
-

8. This form of treachery shall never again endanger us, because this form of treachery we will always fight, and nothing we continue to fight will endanger us.
-
-
-

Additional Exercises for Lesson 30

Translate the following enthymemes into standard categorical syllogisms. Put the assumed statement in parentheses (note that one of the enthymemes assumes the conclusion).

1. Enoch was not found, because God had translated him.
-
-
-

2. The Bible alone is God's Word. Therefore, the Book of Mormon is not God's Word.
-
-
-

3. Anyone who claims to forgive sins is claiming to be God, and Jesus claimed to forgive sins.
-
-
-

4. Blessed are the meek, for they will inherit the earth.
-
-
-

5. You are a teacher who has come from God, for no one could perform the miraculous signs you are doing if God were not with him.
-
-
-

Additional Exercises for Lesson 31

Consider this hypothetical statement: "If you heed instruction then you will prosper."

1. What is the antecedent? What is the consequent?

Antecedent: _____

Consequent: _____

2. Use this statement as the first premise to construct a modus ponens.
-
-
-

3. Use this statement as the first premise to construct a modus tollens.
-
-
-

Identify the form of the following hypothetical syllogisms. Your options are *pure hypothetical syllogism (valid or invalid)*, *modus ponens*, *modus tollens*, *affirming the consequent*, *denying the antecedent*.

4. If anyone is sick, then he should pray. Joseph is not sick, so Joseph does not need to pray.
-
5. If there is no vision, then the people perish. We must have no vision, for we are a perishing people.
-
6. Jesus said, “If you love me you will keep my commandments.” John loves Jesus, therefore John keeps His commandments.
-
7. If you are predestined then you are called, and if you are called then you are justified. Thus, if you are predestined then you are justified.
-
8. If you trust in Christ then you are saved. Judas was not saved, so he must not have trusted in Christ.
-
9. If Jesus is John raised from the dead, then miraculous powers would be at work in Him. Miraculous powers are at work in Him. He must be John raised from the dead.
-
10. If he is the Antichrist, then he opposes God’s people. If he is the Beast, then he opposes God’s people. Therefore, if he is the Antichrist then he is the Beast.
-

Additional Exercises for Lesson 32

Develop valid syllogisms that establish the given statements as conclusions.

1. A joke is a very serious thing.

2. There is no one righteous, not even one.

3. Some athletes earn straight A's.

4. Some earthquakes are not dangerous.

Imagine that you are preparing a debate over whether or not animals will be in heaven.

5. Develop two valid syllogisms with this conclusion: "Some animals will be in heaven."

6. Develop two valid syllogisms with this conclusion: "No animals will be in heaven."

UNIT 5

INFORMAL FALLACIES

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FALLACIES OF DISTRACTION

We have completed our study of categorical logic. We have seen how to distinguish between valid and invalid syllogisms, and have had some practice constructing valid syllogisms. We will now finish this introductory course by taking one more look at informal logic. This unit will consider the use and identification of **informal fallacies**, which are popular, informal forms of reasoning that, despite their popularity, are invalid or unhelpful. Studying and responding to such casual mistakes make up an important part of what we might call “street fighting” logic.

In learning “street fighting” logic, the first thing to do (as always) is to make some distinctions. We distinguish, first, fallacies of distraction, second, fallacies of ambiguity, and third, fallacies of form. We are no longer doing logic in the realm of Euclid, and so you should soon notice that fallacies of ambiguity could, if we wanted them to, be also considered distracting. These categories are for convenience, not for proclaiming an absolute, authoritative classification.

We must also note these are fallacies (or not) *depending upon how they are used*. In other words, it is possible to reason *rightly* while using some of these arguments. Some want to consider them fallacies in each and every situation, but human reasoning, in practice, takes much of its meaning *from the context*. This means that these forms of argument cannot be handled as though they were detached from real-life situations.

Initially, we will consider some of the **fallacies of distraction**, which are arguments that point us to information that seems relevant to the conclusion but is really not relevant. The point of this lesson is to show how each of the informal fallacies can be either a fallacy or not, depending. How can we tell the difference? We must use *wisdom*.



CAUTION

Human reasoning takes much of its meaning from context. Informal or “street fighting” logic is not as neat or mathematical as formal logic.



DEFINITIONS

An **informal fallacy** is a popular but invalid (or unhelpful) form of argument.

A **fallacy of distraction** is an argument that confuses the issue by pointing to information that is actually irrelevant to the conclusion.



DEFINITION

Ipse dixit is an illegitimate appeal to authority.

1. *Ipse dixit.* This is Latin for “he has said it himself.” The fallacy is committed when an *illegitimate* appeal is made to authority. The form this takes is “X says thus and such. Thus and such must be the case.” Or, “If P says it, then Q must be. P does in fact say it. Therefore, Q, and, incidentally, Q.E.D.”

This is *modus ponens*, and is therefore valid. “But how can it be valid *and* a fallacy?” you ask. Remember, this is street logic. The issue is the legitimacy of the appeal—the argument is valid but unsound if the premise is false. If the authority is legitimate (and relevant), then there is no fallacy at all. If not, then it is an instance of *ipse dixit*.

