# Aristotelian Logic

Supplement

to

## *The Pocket Guide to Critical Thinking*

and to

## *Critical Thinking*

Richard L. Epstein

<span style="color:red">Distributed *FREE*</span>

<www.ARFbooks.org>

January, 2013

**Advanced Reasoning Forum**

## A. The Tradition

Aristotle over 2,300 years ago in his *Prior Analytics* focused his study on arguments built from claims of the forms:

> All S are P.
>
> Some S is (are) P.
>
> No S is (are) P.
>
> Some S is (are) not P.

The following argument, for example, uses only claims of these forms:

> No police officers are thieves.
> Some thieves are sent to prison.
> So no police officers are sent to prison.

Aristotle developed a method for determining whether such an argument is valid by inspection of its *form*. From then until the early 1900s his work was the basis for most argument analysis. That tradition, called *Aristotelian logic*, was very broad, and in the Middle Ages—especially from about 1100 to 1400—it was made into a very subtle tool of analysis of reasoning.

In the late 1500s scholars became more interested in studying informal reasoning, inspired also by the work of Aristotle. They ignored the complexities of the formal logic of the medievals and were content with just the rules and forms of Aristotelian logic, rote exercises and puzzles for students. That simplified tradition of Aristotelian logic, current since about 1600, is what I'll present here. It is worth studying because many writers from that time to today have used its terminology. It also makes a contrast with modern formal logic. But it is only in the work of the medievals, which in the last hundred years has begun to be rediscovered, translated, and discussed, that the Aristotelian tradition can offer us anything in the way of a serious study of arguments.

## B. Categorical Claims

> *Categorical claims* A categorical claim is a claim that can be rewritten as an equivalent claim that has one of the following *standard forms*:
>
> > All S are P.
> >
> > Some S is P.
> >
> > No S is P.
> >
> > Some S is not P.

For example,

All dogs are mammals.
No nurse is a doctor.
Some newspaper is written in Arabic.
Some snow is not white.

Most of the claims we reason with in daily speech aren't in any of these forms. But, Aristotelians suggest, we can rewrite many of them to show that they are categorical.  For example, using "≡" to stand for "is equivalent to" we can rewrite:

All dogs bark.  ≡  All dogs are things that bark.

No horse eats meat.  ≡  No horse is a thing that eats meat.

Some cats eat birds.  ≡  Some cat is a thing that eats birds.

Some dogs don't chase cats.  ≡  Some dog is not a thing that does chase cats.

Somewhat more colloquially, or at least avoiding the constant use of the phrase "thing that," we could rewrite these as:

All dogs are barkers.
No horse is a meat eater.
Some cat is a bird eater.
Some dog is not a cat chaser.

It might seem that categorical claims are concerned only with things and collections of things.  But the following argument uses only categorical claims:

All snow is white.
All that is white is visible.
So, all snow is visible.

And snow, whatever it is, isn't a thing or collection of things, like dogs or pencils. Snow is spread out everywhere across many times and places.  It is a mass, like gold or mud, and Aristotelian logic is useful for reasoning about masses, too.

It's often difficult to rewrite claims to "show" their categorical form, and there are no general rules for how to do so.  That's because so many different kinds of words for so many different kinds of things and substances and classes can be used for the S or P in the forms.  In this appendix we'll concentrate on words that stand for classes or collections of things in order to make the discussion easier.  We'll also adopt the Aristotelian assumption that the S and P *stand for things that actually exist*.  So "All dodos are flightless birds" is not a categorical claim, because there are no dodos.

Recall from the text that "All S is not P" is equivalent to "No S is P."  So claims of the form "All S are P" and "No S is P" are called ***universal*** claims. Aristotelians call claims of the form "Some S is P" and "Some S is not P" ***particular***

claims, since they are about some particular things, even if those are not picked out. In order to make their logic more applicable, they also say that claims of the form "a is P" or "a is not P" are *universal* categorical claims, where "a" stands for a name, as in:

> Maria is Hispanic.
> Spot is not a cat.

Claims of the form "All S are P" and "Some S is P" are called ***affirmative***, and claims of the form "No S is P" and "Some S is not P" are called ***negative***. So, for example, "All dogs are mammals" is a universal affirmative claim, while "No dog is a feline" is a negative universal claim. Whether a claim is universal or particular denotes its ***quantity***; whether a claim is affirmative or negative denotes its ***quality***.

