



Algebra and Trigonometry

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Alta Algebra and Trigonometry combines material from our algebra and trigonometry courses, and was developed to allow for more flexible curricula in a variety of math programs. To develop the course, Knewton used three three sources of content: Openstax, videos created by a Math Professor we have partnered with, and a team of Subject Matter Experts (SMEs). The SMEs come from diverse backgrounds and are all accomplished academics in the field of Trigonometry.

Alta Algebra and Trigonometry has two instructional sequences for every learning objective, giving students multiple opportunities to learn new concepts. Between our OpenStax, Video, and Knewton SMEs, we were able to solicit ideas from math instructors and students at all levels of higher education. Alta Algebra and Trigonometry covers the typical breadth of trigonometry and algebra topics and also provides the necessary depth to ensure the course is manageable and engaging for instructors and students alike.

Algebra and Trigonometry | Table of Contents

Chapter 1: Prerequisites

1.1 Algebra Essentials

- Set Operations and Venn Diagrams
 - Represent a set using a written description and the roster method
 - Identify subsets, universal sets, and empty sets
 - Illustrate two sets using a Venn diagram and set notation
- Set Operations
 - Determine the complement of a set using Venn diagrams or set notation
 - Determine the intersection of two sets using Venn diagrams and set notation
 - Determine the union of two sets using Venn diagrams or set notation
 - Perform operations on sets
- 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 inverse and identity properties of real numbers
 - Use the commutative, associative, and distributive properties of real numbers
- 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
- Evaluate and Simplify Absolute Value Expressions
 - Understand absolute value and evaluate absolute value expressions with the order of operations
 - Evaluate algebraic expressions involving absolute value

1.2 Exponents and Scientific Notation

- Product, Quotient, and Power Properties of Exponents
 - Understand exponent notation
 - Use the product rule of exponents
 - Use the quotient rule of exponents
 - Use the power rule of exponents
- Negative Exponents and Simplifying Exponential Expressions
 - Use the negative and zero exponent rule
 - Find the power of a product
 - Find the power of a quotient
 - Simplify exponential expressions
- Scientific Notation
 - Convert between standard and scientific notation
 - Multiply and divide numbers in scientific notation

1.3 Radicals and Rational Exponents

- Simplify Radicals
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 - Use the quotient rule to simplify square roots
- Operations with Radicals
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 - Rationalize denominators with a monomial denominator
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- Properties of Polynomials
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 - Identify monomials, binomials, and trinomials
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- Factor Quadratics
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 - Multiply rational expressions
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Chapter 2: Equations and Inequalities

2.1 The Rectangular Coordinate Systems and Graphs

- Cartesian Coordinates and Distances
 - Plot ordered pairs in a Cartesian coordinate system
 - Graph equations by plotting points
 - Use the distance formula, given two points
 - Use the midpoint formula

2.2 Linear and Rational Equations in One Variable

- Solve Linear Equations in One Variable
 - 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
- Solve Rational Equations
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 - Solve a rational equation, binomials in denominator
 - Solve a rational equation, requires factoring to find least common denominator
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 - Understand the relationship between the slope and y-intercept of a line and its equation
 - Find x -intercepts and y -intercepts
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 - Use a formula to solve a real-world application
 - Problem Solving
 - Solve simple interest applications
 - Solve a formula for a specified variable
 - Use a formula to solve a geometric application
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 - Use interval notation
 - Use properties of inequalities
 - Solve simple inequalities in one variable algebraically
 - Solve compound inequalities in one variable algebraically
 - Absolute Value Equations and Inequalities
 - Solve absolute value equations
 - Solve absolute value inequalities
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- Applications with Linear Inequalities
 - Translate words to an inequality and solve applications with linear inequalities
 - Solve applications with compound inequalities
 - Solve applications with absolute value

2.8 Inequalities Requiring Factoring

- Rational and Quadratic Inequalities
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Chapter 3: Functions

3.1 Functions and Function Notation

- Relations and Functions
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 - Determine whether a relation represents a function
 - Use the vertical line test to identify functions
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 - Determine whether a function is one-to-one
 - Use the horizontal line test to identify one-to-one functions
- Function Notation
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 - Solve a function using function notation
 - Evaluate or solve a function from a table
 - Evaluate or solve a function from a graph