The *ipse dixit*: “Henry Schwartz says there is no Creator, and therefore, there is no Creator.”

Not the *ipse dixit*: “The Bible says God is the Creator, and therefore, God is the Creator.”



DEFINITION

Ad populum is an illegitimate appeal to a majority.

2. *Ad populum.* This fallacy means an appeal “to the masses.” The thing that makes it a fallacy is that the appeal is made to the mere *mass* of the masses, and not to those aspects of mankind which the masses have and which are legitimate to appeal to, such as legitimate authority. When an imbalanced appeal is made (“Mom, all my friends are doing it!”), the fallacy is committed.

The *ad populum*: “This story must be truly great—it’s a best seller.”

Not the *ad populum*: “Everyone has found the Bible to be a profitable book—you should read it too.”



DEFINITION

Ad baculum is an illegitimate appeal to force.

3. *Ad baculum.* This fallacy is an appeal “to the stick,” an illegitimate appeal to force. An *ad baculum* is a thinly-veiled threat. Once again, we find that we do not have a level playing field, which is a drag for modern man because he is an egalitarian and really likes to have a level playing field. The Scriptures tell us that the rod is for the back of fools. Parents bringing up children properly appeal *ad baculum* all the time. The question again comes down to this: Is the authority a legitimate one, and is the goal of the threat proper?

The *ad baculum*: “If you don’t vote for Sen. Snoutsnuffle, the ozone layer will be destroyed in six months, and we will all die!”

Not the *ad baculum*: “If you do not see the wisdom of our laws against murder, perhaps you will be influenced by our death penalty.”

4. Ad hominem. This means “to the man.” *Ad hominem* is verbally attacking a person instead of his argument. Again, this fallacy is not always committed whenever someone is verbally attacked. All these fallacies must have a hidden value system built into them. The fallacy depends upon whether the man being attacked really is a bad person, and whether his character is relevant to the argument he is making.

The *ad hominem*: “Yes, we know that you maintain that the sun rises in the east every morning. But we also know that you’re a jerk.”

Not the *ad hominem*: “How can we believe your testimony? You’ve been convicted of perjury three times in the past two years.”



DEFINITION

Ad hominem is a verbal attack on a person rather than his argument.

5. Bulverism. This is dismissing an argument by simply pointing out why the one presenting the argument came to believe it. This is a fallacy *unless* the person’s reason for adopting the argument is truly relevant to your argument. The name “Bulverism” comes from an essay by C. S. Lewis in *God in the Dock*, in which he affectionately names this fallacy after an imaginary Ezekiel Bulver. It is also known as the *genetic fallacy*. It usually follows this form: “You believe that just because you are a [fill in the blank]. So I don’t need to believe it.”

Bulverism: “You are saying that infants shouldn’t be baptized because you grew up in a Baptist home.”

Not Bulverism: “You are running for Congress as a Democrat today but yesterday you lost the Republican primary. You are just maintaining the Democratic platform because of personal ambition.”



DEFINITION

Bulverism is attacking a position by pointing out how the arguer came to hold it.



DEFINITION

Tu quoque points to an inconsistency between a person's argument and behavior.



DEFINITION

Ad ignorantiam is an argument from lack of evidence.



DEFINITION

Chronological snobbery is an argument based merely on the passage of time.

6. Tu quoque. This means, in essence, “Yeah? Well, you do it too!” A man guilty of this is pointing out an inconsistency between what his opponent says and what his opponent does, and uses the inconsistency as an excuse to ignore his opponent. The fallacy is not committed when the behavior in question is perfectly fine.

Tu quoque: “Don’t tell me I can’t smuggle cocaine—you do it too!”

Not tu quoque: “Why are you telling me it’s wrong to read fiction? You do it too.”

7. Ad ignorantiam. This is an appeal to lack of information. It is, in effect, an argument from silence, i.e., “Nobody has proven it to be false, so it must be true.”

Ad ignorantiam: “UFOs must be alien spaceships. The government has never offered any other satisfactory explanation.”

Not ad ignorantiam: “I remind the jury that my client is innocent until proven guilty.”

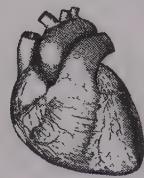
8. Chronological snobbery. You commit this fallacy when you reject (or affirm) a position solely on the basis of how old (or new) it is. Traditionalists commit this fallacy one way and modernists in another. The traditionalist says that it is old, and therefore it is *good*. The modernist says that it is old, and therefore it is *bad*. The passage of time does not establish truth, though it is an element that may be considered.

Chronological snobbery: “Categorical logic may have worked for Aristotle, but it’s outdated now.”

Not chronological snobbery: “I think that we should be more careful before we dismiss something our ancestors have done for centuries.”

