

them are covered in Chapters 4 and 5. At the same time a revival in inductive logic was initiated by the British philosopher John Stuart Mill (1806–1873), whose methods of induction are presented in Chapter 10.

Across the Atlantic, the American philosopher Charles Sanders Peirce (1839–1914) developed a logic of relations, invented symbolic quantifiers, and suggested the truth-table method for formulas in propositional logic. These topics are covered in Chapters 6 and 8 of this book. The truth-table method was completed independently by Emil Post (1897–1954) and Ludwig Wittgenstein (1889–1951).

Toward the end of the nineteenth century, the foundations of modern mathematical logic were laid by Gottlob Frege (1848–1925). His *Begriffsschrift* sets forth the theory of quantification presented in Chapter 8 of this text. Frege's work was continued into the twentieth century by Alfred North Whitehead (1861–1947) and Bertrand Russell (1872–1970), whose monumental *Principia Mathematica* attempted to reduce the whole of pure mathematics to logic. The *Principia* is the source of much of the symbolism that appears in Chapters 6, 7, and 8 of this text.

During the twentieth century, much of the work in logic has focused on the formalization of logical systems and on questions dealing with the completeness and consistency of such systems. A now-famous theorem proved by Kurt Gödel (1906–1978) states that in any formal system adequate for number theory there exists an undecidable formula—that is, a formula such that neither it nor its negation is derivable from the axioms of the system. Other developments include multivalued logics and the formalization of modal logic. Most recently, logic has made a major contribution to technology by providing the conceptual foundation for the electronic circuitry of digital computers.

EXERCISE I.1

I. Each of the following passages contains a single argument. Using the letters “P” and “C,” identify the premises and conclusion of each argument, writing premises first and conclusion last. List the premises in the order in which they make the most sense (usually the order in which they occur), and write both premises and conclusion in the form of separate declarative sentences. Indicator words may be eliminated once premises and conclusion have been appropriately labeled. The exercises marked with a star are answered in the back of the book.

- ★1. Carbon monoxide molecules happen to be just the right size and shape, and happen to have just the right chemical properties, to fit neatly into cavities within hemoglobin molecules in blood that are normally reserved for oxygen molecules. Consequently, carbon monoxide diminishes the oxygen-carrying capacity of blood.

(Nivaldo J. Tro, *Chemistry: A Molecular Approach*, 2nd ed.)

2. Since the good, according to Plato, is that which furthers a person's real interests, it follows that in any given case when the good is known, men will seek it.

(Avrum Stroll and Richard Popkin, *Philosophy and the Human Spirit*)

3. As the denial or perversion of justice by the sentences of courts, as well as in any other manner, is with reason classed among the just causes of war, it will follow that the federal judiciary ought to have cognizance of all causes in which the citizens of other countries are concerned.

(Alexander Hamilton, *Federalist Papers*, No. 80)

- ★4. When individuals voluntarily abandon property, they forfeit any expectation of privacy in it that they might have had. Therefore, a warrantless search or seizure of abandoned property is not unreasonable under the Fourth Amendment.

(Judge Stephanie Kulp Seymour, *United States v. Jones*)

5. Artists and poets look at the world and seek relationships and order. But they translate their ideas to canvas, or to marble, or into poetic images. Scientists try to find relationships between different objects and events. To express the order they find, they create hypotheses and theories. Thus the great scientific theories are easily compared to great art and great literature.

(Douglas C. Giancoli, *The Ideas of Physics*, 3rd ed.)

6. The fact that there was never a land bridge between Australia and mainland Asia is evidenced by the fact that the animal species in the two areas are very different. Asian placental mammals and Australian marsupial mammals have not been in contact in the last several million years.

(T. Douglas Price and Gary M. Feinman, *Images of the Past*)

- ★7. It really does matter if you get enough sleep. We need sleep to think clearly, react quickly, and create memories. Studies show that people who are taught mentally challenging tasks do better after a good night's sleep. Other research suggests that sleep is needed for creative problem solving.

