

# Trigonometry



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|---------------|--|-------------|--------------------------------------|
| OpenStax      | Jay Abramson, Arizona State University | Precalculus | <a href="#">OpenStax</a>             |
| Mathispower4u | James Sousa                            |             | <a href="#">Mathispower4u Videos</a> |

Alta Trigonometry was developed to meet the scope and sequence of a typical one-semester trigonometry course. To develop the course, Knewton used three main 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 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 Trigonometry covers the typical breadth of trigonometry topics, and also provides the necessary depth to ensure the course is manageable and engaging for instructors and students alike.

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## Trigonometry | Table of Contents

### Chapter 1: Angles and Right Triangle Trigonometry

#### 1.1 Vocabulary of Angles and Triangles

- Types of Angles
  - Identify right, acute, obtuse, and straight angles
  - Understand supplementary and complementary angles
- Angles, Triangles, and the Pythagorean Theorem
  - Find the measures of angles of a triangle using properties
  - Use properties of similar triangles to solve for a missing side
  - Use the Pythagorean theorem

#### 1.2 Angles as Rotations and Arc Length

- Angles as Rotations and Radian Measures
  - Identify the measure of positive and negative angles in standard position and the quadrant of the terminal side
  - 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

#### 1.3 Right Triangle Trigonometry

- The Six Trigonometric Ratios
  - Use right triangles to evaluate sine, cosine, and tangent functions
  - 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

### Chapter 2: The Unit Circle

#### 2.1 Sine and Cosine in the First Quadrant

- Sine and Cosine Values in the First Quadrant
  - Understand sine and cosine values on the unit circle
  - Find exact sine and cosine values for angles in the first quadrant of the unit circle

#### 2.2 Reference Angles

- Sine and Cosine Values with Reference Angles
    - Find the reference angle for a given angle
    - Use reference angles to evaluate sine and cosine functions
    - Use reference angles to find coordinates on the unit circle
    - Evaluate sine and cosine functions with a calculator
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## 2.3 The Other Trigonometric Functions

- The Other Trigonometric Ratios on the Unit Circle
  - Find the secant, cosecant, tangent, and cotangent values for angles in the first quadrant of the unit circle
  - Use reference angles to evaluate secant, cosecant, tangent, and cotangent functions
  - Evaluate trigonometric functions with a calculator
- Use Given Trigonometric Ratios to Find Other Ratios
  - Understand the relationship between the quadrant in which an angle falls and the signs of the trig functions of that angle
  - Use the pythagorean identity
  - Find the values of all trigonometric functions given coordinates on a unit circle
  - Find the values of all trigonometric functions given the value of one trigonometric function

## Chapter 3: Periodic Functions

### 3.1 Sine and Cosine Graphs

- Characteristics of Sine and Cosine Graphs
  - Graph the sine function and understand its properties
  - Graph the cosine function and understand its properties
- Transformations of Sine and Cosine Graphs
  - Determine the period and amplitude of a sinusoidal function
  - Determine the phase shift and vertical shift of a sinusoidal function
- Graph Sine and Cosine Functions
  - Find the equation of a sinusoidal function given a graph
  - Find the graph of a sinusoidal function given equation (\*20)
  - Use sinusoidal functions to solve real-world applications

### 3.2 Graphs of Other Trigonometric Functions

- Characteristics of Tangent and Cotangent Graphs
    - Graph tangent functions
    - Graph cotangent functions
  - Transformations of Tangent and Cotangent Functions
    - Graph tangent or cotangent functions over different periods (\*21)
    - Graph transformations of tangent and cotangent functions
  - Characteristics of Secant and Cosecant Graphs
    - Graph cosecant functions
    - Graph secant functions
  - Transformations of Secant and Cosecant Functions
    - Graph transformations of cosecant functions (\*3)
    - Graph transformations of secant functions
    - Find the equation of a cosecant function from a graph
    - Find the equation of a secant function from a graph
-

### 3.3 Inverse Trigonometric Functions

- Introduction to Inverse Trigonometric Functions
  - Understand inverse sine, cosine, and tangent functions
  - Understand inverse sec, csc, and cot functions
  - Use a calculator to evaluate inverse trigonometric functions
- Solve Triangles with Inverse Trigonometric Functions
  - Find an angle given two sides of a right triangle
  - Solve right triangle problems
- Compose Functions with Inverse Trigonometric Functions
  - Evaluate composite functions with inverse trigonometric functions in the form  $f(f^{-1}(x))$  or  $f(g^{-1}(x))$
  - Evaluate composite functions with inverse trigonometric functions in the form  $f^{-1}(f(x))$  or  $f^{-1}(g(x))$

## Chapter 4: Trigonometric Identities and Equations

### 4.1 Fundamental Trigonometric Identities

- Simplify Expressions with Basic Trigonometric Identities
  - Understand quotient and reciprocal identities
  - Use even and odd identities in simplifying trigonometric expressions
- Use Pythagorean and Cofunction Identities
  - Understand all forms of the pythagorean identity
  - Use the cofunction identities
- Verify Trigonometric Identities
  - Use all identities to simplify trigonometric expressions
  - Use algebraic techniques to simplify trigonometric expressions