SUMMARY

Fallacies of distraction point us toward information that is irrelevant to the conclusion. There are many different forms, including *ipse dixit*, *ad populum*, *ad baculum*, *ad hominem*, Bulverism, *tu quoque*, *ad ignorantiam*, and chronological snobbery. We must always use wisdom in identifying an argument as a fallacy.





Exercise 36 (15 points)

Identify the fallacy of distraction that is being made in each of the following examples.

1. Oswald must have been the lone assassin of Kennedy. Nobody has ever been able to prove any of the conspiracy theories.

2. Santa Claus must be real. The editor of the newspaper said so.

3. You believe in Jesus because you were brought up in a Christian home.

4. We need to appropriate billions of dollars for AIDS research. Otherwise, you or someone in your family will probably get AIDS within the next ten years.

5. You don't believe that Genesis is to be understood *literally*, do you? That's a rather old-fashioned doctrine.

6. We should say the pledge of allegiance at our assemblies just like other schools do.

7. A heretic named Servetus was burned at the stake in Geneva, and John Calvin approved of it. Calvinism has to be wrong.

8. You can't tell me it's wrong to cheat. You've cheated before too!

9. Do you disagree with me when I say that mankind is corrupt? That proves that you have been corrupted already.

10. The senator is accused of communist activities, and there is nothing to disprove these suspicions.

11. You should read this book that your boss wrote. You would not want to jeopardize your position in this company, would you?

12. The vice-president said that potato is spelled with an “e” at the end, so it must be true.

13. Professor Pepper thinks teachers should get paid more so they won’t leave teaching for other jobs. But he’s a teacher himself, so that figures.

14. My dad tells me that I shouldn’t shoplift, but I don’t listen to him, because I happen to know that he stole candy from stores when he was a kid.

15. Of course God exists. Belief in a deity is one of the most ancient concepts of man.

FALLACIES OF AMBIGUITY

We have seen that fallacies of distraction point away from the real issue toward something irrelevant. However, some fallacies occur not because the information is irrelevant, but because it is ambiguous, vague, or otherwise unclear. These can all be called **fallacies of ambiguity**.

1. Equivocation. When we use words with more than one definition, we are using them equivocally. In an argument, it is necessary for the terms to retain the same definition throughout. When we change the meaning of our terms in mid-argument, we commit the fallacy of equivocation. Much of our humor depends upon equivocation, but misunderstandings do also. Gordon Clark cites the example of the teenager who answered the first question from the Westminster Shorter Catechism, which asks what the chief end of man is, by saying, “His head, of course.”

Consider this example:

*The only rational being is man.
Women are not men.
This explains why women are so irrational.*

Formally this argument appears to be valid. But obviously the word *man* is used equivocally, first to mean *human*, then to mean specifically *male*.

2. Accent. This is similar to equivocation. We commit this fallacy when we change the meaning of a sentence, not through different definitions, but through different emphases. Compare the subtly



DEFINITION

Fallacies of ambiguity are arguments that confuse the real issue with multiple, vague, or otherwise unclear meanings.



DEFINITIONS

Equivocation is changing the definition of a term in the middle of an argument.

The fallacy of *accent* alters the meaning of a statement through changed emphasis.

different meanings of each of the following versions of “We should not steal our neighbor’s car”:

- a. *We* should not steal our neighbor’s car. (But it is fine if someone else does.)
- b. *We should* not steal our neighbor’s car. (But we will anyway.)
- c. We should not *steal* our neighbor’s car. (It is okay if we vandalize it.)
- d. We should not steal our *neighbor’s* car. (But the folks across town are fair game.)
- e. We should not steal our neighbor’s *car*. (We’re after the lawn mower.)



DEFINITION

Amphiboly is a vagueness of grammar that disguises or alters meaning.

Note that the fallacy occurs at the point of misunderstanding. We can often make a point through emphasis, but no fallacy is made until the sentence is emphasized differently than the speaker intended it, resulting in an erroneous conclusion.

3. Amphiboly. This fallacy results when the grammar of a sentence is such that the sentence is misunderstood. This can occur when someone is being purposely vague. For example, the Oracle of Delphi once told the Greek King Croesus that if he went to war, he would “destroy a mighty kingdom.” The king was heartened and went to war, only to be defeated. When Croesus complained, he was told that he *did* destroy a great kingdom—his own! This fallacy is common among newspaper headlines and advertisements that, in an attempt to be brief, are unintentionally ambiguous. One such headline ran:

Tuna Biting off Washington Coast

If someone were to use this as evidence that they must grow big fish in those waters, they would be committing the fallacy of amphiboly.



DEFINITION

Composition is the fallacy of transferring attributes from parts to whole.

4. Composition. A fallacy of composition occurs when someone assumes that what is true of the parts must be true of the whole. For example, if chlorine is a poison (and it is) and sodium is a poison (and it is), then if we combine them (NaCl), the result should be

twice as poisonous, right? Wrong. We are talking about table salt. Here is another example:

*Each part of the 747 airplane is designed to be lightweight.
So a 747 must not weigh very much.*

Obviously, what is true about every part of a 747 is not necessarily true of the whole.