In a categorical claim, the *term* (word or phrase) that replaces the letter S is called the ***subject*** of the claim. The term that replaces the letter P is called the ***predicate*** of the claim. These words are not used in the way we use them in grammar. In "All dogs are mammals" your English teacher would say that the predicate is "are mammals," while in Aristotelian logic we say that the predicate is "mammals."

## Exercises for Section B

1. What is a categorical claim?

2. What assumption about the existence of things do we make about the terms used in categorical claims?

3. What is a universal categorical claim?

4. What is a particular categorical claim?

5. What is an affirmative categorical claim?

6. What is a negative categorical claim?

7. What does the quantity of a categorical claim designate?

8. What does the quality of a categorical claim designate?

Here are some of Tom's exercises, as graded by Dr. E.

---

**All students are employed.**

*Categorical*? Yes. Already in standard form.

*Subject*: Students.

*Predicate*: Employed.

*Quantity*: Universal.

*Quality*: Affirmative.

*Good, except that since we've decided to view all subjects and predicates as either things or collections of things, let's take the predicate here to be "employed people."*

---

**Not even one art student is enrolled in calculus.**

*Categorical*?  Yes.  "No art student is enrolled in calculus."
*Subject*:  Art students.
*Predicate*:  Enrolled in calculus.
*Quantity*:  Universal.
*Quality*:  Negative.

*Good, except take the predicate here to be "people enrolled in calculus" or "calculus enrollees."*

**Someone who likes Picasso also likes Monet.**

*Categorical*?  Yes.  "Some people who like Picasso are people who like Monet."
*Subject*:  People who like Picasso.
*Predicate*:  People who like Monet.
*Quantity*:  Particular.
*Quality*:  Affirmative.
*Good work.*

**Dr. E's students all pass.**

*Categorical*?  Yes.  "All students of Dr. E pass."
*Subject*:  Students of Dr. E.
*Predicate*:  Pass.
*Quantity*:  Universal.
*Quality*:  Affirmative.

*Almost.  But you haven't given a categorical form for the claim.  Where is "is a" or "is not a" or "are"?  We need "All students of Dr. E are people who pass." Then the predicate is "people who pass."*

**Very few dogs chase mice.**

*Categorical*?  Yes.  "No dog chases mice."
*Subject*:  Dogs.
*Predicate*:  Mice chasers.
*Quantity*:  Universal.
*Quality*:  Negative.

*No.  "Very few" does not mean the same as "No," which means the same as "None." Don't try to force every claim into one of these forms.*

**Some football players don't take steroids.**

*Categorical*?  Yes.  "Some student who is a football player is not
        someone who takes steroids."

*Subject*:  Students who are football players.

*Predicate*:  People who take steroids.

*Quantity*:  Particular.

*Quality*:  Negative.

*Almost—just delete the words "student who is a": "Some football player is not someone who takes steroids."  Your claim isn't equivalent, because it could be true and the original false if a professional football player takes steroids.*

**Some student at this school is majoring in football or there is a student who will not get a degree.**

*Categorical*?  No.  This is a compound claim, and I can't figure out how to
        get it into a standard form.

*Subject*:  Students.

*Predicate*:  Football players and people who get degrees.

*Quantity*:  Particular.

*Quality*:  Affirmative and negative.

I don't think this exercise is very funny, Dr. E.  We football players work hard at school and sport.

*You're right that if it's a compound it isn't a categorical claim.  But then why did you fill in after the other parts?  Were you on automatic pilot?  Only categorical claims have subjects and predicates, quantity and quality.*

*       You're also right that I should be more sensitive about the examples.  In the future I'll talk about basketball players.*

For each of the following fill in the blanks

*Categorical*?  (If yes, and it is not already in one of the standard forms, rewrite it.)
*Subject*:
*Predicate*:
*Quantity*:
*Quality*:

9.  All dogs are carnivores.

10. Some cat is not a carnivore.

11. Tom is a basketball player.

12. No fire truck is painted green.

13. Donkeys eat meat.

14. There is at least one chimpanzee who can communicate by sign language.

15. Every border collie likes to chase sheep.

16. No one who knows critical thinking will ever starve.

17. Nearly every college graduate is employed at a full-time job.

18. All dogs bark or Spot is not a dog.

19. There is a teacher of critical thinking at this school who gives all A's to her students.

20. Heroin addicts cannot function in a 9–5 job.

21. Some people who like pizza are vegetarians.

22. Not every canary can sing.

23. Dr. E does not have a cat.

24. If Zoe does the dishes, then Dick will take Spot for a walk.

25. Of all the teachers at his school, none is as good as Dr. E.

26. Maria has a part-time job.

27. Waiters in Las Vegas make more money than lecturers at the university there.

28. In at least one instance a professor at this school is known to have failed all the students in his class.

29. Make up five claims, three of which are categorical and two of which are not. Give them to a classmate to classify.


## C.  Contradictories, Contraries, and Subcontraries

> ***Contradictory claims***   Two claims are contradictory if they must always have opposite truth-values.
>
> ***Contrary claims***   Two claims are contrary if it is not possible for them both to be true at the same time.
>
> ***Subcontrary claims***   Two claims are subcontrary if it is not possible for them both to be false at the same time.

If two claims are contradictory, they're also contrary, but not vice-versa. For example, "All dogs bark" and "No dogs bark" are contrary (they can't both be true), but they're not contradictory: Since "dogs" must refer to some object when it's used here, they can both be false.

Contradictories are also subcontraries, but not vice-versa. For example, "Some dogs bark" and "Some dogs don't bark" can't both be false, since to use the term "dogs" in a categorical claim is to assume there are such things. But both of these claims could be true.

In order to discuss these relationships when they apply to pairs of categorical claims, it is traditional to name the forms with letters:

All S are P. **A**

No S is P. **E**

Some S is P. **I**

Some S is not P. **O**

From the textbook we already know that "All S are P" and "Some S is not P" are contradictory. So any A claim and O claim using the same S and P are contradictory. Also "No S is P" and "Some S is P" are contradictory: any E claim and I claim using the same S and P are contradictory.

On the other hand, "All S are P" and "No S is P" are contraries (they can't both be true). And "Some S is P" and "Some S is not P" are subcontraries (they can't both be false), since to use S as a subject term there must be something that is an S.

There is a further relationship that Aristotelians noted. From "All dogs bark" we can conclude "Some dogs bark." Since using a term S as subject in a categorical claim requires that there be at least one thing that is an S, we have generally:

- If an A claim is true, then the I claim using the same S and P is true.

Similarly, from "No S is P" we can conclude "Some S is not P," because "No S is P" is equivalent to "All S is not P," and the use of S comes with the assumption that there is at least one S. That is:

- If an E claim is true, then the O claim using the same S and P is true.

Going the other direction works, too, except that it's falsity that's inherited:

- If an I claim is false, then the corresponding A claim is also false
- If an O claim is false, then the corresponding E claim is false.

Aristotelians summarized these relationships by saying that A and I claims using the same subject and predicate are **subalternates**, and E and O claims using the same subject and predicate are subalternates. Here is how they diagrammed these relationships:

### The Square of Opposition
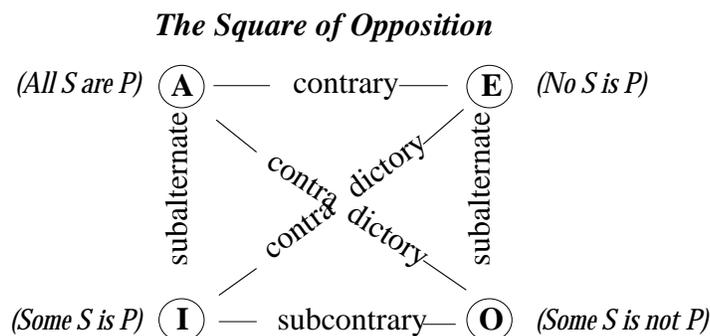
For nearly 700 years students were expected to commit this diagram to memory.  But don't bother.  Even if you don't remember the definitions, it's not hard to spot that "All basketball players at this school are on scholarship" and "Some basketball player at this school is not on scholarship" are contradictory, or that "No employee of this school is enrolled in a health-care plan" and "All employees at this school are enrolled in a health-care plan" can't both be true.

