Chapter 1: Algebra Reference

1.1 Properties of Real Numbers and Polynomials
- Properties of Real Numbers
  - Use the following properties of real numbers: inverse and identity
  - Use the following properties of real numbers: commutative, associative, and distributive
- Polynomials
  - Add and subtract polynomials
  - Multiply binomials together
  - Multiply polynomials together
  - Perform operations with polynomials of several variables
- Properties of Real Numbers and Order of Operations
  - Distinguish between natural numbers, whole numbers, and integers
  - Distinguish between rational and irrational numbers
  - Perform calculations using order of operations
  - Use the following properties of real numbers: inverse and identity
  - Use the following properties of real numbers: commutative, associative, and distributive
- Evaluate and Simplify Algebraic Expressions
  - Evaluate algebraic expressions with a single variable
  - Evaluate algebraic expressions with two variables
  - Identify constants and variables
  - Use a formula
  - Simplify algebraic expressions

1.2 Factoring
- Factoring Quadratics
  - Factor the greatest common factor of a polynomial
  - Factor a trinomial
  - Factor a trinomial by grouping
  - Factor a perfect square trinomial
  - Factor a difference of squares
- Other Factoring Techniques
  - Factor a cubic by grouping
  - Factor the sum and difference of cubes
  - Factor expressions using fractional or negative exponents
  - Factor expressions using greatest common factor and other technique

1.3 Rational Expressions
- Operations on Rational Expressions
  - Simplify rational expressions
  - Multiply rational expressions
- Divide rational expressions
- Add and subtract rational expressions

1.4 Equations
- Linear Equations
  - Identify identity, conditional, and inconsistent equations
  - Solve equations in one variable algebraically, variable just on one side
  - Solve equations in one variable algebraically, variable on both sides
- Quadratic Equations
  - Solve quadratic equations by factoring, leading coefficient 1
  - Solve quadratic equations by factoring, leading coefficient > 1
  - Solve quadratic equations by using the quadratic formula
- Rational Equations
  - Solve a rational equation, monomials in denominator
  - Solve a rational equation, binomials in denominator
  - Solve a rational equation, requires factoring to find least common denominator

1.5 Inequalities
- Linear Inequalities
  - Use interval notation
  - Use properties of inequalities
  - Solve simple inequalities in one variable algebraically
- Quadratic and Rational Inequalities
  - Solve quadratic inequalities in one variable, graph the solution set, and express the solution set using interval notation
  - Solve inequalities that involve rational expressions, graph the solution sets, and express the solution set using interval notation

1.6 Exponents
- Properties of Exponents
  - Understand exponent notation
  - Use the product rule of exponents
  - Use the quotient rule of exponents
  - Use the power rule of exponents
- Advanced Properties of Exponents
  - Use the negative and zero exponent rule
  - Find the power of a product
  - Find the power of a quotient
  - Simplify exponential expressions
1.7 Radicals
- Simplify Radicals
  - Evaluate square roots
  - Use the product rule to simplify square roots
  - Use the quotient rule to simplify square roots
- Operations with Radicals
  - Add and subtract square roots
  - Rationalize denominators with a monomial denominator
  - Rationalize denominators using the conjugate

Chapter 2: Linear Functions
2.1 Slopes and Equations of Lines
- Cartesian Coordinate System
  - Plot ordered pairs in a Cartesian coordinate system
  - Graph equations by plotting points
- Identify Slopes and Intercepts
  - Find the slope of a line given two points
  - Understand the relationship between the slope and y-intercept of a line and its equation
  - Find x-intercepts and y-intercepts
- Finding Linear Equations
  - Find equation of a line, in slope-intercept form, given slope and one point (point-slope formula)
  - Find equation, in slope-intercept form, of a line passing through two given points
  - Given slope and intercept, find the equation of a line and write it in standard form
  - Find the equation of vertical and horizontal lines
- Graphing Linear Equations
  - Graph a linear equation using the slope and the origin
- Parallel and Perpendicular Lines
  - Given the equations of two lines, determine whether their graphs are parallel or perpendicular
  - Write the equation of a line parallel to a given line
  - Write the equation of a line perpendicular to a given line

