

Unit 2 Logic And Proof

Use the statements below to complete questions 7-10.
 p : a month begins with the letter M; q : it has 31 days

7. Conditional: If a month begins with the letter M, then it also has 31 days Truth Value: T

8. Inverse: If a month doesn't begin with the letter M then it also doesn't have 31 days Truth Value: F

9. Converse: If a month has 31 days, then it begins with the letter M Truth Value: F

10. Contrapositive: If a month doesn't have 31 days then it also doesn't begin with letter M Truth Value: F

11. Which symbolic notation represents the inverse of a conditional statement?
A. $q \rightarrow p$
B. $p \rightarrow q$
C. $\sim q \rightarrow \sim p$
D. $\sim p \rightarrow \sim q$
D

12. Which bi-conditional statement below is true?
A. Angles are congruent if and only if they are vertical angles.
B. Angles are supplementary if and only if their sum is 180° .
C. A number is a whole number if and only if it is a natural number.
D. Points are collinear if and only if they are coplanar.
B

State whether the Law of Detachment or the Law of Syllogism was used to draw the conclusion from the given statements. If it's an invalid conclusion, write invalid.

13. Given: If you live in Orlando, then you live in Florida.
Given: Morgan does not live in Orlando.
Conclusion: Morgan does not live in Florida.
Answer: Invalid Conclusion

14. Given: If two angles in a triangle are 40° and 30° , then the third angle measures 110° .
Given: If a triangle has an angle that measures 110° , then it is an obtuse triangle.
Conclusion: If two angles in a triangle are 40° and 30° , then it is an obtuse triangle.
Answer: Law of Syllogism

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Unit 2: Logic and Proof: Mastering Deductive Reasoning and Mathematical Arguments

Unlocking the power of logical reasoning and rigorous proof is a cornerstone of mathematical understanding. This comprehensive guide dives deep into the intricacies of "Unit 2: Logic and Proof," equipping you with the tools and strategies to conquer this crucial area of mathematics. We'll explore fundamental concepts, dissect complex problems, and provide actionable tips to boost your

understanding and improve your problem-solving skills. Whether you're a high school student tackling geometry proofs or a university student grappling with abstract algebra, this post will serve as your comprehensive resource.

Understanding the Fundamentals of Logic (H2)

Before delving into proofs, a solid grasp of fundamental logic is essential. This section lays the groundwork for your success in "Unit 2: Logic and Proof."

Statements and their Truth Values (H3)

Mathematical logic revolves around statements – declarative sentences that are either true or false. It's crucial to distinguish between statements and non-statements (like questions or commands). Understanding truth values allows us to analyze the relationships between different statements.

Logical Connectives (H3)

Logical connectives, such as "and," "or," "not," "implies," and "if and only if," allow us to combine and modify statements to create more complex logical expressions. Mastering these connectives is paramount for constructing and interpreting proofs. Understanding their truth tables is key to recognizing valid arguments.

Truth Tables and Logical Equivalence (H3)

Truth tables provide a systematic way to evaluate the truth value of complex logical expressions for all possible combinations of truth values of their component statements. They are invaluable for determining logical equivalence – whether two different statements always have the same truth value.

Methods of Proof (H2)

This section explores the various techniques used to construct rigorous mathematical proofs within the context of "Unit 2: Logic and Proof."

Direct Proof (H3)

A direct proof starts with the given premises and, through a series of logical steps, directly arrives at the conclusion. This is often the most straightforward approach, but it requires careful structuring and a clear understanding of logical implications.

Indirect Proof (Proof by Contradiction) (H3)

In an indirect proof, you assume the negation of the conclusion and demonstrate that this assumption leads to a contradiction. Since a contradiction is impossible in a consistent logical system, the original conclusion must be true. This technique is particularly useful when a direct

proof is difficult or impossible to construct.

Proof by Cases (H3)

When dealing with a statement that can be broken down into several distinct cases, a proof by cases involves proving the statement separately for each case. This ensures comprehensive coverage and avoids overlooking potential exceptions.