## Exercises for Section C

1. What is the contradictory of a claim?

2. a.  What does it mean to say that two claims are contrary?
   b.  Give an example of two claims that are contrary but not contradictory.

3. a.  What does it mean to say that two claims are subcontrary?
   b.  Give an example of two claims that are subcontrary but not contradictory.

4. a.  What does it mean to say that "All dogs bark" and "Some dogs bark" are subalternate?
   b.  What does it mean to say that "No cats bark" and "Some cats do not bark" are subalternate?

5. a.  What is an A claim?  Give an example.
   b.  What is an E claim?  Give an example.
   c.  What is an I claim?   Give an example.
   d.  What is an O claim?  Give an example.

6. Show that for claims that use the same subject and predicate:
   a.  If the I claim is false, then the A claim is false.
   b.  If the O claim is false, then the E claim is false.

For each pair of claims below state which of the terms following it apply.

contradictory     contrary     subcontrary     subalternate     none

7. All dogs bark.
   Some dogs do not bark.

8. No Russians are communists.
   All Russians are communists.

9. Maria is a widow.
   Maria was never married.

10. No animals with horns are carnivores.
    Some animals with horns are carnivores.

11. All uranium isotopes are highly unstable substances.
    Some uranium isotopes are highly unstable substances.

12. Some assassinations are morally justifiable.
    Some assassinations are not morally justifiable.

13. Dick and Tom are friends.
    Dick and Tom can't stand to be in the same room together.

14. Not even one zebra can be trained to jump through fire.
    Every zebra can be trained to jump through fire.

15. Homeless people don't like to sleep on the street.
    Some homeless people don't like to sleep on the street.

16. Dick almost always washes the dishes after dinner.
    Dick almost never washes the dishes after dinner.

17. Very few cats will willingly take a bath.
    Very few cats won't willingly take a bath.

# D. Syllogisms

We said that the arguments for which Aristotelian logic was devised contain only categorical claims. Many of those can be reduced to arguments of a special kind.

> *Categorical syllogism* A categorical syllogism is an inference composed of three categorical claims: two premises and a conclusion. Exactly three terms are used as subject or predicate in those claims, each of which appears in exactly two of the claims.

The first argument we considered in this supplement is a categorical syllogism:

No police officers are thieves.
Some thieves are sent to prison.
So no police officers are sent to prison.

The terms in this are "police officers," "thieves," and "people sent to prison." Each appears in exactly two of the claims.

Aristotelians identify the predicates and subjects in syllogisms by the roles they play in determining whether the argument is valid.

> *Major, minor, middle terms* of a categorical syllogism
>
> | | | |
> |---|---|---|
> | *major term* | = | predicate of the conclusion |
> | *minor term* | = | subject of the conclusion |
> | *middle term* | = | the term that appears in both premises |
> | *major premise* | = | the premise that contains the major term |
> | *minor premise* | = | the premise that contains the minor term |

For example, in the last argument:

The major term is "people sent to prison."
The minor term is "police officers."
The middle term is "thieves."
The major premise is "Some thieves are sent to prison."
The minor premise is "No police officers are thieves."

The main focus of Aristotelian logic, as traditionally presented, is to show that we can mechanically determine of any given categorical syllogism whether it is valid or invalid. One way to do that is by inspecting its form. We first say that a syllogism is in ***standard form*** if all the claims in it are in standard form, the major premise comes first, then the minor premise, then the conclusion. Then we list all possible forms of syllogisms in standard form. For example,

No S is M
All M are P
So No S is P.

has form EAE. Given any categorical syllogism, we can first rewrite it in standard form and then check whether it is one of the valid forms.

But instead of listing all the forms, Aristotelians have shown how we can start with knowing whether a few are valid or invalid, and then convert any other form into one of those by a detailed reduction procedure.

Alternatively, we can take any categorical syllogism, put it in standard form, and then use the method of diagrams presented in Chapter 8 of *Critical Thinking* to determine whether it is valid. Or we can use one of several other well-known diagram methods, similar to but distinct from the methods of Chapter 8.

Once we've checked for validity, we still have to decide whether the syllogism is a good argument. We know that a valid argument need not be good, for a premise could be false, or a premise might not be more plausible than the conclusion. Indeed, many valid Aristotelian syllogisms beg the question. Consider, for example:

All dogs eat meat.
Spot is a dog.
So Spot eats meat.

