

Virginia High School Math
Content standards

Standards of Learning 2009	Boardworks Precalculus and Trigonometry presentations
Mathematical Analysis	
MA.1 The student will investigate and identify the characteristics of polynomial and rational functions and use these to sketch the graphs of the functions. This will include determining zeros, upper and lower bounds, y-intercepts, symmetry, asymptotes, intervals for which the function is increasing or decreasing, and maximum or minimum points. Graphing utilities will be used to investigate and verify these characteristics.	Plotting and sketching graphs Even, odd and periodic functions Graphs of quadratic functions Transforming functions part 1 Transforming functions part 2 Polynomials of degree 3 or more Graphs of important non-linear functions Graphing rational functions
MA.2 The student will apply compositions of functions and inverses of functions to real-world situations. Analytical methods and graphing utilities will be used to investigate and verify the domain and range of resulting functions.	Domain, range and composite functions Inverse functions The inverse trigonometric functions Exponentials and logarithms Exponential growth and decay
MA.3 The student will investigate and describe the continuity of functions, using graphs and algebraic methods.	Trigonometric graphs and exact values Limits Piecewise-defined functions Plotting and sketching graphs Graphing rational functions Graphs of important non-linear functions
MA.4 The student will expand binomials having positive integral exponents through the use of the Binomial Theorem, the formula for combinations, and Pascal's Triangle.	–
MA.5 The student will find the sum (sigma notation included) of finite and infinite convergent series, which will lead to an intuitive approach to a limit.	The sum of an arithmetic series The sum of a geometric series
MA.6 The student will use mathematical induction to prove formulas and mathematical statements.	–
MA.7 The student will find the limit of an algebraic function, if it exists, as the variable approaches either a finite number or infinity. A graphing utility will be used to verify intuitive reasoning, algebraic methods, and numerical substitution.	Limits Piecewise-defined functions Graphing rational functions

<p>MA.8 The student will investigate and identify the characteristics of conic section equations in (h, k) and standard forms. Transformations in the coordinate plane will be used to graph conic sections.</p>	<p>The equation of a circle Parametric equations of curves Conic sections part 1 Conic sections part 2</p>
<p>MA.9 The student will investigate and identify the characteristics of exponential and logarithmic functions in order to graph these functions and solve equations and real-world problems. This will include the role of e, natural and common logarithms, laws of exponents and logarithms, and the solution of logarithmic and exponential equations.</p>	<p>The laws of logarithms Solving equations involving logarithms Exponentials and logarithms Exponential growth and decay Exponentials with bases other than e Linear and exponential modeling Using graphing calculators in applications Solving quadratic equations</p>
<p>MA.10 The student will investigate and identify the characteristics of the graphs of polar equations, using graphing utilities. This will include classification of polar equations, the effects of changes in the parameters in polar equations, conversion of complex numbers from rectangular form to polar form and vice versa, and the intersection of the graphs of polar equations.</p>	<p>Polar coordinates</p>
<p>MA.11 The student will perform operations with vectors in the coordinate plane and solve real-world problems, using vectors. This will include the following topics: operations of addition, subtraction, scalar multiplication, and inner (dot) product; norm of a vector; unit vector; graphing; properties; simple proofs; complex numbers (as vectors); and perpendicular components.</p>	<p>Vectors in two and three dimensions The magnitude of a vector Adding and subtracting vectors Position vectors and coordinate geometry Vector arithmetic Using vectors The dot product The vector equation of a line Intersecting lines The intersection of a line and a plane Questions on vectors</p>
<p>MA.12 The student will use parametric equations to model and solve application problems.</p>	<p>Parametric functions Parametric equations of curves Questions on vectors</p>