(U.S. National Institutes of Health, "Your Guide to Healthy Sleep")

8. The classroom teacher is crucial to the development and academic success of the average student, and administrators simply are ancillary to this effort. For this reason, classroom teachers ought to be paid at least the equivalent of administrators at all levels, including the superintendent.

(Peter F. Falstrup, letter to the editor)

9. An agreement cannot bind unless both parties to the agreement know what they are doing and freely choose to do it. This implies that the seller who intends to enter a contract with a customer has a duty to disclose exactly what the customer is buying and what the terms of the sale are.

(Manuel G. Velasquez, "The Ethics of Consumer Production")

- ★10. Punishment, when speedy and specific, may suppress undesirable behavior, but it cannot teach or encourage desirable alternatives. Therefore, it is crucial to use positive techniques to model and reinforce appropriate behavior that the person can use in place of the unacceptable response that has to be suppressed.

(Walter Mischel and Harriet Mischel, *Essentials of Psychology*)

11. Profit serves a very crucial function in a free-enterprise economy, such as our own. High profits are the signal that consumers want more of the output of the industry. High profits provide the incentive for firms to expand output and for more firms to enter the industry in the long run. For a firm of above-average efficiency, profits represent the reward for greater efficiency.
(Dominic Salvatore, *Managerial Economics*, 3rd ed.)
12. Cats can think circles around dogs! My cat regularly used to close and lock the door to my neighbor's doghouse, trapping their sleeping Doberman inside. Try telling a cat what to do, or putting a leash on him—he'll glare at you and say, "I don't think so. You should have gotten a dog."
(Kevin Purkiser, letter to the editor)
- ★13. Since private property helps people define themselves, since it frees people from mundane cares of daily subsistence, and since it is finite, no individual should accumulate so much property that others are prevented from accumulating the necessities of life.
(Leon P. Baradat, *Political Ideologies, Their Origins and Impact*)
14. To every existing thing God wills some good. Hence, since to love any thing is nothing else than to will good to that thing, it is manifest that God loves everything that exists.
(Thomas Aquinas, *Summa Theologica*)
15. Women of the working class, especially wage workers, should not have more than two children at most. The average working man can support no more and the average working woman can take care of no more in decent fashion.
(Margaret Sanger, *Family Limitations*)
- ★16. Radioactive fallout isn't the only concern in the aftermath of nuclear explosions. The nations of planet Earth have acquired nuclear weapons with an explosive power equal to more than a million Hiroshima bombs. Studies suggest that explosion of only half these weapons would produce enough soot, smoke, and dust to blanket the Earth, block out the sun, and bring on a nuclear winter that would threaten the survival of the human race.
(John W. Hill and Doris K. Kolb, *Chemistry for Changing Times*, 7th ed.)
17. An ant releases a chemical when it dies, and its fellows then carry it away to the compost heap. Apparently the communication is highly effective; a healthy ant painted with the death chemical will be dragged to the funeral heap again and again.
(Carol R. Ember and Melvin Ember, *Cultural Anthropology*, 7th ed.)
18. Every art and every inquiry, and similarly every action and pursuit, is thought to aim at some good; and for this reason the good has rightly been declared to be that at which all things aim.
(Aristotle, *Nicomachean Ethics*)

