

# Answer Key For Discrete Mathematics

## Seventh Edition

Answer Key For Discrete Mathematics Seventh Edition Answer Key for Discrete Mathematics Seventh Edition This document serves as an answer key for the exercises found in the seventh edition of Discrete Mathematics by Kenneth H Rosen. It provides solutions and explanations for a selection of problems from each chapter aiming to facilitate student learning and understanding of the concepts covered. The answer key is structured according to the book's chapter organization. For each chapter a concise overview of the key concepts and definitions is provided followed by a breakdown of selected exercises with their solutions presented in a clear and detailed manner. Please note that this answer key is not intended to be a comprehensive solution manual. It focuses on providing guidance and explanations for a representative selection of exercises encouraging students to engage in independent problem-solving and critical thinking.

**Chapter 1: The Foundations Logic and Proofs**

1.1 Propositional Logic: This section introduces the basic building blocks of logic propositions, truth values, logical connectives, and truth tables.

**Exercise 1.1** Question: Construct a truth table for the proposition  $p \wedge p \vee q$ .  
Solution:  $\begin{array}{cc|c} p & q & p \wedge p \vee q \\ \hline T & T & T \\ T & F & T \\ F & T & T \\ F & F & F \end{array}$

**Exercise 1.25** Question: Express the following statement using predicates and quantifiers: Every computer science student has taken a course in discrete mathematics.  
Solution: Let  $Cx$  represent "x is a computer science student" and  $Dx$  represent "x has taken a course in discrete mathematics". The statement can be expressed as  $\forall x Cx \rightarrow Dx$ .

**Exercise 1.33** Question: Prove by contradiction that if  $n$  is an integer and  $n$  is even then  $n$  is even.  
Solution: Assume for the sake of contradiction that  $n$  is odd. Then  $n$  can be written as  $n = 2k + 1$  for some integer  $k$ . Squaring both sides we get  $n^2 = 4k^2 + 4k + 1 = 2(2k^2 + 2k) + 1$ . This shows that  $n$  is odd, contradicting our initial assumption that  $n$  is even. Therefore our assumption that  $n$  is odd must be false meaning  $n$  must be even.

**Chapter 2: Basic Structures Sets Functions Sequences and Sums**

2.1 Sets: This chapter introduces the concept of sets, various set operations, and basic set properties.

2.2 Functions: Properties of functions including injectivity, surjectivity, and bijectivity are explored in detail.

2.3 Sequences and Summations: Sequences, summation notation, and various summation properties are discussed.

**Selected Exercises and Solutions**

**Exercise 2.17** Question: Let  $A = \{a, b, c\}$ ,  $B = \{x, y\}$ , and  $C = \{1, 2\}$ . Find  $A \times B \times C$ .  
Solution:  $A \times B \times C = \{(a, x, 1), (a, x, 2), (a, y, 1), (a, y, 2), (b, x, 1), (b, x, 2), (b, y, 1), (b, y, 2), (c, x, 1), (c, x, 2), (c, y, 1), (c, y, 2)\}$

**Exercise 2.29** Question: Determine whether the function  $f: \mathbb{R} \rightarrow \mathbb{R}$  defined by  $f(x) = x^2$  is injective, surjective, or bijective.  
Solution: The function  $f(x) = x^2$  is not injective because for any two distinct real numbers  $x$  and  $-x$ ,  $f(x) = f(-x)$ . It is also not surjective because for any real number  $y$  there exists a real number  $x$  such that  $f(x) = y$  namely  $x = \pm\sqrt{y}$ . Since  $f$  is both injective and surjective it is bijective.

**Exercise 2.35** Question: Evaluate the sum  $\sum_{i=1}^{10} i^3$ .  
Solution:  $\sum_{i=1}^{10} i^3 = 1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3 + 7^3 + 8^3 + 9^3 + 10^3 = 33550$

**Chapter 3: Counting**

3.1 The Basics of Counting: Introduces fundamental counting principles including the sum rule, product rule, and the pigeonhole principle.

3.2 Permutations and Combinations: Explores the concepts of permutations and combinations and their applications in counting arrangements and selections.

3.3 Binomial Coefficients and Identities: Introduces binomial coefficients, Pascal's Identity, and other important binomial identities.

**Selected Exercises and Solutions**

Exercise 313 Question A restaurant offers 5 appetizers 10 main courses and 4 desserts How many different meals can be ordered if a meal consists of one appetizer one main course and one dessert Solution By the product rule there are  $5 \times 10 \times 4 = 200$  different meals possible Exercise 321 Question How many ways can we arrange the letters in the word APPLE Solution There are 5 letters with the letter P repeating twice Therefore the number of arrangements is  $5! / (2! \times 1! \times 1! \times 1!) = 60$  Exercise 337 Question Use Pascals Identity to prove that for any positive integer  $n$   $\binom{n}{k} = \binom{n-1}{k-1} + \binom{n-1}{k}$  Solution Base case For  $n = 1$   $\binom{1}{1} = \binom{0}{0} + \binom{0}{1}$  holds Inductive step Assume that for some positive integer  $k$   $\binom{k}{j} = \binom{k-1}{j-1} + \binom{k-1}{j}$  We need to show that  $\binom{k+1}{j} = \binom{k}{j-1} + \binom{k}{j}$  Using Pascals Identity  $\binom{k+1}{j} = \binom{k}{j-1} + \binom{k}{j}$  By mathematical induction the formula holds for all positive integers  $n$  4 Chapter 4 Induction and Recursion 41 Mathematical Induction Introduces the principle of mathematical induction and its applications in proving statements about integers 42 Recursive Definitions and Structural Induction Covers recursive definitions and structural induction providing tools for defining and proving properties of recursively defined structures 43 Recursive Algorithms Explores the design and analysis of recursive algorithms illustrating their effectiveness in solving various problems Selected Exercises and Solutions Exercise 413 Question Prove that for all positive integers  $n \geq 1$   $1 + 2 + 3 + \dots + n = \frac{n(n+1)}{2}$  Solution Base case For  $n = 1$  the equation holds  $1 = \frac{1(1+1)}{2}$  Inductive step Assume that for some positive integer  $k$   $1 + 2 + 3 + \dots + k = \frac{k(k+1)}{2}$  We need to show that  $1 + 2 + 3 + \dots + k + (k+1) = \frac{(k+1)(k+2)}{2}$  Using the inductive hypothesis  $1 + 2 + 3 + \dots + k + (k+1) = \frac{k(k+1)}{2} + (k+1) = \frac{(k+1)(k+2)}{2}$  By mathematical induction the formula holds for all positive integers  $n$  Exercise 425 Question Define the Fibonacci sequence recursively Solution The Fibonacci sequence  $F_n$  is defined as  $F_0 = 0$ ,  $F_1 = 1$ ,  $F_n = F_{n-1} + F_{n-2}$  for  $n \geq 2$  Exercise 433 Question Write a recursive algorithm to compute the greatest common divisor GCD of two positive integers Solution function  $gcd(a, b)$  if  $b = 0$  return  $a$  else  $return gcd(b, a \% b)$  Conclusion This answer key provides a foundation for understanding the concepts and problemsolving techniques presented in Discrete Mathematics Seventh Edition By working through the provided solutions and engaging in independent problemsolving students can gain a deeper understanding of the essential concepts in this field Remember this is just a starting point The true learning comes from actively engaging with the material exploring different approaches and seeking clarification when necessary Embrace the challenge and let the world of discrete mathematics open up to you

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