2.2 Linear Functions and Applications
- Linear Functions
  - Understand function notation
  - Evaluate a linear function at a value
- Applications of Linear Functions
  - Solve supply and demand problems using linear functions
  - Solve cost analysis problems using linear functions
  - Solve break even analysis problems using linear functions
- Mass and Temperature
  - Identify unit of mass correctly for a given situation
  - Convert between celsius and fahrenheit

2.3 The Least Squares Line
- The Least Squares Line
  - Find the linear regression equation given a list of data points
  - Make predictions using a line of best fit
  - Find and interpret the correlation coefficient

Chapter 3: Systems of Linear Equations and Matrices
3.1 Solving Linear Systems
- Linear Systems in Two Variables
  - Solve systems of equations in two variables by graphing
  - Solve systems of equations in two variables by substitution
  - Solve systems of equations in two variables by addition
  - Identify inconsistent and dependent systems of equations containing two variables, and express the solution of dependent equations
- Linear System in Three Variables
  - Determine whether an ordered triple is a solution to a system
  - Solve systems of three equations in three variables
  - Identify inconsistent and dependent systems of equations containing three variables, and express the solution of a system of dependent equations
- Applications of Linear Systems
  - Use systems of equations to investigate profits
  - Write and solve a system of equations in two variables from a word problem

3.2 Solving Linear Systems by the Gauss-Jordan Method
- Solving Systems with Gaussian Elimination
  - Convert between a system of equations and its corresponding augmented matrix
  - Use row operations to solve a system of linear equations in two variables
  - Use row operations to solve a system of linear equations in three variables
  - Use matrices to solve applications of systems of linear equations

3.3 Operations with Matrices
- Addition and Subtraction of Matrices
  - Determine the order of a matrix and describe elements within a matrix
  - Add or subtract matrices
- Multiplication of Matrices
  - Multiply a matrix by a scalar
  - Find the sum or difference of scalar multiples
  - Multiply two matrices
3.4 Matrix Inverses and Determinants

- Determinants of Matrices
  - Find the determinant of a 2x2 matrix
  - Find the determinant of a 3x3 matrix

- Inverse and Identity Matrices
  - Understand the identity matrix and how it relates to the inverse matrix
  - Determine if a matrix is invertible using the determinant
  - Find the inverse of a 2x2 matrix
  - Find the inverse of a 3x3 matrix

- Solving Systems with Inverses
  - Solve a system of linear equations using the inverse of a 2x2 matrix
  - Solve a system of linear equations using the inverse of a 3x3 matrix

3.5 Input-Output Models

- Input-Output Matrices
  - Create an input output matrix for a given application
  - Calculate the amount of commodities produced given an input output matrix and a production matrix
  - Determine the production matrix that will satisfy a given demand matrix
  - Find the production of a commodity in a closed input output model

**Chapter 4: Linear Programming - The Graphical Method**

4.1 Graphing Linear Inequalities

- Graphs of Linear Inequalities
  - Solve a linear inequality in two variables by graphing
  - Solve a linear system of inequalities by graphing

4.2 Solving Linear Programming Problems Graphically

- Solving Linear Programming Problems Graphically
  - Graph a feasible region given a set of constraints
  - Find the maximum value of an objective function given constraints by graphing

4.3 Applications of Linear Programming

- Applications of Linear Programming
  - Solve application problems using linear programming

**Chapter 5: Linear Programming - The Simplex Method**

5.1 Slack Variables and the Pivot

- Finding Solutions using Initial Simplex Tableaus
  - Rewrite a linear programming problem using slack variables and create an initial simplex tableau
  - Read a solution from an initial simplex tableau
  - Find a new solution by pivoting an initial simplex tableau
5.2 Maximization and Minimization Problems
- Solving Maximization Problems with the Simplex Method
  - Solve maximization problems using the simplex method
- Transposing a Matrix and Finding the Dual of a Linear Programming Problem
  - Determine the transpose of a matrix
  - Determine the dual of a linear programming problem
- Solving Minimization Problems with Duality
  - Solve minimization problems using the theorem of duality

5.3 Nonstandard Problems
- Solving Nonstandard Problems
  - Solve a nonstandard linear programming problem
  - Solve a nonstandard linear programming application problem