It's more plausible that Spot eats meat than that all dogs do. Categorical syllogisms, as originally used by Aristotle, are really a logic of explanations, not arguments. In an explanation the conclusion is supposed to be more plausible than the premises, as when someone tries to explain why "The sky is blue" is true, which is discussed in Chapter 19 of *The Pocket Guide to Critical Thinking*.

In any case, in ordinary speech we first have to decide how the person giving the argument intends "all" and "some" to be understood, and many times those readings won't be compatible with the assumptions of Aristotelian logic. Even if those readings are compatible, we often have to do a lot of work to rewrite the claims

into standard categorical form. Then we have to check against a (memorized?) list of valid Aristotelian forms. Then we have to ask about the plausibility of the premises to determine whether the syllogism is a good argument. Even then, many simple arguments using "some" or "all" can't be analyzed as categorical syllogisms, such as "Some dogs like cats; some cats like dogs; so some dogs and cats like each other."

  For hundreds and hundreds of years students and scholars preoccupied themselves with the methods of Aristotelian logic as the primary focus of their analysis of reasoning. They could rely on standard methods and checkable rules. But that tradition missed most of the important work in critical thinking that has been incorporated into the foundations of reasoning analysis only in the last 150 years, even though much of that can also be traced to Aristotle.

  For reasoning in your daily life, being able to listen and analyze as you read and speak, the methods and work we did in Chapter 8 of *Critical Thinking* or Chapter 10 of *The Pocket Guide to Critical Thinking* will be more useful than the formal methods of Aristotelian logic. To decide whether a categorical syllogism is valid, do what we've always done: See if there is a possible way for the premises to be true and the conclusion false.

## Exercises for Section D

1. What is a categorical syllogism?

2. What is the major term of a categorical syllogism?

3. What is the minor term of a categorical syllogism?

4. What is the middle term of a categorical syllogism?

5. What is the major premise of a categorical syllogism?

6. What is the minor premise of a categorical syllogism?

7. What is the standard form for a categorical syllogism?

Which of the forms of categorical syllogisms in Exercises 8–15 are forms of arguments that must be valid? The forms are presented by giving the letter name of the standard form of the major premise, then the minor premise, then the conclusion.

8. EAE  (No S is M; all M are P; so no S is P.)

9. AAA

10. AEO

11. IAO

12. III

13. AEE

14. AOO

15. AAI

For each of the following arguments, either rewrite it in the standard form of a categorical syllogism and identify the form, or explain why it cannot be rewritten in a standard form. In either case, determine if the argument is valid.

16. All students at this school pay tuition.  Some people who pay tuition at this school will fail.  So some students at this school will fail.

17. There aren't any wasps that will not sting.  Some bumblebees will not sting.  So some bumblebees aren't wasps.

18. Badly managed businesses are unprofitable.  No oyster cultivating business in North Carolina is badly managed.  So some oyster cultivating business in North Carolina is profitable.

19. Most critical thinking books do not teach Aristotelian logic.  Chemistry textbooks never teach Aristotelian logic.  So most chemistry books are not critical thinking textbooks.

20. Nothing that's smarter than a dog will cough up hair balls.  Cats cough up hair balls.  So cats are not smarter than dogs.

21. Dick will not visit Tom tonight if Zoe cooks dinner.  Zoe didn't cook dinner.  So Dick visited Tom tonight.

22. No pacifists will fight in a war.  Dick is a pacifist.  So Dick will not fight in a war.

23. Police chiefs who interfere with the arrest of city officials are always fired.  People who are fired collect unemployment.  So some police chiefs who interfere with the arrest of city officials collect unemployment.

