

## TRIGONOMETRY

The trigonometry course offers students the opportunity to understand and learn concepts in the study of circular and trigonometric functions. The topics studied in this course as listed below are aligned to the State of New Hampshire Grade Span Expectations (GSEs) in mathematics at both the high school and advanced mathematics levels. The code numbers in parentheses after each unit indicate which strands of the GSEs are reflected in the unit.

### MAJOR CONCEPTS

**Trigonometric Functions**  
**Right Triangles**  
**Oblique Triangles and Vectors**  
**Radian Measure and Circular Functions**  
**Graphs of trigonometric functions**  
**Trigonometric identities**  
**Inverse trigonometric functions**

### TRIGONOMETRY CONTENT COMPETENCIES

Geometry and Measurement

Functions and Algebra

Numbers and Operations

1. Applies the concept of congruence by solving problems on or off the coordinate plane involving reflections, translations and rotations; or solves problems using congruency involving problems within mathematics across the curriculum.
2. Applies concepts of similarity to define the trigonometric functions as ratios of right triangles and uses the ratios of the sides of special triangles.
3. Applies the concepts of similarity by solving problems within mathematics and across the curriculum.
4. Applies trigonometric formulas to find angles, lengths and areas of polygons.
5. Derives and uses formulas of length of arcs and areas of sectors and segments of circles.
6. Used radian measure appropriately when solving problems and converts between radian measure and degree measure.
7. Solves problems on and off the coordinate plane.
8. Makes and defends conjectures, uses geometric properties, or uses theorems to solve problems.
9. Demonstrates conceptual understanding of linear and nonlinear functions and

- relations.
10. Solves equations and verifies/proves identities involving trigonometric expressions.
  11. Algebraically/geometrically interpret vectors, vector addition, and scalar multiplication.

**DISCIPLINE COURSE PROCESS COMPETENCIES**

1. Students will use mathematical reasoning and proof.
2. Students will communicate their understanding of mathematics.
3. Students will recognize and develop mathematical connections.

**Unit 1: Trigonometric Functions**

<b>Topics</b>	Functions and relations, Domain and Range, Introduction of trigonometric functions and ratios.
<b>Competencies</b>	<ol style="list-style-type: none"> <li>7. Solves problems on and off the coordinate plane.</li> <li>8. Makes and defends conjectures, uses geometric properties, or uses theorems to solve problems.</li> <li>9. Demonstrates conceptual understanding of linear and nonlinear functions and relations.</li> </ol>
<b>Knowledge/Skills</b>	<ul style="list-style-type: none"> <li>• Analyze relations and functions</li> <li>• Identify the domain and range of polynomial, quadratic, and rational functions</li> <li>• Draw angles in standard position</li> <li>• Identify types of angles and angle relationships</li> <li>• Convert angle measures between degrees/minutes/seconds and decimal degrees</li> <li>• Solve problems using angle relationships and similar triangles</li> <li>• Identify the six trigonometric functions and their value limits</li> <li>• Identify quadrantal angles and find their trigonometric function values</li> <li>• Identify coterminal angles</li> <li>• Memorize the fundamental identities: reciprocal, Pythagorean, quotient, and negative angle</li> <li>• Solve problems using fundamental trigonometric identities, including the reciprocal identities and the Pythagorean identities</li> </ul>

<b>Process Skills</b>	1. Students will use mathematical reasoning and proof.

### Unit 2: Right Triangles

<b>Topics</b>	Solving right triangles. Introduction to bearings.
<b>Competencies</b>	<ol style="list-style-type: none"> <li>Applies concepts of similarity to define the trigonometric functions as ratios of right triangles and uses the ratios of the sides of special triangles.</li> <li>Applies the concepts of similarity by solving problems within mathematics and across the curriculum.</li> </ol>
<b>Knowledge/Skills</b>	<ul style="list-style-type: none"> <li>Solve problems using the cofunction identities</li> <li>Know and use the <math>45^\circ - 45^\circ - 90^\circ</math> and <math>30^\circ - 60^\circ - 90^\circ</math> right triangle relationships to solve problems</li> <li>Use the trigonometric functions of special angles (<math>30^\circ</math>, <math>45^\circ</math>, <math>60^\circ</math>, <math>90^\circ</math>, etc.) and their coterminal angles to solve problems</li> <li>Use reference angles to find the values of the trigonometric functions for a given angle</li> <li>Use the trigonometric functions to solve right triangles</li> <li>Use the trigonometric functions to solve problems involving angles of depression, elevation and navigation problems.</li> <li>Find the values of trigonometric ratios and their inverses for acute angles in degrees with and without a calculator.</li> </ul>
<b>Process Skills</b>	1. Students will use mathematical reasoning and proof.