Chapter 6: Mathematics of Finance

6.1 Simple Interest
- Simple Interest
  - Calculate simple interest
  - Calculate interest discounts on a discounted loan

6.2 Compound Interest
- Compound Interest
  - Calculate periodically compounded interest
  - Calculate compound interest
  - Calculate continuously compounded interest
  - Calculate effective annual yield
- Geometric Sequences
  - Find the common ratio of a geometric sequence
  - Write terms of a geometric sequence
  - Write a recursive formula for a geometric sequence
  - Write an explicit formula for a geometric sequences
  - Find the sum of a finite geometric sequence

6.3 Annuities, Stocks, and Bonds
- Annuities
  - Calculate the value of an annuity
  - Calculate the payment needed to achieve a determined future value
- Stocks
  - Define stock terminology
  - Read a stock table
6.4 Installment Loans, Amortization, and Credit Cards

- Mortgages and Loans
  - Calculate the monthly payment and interest cost for a mortgage
  - Construct a loan amortization schedule
  - Choose the best installment loan plan
- Credit Cards
  - Recognize key features of credit cards
  - Calculate the average daily balance of a credit card
  - Determine interest to be paid on a card's next billing date

Chapter 7: Logic

7.1 Statements and Logical Connectives

- The Building Blocks of Logic
  - Identify and negate simple statements
  - Identify and negate quantified statements
- Symbolic Representation of Statements
  - Identify logical connectives and compound statements
  - Represent and/or/not statements in symbolic form and English
- Conditional Statements
  - Represent conditional statements in symbolic form and English
  - Write biconditional statements in symbolic form and English
  - Represent symbolic statements with parentheses using dominance of connectives

7.2 Truth Tables for Negation, Conjunction, and Disjunction

- Introduction to Truth Tables
  - Construct a truth table for a statement with a conjunction and/or a negation and determine its truth value
  - Construct a truth table for a statement with a disjunction and/or a negation and determine its truth value
  - Construct a truth table for a compound statement with a conjunction and disjunction and determine its truth value

7.3 Truth Tables for the Conditional and Biconditional

- Truth Tables for Conditional and Biconditional Statements
  - Construct a truth table for a conditional statement and determine its truth value
  - Construct a truth table for a biconditional statement and determine its truth value
- Self-Contradictions, Tautologies, and Implications
  - Identify self-contradictions, tautologies, and implications
7.4 Equivalent Statements
- Equivalent Statements and De Morgan's Equivalence Laws
  - Determine if two symbolic statements are equivalent using a truth table
  - Determine if two statements given in English are equivalent using a truth table
  - Determine if two statements are equivalent using De Morgan's laws
- Conditional States and Equivalence
  - Convert a disjunction into an equivalent conditional statement
  - Determine if two conditional statements are equivalent

7.5 Symbolic Arguments
- Drawing and Verifying Conclusions
  - Draw a conclusion from a conditional statement
  - Determine if an argument is valid using a truth table
  - Identify and validate the standard forms of arguments

7.6 Euler Diagrams and Syllogistic Arguments
- Euler Diagrams and Syllogistic Arguments
  - Identify syllogistic arguments
  - Represent a syllogistic argument with a Euler diagram
  - Determine if a syllogistic argument is valid with a Euler diagram

7.7 Switching Circuits
- Switching Circuits and Symbolic Logic
  - Convert between symbolic statements and switching circuits
  - Determine conditions for when a lightbulb will be turned on in a switching circuit
  - Determine if two switching circuits are equivalent

Chapter 8: Sets and Counting Principles
8.1 Set Concepts
- Introduction to Sets and Set Builder Notation
  - Represent a set using a written description and the roster method
  - Represent a set using set builder notation
- Set Equivalence
  - Identify the cardinal number for a set
  - Determine if two sets are equivalent
  - Determine if two sets are equal
- Types of Sets
  - Identify subsets, universal sets, and empty sets
  - Distinguish between finite and infinite sets
- Subsets and Proper Subsets
  - Identify subsets and proper subsets using set notation
  - Determine the number of subsets and proper subsets in a given set
8.2 Venn Diagrams and Set Operations