24. Some temporary employment agencies do not give employee benefits.  All employees of Zee Zee Frap's restaurant get employee benefits.  So no employee of Zee Zee Frap's is hired through a temporary employment agency.

| **Key Words** | categorical claim | A claim |
| --- | --- | --- |
| | standard form of a | E claim |
| | categorical claim | I claim |
| | universal categorical claim | O claim |
| | particular categorical claim | subalternate |
| | affirmative categorical claim | Square of Opposition |
| | negative categorical claim | categorical syllogism |
| | quantity of a categorical claim | major term |
| | quality of a categorical claim | minor term |
| | subject of a categorical claim | middle term |
| | predicate of a categorical claim | major premise |
| | contradictory | minor premise |
| | contrary | standard form of a |
| | subcontrary | categorical syllogism |

**Further Study**   There are many textbooks that present the "traditional" Aristotelian logic with lots of diagrams and a listing of all valid and invalid forms of categorical syllogisms.  But to see the real power of the Aristotelian tradition, you need to study medieval logic in the work of Buridan, Duns Scotus, Peter of Spain, and others. There are some good translations and expositions of the work of those logicians, but you're best off taking a philosophy course on the history of logic.

# Answers to Exercises

## Section B

1.  A claim that is, or can be rewritten as, one in the form of either: All S are P; No S is P; Some S is P; Some S is not P.

2.  To use a term in a categorical syllogism, there must be at least one thing that term stands for.

3.  A claim equivalent to one in the form of either "All S are P" or "No S is P" or "*a* is P" or "*a* is not P."

4.  A claim equivalent to one in the form of either "Some S is P" or "Some S is not P"

5.  A claim equivalent to one in the form of either "All S are P" or "Some S is P" or "a is P."

6.  A claim equivalent to one in the form of either "No S is P" or "Some S is not P" or "a is not P."

7.  Whether the claim is universal or particular.

8.  Whether the claim is affirmative or negative.

9.  *Categorical*? Yes.
    *Subject*: Dogs.
    *Predicate*: Carnivores.
    *Quantity*: Universal.
    *Quality*: Affirmative.

10. *Categorical*? Yes.
    *Subject*: Cats.
    *Predicate*: Carnivores.
    *Quantity*: Particular.
    *Quality*: Negative.

11. *Categorical*? Yes.
    *Subject*: Tom.
    *Predicate*: Football players.
    *Quantity*: Universal.
    *Quality*: Affirmative.

12. *Categorical*? Yes.
    *Subject*: Fire trucks.
    *Predicate*: Things that are painted green.
    *Quantity*: Universal.
    *Quality*: Negative.

13. *Categorical*? Yes. All donkeys are meat eaters.
    *Subject*: Donkeys.
    *Predicate*: Meat eaters.
    *Quantity*: Universal.
    *Quality*: Affirmative.

14. *Categorical*?  Yes.  Some chimpanzee is a  sign language communicator.
    *Subject*:  Chimpanzees.
    *Predicate*:  Sign language communicators.
    *Quantity*:  Particular.
    *Quality*:  Affirmative.

15. *Categorical*?  Yes.  All border collies are things that like to chase sheep.
    *Subject*:  Border collies.
    *Predicate*:  Things that like to chase sheep.
    *Quantity*:  Universal.
    *Quality*:  Affirmative.

16. *Categorical*?  Yes (though it's a stretch).  No knowers of critical thinking are things
        that will ever starve.
    *Subject*:  Knowers of critical thinking.
    *Predicate*:  Things that will ever starve.
    *Quantity*:  Universal.
    *Quality*:  Negative.

17. *Categorical*?  No.  Nearly every ≠ all.  Nearly every ≠ some.

18. *Categorical*?  No.  It's a compound.

19. *Categorical*?  Yes.  Some female teacher of critical thinking at this school is a person
        who gives A's to all her students.
    *Subject*:  Female teachers of critical thinking at this school.
    *Predicate*:  Things who give A's to all their students.
    *Quantity*:  Particular.
    *Quality*:  Affirmative.

20. *Categorical*?  Yes.  No heroin addict is a person who can function in a 9–5 job.
    *Subject*:  Heroin addicts.
    *Predicate*:  Things who can function in a 9–5 job.
    *Quantity*:  Universal.
    *Quality*:  Negative.

21. *Categorical*?  Yes.
    *Subject*:  Things who like pizza.
    *Predicate*:  Vegetarians.
    *Quantity*:  Particular.
    *Quality*:  Affirmative.

22. *Categorical*?  Yes.  Some canary is not a thing that can sing.
    *Subject*:  Canaries.
    *Predicate*:  Things that can sing.
    *Quantity*:  Particular.
    *Quality*:  Negative.