5. Division: This is the opposite of composition. The fallacy of division is therefore made when one assumes that what is true of the whole must be true of each of the individual parts. Here is an example:

The Lakers are a great basketball team, so each member of the team must be a great basketball player.



DEFINITION

Division is the fallacy of transferring attributes from whole to part.

SUMMARY

Fallacies of ambiguity occur when an argument is unclear in some way. This can be due to the lack of clarity of individual words or of the sentence as a whole. We considered five types: equivocation, accent, amphiboly, composition, and division.





Exercise 37 (10 points)

Name the fallacies of ambiguity being made in the following examples.

1. Mother, you told me not to take any cookies. I didn't *take* them anywhere—I ate them right here. _____
2. Chocolate Frosted Sugar Bombs must be nutritious, because they are part of this nutritious breakfast. _____
3. My friend said that he hit his head on a rock, breaking it into a million pieces. But I don't think anyone could live with a shattered head! _____
4. Teacher: "I instructed you to write a letter to someone, and you haven't done it." Student: "Yes I did. I wrote the letter *A*." _____
5. Jesus taught that we should love our *neighbor*. So it's okay to hate the people across town. _____
6. If two teaspoons of sugar make this taste good, then four will make it taste twice as good! _____
7. Bread and water is better than nothing, but nothing is better than a steak dinner. So bread and water is better than a steak dinner. _____
8. That was an expensive dinner. I wonder how much the water cost! _____
9. I read on the front page, "Grandmother of Eight Makes Hole in One." Her poor grandchild! _____
10. "Mary had a little lamb"? I'll bet the doctor was surprised. _____

FALLACIES OF FORM

Fallacies of form are arguments with a structural problem. Thus an informal argument can be invalid because of improper form like a formal argument can. Let's see how.

1. Circular reasoning. Someone who commits this fallacy is guilty of assuming what must be proven. In other words, one of his premises already contains the conclusion, though usually in disguise. Circular reasoning follows this basic, simplified form:

P is true, therefore P is true.

Suppose you hear someone arguing that rock music is better than classical music because classical music is not as good. Bach would not be impressed with this reasoning.

But most examples of circular reasoning are not so glaring. Consider this one, for instance:

She must love me, because she says she does. And she would not lie to someone she loves, would she?

Note: Some instances of circular reasoning are not necessarily fallacious. When trying to defend the truth of our ultimate standards, we find that we must reason circularly. For believers, the ultimate standard is the Bible. So when a Christian apologist argues that the Bible is true because it is from God, as the Bible declares, he is simply demonstrating the Bible to be his absolute standard. An unbelieving scientist might also appeal to science to prove that science is true. This merely shows what his ultimate standard is. But if that standard is not truly ultimate, then he is guilty of circular reasoning.



DEFINITIONS

Fallacies of form are arguments that fail to establish their conclusions because of a weakness in logical structure.

Circular reasoning is secretly assuming what you are trying to prove.



CAUTION

When discussing ultimate standards of authority, circular reasoning is eventually inevitable.



DEFINITION

Post hoc ergo propter hoc is improperly assuming that a sequence in time implies a cause and effect.



DEFINITION

Either/or is making an argument based on a false dilemma.



DEFINITIONS

A **complex question** is a question crafted to exclude any possible legitimate response.

2. Post hoc ergo propter hoc. This is Latin for “after this, therefore because of this.” It is also called **false cause**. This fallacy is committed by the rooster who thought the sun rose because of his crowing. After all, every morning after he crowed, the sun rose. *Post hoc* thus follows this pattern:

P happened before Q, therefore P caused Q.

This is an easy error to fall into, particularly for over-simplistic historians.

The American War for Independence happened after the Renaissance; therefore the Renaissance was one of the causes.

It may have been, but chronological sequence itself does not establish the fact.

3. Either/or. This is the fallacy of oversimplifying the choices. It is also called **bifurcation**. The one guilty of the fallacy presents a false dilemma; you must believe *either* this *or* that. There may be other options, and if there are, this fallacy is present. Here is an example:

What, you didn't finish your homework? You must be either stupid or lazy.

Obviously, there could be other reasons. The questioner has assumed something that he should not have before making this conclusion.

4. Complex question. This is the error committed when a question is framed in such a way as to exclude a legitimate response. It is also called a loaded question. For example, suppose a man were asked,

Have you stopped beating your wife yet?

To say “yes” is to admit past guilt, and to say “no” is to continue unrepentant. This fallacy is thus related to either/or. In both cases, something unstated is being assumed which causes a fallacy. The fallacy occurs at the point that an erroneous conclusion is drawn when the question is answered, as shown here:

Lawyer: What did you do with the money you stole?

Witness: Nothing!

Lawyer: Aha! So you admit to stealing the money!



DEFINITION

Apriorism is a hasty generalization.



CAUTION

Make sure you know the difference between apriorism (inference from a member of a category to the entire category) and composition (inference from all parts of a whole to a whole).