- Representing Sets with Venn Diagrams
  - Illustrate the universal set, a set, and complement of a set using a Venn diagram
  - Illustrate two sets using Venn diagram and set notation
- Set Relationships
  - Determine the complement of a set using Venn diagrams and proper set notation
  - Determine the intersection of two sets using Venn diagrams and set notation
  - Determine the union of two sets using Venn diagrams and set notation
- Set Operations
  - Perform operations on sets
  - Find the difference and cartesian product of two sets
  - Use Venn diagrams to find the result of set operations on two sets
  - Determine the cardinal number of a union of two finite sets

8.3 Venn Diagrams with Three Sets and Verification of Equality of Sets

- Construct a Venn Diagram of Three Sets
- Perform set operations on three sets
- Represent three sets using Venn diagrams

8.4 The Fundamental Counting Principle

- The Fundamental Counting Principle
  - Solve counting problems using the addition principle
  - Solve counting problems using the multiplication principle

8.5 Permutations and Combinations

- Permutations
  - Evaluate an expression with factorials
  - Find the number of permutations of n distinct objects using the multiplication principle
  - Find the number of permutations of n distinct objects using a formula
  - Find the number of permutations of n non-distinct objects
- Combinations
  - Find the number of combinations using the formula
  - Find the number of subsets of a set

Chapter 9: Probability

9.1 Introduction to Probability

- Sample Spaces and Events
  - Determine the sample space of an experiment
  - Determine an event of an experiment
- Fundamentals of Probability
  - Compute the probability of equally likely outcomes
  - Compute the probability of equally likely outcomes in application
• Probability with Permutations and Combinations
  • Compute probability involving permutations
  • Compute probability involving combinations
• The Complement Rule and Probability
  • Use the complement rule to compute probabilities
  • Compute the probability of an event happening at least once
• Odds and Expected Value
  • Compute the expected value of an event
  • Compute odds using probability

9.2 Conditional Probability and Independent Events
• Independent Events
  • Compute the probability of the union of two events
  • Compute the probability of two independent events occurring
• Dependent Events and Conditional Probability
  • Compute the conditional probability of a dependent event occurring
  • Compute the probability of two or more dependent events occurring

9.3 Binomial Probability
• Binomial Experiments
  • Identify a binomial experiment
  • Determine the binomial probability of success in an experiment performed multiple times
  • Calculate expected value for binomial probability

9.4 Bayes' Theorem
• Bayes' Theorem
  • Apply Bayes' theorem to solve an application problem

9.5 Random Variables, Probability Distributions and Expected Value
• Random Variables, Probability Distributions, and Expected Value
  • Calculate probability distribution
  • Calculate the expected value of a random variable

Chapter 10: Statistics
10.1 Sampling, Frequency Distributions, and Graphs
• Sampling and Parameters
  • Understand the definitions of population, sampling, statistic, parameter, and data
  • Identify stratified, cluster, systematic, and convenience sampling
  • Identify sampling errors and bias
  • Identify situations in which statistics can be misleading
• Frequency Distributions and Histograms
  • Construct and understand frequency tables for a set of data
  • Create and interpret histograms
  • Create and interpret stem-and-leaf plots
10.2 Measures of Central Tendency and Measures of Dispersion

- **Means and Medians**
  - Find the mean of a set of data
  - Find the mean from a frequency table
  - Find the median of a set of data

- **Modes, Midranges, and Choosing a Measurement**
  - Find the mode of a set of data
  - Find the midrange of a set of data
  - Determine whether the mean, median, or mode is the best measure of center for a data set

- **Standard Deviation**
  - Compute the sample variance and sample standard deviation
  - Interpret the standard deviation of a set of data

10.3 The Normal Distribution, Margins of Error, and Skewness

- **The Normal Distribution**
  - Understand the notation and interpret the parameters of a normal distribution
  - Compute z-scores and use them to compare values from different data sets
  - Determine if a data set is skewed

- **Percentiles, Quartiles, and Margins of Error**
  - Find and interpret percentiles and quartiles of a data set
  - Calculate and interpret margin of error