Proof by Induction (H3)

Mathematical induction is a powerful technique used to prove statements about integers. It involves proving a base case and then demonstrating that if the statement is true for a particular integer, it's also true for the next integer. This recursive approach allows you to prove the statement for all integers greater than or equal to the base case.

Applying Logic and Proof in Geometry (H2)

Geometry provides a rich context for applying the principles of logic and proof. "Unit 2: Logic and Proof" often includes a significant focus on geometric proofs.

Two-Column Proofs (H3)

Two-column proofs are a structured format for presenting geometric arguments, listing each statement and its corresponding justification in separate columns. This method promotes clarity and helps organize the steps of a proof.

Working with postulates, theorems, and definitions (H3)

Geometric proofs rely on previously established truths (postulates and theorems) and precise definitions. Understanding and correctly applying these elements is crucial for constructing valid geometric arguments.

Strategies for Success in Unit 2: Logic and Proof (H2)

Mastering "Unit 2: Logic and Proof" requires consistent effort and strategic learning.

Practice, Practice, Practice (H3)

The key to success is consistent practice. Work through numerous examples, gradually increasing the complexity of the problems you tackle.

Seek Clarification (H3)

Don't hesitate to seek clarification from your teacher, tutor, or classmates if you encounter concepts

you don't fully understand.

Organize Your Work (H3)

A well-organized approach is vital, particularly for complex proofs. Use clear notation, label your steps, and systematically present your arguments.

Conclusion

Understanding "Unit 2: Logic and Proof" is not just about memorizing theorems; it's about developing a powerful analytical mindset. By mastering the fundamentals of logic, different proof techniques, and applying them consistently through practice, you'll build a strong foundation for further mathematical exploration. This unit lays the groundwork for more advanced mathematical topics, and your efforts here will pay significant dividends in the future.

FAQs

1. What is the difference between a theorem and a postulate? A postulate is a statement accepted as true without proof, while a theorem is a statement that has been proven to be true.
2. How can I improve my ability to construct proofs? Practice is key. Start with simpler proofs and gradually work your way up to more complex ones. Break down the problem into smaller, more manageable steps.
3. What are some common mistakes students make in logic and proof? Common mistakes include incorrectly applying logical connectives, making assumptions without justification, and failing to provide sufficient reasoning for each step in a proof.
4. Are there online resources to help me learn more about logic and proof? Yes, many online resources, including Khan Academy, YouTube channels dedicated to mathematics, and various university websites, offer valuable tutorials and practice problems.
5. How important is understanding "Unit 2: Logic and Proof" for future math courses? It's extremely important. The logical reasoning and proof-writing skills developed in this unit are fundamental to success in higher-level mathematics courses, including calculus, linear algebra, and abstract algebra.

unit 2 logic and proof: Book of Proof Richard H. Hammack, 2016-01-01 This book is an introduction to the language and standard proof methods of mathematics. It is a bridge from the computational courses (such as calculus or differential equations) that students typically encounter in their first year of college to a more abstract outlook. It lays a foundation for more theoretical courses such as topology, analysis and abstract algebra. Although it may be more meaningful to the

student who has had some calculus, there is really no prerequisite other than a measure of mathematical maturity.

unit 2 logic and proof: *Proofs from THE BOOK* Martin Aigner, Günter M. Ziegler, 2013-06-29 According to the great mathematician Paul Erdős, God maintains perfect mathematical proofs in The Book. This book presents the authors candidates for such perfect proofs, those which contain brilliant ideas, clever connections, and wonderful observations, bringing new insight and surprising perspectives to problems from number theory, geometry, analysis, combinatorics, and graph theory. As a result, this book will be fun reading for anyone with an interest in mathematics.

unit 2 logic and proof: Principia Mathematica Alfred North Whitehead, Bertrand Russell, 1910

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unit 2 logic and proof: Proofs and Fundamentals Ethan D. Bloch, 2013-12-01 The aim of this book is to help students write mathematics better. Throughout it are large exercise sets well-integrated with the text and varying appropriately from easy to hard. Basic issues are treated, and attention is given to small issues like not placing a mathematical symbol directly after a punctuation mark. And it provides many examples of what students should think and what they should write and how these two are often not the same.