### 4.2 Sum and Difference Identities

- Sum and Difference Formulas
  - Use the sum and difference formula for cosine
  - Use the sum and difference formula for sine
  - Use the sum and difference formula for tangent
  - Use the sum and difference formulas to simplify trigonometric expressions

### 4.3 Double-Angle, Half-Angle, and Reduction Formulas

- Double-Angle Formulas
  - Use double-angle formulas to find values of trigonometric functions
  - Use double-angle formulas to simplify trigonometric expressions
- Half-Angle and Power-Reduction Formulas
  - Use reduction formulas to simplify an expression
  - Use half-angle formulas to find values of trigonometric functions

### 4.4 Sum-to-Product and Product-to-Sum Formulas

- Sum-to-Product and Product-to-Sum Formulas
    - Express the product of trigonometric functions as a sum
    - Express sums of trigonometric functions as a product
-

#### 4.5 Solving Trigonometric Equations

- Trigonometric Equations in Sine and Cosine
  - Solve linear trigonometric equations in sine
  - Solve linear trigonometric equations in cosine
- Trigonometric Equations Involving a Single Trigonometric Function
  - Solve linear trigonometric equations in secant and cosecant
  - Solve linear trigonometric equations in tangent and cotangent
  - Solve trigonometric equations using a calculator
- Trigonometric Equations in Quadratic Form or Requiring Factoring
  - Solve equations with a single trigonometric function
  - Solve factorable trigonometric equations in quadratic form
  - Solve trigonometric equations in quadratic form requiring the quadratic formula
- Trigonometric Equations Requiring Identities or Multiple Angles
  - Solve trigonometric equations using fundamental identities
  - Solve trigonometric equations with multiple angles
  - Solve trigonometric equations using cofunction identities

### Chapter 5: Further Applications of Trigonometry

#### 5.1 Non-right Triangles - Law of Sines

- Law of Sines
  - Use the law of sines to solve ASA or AAS triangles
  - Use the law of sines to solve SSA triangles
  - Solve applied problems with the law of sines

#### 5.2 Non-right Triangles - Law of Cosines and Area of Oblique Triangles

- Law of Cosines
  - Use the law of cosines to solve SAS triangles
  - Use the law of cosines to solve SSS triangles
  - Solve applied problems with the law of cosines
- Area of Oblique Triangles
  - Find the area of an oblique triangle using the sine function
  - Use Heron's formula to find the area of a triangle

#### 5.3 Polar Coordinates

- Convert Coordinates Between Rectangular and Polar Forms
    - Plot points using polar coordinates
    - Convert from polar coordinates to rectangular coordinates
    - Convert from rectangular coordinates to polar coordinates
  - Convert Equations Between Rectangular and Polar Forms
    - Write a cartesian equation in polar form
    - Write a polar equation in cartesian form
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#### 5.4 Graphs in Polar Coordinates

- Introductions to Graphing Polar Equations
  - Test a polar equation for symmetry
  - Find zeros and maximum values for a polar equation and graph polar equations by plotting points
  - Graph a circle or a line from a polar equation
- Graph Classic Polar Curves
  - Graph a cardioid from a polar equation
  - Graph a limaçon from a polar equation
  - Graph a lemniscate from a polar equation
  - Graph a rose curve from a polar equation

#### 5.5 Polar Form of Complex Numbers

- Write Complex Numbers in Polar Form
  - Plot complex numbers
  - Find the absolute value of a complex number
  - Write complex numbers in polar form
  - Convert a complex number from polar to rectangular form
- Product and Quotient of Complex Numbers in Polar Form
  - Find the product of complex numbers in polar form
  - Find the quotient of complex numbers in polar form
- Powers and Roots of Complex Numbers in Polar Form
  - Find powers of complex numbers in polar form
  - Find roots of complex numbers in polar form

#### 5.6 Parametric Equations

- Write Parametric Equations
  - Parameterize a curve
  - Find the parametric equations for a line segment given an orientation
- Eliminate the Parameter
  - Eliminate the parameter in linear equations
  - Eliminate the parameter in polynomial and radical equations
  - Eliminate the parameter in exponential and logarithmic equations
  - Eliminate the parameter in trigonometric parametric equations

#### 5.7 Graphs with Parametric Equations

- Graph Parametric Equations
  - Graph parametric equations by plotting points
  - Graph trigonometric parametric equations by plotting points
  - Use parametric equations in applications

#### 5.8 Vectors

- Properties of Vectors
    - Understand properties of vectors and find the position vector
    - Find magnitude and direction of a vector
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- Vector Additions and Scalar Multiplication
    - Add or subtract vectors (\*11)
    - Multiply a vector by a scalar
    - Use vector addition and scalar multiplication to find a new vector
  - The Unit Vector
    - Write a vector in terms of  $i$  and  $j$
    - Find the unit vector
    - Perform operations on vectors in terms of  $i$  and  $j$
    - Write a vector in terms of magnitude and direction (\*10)
  - The Dot Product and Vector Applications
    - Find the dot product of two vectors
    - Find the angle between two vectors
    - Use vectors in applications
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