- ★19. Poverty offers numerous benefits to the nonpoor. Antipoverty programs provide jobs for middle-class professionals in social work, penology, and public health. Such workers' future advancement is tied to the continued growth of bureaucracies dependent on the existence of poverty.
(J. John Palen, *Social Problems*)
20. Corn is an annual crop. Butcher's meat, a crop which requires four or five years to grow. As an acre of land, therefore, will produce a much smaller quantity of the one species of food than the other, the inferiority of the quantity must be compensated by the superiority of the price.
(Adam Smith, *The Wealth of Nations*)
21. Neither a borrower nor lender be
For loan oft loses both itself and friend,
And borrowing dulls the edge of husbandry.
(William Shakespeare, *Hamlet* I, 3)
- ★22. The stakes in whistleblowing are high. Take the nurse who alleges that physicians enrich themselves in her hospital through unnecessary surgery; the engineer who discloses safety defects in the braking systems of a fleet of new rapid-transit vehicles; the Defense Department official who alerts Congress to military graft and overspending; all know that they pose a threat to those whom they denounce and that their own careers may be at risk.
(Sissela Bok, "Whistleblowing and Professional Responsibility")
23. If a piece of information is not "job relevant," then the employer is not entitled qua employer to know it. Consequently, since sexual practices, political beliefs, associational activities, etc., are not part of the description of most jobs, that is, since they do not directly affect one's job performance, they are not legitimate information for an employer to know in the determination of the hiring of a job applicant.
(George G. Brenkert, "Privacy, Polygraphs, and Work")
24. Many people believe that a dark tan is attractive and a sign of good health, but mounting evidence indicates that too much sun can lead to health problems. One of the most noticeable effects is premature aging of the skin. The sun also contributes to certain types of cataracts, and, what is most worrisome, it plays a role in skin cancer.
(Joseph M. Moran and Michael D. Morgan, *Meteorology*, 4th ed.)
- ★25. Contrary to the tales of some scuba divers, the toothy, gaping grin on the mouth of an approaching shark is not necessarily anticipatory. It is generally accepted that by constantly swimming with its mouth open, the shark is simply avoiding suffocation. This assures a continuous flow of oxygen-laden water into their mouths, over their gills, and out through the gill slits.
(Robert A. Wallace et al., *Biology: The Science of Life*)
26. Not only is the sky blue [as a result of scattering], but light coming from it is also partially polarized. You can readily observe this by placing a piece of Polaroid (for example, one lens of a pair of Polaroid sunglasses) in front of

your eye and rotating it as you look at the sky on a clear day. You will notice a change in light intensity with the orientation of the Polaroid.

(Frank J. Blatt, *Principles of Physics*, 2nd ed.)

27. Since the secondary light [from the moon] does not inherently belong to the moon and is not received from any star or from the sun, and since in the whole universe there is no other body left but the earth, what must we conclude? What is to be proposed? Surely we must assert that the lunar body (or any other dark and sunless orb) is illuminated by the earth.

(Galileo Galilei, *The Starry Messenger*)

- ★28. Anyone familiar with our prison system knows that there are some inmates who behave little better than brute beasts. But the very fact that these prisoners exist is a telling argument against the efficacy of capital punishment as a deterrent. If the death penalty had been truly effective as a deterrent, such prisoners would long ago have vanished.

(“The Injustice of the Death Penalty,” *America*)

29. Though it is possible that REM sleep and dreaming are not necessary in the adult, REM deprivation studies seem to suggest otherwise. Why would REM pressure increase with deprivation if the system is unimportant in the adult?

(Herbert L. Petri, *Motivation: Theory and Research*, 2nd ed.)

30. We say that an end pursued in its own right is more complete than an end pursued because of something else, and that an end that is never choice-worthy because of something else is more complete than ends that are choiceworthy both in their own right and because of this end. Hence, an end that is always choiceworthy in its own right, and never because of something else, is complete without qualification.

(Aristotle, *Nicomachean Ethics*)

- II. The following arguments were taken from magazine and newspaper editorials and letters to the editor. In most instances the main conclusion must be rephrased to capture the full intent of the author. Write out what you interpret the main conclusion to be.

- ★1. University administrators know well the benefits that follow notable success in college sports: increased applications for admissions, increased income from licensed logo merchandise, more lucrative television deals, post-season game revenue and more successful alumni fund drives. The idea that there is something ideal and pure about the amateur athlete is self-serving bunk.

(Michael McDonnell, *letter to the editor*)

2. In a nation of immigrants, people of diverse ethnic backgrounds must have a common bond through which to exchange ideas. How can this bond be accomplished if there is no common language? It is those who shelter the immigrant from learning English by encouraging the development of a multilingual society who are creating a xenophobic atmosphere. They allow the immigrant to surround himself with a cocoon of language from which he cannot escape and which others cannot penetrate.