SUMMARY



Fallacies of form result when an argument is put together in an improper way. We looked at five fallacies of form: circular reasoning, *post hoc ergo propter hoc*, either/or, complex question, and apriorism.

Exercise 38 (10 points)

Identify the following fallacies of form by name.

1. My mom wouldn't take me to the movies, and she wouldn't let me watch a video. She never lets me have any fun!

2. President Schwartz was just elected, and the stock market soared to new heights. I'm glad I voted for him.

3. "Have you stopped getting drunk all the time?"
"No!" "Oh, so you admit to being a drinker!"

4. Rotten Banana is a great band. I know, because all the cool kids like them. Which are the cool kids? The ones who like Rotten Banana, of course!

5. That guy from the community church reads all the time. They must all be bookworms out there.

6. If you leave the Christian school, then you will have to go to the public schools.

7. I didn't study because I had to go to church. I got an A on the test anyway. I'm going to go to church before tests more often!

8. Miracles don't happen because that would violate natural law, and natural law cannot be violated.

9. She killed the Wicked Witch of the East. So she must either be a good witch, or a bad witch.

10. Ever since I started eating seaweed with my meals, I haven't gotten sick once. You should eat it, too!



DETECTING FALLACIES

We have seen numerous informal fallacies, some of which are harder to identify than others. Recognizing fallacies as they occur in daily life (such as those found in the editorial page of most newspapers) can be even more difficult. You may have read a fallacious argument in a letter to the editor and said to yourself, “I know that’s not true. I wish I could tell what is really wrong with this line of thought.” How do you figure it out?

The technique for identifying informal fallacies is the same as identifying any kind of reasoning. You must ask two questions about the person doing the arguing:

1. What is he trying to prove?
2. How is he trying to prove it?

For example, consider this section out of Bertrand Russell’s essay entitled “Why I am not a Christian”:

Religion is based, I think, primarily and mainly on fear. It is partly the terror of the unknown and partly, as I have said, the wish to feel that you have kind of an elder brother who will stand by you in all your troubles and disputes. Fear is the basis of the whole thing—fear of the mysterious, fear of defeat, fear of death.

Now, what is Lord Russell trying to prove? He is trying to prove that Christianity is not true (consider the title of the essay). How is he trying to prove that in this paragraph? We see him attempting to identify the source of Christian faith. Apparently, he thinks that if he can say why someone believes Christianity, then it must not be true. Having answered these questions, we can readily spot this as an extended Bulverism.



KEY POINT

It takes practice to identify fallacies accurately. Always ask yourself what the conclusion is and how it is reached.



FURTHER STUDY

Most traditional logic texts, from Aristotle’s books up to today, include the identification of various informal fallacies. Almost no two texts include the same list or follow the same arrangement. One helpful recent exposition of the informal fallacies has been made by Hans and Nathaniel Bluedorn in their delightful book *The Fallacy Detective: Thirty-Six Lessons on How to Recognize Bad Reasoning*, published by Trivium Pursuit.



CAUTION

Remember that an argument can commit more than one fallacy at a time.

We will do one more exercise identifying fallacies. As you work through them, ask yourself the two questions above. Your answers should guide you to identifying the correct fallacy. Also, keep in mind that some bad arguments can commit more than one fallacy at a time. If you cannot decide between two possible fallacies, it may be that both are correct.

SUMMARY



Pinpointing fallacies can sometimes be difficult. Ask yourself, “What is being argued?” and “How is it being argued?” to help identify the fallacy.

Exercise 39 (20 points)

Identify the fallacies made in the examples below. They can be any of the fallacies of distraction, ambiguity, or form.

1. The Facebook post read, “If you don’t share this, you may lose your job, get in an accident, or go bald!”

2. That Facebook post was real! Just a week after I ignored it, I failed my logic test.

3. My girlfriend always shares posts. She says that nobody has proven to her that they don’t really work.

4. A recycling poster said, “Recycle cans and waste paper,” so I am wasting paper every chance I get!

5. All my friends recycle their cans, so it must be a good thing to do.

6. I read that “Life is either a daring adventure, or nothing.” My life certainly isn’t a daring adventure, so I guess it’s nothing.

7. The apostle Paul told us to honor our leaders. But he dishonored the high priest, so why should I listen to him?

8. Honoring your leaders is an old tradition that no longer applies to our modern, sophisticated age.

9. The Japanese always score higher on math than the Americans. So I am sure our Japanese neighbor can help you with your calculus.

10. The Japanese are better at math because they’re smarter. We know that they’re smarter, because they always do better at math.

Continued on next page.