<p>MA.13 The student will identify, create, and solve real-world problems involving triangles. Techniques will include using the trigonometric functions, the Pythagorean Theorem, the Law of Sines, and the Law of Cosines.</p>	<p>The sine, cosine and tangent of any angle Transforming trigonometric functions The law of sines and the area of a triangle The law of cosines Degrees and radians Solving equations using radians The inverse trigonometric functions 3–D trigonometry Questions on trigonometry</p>
<p>MA.14 The student will use matrices to organize data and will add and subtract matrices, multiply matrices, multiply matrices by a scalar, and use matrices to solve systems of equations.</p>	<p>–</p>
Trigonometry	
<p>T.1 The student, given a point other than the origin on the terminal side of an angle, will use the definitions of the six trigonometric functions to find the sine, cosine, tangent, cotangent, secant, and cosecant of the angle in standard position. Trigonometric functions defined on the unit circle will be related to trigonometric functions defined in right triangles.</p>	<p>The sine, cosine and tangent of any angle Trigonometric graphs and exact values Trigonometric equations Trigonometric identities The inverse trigonometric functions The reciprocal trigonometric functions Trigonometric identities using reciprocal functions Questions on trigonometry 3–D trigonometry</p>
<p>T.2 The student, given the value of one trigonometric function, will find the values of the other trigonometric functions, using the definitions and properties of the trigonometric functions.</p>	<p>The sine, cosine and tangent of any angle Trigonometric graphs and exact values Trigonometric identities The inverse trigonometric functions The reciprocal trigonometric functions Trigonometric identities using reciprocal functions Questions on trigonometry</p>
<p>T.3 The student will find, without the aid of a calculator, the values of the trigonometric functions of the special angles and their related angles as found in the unit circle. This will include converting angle measures from radians to degrees and vice versa.</p>	<p>The sine, cosine and tangent of any angle Trigonometric graphs and exact values Trigonometric equations Trigonometric identities The reciprocal trigonometric functions Degrees and radians Solving equations using radians</p>

T.4 The student will find, with the aid of a calculator, the value of any trigonometric function and inverse trigonometric function.	<p>The sine, cosine and tangent of any angle Trigonometric graphs and exact values Trigonometric equations Trigonometric identities The law of sines and the area of a triangle The law of cosines Degrees and radians Solving equations using radians The inverse trigonometric functions The reciprocal trigonometric functions Trigonometric identities using reciprocal functions The addition formulas The double angle formulas 3–D trigonometry Questions on trigonometry</p>
T.5 The student will verify basic trigonometric identities and make substitutions, using the basic identities.	<p>The sine, cosine and tangent of any angle Trigonometric identities The double angle formulas Questions on trigonometry The reciprocal trigonometric functions Trigonometric identities using reciprocal functions Parametric functions</p>
T.6 The student, given one of the six trigonometric functions in standard form, will	
a) state the domain and the range of the function;	<p>Trigonometric graphs and exact values The reciprocal trigonometric functions</p>
b) determine the amplitude, period, phase shift, vertical shift, and asymptotes;	<p>Trigonometric graphs and exact values Transforming trigonometric functions The reciprocal trigonometric functions</p>
c) sketch the graph of the function by using transformations for at least a two-period interval; and	<p>Trigonometric graphs and exact values The reciprocal trigonometric functions Transforming trigonometric functions</p>
d) investigate the effect of changing the parameters in a trigonometric function on the graph of the function.	<p>Transforming trigonometric functions Transforming functions part 1</p>

T.7 The student will identify the domain and range of the inverse trigonometric functions and recognize the graphs of these functions. Restrictions on the domains of the inverse trigonometric functions will be included.	The inverse trigonometric functions
T.8 The student will solve trigonometric equations that include both infinite solutions and restricted domain solutions and solve basic trigonometric inequalities.	The sine, cosine and tangent of any angle Trigonometric equations Trigonometric identities Degrees and radians Solving equations using radians The inverse trigonometric functions The addition formulas The double angle formulas Questions on trigonometry 3D trigonometry
T.9 The student will identify, create, and solve real-world problems involving triangles. Techniques will include using the trigonometric functions, the Pythagorean Theorem, the Law of Sines, and the Law of Cosines.	The sine, cosine and tangent of any angle Transforming trigonometric functions The law of sines and the area of a triangle The law of cosines Degrees and radians Solving equations using radians The inverse trigonometric functions 3-D trigonometry Questions on trigonometry

Standards of Learning 2001	Boardworks Precalculus and Trigonometry presentations
Mathematical Analysis	
MA.1 The student will investigate and identify the characteristics of polynomial and rational functions and use these to sketch the graphs of the functions. This will include determining zeros, upper and lower bounds, y-intercepts, symmetry, asymptotes, intervals for which the function is increasing or decreasing, and maximum or minimum points. Graphing utilities will be used to investigate and verify these characteristics.	Plotting and sketching graphs Even, odd and periodic functions Graphs of quadratic functions Transforming functions part 1 Transforming functions part 2 Polynomials of degree 3 or more Graphs of important non-linear functions Graphing rational functions