(Rita Toften, *letter to the editor*)

3. The health and fitness of our children has become a problem partly because of our attitude toward athletics. The purpose of sports, especially for children, should be to make healthy people healthier. The concept of team sports has failed to do this. Rather than learning to interact and cooperate with others, youngsters are taught to compete. Team sports have only reinforced the notion that the team on top is the winner, and all others are losers. This approach does not make sports appealing to many children, and some, especially among the less fit, burn out by the time they are twelve.

(Mark I. Pitman, “Young Jocks”)

- ★4. College is the time in which a young mind is supposed to mature and acquire wisdom, and one can only do this by experiencing as much diverse intellectual stimuli as possible. A business student may be a whiz at accounting, but has he or she ever experienced the beauty of a Shakespearean sonnet or the boundless events composing Hebrew history? Most likely not. While many of these neoconservatives will probably go on to be financially successful, they are robbing themselves of the true purpose of collegiate academics, a sacrifice that outweighs the future salary checks.

(Robert S. Griffith, “Conservative College Press”)

5. History has shown repeatedly that you cannot legislate morality, nor does anyone have a right to. The real problem is the people who have a vested interest in sustaining the multibillion-dollar drug industry created by the laws against drugs. The legalization of drugs would remove the thrill of breaking the law; it would end the suffering caused by unmetered doses, impurities, and substandard paraphernalia. A huge segment of the underground and extralegal economy would move into a legitimate economy, taking money away from criminals, eliminating crime and violence, and restoring many talented people to useful endeavor.

(Thomas L. Wayburn, letter to the editor)

6. Infectious disease is no longer the leading cause of death in this country, thanks to antibiotics, but there are new strains of bacteria that are resistant to—and others that grow only in the presence of—antibiotics. Yet Congress wants to cut the National Institutes of Health budget. Further cuts would leave us woefully unprepared to cope with the new microbes Mother Nature has cooking in her kitchen.

(Valina L. Dawson, letter to the editor)

- ★7. A person cannot reject free will and still insist on criminality and codes of moral behavior. If people are compelled by forces beyond their control (genes or environment), then their actions, no matter how vile, are excusable. That means the Nuremberg trials of Nazi murderers were invalid, and all prison gates should be flung open. The essence of our humanity is the ability to choose between right and wrong, good and evil, and act accordingly. Strip that from us and we are mere animals.

(Rabbi Gilbert S. Rosenthal, letter to the editor)

8. Ideally, decisions about health-care should be based on the doctor's clinical judgment, patient preference, and scientific evidence. Patients should always be presented with options in their care. Elective cesarean section, however, is not used to treat a problem but to avoid a natural process. An elective surgery like this puts the patient at unnecessary risk, increases the risk for complications in future deliveries, and increases health-care costs.

(Anne Foster-Rosales, M.D., letter to the editor)

9. Parents who feel guilty for the little time they can (or choose to) spend with their children “pick up” after them—so the children don't learn to face the consequences of their own choices and actions. Parents who allow their children to fail are showing them greater love and respect.

(Susan J. Peters, letter to the editor)

- ★10. Most of the environmental problems facing us stem, at least in part, from the sheer number of Americans. The average American produces three quarters of a ton of garbage every year, consumes hundreds of gallons of gasoline, and uses large amounts of electricity (often from a nuclear power plant, coal burning, or a dam). The least painful way to protect the environment is to limit population growth.

(Craig M. Bradley, letter to the editor)

III. Define the following terms:

logic	premise	inference
argument	conclusion	proposition
statement	conclusion indicator	sylogistic logic
truth value	premise indicator	modal logic

IV. Answer “true” or “false” to the following statements:

1. The purpose of the premise or premises is to set forth the reasons or evidence given in support of the conclusion.
2. Some arguments have more than one conclusion.
3. All arguments must have more than one premise.
4. The words “therefore,” “hence,” “so,” “since,” and “thus” are all conclusion indicators.
5. The words “for,” “because,” “as,” and “for the reason that” are all premise indicators.
6. In the strict sense of the terms, *inference* and *argument* have exactly the same meaning.
7. In most (but not all) arguments that lack indicator words, the conclusion is the first statement.
8. Any sentence that is either true or false is a statement.
9. Every statement has a truth value.
10. Aristotle is the person usually credited with being the father of logic.



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