11. Hi, I am selling tickets to the policemen's ball,
and I am sure you would like to support your
local police, so how much would you like to give? _____
12. Of course the Joint Chiefs of Staff say we ought
to increase military spending. As members of the
armed forces, they want as much as they can get. _____
13. We shouldn't listen to Senator Slug either,
since we all know he is a card-carrying member
of the radical right. _____
14. Oh, so you believe in evolution? Tell me, are
you descended from a monkey on your mother's
side or your father's side? _____
15. The world was not created by God, for matter
has always existed, and thus needs no God to
explain where it came from. _____
16. The press has a duty to publish what is clearly in
the public interest. And there is certainly public
interest in the private life of the rich and famous. _____
17. I had a bad time with my former husband.
Trust me, dear, men are no good. _____
18. The idea of trying to colonize Mars is ridiculous.
My mother said it couldn't possibly work. _____
19. Each snowflake is very light. There is no way
that snow could make that roof collapse. _____
20. Did that last guy say that snowflakes were light?
I always thought that snow was frozen water. _____

Challenge: Find and identify some informal fallacies from books, newspaper articles, headlines, or even comic strips. Copy them onto a separate sheet of paper.

REVIEW QUESTIONS

Answers can be found in the lesson under which the questions are listed.

Lesson 33: Fallacies of Distraction

1. What are the three types of informal fallacies?
2. What do fallacies of distraction do?
3. What are the eight forms of fallacies of distraction considered in this lesson?
4. Is it ever legitimate to use arguments that follow the same form as these informal fallacies?
5. Translate the following Latin fallacy names: *ipse dixit, ad populum, ad baculum, ad hominem, tu quoque, ad ignorantiam.*

Lesson 34: Fallacies of Ambiguity

1. What is a fallacy of ambiguity?
2. What are the five fallacies of ambiguity considered in this lesson?
3. What is equivocation?
4. How does equivocation differ from accent?
5. How does it differ from amphiboly?
6. How are composition and division related?

Lesson 35: Fallacies of Form

1. What is a fallacy of form?
2. What are the five fallacies of form considered in this lesson?
3. Is circular reasoning always fallacious?
4. Translate from the Latin: *post hoc ergo propter hoc.*
5. What is another name for this fallacy?
6. What is another name for the either/or fallacy?
7. What is the fallacy of a hasty generalization?
8. What is a legitimate generalization called?

Lesson 36: Detecting Fallacies

1. What two questions should be asked when evaluating any kind of reasoning?
2. Where can examples of informal fallacies be found?



REVIEW EXERCISES

Students may do these exercises for further review of this unit.

Additional Exercises for Lesson 33

1. Most of the fallacies of distraction appeal to some element of fear. Explain the form of fear being appealed to for each one.

Ipse dixit _____

Ad populum _____

Ad baculum _____

Ad hominem _____

Bulverism _____

Tu quoque _____

Ad ignorantiam _____

Chronological snobbery _____

2. *Ipse dixit* is an illegitimate appeal to authority. What are the characteristics of a legitimate authority? Where do we as men derive true authority over other men?

3. The classic counterexample for *ad populum* is apparently learned by all mothers of teenagers. Give the classic response of a mother whose teenage child argues, “But mom, all my friends are doing it!”

4. Find some characters in comic strips who regularly appeal *ad baculum*.

5. Explain why World War II was not simply a massive example of *ad baculum*.

6. How is *ad hominem* the counterpart to *ipse dixit*?

7. Bulverism and *tu quoque* are often considered to be species of *ad hominem*. Explain why.

8. *Ad ignorantiam* is part of our legal system—someone is innocent if they have not been proven guilty. Does something like chronological snobbery operate in our legal system as well? Explain.

Additional Exercises for Lesson 34

1. What type of definition helps to avoid equivocation?

2. How does equivocation relate to what you learned earlier about verbal disagreements?

3. A fallacy similar to equivocation may occur when people misinterpret completely different words that happen to sound the same. Give an example.

4. Consider this fallacious argument: “The buffalo are disappearing. That creature is a buffalo, so it must be disappearing too!” How could this be considered a fallacy of equivocation? How could it be considered a fallacy of division? Which is the better answer, and why?

Additional Exercises for Lesson 35

1. In one sense, circular reasoning is perfectly valid: obviously a statement follows from itself. Why, then, is circular reasoning considered a fallacy?

2. What distinguishes apriorism from a legitimate generalization? Consider doing some additional study on inductive reasoning.

Additional Exercises for Lesson 36

1. This book does not include all the possible informal fallacies. What other fallacies exist? Consider doing some research to learn about other fallacies.

2. What is the value of learning how to identify informal fallacies? How should a Christian respond to someone whom they hear committing an informal fallacy?

3. Find the book *The Many Loves of Dobie Gillis* by Max Shulman, and read the short story "Love is a Fallacy." List all of the fallacies mentioned in the story, and circle the ones that are included in this text..

4. Write your own examples of each of the informal fallacies. For an additional challenge, work them into a continuous narrative.

ipse dixit _____

ad populum _____

ad baculum _____

ad hominem _____

Bulverism _____

tu quoque _____

ad ignorantiam _____

chronological snobbery _____

equivocation _____

accent _____

amphiboly _____

composition _____

division _____

circular reasoning _____

post hoc ergo propter hoc _____

either/or _____

complex question _____

apriorism _____

Identify the following fallacies by name.