3.2 Absolute Value Functions and Other Toolkit Functions

- Graph Absolute Value Functions
 - Graph an absolute value function
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- Domain and Range of Functions
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3.4 Rates of Change and Behavior of Graphs

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 - Given table of values of a function, find value of inverse function
- Find Inverse Functions
 - Verify inverse function pairs algebraically
 - Determine the domain and range of an inverse function, and restrict the domain of a function to make it one-to-one
 - Given function, find the inverse function
 - Use the graph of a one-to-one function to graph its inverse function on the same axes

3.8 Circles

- Graphs of Circles
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Chapter 4: Linear Functions and Modeling

4.1 Linear Functions

- Interpretations of Linear Functions
 - Represent a linear function in table form
 - Determine whether a linear function is increasing, decreasing, or constant
 - Interpret slope as a rate of change
-

- Represent a real-world application as a linear function
- Graph linear functions

4.2 Modeling with Linear Functions

- Application of Linear Functions
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 - Build linear models from verbal descriptions, given inputs and outputs
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 - Model a set of data with a linear function

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- Scatter Diagrams and Lines of Best Fit
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Chapter 5: Polynomial and Rational Functions

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 - Determine x- and y-intercepts of parabolas from a graph
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 - 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
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- Quadratic Regressions
 - Find the parabola of best fit using a graphing utility
 - Use the parabola of best fit to make predictions

5.2 Graphs of Polynomial and Power Functions

- End Behavior of Polynomial Functions
 - Identify power functions and polynomial functions
 - Identify if a graph is a polynomial function
 - Determine end behavior
 - Local Behavior of Polynomial Functions
 - Identify intercepts of polynomial functions in factored form
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- Understand the relationship between degree, turning points, and x-intercepts
- Understand the intermediate value theorem
- Use factoring to find zeros of polynomial functions
- Identify zeros and their multiplicities from an equation or a graph
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- Long Division of Polynomials
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- Inverses of Polynomial Functions
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-

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Chapter 6: Exponential and Logarithmic Functions

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 - Calculate continuous growth and decay

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 - Convert from exponential to logarithmic form
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- Logarithmic Function Graphs
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-

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 - Condense logarithmic expressions
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 - Build a logarithmic model from data using a graphing utility
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 - Build a logistic model from data using a graphing utility

Chapter 7: Right Triangle Trigonometry and the Unit Circle

7.1 Angles as Rotations and Arc Length

- Angles as Rotations and Radian Measures
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 - Convert between degree and radian measure of an angle
 - Understand when two angles are coterminal
- Arc Length and Area of a Sector
 - Find the length of an arc
 - Find the area of a sector
 - Understand the relationship between linear and angular speed

7.2 Right Triangle Trigonometry

- The Six Trigonometric Ratios
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-

- Evaluate reciprocal trig functions using right triangles or a sine, cosine, or tangent function
- Evaluate trigonometric functions of angles not in standard position
- Use Right Triangle Trigonometry in Solving Problems
 - Find missing side lengths using trig ratios
 - Use right triangle trigonometry to solve applied problems

7.3 The Unit Circle

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- Sine and Cosine Values with Reference Angles
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 - Use reference angles to find coordinates on the unit circle
 - Evaluate sine and cosine functions with a calculator

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 - Evaluate composite functions with inverse trigonometric functions in the form $f^{-1}(f(x))$ or $f^{-1}(g(x))$

Chapter 9: Trigonometric Identities and Equations

9.1 Fundamental Trigonometric Identities

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- Use double-angle formulas to simplify trigonometric expressions
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 - Use Cramer's rule to solve inconsistent or dependent systems

11.9 Linear Programming

- Using Linear Programming
 - Graph a feasible region given a set of constraints
 - Find the maximum value of an objective function given constraints by graphing
 - Solve application problems using linear programming

Chapter 12: Conic Sections

12.1 Ellipses

- Ellipses Centered at the Origin
 - Identify key points and axes of ellipses from a graph
 - Identify key points and axes of ellipses from an equation
 - Write the equation in standard form of an ellipse centered at the origin
 - Graph an ellipse centered at the origin from an equation in standard form
- Ellipses Not Centered at the Origin
 - Identify key points and axes of ellipses not centered at the origin
 - Write the equation in standard form of an ellipse not centered at the origin
 - Graph an ellipse not centered at the origin
- Ellipses Not in Standard Form and Applications of Ellipses
 - Convert an equation of an ellipse into standard form
 - Graph an ellipse where the equation is not given in standard form
 - Use ellipses in applications