- **Problem Solving with the Normal Distribution**
  - Standardize a normally distributed random variable
  - Calculate the mean and standard deviation of a standard normal distribution

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**Chapter 11: Nonlinear Functions**

11.1 Properties of Functions

- **Functions and Function Notation**
  - Identify domain and range from a set of ordered pairs
  - Determine whether a relation represents a function

- **Relations and Functions**
  - Determine whether a function is one-to-one
  - Use the vertical line test to identify functions
  - Use the horizontal line test to identify one-to-one functions
11.2 Quadratic Functions

- Characteristics of Parabolas
  - Determine axis of symmetry and vertex of parabolas from a graph
  - Determine x- and y-intercepts of parabolas from a graph

- Graphs of Quadratic Functions
  - Find the direction a parabola opens and its axis of symmetry and vertex from the general form of its equation
  - Identify the axis of symmetry and vertex of a parabola from its equation in standard form
  - Write the equation of a quadratic function given vertex and a point on a graph
  - Write the equation of a quadratic function given intercepts on a graph
  - Write the equation of a quadratic function in standard form given the equation in general form

- Applications of Quadratic Functions
  - Find the domain and range of a quadratic function
  - Determine the maximum and minimum values of quadratic functions
  - Find the x- and y-intercepts of a quadratic function

11.3 Transformations of Functions

- Transformations of Functions
  - Graph functions using vertical and horizontal shifts
  - Graph functions using reflections about the x-axis and the y-axis
  - Graph functions using compressions and stretches
  - Combine transformations

11.4 Polynomial and Rational Functions

- Polynomial Functions
  - Identify power functions and polynomial functions
  - Graph polynomial functions
  - Write a formula for a polynomial function from a graph
  - Determine equation of a polynomial given key information

- Asymptotic Behavior of Rational Functions
  - Use arrow notation to describe local behavior and end behavior of rational functions
  - Identify vertical asymptotes and removable discontinuities of rational functions
  - Identify horizontal and slant asymptotes of rational functions

- Graphs and Applications of Rational Functions
  - Find the intercepts of a rational function
  - Graph rational functions
  - Find the equation of a rational function from a graph
11.5 Exponential and Logarithmic Functions

- Identify and Evaluate Exponential Functions
  - Identify exponential functions
  - Evaluate exponential functions
  - Calculate continuous growth and decay

- Graphing Exponential Functions
  - Graph exponential functions
  - Graph exponential functions using transformations

- Relate Logarithms and Exponents
  - Convert from logarithmic to exponential form
  - Convert from exponential to logarithmic form

- Evaluate Logarithmic Expressions
  - Evaluate logarithms with positive integer solutions
  - Evaluate logarithms with negative integer solutions
  - Use common logarithms
  - Use natural logarithms

- Basic Properties of Logarithms
  - Understand the basic properties of logarithms
  - Use the product rule for logarithms
  - Use the quotient rule for logarithms
  - Use the power rule for logarithms

- Solve Logarithmic Equations
  - Use the definition of a logarithm to solve logarithmic equations
  - Use logarithm properties and the definition of the logarithm to solve logarithmic equations
  - Use the one-to-one property of logarithms to solve logarithmic equations

- Applications of Exponential and Logarithmic Functions
  - Model exponential growth
  - Model exponential decay
  - Applied logarithmic models
  - Choose an appropriate model for data
  - Express an exponential model in base e

Chapter 12: Markov Chains

12.1 Properties of Markov Chains

- Transitions
  - Identify transition diagrams and transition matrices
  - Create a transition diagram and matrix for a given word problem
- States
  - Find the second state of a system given a transition matrix and initial state
  - Find powers of a transition matrix
  - Solve application problems using powers of transition matrices

12.2 Regular Markov Chains
- Regular Transition Matrices and Stationary Matrices
  - Determine if a transition matrix is regular
  - Find a stationary matrix for a given transition matrix
  - Solve application problems using stationary matrices

12.3 Absorbing Markov Chains
- Absorbing States
  - Find absorbing states given a transition matrix
  - Determine if a transition matrix is for an absorbing Markov chain
  - Write a transition matrix in standard form
- Limiting Matrix
  - Find the limiting matrix for an absorbing Markov chain