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unit 2 logic and proof: Mathematical Reasoning Theodore A. Sundstrom, 2007 Focusing on the formal development of mathematics, this book shows readers how to read, understand, write, and

construct mathematical proofs. Uses elementary number theory and congruence arithmetic throughout. Focuses on writing in mathematics. Reviews prior mathematical work with "Preview Activities" at the start of each section. Includes "Activities" throughout that relate to the material contained in each section. Focuses on Congruence Notation and Elementary Number Theory throughout. For professionals in the sciences or engineering who need to brush up on their advanced mathematics skills. Mathematical Reasoning: Writing and Proof, 2/E Theodore Sundstrom

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unit 2 logic and proof: *Mathematical Logic through Python* Yannai A. Gonczarowski, Noam Nisan, 2022-07-31 Using a unique pedagogical approach, this text introduces mathematical logic by guiding students in implementing the underlying logical concepts and mathematical proofs via Python programming. This approach, tailored to the unique intuitions and strengths of the ever-growing population of programming-savvy students, brings mathematical logic into the comfort zone of these students and provides clarity that can only be achieved by a deep hands-on understanding and the satisfaction of having created working code. While the approach is unique, the text follows the same set of topics typically covered in a one-semester undergraduate course, including propositional logic and first-order predicate logic, culminating in a proof of Gödel's completeness theorem. A sneak peek to Gödel's incompleteness theorem is also provided. The textbook is accompanied by an extensive collection of programming tasks, code skeletons, and unit tests. Familiarity with proofs and basic proficiency in Python is assumed.

unit 2 logic and proof: *Handbook of Proof Theory* S.R. Buss, 1998-07-09 This volume contains articles covering a broad spectrum of proof theory, with an emphasis on its mathematical aspects. The articles should not only be interesting to specialists of proof theory, but should also be accessible to a diverse audience, including logicians, mathematicians, computer scientists and philosophers. Many of the central topics of proof theory have been included in a self-contained expository of articles, covered in great detail and depth. The chapters are arranged so that the two introductory articles come first; these are then followed by articles from core classical areas of proof theory; the handbook concludes with articles that deal with topics closely related to computer science.

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unit 2 logic and proof: An Introduction to Abstract Mathematics Robert J. Bond, William J. Keane, 2007-08-24 Bond and Keane explicate the elements of logical, mathematical argument to elucidate the meaning and importance of mathematical rigor. With definitions of concepts at their disposal, students learn the rules of logical inference, read and understand proofs of theorems, and write their own proofs all while becoming familiar with the grammar of mathematics and its style. In addition, they will develop an appreciation of the different methods of proof (contradiction, induction), the value of a proof, and the beauty of an elegant argument. The authors emphasize that mathematics is an ongoing, vibrant discipline its long, fascinating history continually intersects with territory still uncharted and questions still in need of answers. The authors' extensive background in teaching mathematics shines through in this balanced, explicit, and engaging text, designed as a primer for higher-level mathematics courses. They elegantly demonstrate process and application and recognize the byproducts of both the achievements and the missteps of past thinkers. Chapters 1-5 introduce the fundamentals of abstract mathematics and chapters 6-8 apply the ideas and techniques, placing the earlier material in a real context. Readers' interest is continually piqued by the use of clear explanations, practical examples, discussion and discovery exercises, and historical comments.

unit 2 logic and proof: *Introduction to Mathematical Logic* Elliot Mendelsohn, 2012-12-06 This is a compact introduction to some of the principal topics of mathematical logic. In the belief that beginners should be exposed to the most natural and easiest proofs, I have used free-swinging set-theoretic methods. The significance of a demand for constructive proofs can be evaluated only after a certain amount of experience with mathematical logic has been obtained. If we are to be expelled from Cantor's paradise (as nonconstructive set theory was called by Hilbert), at least we should know what we are missing. The major changes in this new edition are the following. (1) In Chapter 5, Effective Computability, Turing-computability is now the central notion, and diagrams (flow-charts) are used to construct Turing machines. There are also treatments of Markov algorithms, Herbrand-Gödel-computability, register machines, and random access machines. Recursion theory is gone into a little more deeply, including the s-m-n theorem, the recursion theorem, and Rice's Theorem. (2) The proofs of the Incompleteness Theorems are now based upon the Diagonalization Lemma. Löb's Theorem and its connection with Gödel's Second Theorem are also studied. (3) In Chapter 2, Quantification Theory, Henkin's proof of the completeness theorem has been postponed until the reader has gained more experience in proof techniques. The exposition of the proof itself has been improved by breaking it down into smaller pieces and using the notion of a scapegoat theory. There is also an entirely new section on semantic trees.