<p>MA.2 The student will find compositions of functions and inverses of functions. Analytical methods and graphing utilities will be used to investigate and verify the domain and range of resulting functions.</p>	<p>Domain, range and composite functions Inverse functions The inverse trigonometric functions Exponentials and logarithms Exponential growth and decay</p>
<p>MA.3 The student will investigate and describe the continuity of functions, using graphs. The functions will include absolute value, piecewise, and step functions.</p>	<p>Trigonometric graphs and exact values Limits Piecewise-defined functions Plotting and sketching graphs Graphing rational functions Graphs of important non-linear functions Absolute value functions</p>
<p>MA.4 The student will expand binomials having positive integral exponents through the use of the Binomial Theorem, the formula for combinations, and Pascal's Triangle.</p>	<p>–</p>
<p>MA.5 The student will solve practical problems involving arithmetic and geometric sequences and series. This will include finding the sum (sigma notation included) of finite and infinite convergent series that will lead to an intuitive approach to a limit.</p>	<p>Sequences Arithmetic sequences Geometric sequences Quadratic sequences part 1 Quadratic sequences part 2 Other types of sequences The sum of an arithmetic series The sum of a geometric series Linear and exponential modeling</p>
<p>MA.6 The student will use mathematical induction to prove formulas/statements.</p>	<p>–</p>
<p>MA.7 The student will find the limit of an algebraic function, if it exists, as the variable approaches either a finite number or infinity. A graphing utility will be used to verify intuitive reasoning, algebraic methods, and numerical substitution.</p>	<p>Limits Piecewise-defined functions Graphing rational functions</p>
<p>MA.8 The student will investigate and identify the characteristics of conic section equations in (h, k) and standard forms. The techniques of translation and rotation of axes in the coordinate plane will be used to graph conic sections.</p>	<p>The equation of a circle Parametric equations of curves Conic sections part 1 Conic sections part 2</p>

<p>MA.9 The student will investigate and identify the characteristics of exponential and logarithmic functions in order to graph these functions and solve equations and practical problems. This will include the role of e, natural and common logarithms, laws of exponents and logarithms, and the solution of logarithmic and exponential equations. Graphing utilities will be used to investigate and verify the graphs and solutions.</p>	<p>The laws of logarithms Solving equations involving logarithms Exponentials and logarithms Exponential growth and decay Exponentials with bases other than e Linear and exponential modeling Using graphing calculators in applications Solving quadratic equations</p>
<p>MA.10 The student will investigate and identify the characteristics of the graphs of polar equations, using graphing utilities. This will include classification of polar equations, the effects of changes in the parameters in polar equations, conversion of complex numbers from rectangular form to polar form and vice versa, and the intersection of the graphs of polar equations.</p>	<p>Polar coordinates</p>
<p>MA.11 The student will perform operations with vectors in the coordinate plane and solve practical problems using vectors. This will include the following topics: operations of addition, subtraction, scalar multiplication, and inner (dot) product; norm of a vector; unit vector; graphing; properties; simple proofs; complex numbers (as vectors); and perpendicular components.</p>	<p>Vectors in two and three dimensions The magnitude of a vector Adding and subtracting vectors Position vectors and coordinate geometry Vector arithmetic Using vectors The dot product The vector equation of a line Intersecting lines The intersection of a line and a plane Questions on vectors</p>
<p>MA.12 The student will use parametric equations to model and solve application problems. Graphing utilities will be used to develop an understanding of the graph of parametric equations.</p>	<p>Parametric functions Parametric equations of curves Questions on vectors</p>
<p>MA.13 The student will identify, create, and solve practical problems involving triangles. Techniques will include using the trigonometric functions, the Pythagorean Theorem, the Law of Sines, and the Law of Cosines.</p>	<p>The sine, cosine and tangent of any angle Transforming trigonometric functions The law of sines and the area of a triangle The law of cosines Degrees and radians Solving equations using radians The inverse trigonometric functions 3-D trigonometry Questions on trigonometry</p>