5. UFOs are either alien spaceships, or the delusions of a few crazy people looking for instant fame.

6. UFOs aren't alien spaceships. That idea went out of style with the *Star Trek* generation.

7. The advertisement read, "Dog for sale. Eats anything and is especially fond of children." Well, I sure won't buy *that* dog!

8. I am nobody. Nobody is perfect. Therefore, I am perfect.

9. You're telling me that speeding is illegal? Well, how many speeding tickets do *you* have?

10. Mr. Jones says he is honest, so I believe him, since honest people don't lie.

11. You can't believe anything Jones says. He's just a blue collar worker who doesn't even have a college diploma.

12. If taking a vitamin a day will help me to be healthy, I should take a whole bottle of vitamins to be really healthy!

13. I don't need vitamins! You just think you should take vitamins because your father works in a drug store.

14. Teacher: "The study of logic is valuable." Student: "Oh, so it's the *study* of logic that is valuable? That must mean that the practice of logic is a waste of time."

15. Of course the study of logic is valuable. Schools all across the country are starting to teach logic.

16. God does not exist. That philosophy professor said so, and he sounded like he knew what he was talking about.

17. I don't think God exists either. Nobody has proven to me that he does.

18. Let it be known at the outset of this biology class that I will not tolerate arguments seeking to support creationism. You do want to pass this class, don't you?

19. The archeopteryx fossil is half bird, half dinosaur. This proves that all animals evolved from one species.

20. Doctor: "Have you ever given up smoking?" Patient: "No, I haven't." Doctor: "Then I'll just write down that you are still a smoker."

21. Sandy must be rich. She is a member of one of the wealthiest sororities on campus.

22. Those are Sandy's lucky shoes. The last time she wore them she passed her logic test.

23. Neighbor: "Your hog got into our garden again. You need to get him a pen." Farmer: "Why? He can't even write with a pencil!"

24. Men must be basically good. I heard them sing a song about it on children's television.

25. That sign said, "Use right shoulder to install chains." Why, that would take years!

26. Each pixel on the computer monitor is motionless.
Obviously, the monitor cannot show motion.

27. Politician: "Thus I have proven that all communist nations are allied with Russia."

Reporter: "What about China? They aren't allied with Russia."

Politician: "Really? Then they must not be true communists."

28. My opponent says that abortion is murder, but 76% of the people disagree. He is clearly wrong.

29. You can't believe what doctors tell you these days. They wear those ugly outfits, and most of them don't even sign their names legibly!

30. The televangelist said that if I didn't send any money to his ministry, I wouldn't be blessed by God. That's why I gave him so much.

31. That televangelist must have been right, because my uncle had a stroke less than a week after he refused to send him money.

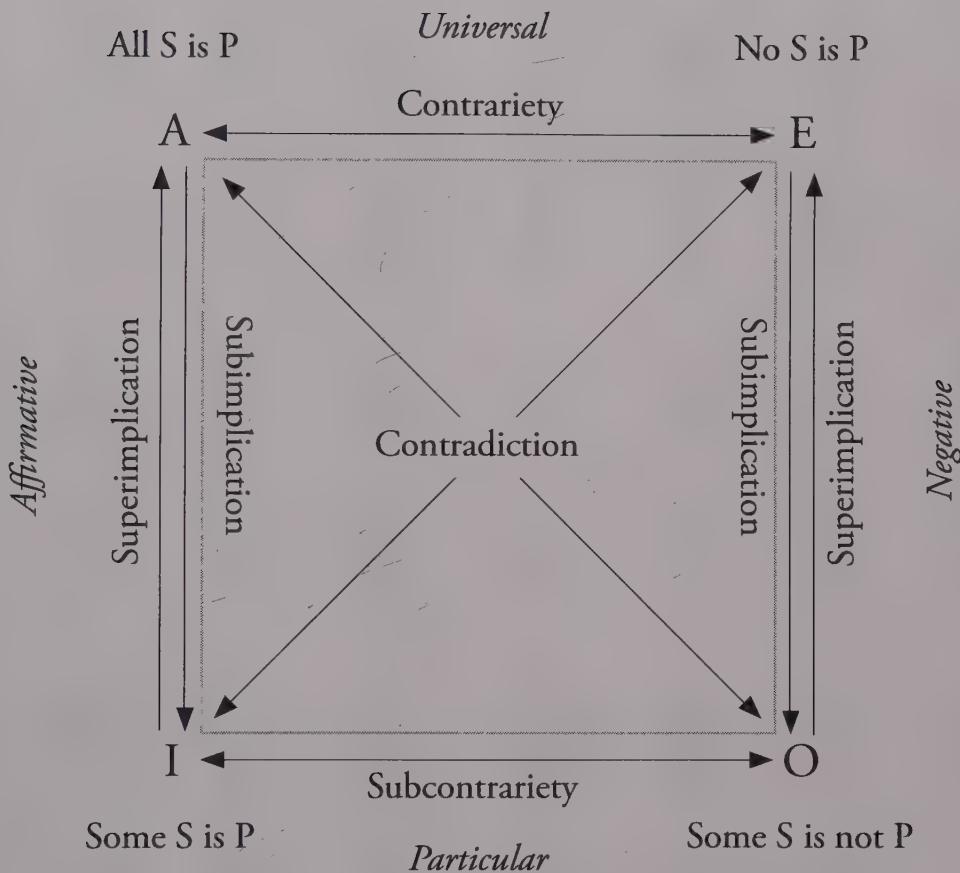
32. He thinks that the husband should be the head of the wife just because he is a man.

