INTRODUCTORY LOGIC
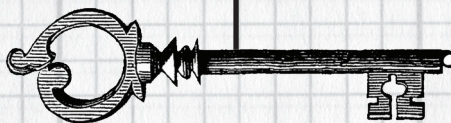*The Fundamentals of Thinking Well*

STUDENT: FIFTH EDITION

Canon Logic Series

INTRODUCTORY LOGIC

CONTENTS

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SYLLOGISMS AND VALIDITY

UNIT FOUR:
ARGUMENTS IN NORMAL ENGLISH

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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.

1

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)

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.

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.

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.
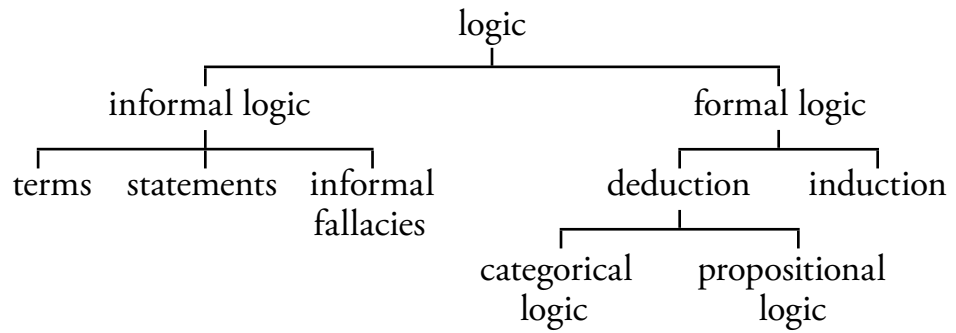
DEFINITIONS

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

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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:

```
                            logic
            ┌─────────────────┴─────────────────┐
       informal logic                      formal logic
   ┌────────┼────────┐                  ┌──────┴──────┐
 terms  statements informal         deduction     induction
                   fallacies       ┌─────┴─────┐
                               categorical  propositional
                                  logic         logic
```

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

Contents

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.

1. *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.

2. *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.
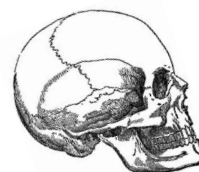
CAUTION

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 H_2O, 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.
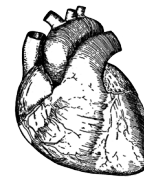
EXERCISE 1 (16 points)

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

   _____

   _____

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

   _____

   _____

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

   _____

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

   _____

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.

   _____

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.)

   _____

   _____

   _____

   _____

   _____

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:

```
                          food
        ┌───────┬───────┬──────────┬────────┐
      meats   dairy   fruits   vegetables  grains
           ┌────┬─────┬────┐         ┌──────┬─────┐
        butter cheese cream milk   wheat barley rye
```
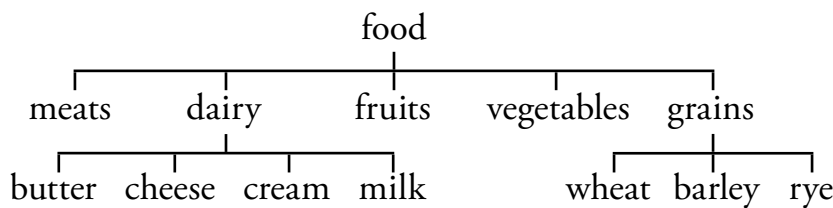
Here we see the genus *food*, and under it some of the species of the term food: meats, dairy products, fruits, vegetables, and grains. Of these, the terms *dairy products* and *grains* are shown to be genera (the plural of genus) for the species under them. The genus *dairy products* is broader than 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.

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Food can be considered a species of *material* (if it is defined as "edible material"), and so on.
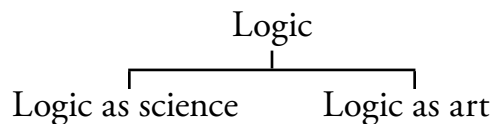
One caution: do not confuse the genus and species hierarchies of logic with the similar hierarchy you may have learned in biology. In logic, there are no levels other than genus and species—no family, order, class, phylum, or kingdom.

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

Logic
├─ Informal logic
└─ Formal logic
   ├─ Induction
   └─ Deduction
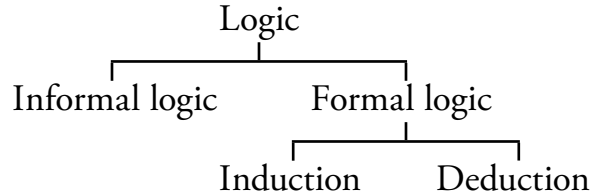
Two types of logic are identified as species: informal and formal. These species are **mutually exclusive**—they do not overlap. No branch of logic is both formal and informal. They are also **exhaustive**—no other types of logic exist. Theoretically, every genus can be divided into species that are 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:

Logic
├─ Logic as science
└─ Logic as art

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.

16

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:

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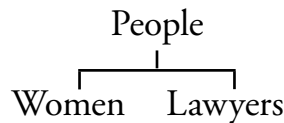
This is an error because the species overlap: some women are lawyers. The error was caused by using two different dividing principles for the term *people:* division by gender and division by profession.

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

Logic
┌──────┴──────┐
Formal logic   Induction
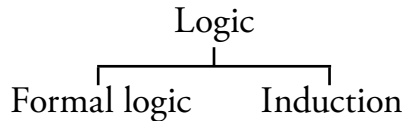
Here the species overlap because induction itself is a species of formal logic, and thus should appear beneath it.

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:

Ball
┌──────┴──────┐
Baseball   Mid-winter ball
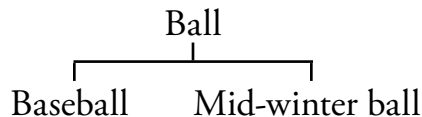
Finally, remember that a species is not a part of the genus, but rather a type or kind of that genus. The species of the genus *bicycle* may include *mountain bike*, but not *handlebars*. So when asked to make a genus and species chart, do not make a "whole to parts" chart like this:

Bicycle
┌──────┴──────┐
Frame   Pedals
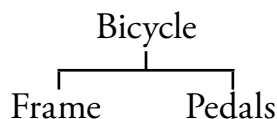
THINKING DEEPER

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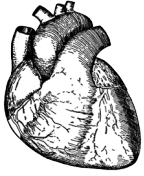
Terms can be organized into genus and species charts. A genus is a category into which a given term fits. A species is a type, kind, or example of a given term. Species should be mutually exclusive, and may be an exhaustive list.

Exercise 2 (20 points)

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

1.
animals
mammals   fish   air-breathers

_____

_____

2.
hand
fingers   thumb   palm

_____

_____

3.
glasses
sunglasses   wine glasses

_____

_____

4.
airplane
jet   biplane   Boeing airplane

_____

_____

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.

5.   (a) _____
angel   (b) _____

(c) _____

6.   (a) _____
chair   (b) _____

(c) _____

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

_____

_____   _____

_____ _____   _____ _____ _____