Trigonometry	
<p>T.1 The student will use the definitions of the six trigonometric functions to find the sine, cosine, tangent, cotangent, secant, and cosecant of an angle in standard position, given a point, other than the origin, on the terminal side of the angle. Circular function definitions will be connected with trigonometric function definitions.</p>	<p>The sine, cosine and tangent of any angle Trigonometric graphs and exact values Trigonometric equations Trigonometric identities The inverse trigonometric functions The reciprocal trigonometric functions Trigonometric identities using reciprocal functions Degrees and radians Solving equations using radians Questions on trigonometry 3-D trigonometry</p>
<p>T.2 The student, given the value of one trigonometric function, will find the values of the other trigonometric functions. Properties of the unit circle and definitions of circular functions will be applied.</p>	<p>The sine, cosine and tangent of any angle Trigonometric graphs and exact values Trigonometric identities The inverse trigonometric functions The reciprocal trigonometric functions Trigonometric identities using reciprocal functions Degrees and radians Solving equations using radians Questions on trigonometry</p>
<p>T.3 The student will find without the aid of a calculating utility the values of the trigonometric functions of the special angles and their related angles as found in the unit circle. This will include converting radians to degrees and vice versa.</p>	<p>The sine, cosine and tangent of any angle Trigonometric graphs and exact values Trigonometric equations Trigonometric identities The reciprocal trigonometric functions Degrees and radians Solving equations using radians</p>

T.4 The student will find with the aid of a calculator the value of any trigonometric function and inverse trigonometric function.	<p>The sine, cosine and tangent of any angle Trigonometric graphs and exact values Trigonometric equations Trigonometric identities The law of sines and the area of a triangle The law of cosines Degrees and radians Solving equations using radians The inverse trigonometric functions The reciprocal trigonometric functions Trigonometric identities using reciprocal functions The addition formulas The double angle formulas 3–D trigonometry Questions on trigonometry</p>
T.5 The student will verify basic trigonometric identities and make substitutions, using the basic identities.	<p>The sine, cosine and tangent of any angle Trigonometric identities The double angle formulas The reciprocal trigonometric functions Trigonometric identities using reciprocal functions Questions on trigonometry Parametric functions</p>
T.6 The student, given one of the six trigonometric functions in standard form [e.g., $y = A \sin (Bx + C) + D$, where A, B, C, and D are real numbers], will	
a) state the domain and the range of the function;	<p>Trigonometric graphs and exact values The reciprocal trigonometric functions</p>
b) determine the amplitude, period, phase shift, and vertical shift; and	<p>Trigonometric graphs and exact values Transforming trigonometric functions The reciprocal trigonometric functions</p>
c) sketch the graph of the function by using transformations for at least a one-period interval.	<p>Trigonometric graphs and exact values The reciprocal trigonometric functions Transforming trigonometric functions</p>
The graphing calculator will be used to investigate the effect of changing A, B, C, and D on the graph of a trigonometric function.	<p>Transforming trigonometric functions Transforming functions part 1 Using graphing calculators in applications</p>

<p>T.7 The student will identify the domain and range of the inverse trigonometric functions and recognize the graphs of these functions. Restrictions on the domains of the inverse trigonometric functions will be included.</p>	<p>The inverse trigonometric functions</p>
<p>T.8 The student will solve trigonometric equations that include both infinite solutions and restricted domain solutions and solve basic trigonometric inequalities. Graphing utilities will be used to solve equations, check for reasonableness of results, and verify algebraic solutions.</p>	<p>The sine, cosine and tangent of any angle Trigonometric equations Trigonometric identities Degrees and radians Solving equations using radians The inverse trigonometric functions The addition formulas The double angle formulas 3-D trigonometry Questions on trigonometry</p>
<p>T.9 The student will identify, create, and solve practical problems involving triangles. Techniques will include using the trigonometric functions, the Pythagorean Theorem, the Law of Sines, and the Law of Cosines.</p>	<p>The sine, cosine and tangent of any angle Transforming trigonometric functions The law of sines and the area of a triangle The law of cosines Degrees and radians Solving equations using radians The inverse trigonometric functions Questions on trigonometry 3-D trigonometry</p>