33. Did you vote to increase money for food stamps, or do you prefer to let the poor starve?

34. "There are no mountain lions within a hundred miles of this city." "How do you know?" "Well, have you seen any?"

35. The Old Testament law cannot be applied to society today. We need twenty-first century solutions to twenty-first century problems.

THE SQUARE OF OPPOSITION



Relationship

Contradiction
Contrariety
Subcontrariety
Subimplication
Superimplication

Truth value between statements

Opposite truth values; one must be true, the other must be false
Cannot both be true; can both be false
Can both be true; cannot both be false
If the universal is true, the particular of the same quality is true
If the particular is false, the universal of the same quality is false



APPENDIX B

THE 256 FORMS OF SYLLOGISMS

AAA-1	AAA-2	AAA-3	AAA-4	IAA-1	IAA-2	IAA-3	IAA-4
AAE-1	AAE-2	AAE-3	AAE-4	IAE-1	IAE-2	IAE-3	IAE-4
AAI-1	AAI-2	AAI-3	AAI-4	IAI-1	IAI-2	IAI-3	IAI-4
AAO-1	AAO-2	AAO-3	AAO-4	IAO-1	IAO-2	IAO-3	IAO-4
AEA-1	AEA-2	AEA-3	AEA-4	IEA-1	IEA-2	IEA-3	IEA-4
AEE-1	AEE-2	AEE-3	AEE-4	IEE-1	IEE-2	IEE-3	IEE-4
AEI-1	AEI-2	AEI-3	AEI-4	IEI-1	IEI-2	IEI-3	IEI-4
AOE-1	AOE-2	AOE-3	AOE-4	IEO-1	IEO-2	IEO-3	IEO-4
AIA-1	AIA-2	AIA-3	AIA-4	IIA-1	IIA-2	IIA-3	IIA-4
AIE-1	AIE-2	AIE-3	AIE-4	IIE-1	IIE-2	IIE-3	IIE-4
AII-1	AII-2	AII-3	AII-4	III-1	III-2	III-3	III-4
AIO-1	AIO-2	AIO-3	AIO-4	IIO-1	IIO-2	IIO-3	IIO-4
AOA-1	AOA-2	AOA-3	AOA-4	IOA-1	IOA-2	IOA-3	IOA-4
AOE-1	AOE-2	AOE-3	AOE-4	IOE-1	IOE-2	IOE-3	IOE-4
AOI-1	AOI-2	AOI-3	AOI-4	IOI-1	IOI-2	IOI-3	IOI-4
AOO-1	AOO-2	AOO-3	AOO-4	IOO-1	IOO-2	IOO-3	IOO-4
EAA-1	EAA-2	EAA-3	EAA-4	OAA-1	OAA-2	OAA-3	OAA-4
EAE-1	EAE-2	EAE-3	EAE-4	OAE-1	OAE-2	OAE-3	OAE-4
EAI-1	EAI-2	EAI-3	EAI-4	OAI-1	OAI-2	OAI-3	OAI-4
EAO-1	EAO-2	EAO-3	EAO-4	OAO-1	OAO-2	OAO-3	OAO-4
EEA-1	EEA-2	EEA-3	EEA-4	OEA-1	OEA-2	OEA-3	OEA-4
EEE-1	EEE-2	EEE-3	EEE-4	OEE-1	OEE-2	OEE-3	OEE-4
EEI-1	EEI-2	EEI-3	EEI-4	OEI-1	OEI-2	OEI-3	OEI-4
EEO-1	EEO-2	EEO-3	EEO-4	OEO-1	OEO-2	OEO-3	OEO-4
EIA-1	EIA-2	EIA-3	EIA-4	OIA-1	OIA-2	OIA-3	OIA-4
EIE-1	EIE-2	EIE-3	EIE-4	OIE-1	OIE-2	OIE-3	OIE-4
EII-1	EII-2	EII-3	EII-4	OII-1	OII-2	OII-3	OII-4
EIO-1	EIO-2	EIO-3	EIO-4	OIO-1	OIO-2	OIO-3	OIO-4
EOA-1	EOA-2	EOA-3	EOA-4	OOA-1	OOA-2	OOA-3	OOA-4
EOE-1	EOE-2	EOE-3	EOE-4	OOE-1	OOE-2	OOE-3	OOE-4
EOI-1	EOI-2	EOI-3	EOI-4	OOI-1	OOI-2	OOI-3	OOI-4
EOO-1	EOO-2	EOO-3	EOO-4	OOO-1	OOO-2	OOO-3	OOO-4

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