23. *Categorical*?  Yes.  Dr. E is not a cat owner.
    *Subject*:  Dr. E.
    *Predicate*:  Cat owners.
    *Quantity*:  Universal.
    *Quality*:  Negative.

24. *Categorical*?  No.  It's a compound.

25. *Categorical*?  No.  You can't make comparisons in categorical claims, or at least not in a way that's useful for reasoning.

26. *Categorical*?  Yes.  Maria is a part-time job holder.
    *Subject*:  Maria.
    *Predicate*:  Part-time job holders.
    *Quantity*:  Universal.
    *Quality*:  Affirmative.

27. *Categorical*?  No.  You can't make comparisons in categorical claims, or at least not in a way that's useful for reasoning.

28. *Categorical*?  Yes.  Some professor at this school is a person known to have failed all students in his class.
    *Subject*:  Professors at this school.
    *Predicate*:  People known to have failed all students in his class.
    *Quantity*:  Particular.
    *Quality*:  Affirmative.

## Section C

1. A claim that has the opposite truth-value in every possible circumstance.

2. a.  In no possible circumstance can they both be true, though they can both be false.

3. a.  In no possible circumstance can they both be false, though they can both be true.

4. a.  If "All dogs bark" is true, then "Some dogs bark" is true.  If "Some dogs bark" is false, then "All dogs bark" is false.
   b.  If "No cats bark" is true, then "Some cats do not bark" is true.  If "Some cats do not bark" is false, then "No cats bark" is false.

5. a.  A claim equivalent to one in the form "All S are P."
   b.  A claim equivalent to one in the form "No S is P."
   c.  A claim equivalent to one in the form "Some S is P."
   d.  A claim equivalent to one in the form "Some S is not P."

6. a.  If the A claim is true, then the I claim is true. But that's equivalent to the contrapositive: If the I claim is false, the A claim is true.
   b.  Similarly.

7. Contradictory.

8. Contrary.

9. Contrary, but not via categorical form.

10. Contradictory.

11. Subalternate.

12. Subcontrary.

13. Contrary, but not via categorical form.

14. Contrary.

15. Subalternate.

16. Contrary, but neither are categorical.

17. Subcontrary, but neither are categorical.

## Section D

1. A two-premise, one-conclusion argument, where the three claims use exactly three terms for subject and predicate, each claim using exactly two of those.

2. The predicate of the conclusion.

3. The subject of the conclusion.

4. The term that appears in both premises.

5. The premise that uses the major term.

6. The premise that uses the minor term.

7. Major premise, minor premise, conclusion, where all are in standard categorical form.

   Implicitly we're assuming the forms in Exercises 8–15 are in the first figure (terms are arranged: S-M, M-P, S-P).

8. Invalid. Reasoning backwards with "no."

9. All S are M. So all M are P. So all S are P. Valid. Reasoning in a chain with "all."

10. All S are M. No M is P. So some S is not P. Valid.

11. Some S is M. All M are P. So some S is not P. Invalid.

12. Some S is M. Some M is P. So some S is P. Invalid. Reasoning in a chain with "some."

13. All S are M. No M are P. So no S are P. Valid.

14. All S are M. Some M is not P. So some S is not P. Invalid.

15. All S are M. All M are P. So some S are P. Valid.

16. All students at this school are tuition payers at this school (A).
    Some tuition payers at this school are people who will fail (I).
    So some students at this school are people who will fail (I).
    Invalid. (Perhaps other people pay tuition, too.)

17. All wasps are stingers (A).
    Some bumblebees are not stingers (O).
    So some bumblebee is not a wasp (O).
    Valid.

18. No badly managed business is profitable (E).
    No oyster cultivating business in North Carolina is badly managed (E).
    So some oyster cultivating business in North Carolina is profitable (I).
    Invalid.

19. Not categorical because "most" ≠ "all" and "most" ≠ "some."  Invalid, but strong.

20. No straightforward way to view this as categorical.  But valid.

21. Not categorical, because compounds aren't categorical.  Invalid, weak, affirming the consequent.

22. EAE.  Valid.

23. Police chiefs who interfere with the arrest of city officials are always fired.   (A)
    People who are fired are people who collect unemployment.  (A)
    So some police chiefs who interfere with the arrest of city officials are people
        who collect unemployment (I).
    Valid.

24. No obvious rewrite as categorical.  But valid.