unit 2 logic and proof: *The Logic of Our Language* Rodger L. Jackson, Melanie L. McLeod, 2014-11-04 The Logic of Our Language teaches the practical and everyday application of formal logic. Rather than overwhelming the reader with abstract theory, Jackson and McLeod show how the skills developed through the practice of logic can help us to better understand our own language and reasoning processes. The authors' goal is to draw attention to the patterns and logical structures inherent in our spoken and written language by teaching the reader how to translate English sentences into formal symbols. Other logical tools, including truth tables, truth trees, and natural deduction, are then introduced as techniques for examining the properties of symbolized sentences and assessing the validity of arguments. A substantial number of practice questions are offered both within the book itself and as interactive activities on a companion website.

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introduction is followed by discussions of classes and sets, functions, natural and cardinal numbers, the arithmetic of ordinal numbers, and related topics. 1971 edition with new material by the author--

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ACM Monograph Series: *A Computational Logic* focuses on the use of induction in proving theorems, including the use of lemmas and axioms, free variables, equalities, and generalization. The publication first elaborates on a sketch of the theory and two simple examples, a precise definition of the theory, and correctness of a tautology-checker. Topics include mechanical proofs, informal development, formal specification of the problem, well-founded relations, natural numbers, and literal atoms. The book then examines the use of type information to simplify formulas, use of axioms and lemmas as rewrite rules, and the use of definitions. Topics include nonrecursive functions, computing values, free variables in hypothesis, infinite backwards chaining, infinite looping, computing type sets, and type prescriptions. The manuscript takes a look at rewriting terms and simplifying clauses, eliminating destructors and irrelevance, using equalities, and generalization. Concerns include reasons for eliminating isolated hypotheses, precise statement of the generalization heuristic, restricting generalizations, precise use of equalities, and multiple destructors and infinite looping. The publication is a vital source of data for researchers interested in computational logic.

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to advanced students in computer science and philosophy. Topics include propositional logic; first-order languages and logic; incompleteness, undecidability, and indefinability; recursive functions; computability; and Hilbert's Tenth Problem. Reprint of the PWS Publishing Company, Boston, 1995 edition.

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unit 2 logic and proof: Theoretical Aspects of Computing Ana Cavalcanti, David Deharbe, Marie-Claude Gaudel, Jim Woodcock, 2010-08-11 The now well-established series of International Colloquia on Theoretical Aspects of Computing (ICTAC) brings together practitioners and researchers from academia, industry and government to present research results, and exchange experience and ideas. Beyond these scholarly goals, another main purpose is to promote cooperation in research and education between participants and their institutions, from developing and industrial countries. This volume contains the papers presented at ICTAC 2010. It was held during September 1-3 in the city of Natal, Rio Grande do Norte, Brazil. There were 68 submissions by authors from 24 countries all around the world. Each submission was reviewed by at least three, and on average four, Program Committee members and external reviewers. After extensive discussions, they decided to accept the 23 (regular) papers presented here. Authors of a selection of these papers were invited to submit an extended version of their work to a special issue of the Theoretical Computer Science journal. Seven of the papers were part of a special track including one paper on "Formal Aspects of Software Testing", and six on the "Grand Challenge in Verified Software." The special track was jointly organized by Marie-Claude Gaudel, from the Université de Paris-Sud, and Jim Woodcock, from the University of York.

unit 2 logic and proof: *First Steps in Modal Logic* Sally Popkorn, 1994-12-08 This is a first course in propositional modal logic, suitable for mathematicians, computer scientists and philosophers. Emphasis is placed on semantic aspects, in the form of labelled transition structures, rather than on proof theory.