12.2 Hyperbolas

- Hyperbolas Centered at the Origin
 - Locate the vertices and foci of a hyperbola from a graph
 - Identify vertices, foci, and asymptotes of a hyperbola from an equation
 - Write the equation of a hyperbola centered at the origin in standard form
 - Graph a hyperbola centered at the origin from an equation in standard form
- Hyperbolas Not Centered at the Origin
 - Identify vertices, foci, and asymptotes of a hyperbola not centered at the origin
 - Write the equation of a hyperbola not centered at the origin
 - Graph a hyperbola not centered at the origin from an equation in standard form
- Hyperbolas Not in Standard Form and Applications of Hyperbolas
 - Convert an equation of a hyperbola into standard form
 - Graph a hyperbola from an equation given in general form
 - Use hyperbolas in applications

12.3 Parabolas

- Parabolas Centered at the Origin
 - Identify key components of a parabola from a graph
 - Identify key components of a parabola from an equation
 - Graph a parabola centered at the origin
 - Write the equation of a parabola centered at the origin in standard form
 - Parabolas Not Centered at the Origin
 - Identify key components of a parabola not centered at the origin
 - Graph a parabola not centered at the origin
 - Write the equation of a parabola not centered at the origin in standard form
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- Parabolas Not in Standard Form and Applications of Parabolas
 - Convert an equation of a parabola into standard form
 - Graph a parabola from an equation given in general form
 - Use parabolas in applications

12.4 Rotation of Axes

- Conics in General Form and Rotation of Conics
 - Identify a conic from its general form
 - Find the location of a point after a rotation of axes
 - Find a new representation of an equation after rotating through a given angle

12.5 Conic Sections in Polar Coordinates

- Conic Sections in Polar Coordinates
 - Identify the type of conic from its polar equation
 - Find the polar equation of a conic given its focus, eccentricity, and directrix

Chapter 13: Sequences, Probability, and Counting Theory

13.1 Sequences

- Introduction to Sequences
 - Write the terms of a sequence defined by an explicit formula
 - Write the terms of a sequence defined by a piecewise explicit formula
- Recursive Sequences
 - Write the terms of a sequence defined by a recursive formula
 - Write the terms of a sequence defined by a recursive formula with more than one initial term

13.2 Arithmetic Sequences

- Arithmetic Sequences
 - Find the common difference of an arithmetic sequence
 - Write terms of an arithmetic sequence
 - Write a recursive formula for an arithmetic sequence
 - Write an explicit formula for an arithmetic sequence
- Applications of Arithmetic Sequences
 - Find specific terms of an arithmetic sequence given other terms
 - Solve application problems with arithmetic sequences

13.3 Geometric Sequences

- 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 sequence
- Applications of Geometric Sequences
 - Write an explicit formula for the n th term of a sequence
 - Solve application problems with geometric sequences
 - Solve geometric sequence problems

13.4 Series

- Summation Notation and Arithmetic Series
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- Evaluate expressions using summation notation
- Find the sum of a finite arithmetic series
- Finite and Infinite Geometric Series
 - Find the sum of a finite geometric series
 - Determine if the sum of an infinite series is defined
 - Find the sum of an infinite geometric series
- Applications of Series
 - Solve application problems with arithmetic series
 - Solve application problems with geometric series
 - Find the equivalent fraction for a repeating decimal
 - Solve an annuity problem

13.5 Counting Theory

- The Addition and Multiplication Principles
 - Solve counting problems using the addition principle
 - Solve counting problems using the multiplication principle
 - Evaluate an expression with factorials
- Permutations
 - 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

13.6 Binomial Theorem

- Binomial Expansion
 - Find a binomial coefficient
 - Expand a binomial using the binomial theorem
 - Use the binomial theorem to find a single term

13.7 Probability

- Basic Probability
 - Compute the probability of equally likely outcomes
 - Compute the probability of the union of two events
 - Use the complement rule to compute probabilities
 - Compute probability using counting theory
 - Binomial Probability
 - Identify a binomial experiment
 - Determine the binomial probability of success in an experiment performed multiple times
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