### Unit 3: Oblique Triangles and Vectors

<b>Topics</b>	Solving oblique triangles, Law of sines and law of cosines, Solving bearing problems.
<b>Competencies</b>	<ol style="list-style-type: none"> <li>Applies trigonometric formulas to find angles, lengths and areas of polygons.</li> <li>Algebraically/geometrically interpret vectors,</li> </ol>

	vector addition, and scalar multiplication
<b>Knowledge/Skills</b>	<ul style="list-style-type: none"> <li>• Solve oblique triangle problems using the law of sines and the law of cosines</li> <li>• Use the ambiguous case of the law of sines to solve oblique triangles where more than one solution exists</li> <li>• Use the law of sines and Heron's formula to calculate the area of oblique triangles</li> <li>• Find the sum, difference, and scalar multiples of two dimensional vectors</li> <li>• Find the vertical and horizontal components of vectors</li> <li>• Solve problems using vectors in physics and navigation problems</li> </ul>
<b>Process Skills</b>	<ol style="list-style-type: none"> <li>1. Students will use mathematical reasoning and proof.</li> <li>3. Students will recognize and develop mathematical connections.</li> </ol>
<b>Unit 4: Radian Measure and Circular Functions</b>	
<b>Topics</b>	Radian measure, Arc length, Linear and angular velocity, Area of sectors.
<b>Competencies</b>	<ol style="list-style-type: none"> <li>5. Derives and uses formulas of length of arcs and areas of sectors and segments of circles.</li> <li>6. Used radian measure appropriately when solving problems and converts between radian measure and degree measure.</li> </ol>
<b>Knowledge/Skills</b>	<p style="text-align: center;">M(CCR)-HS-1]</p> <ul style="list-style-type: none"> <li>• Convert angle measure between degrees and radians</li> <li>• Use central angle measures to find the arc length and sector area within a circle</li> <li>• Use the six trigonometric functions to identify the six circular functions</li> <li>• Find the values of trigonometric ratios and their inverses for acute angles in radians with and without a calculator</li> <li>• Know the relationship between the circular and</li> </ul>

	<p>triangular definitions of the six trigonometric functions</p> <ul style="list-style-type: none"> <li>• Memorize the six trigonometric function values for special angles and their coterminal angles in radians</li> <li>• Solve linear and angular velocity problems</li> </ul>
<b>Process Skills</b>	<ol style="list-style-type: none"> <li>1. Students will use mathematical reasoning and proof.</li> <li>2. Students will communicate their understanding of mathematics.</li> <li>3. Students will recognize and develop mathematical connections.</li> </ol>

### Unit 5: Graphs of trigonometric functions

<b>Topics</b>	Graphing trigonometric functions
<b>Competencies</b>	<ol style="list-style-type: none"> <li>1. Applies the concept of congruence by solving problems on or off the coordinate plane involving reflections, translations and rotations; or solves problems using congruency involving problems within mathematics across the curriculum.</li> <li>6. Used radian measure appropriately when solving problems and converts between radian measure and degree measure.</li> <li>9. Demonstrates conceptual understanding of linear and nonlinear functions and relations.</li> </ol>
<b>Knowledge/Skills</b>	<ul style="list-style-type: none"> <li>• Identify the domain and range of trigonometric functions</li> <li>• Identify the period, amplitude, vertical translation, and phase shift, when applicable, of a trigonometric function from an equation</li> <li>• Use reflection, translation, and dilation to graph trigonometric functions</li> <li>• Identify the period, amplitude, vertical translation, and phase shift, when applicable, of a trigonometric function from a graph</li> </ul>
<b>Process Skills</b>	<ol style="list-style-type: none"> <li>3. Students will recognize and develop mathematical connections.</li> </ol>

### Unit 6: Trigonometric identities

Unit 7: Inverse trigonometric functions	
<b>Topics</b>	Verifying identities, Sum and difference identities, double angle identities.
<b>Competencies</b>	10. Solves equations and verifies/proves identities involving trigonometric expressions.
<b>Knowledge/Skills</b>	<ul style="list-style-type: none"> <li>• Solve problems using the reciprocal identities and the Pythagorean identities</li> <li>• Verify trigonometric identities</li> <li>• Identify the sum and difference identities for cosine, sine, and tangent</li> <li>• Identify double angle identities for cosine, sine, and tangent</li> <li>• Use identities to simplify trigonometric expressions</li> <li>• Solve problems using identities</li> </ul>
<b>Process Skills</b>	<ol style="list-style-type: none"> <li>1. Students will use mathematical reasoning and proof.</li> <li>2. Students will communicate their understanding of mathematics.</li> <li>3. Students will recognize and develop mathematical connections.</li> </ol>
Unit 7: Inverse trigonometric functions	
<b>Topics</b>	Inverse trigonometric functions, Solving trigonometric equations.
<b>Competencies</b>	<ol style="list-style-type: none"> <li>9. Demonstrates conceptual understanding of linear and nonlinear functions and relations.</li> <li>10. Solves equations and verifies/proves identities involving trigonometric expressions.</li> </ol>
<b>Knowledge/Skills</b>	<ul style="list-style-type: none"> <li>• Determine whether a function is one-to-one</li> <li>• Find the inverse of a one-to-one function</li> <li>• Identify the domains and ranges of the inverse trigonometric functions</li> <li>• Find the value of an inverse trigonometric function in radian measure and degrees</li> <li>• Solve trigonometric equations</li> <li>• Solve trigonometric equations with multiple angles</li> </ul>
	<ol style="list-style-type: none"> <li>1. Students will use mathematical reasoning and</li> </ol>

<b>Process Skills</b>	proof. 2. Students will communicate their understanding of mathematics.
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