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unit 2 logic and proof: The Principles of Mathematics Bertrand Russell, 1903

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motivated by epistemological considerations; some papers originated in the critique of certain views that at one time dominated the discussions of the Vienna Circle; others grew out of problems in teaching fundamental ideas of mathematics; still others were occasioned by personal relations with economists. Hence a wide range of subjects will be discussed: epistemology, logic, basic concepts of pure and applied mathematics, philosophical ideas resulting from geometric studies, mathematical didactics and, finally, economics. The papers also span a period of more than fifty years. What unifies the various parts of the book is the spirit of searching for the clarification of basic concepts and methods and of articulating hidden ideas and tacit procedures. Part 1 includes papers published about 1930 which expound an idea that Carnap, after a short period of opposition in the Circle, fully adopted; and, under the name Principle of Tolerance, he eloquently formulated it in great generality in his book, *Logical Syntax of Language* (1934), through which it was widely disseminated. The New Logic in Chapter 1 furthermore includes the first report (1932) to a larger public of Gödel's epochal discovery presented among the great logic results of all time. Chapter 2 is a translation of an often quoted 1930 paper presenting a detailed exposition and critique of intuitionism.

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unit 2 logic and proof: Q.E.D., 2004-05-01 Q.E.D. presents some of the most famous mathematical proofs in a charming book that will appeal to nonmathematicians and math experts alike. Grasp in an instant why Pythagoras's theorem must be correct. Follow the ancient Chinese proof of the volume formula for the frustrating frustum, and Archimedes' method for finding the volume of a sphere. Discover the secrets of pi and why, contrary to popular belief, squaring the circle really is possible. Study the subtle art of mathematical domino tumbling, and find out how slicing cones helped save a city and put a man on the moon.

unit 2 logic and proof: Uncle Petros and Goldbach's Conjecture Apostolos Doxiadis, 2012-11-15 Uncle Petros is a family joke. An ageing recluse, he lives alone in a suburb of Athens, playing chess and tending to his garden. If you didn't know better, you'd surely think he was one of life's failures. But his young nephew suspects otherwise. For Uncle Petros, he discovers, was once a celebrated mathematician, brilliant and foolhardy enough to stake everything on solving a problem that had defied all attempts at proof for nearly three centuries - Goldbach's Conjecture. His quest brings him into contact with some of the century's greatest mathematicians, including the Indian prodigy Ramanujan and the young Alan Turing. But his struggle is lonely and single-minded, and by the end it has apparently destroyed his life. Until that is a final encounter with his nephew opens up to Petros, once more, the deep mysterious beauty of mathematics. Uncle Petros and Goldbach's Conjecture is an inspiring novel of intellectual adventure, proud genius, the exhilaration of pure mathematics - and the rivalry and antagonism which torment those who pursue impossible goals.

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unit 2 logic and proof: A Course in Mathematical Logic for Mathematicians Yu. I. Manin, 2009-10-13 1. The first edition of this book was published in 1977. The text has been well received and is still used, although it has been out of print for some time. In the intervening three decades, a lot of interesting things have happened to mathematical logic: (i) Model theory has shown that

insights acquired in the study of formal languages could be used fruitfully in solving old problems of conventional mathematics. (ii) Mathematics has been and is moving with growing acceleration from the set-theoretic language of structures to the language and intuition of (higher) categories, leaving behind old concerns about infinities: a new view of foundations is now emerging. (iii) Computer science, a no-nonsense child of the abstract computability theory, has been creatively dealing with old challenges and providing new ones, such as the P/NP problem. Planning additional chapters for this second edition, I have decided to focus on model theory, the conspicuous absence of which in the first edition was noted in several reviews, and the theory of computation, including its categorical and quantum aspects. The whole Part IV: Model Theory, is new. I am very grateful to Boris I. Zilber, who kindly agreed to write it. It may be read directly after Chapter II. The contents of the first edition are basically reproduced here as Chapters I–VIII. Section IV.7, on the cardinality of the continuum, is completed by Section IV.7.3, discussing H. Woodin’s discovery.

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