Mathematics Standard
Catalina Foothills School District
High School: Honors Algebra 2

Honors Algebra 2 with Trigonometry explores advanced algebraic concepts at a more extensive breadth, depth, and pace than in Algebra 2. Trigonometry concepts are introduced and developed. Each topic is studied with emphasis on conceptual understanding, graphical representation and applications through the creation of mathematical models. This rigorous course is designed to prepare students who excel in mathematics for future Honors and AP courses.

Standard for Honors Algebra 2 by Unit and Measurement Topic

UNITS 1 & 2: FUNCTIONS	
Functions: Building Functions (F-BF)	
HS.F-BF.1	Write a function that describes a relationship between two quantities. b. Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.*
HS.F-BF.3	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.*
HS.F-BF.4	Find inverse functions. a. Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. *For example, $f(x) = 2x^3$ or $f(x) = (x+1)/(x-1)$ for $x \neq 1$*
Functions: Interpreting Functions (F-IF)	
HS.F-IF.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph linear and quadratic functions and show intercepts, maxima, and minima. b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
HS.F-IF.8	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.
HS.F-IF.9	Compare properties of two functions each represented in a different way, algebraically, graphically, numerically, and in tables, or by verbal descriptions. For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.
Algebra: Reasoning with Equations and Inequalities (A-REI)	
HS.A-REI.1	Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
HS.A-REI.2	Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
HS.A-REI.4	Solve quadratic equations in one variable. a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.

	Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.
Number and Quantity: Quantities (N-Q)	
HS.N-Q.2	Define appropriate quantities for the purpose of descriptive modeling.
Algebra: Seeing Structure in Expressions (A-SSE)	
HS.A-SSE.2	Use the structure of an expressions to identify and rewrite it. *For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$.*
Algebra: Creating Equations (A-CED)	
HS.A-CED.1	Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.*
UNIT 3: POLYNOMIALS	
Algebra: Arithmetic with Polynomials and Rational Expressions (A-APR)	
HS.A-APR.2	Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a, the remainder on division by $x - a$ is $p(a)$, so $p(a) = 0$ if and only if $(x - a)$ is a factor of $p(x)$.
HS.A-APR.3	Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.
HS.A-APR.4.	Prove polynomial identities and use them to describe numerical relationships. *For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples.*
Number and Quantity: The Complex Number System (N-CN)	
HS.N-CN.1	Know there is a complex number i such that $i^2 = -1$, and every complex number has the form $a + bi$ with a and b real.
HS.N-CN.2	Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.
HS.N-CN.7	Solve quadratic equations with real coefficients that have complex solutions.
HS.N-CN.8	Extend polynomial identities to the complex numbers.
Functions: Interpreting Functions (F-IF)	
HS.F-IF.4	For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*
HS.F-IF.6	Calculate and interpret the average rate of change of a function presented symbolically or as a table over a specified interval. Estimate the rate of change from a graph.
HS.F-IF.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
HS.F-IF.9	Compare properties of two functions each represented in a different way, algebraically, graphically, numerically, and in tables, or by verbal descriptions. For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.
UNIT 4: RATIONAL FUNCTIONS	
Algebra: Arithmetic with Polynomials and Rational Expressions (A-APR)	
HS.A-APR.6	Rewrite simple rational expressions in different forms; write $a(x)/b(x)$ in the form $q(x) + r(x)/b(x)$, where $a(x)$, $b(x)$, $q(x)$, and $r(x)$ are polynomials with the degree of $r(x)$ less than the degree of $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.
HS.A-APR.7	Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.
Algebra: Reasoning with Equations and Inequalities (A-REI)	
HS.A-REI.2	Solve simple rational in one variable, and give examples showing how extraneous solutions may arise.
Functions: Interpreting Functions (F-IF)	
HS.F-IF.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. d. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
UNIT 5: EXPONENTIAL AND LOGARITHMIC FUNCTIONS	

Functions: Building Functions (F-BF)	
HS.F-BF.3	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.*
HS.F-BF.5	Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.
Functions: Linear, Quadratic and Exponential Models (F-LE)★	

HS.F-LE.1	Distinguish between situations that can be modeled with linear functions and with exponential functions.
	   a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
	   b. Use the properties of exponents to interpret expressions for exponential functions.
	   c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

HS.F-LE.2	Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table).
HS.F-LE.3	Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
HS.F-LE.4	For exponential models expressed as a logarithm the solution to where a, c, and d are numbers and the base b is 2 or 10. Evaluate the logarithm using technology.
HS.F-LE.5	Interpret the parameters in a linear or exponential function in terms of a context.
Functions: Interpreting Functions (F-IF)	
HS.F-IF.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph exponential and logarithmic functions, showing intercepts and end behavior.

HS.F-IF.8	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
	   b. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.
	   c. Use the properties of exponents to interpret expressions for exponential functions. *For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)^{12t}$, $y = (1.2)^{t/10}$, and classify them as representing exponential growth or decay.*

HS.F-IF.9	Compare properties of two functions each represented in a different way, algebraically, graphically, numerically, and in tables, or by verbal descriptions. For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.
UNIT 6: TRIGONOMETRY, GRAPHING, AND SINUSOIDAL APPLICATION	
Functions: Building Functions (F-BF)	
HS.F-BF.3	Identify the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k\,f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.*
Functions: Interpreting Functions (F-IF)	
HS.F-IF.4	For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. *Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.*
HS.F-IF.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. e. Graph trigonometric functions, showing period, midline, and amplitude.
Functions: Trigonometric Functions (F-TF)	
HS.F-TF.1	Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
HS.F-TF.2	Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.
HS.F-TF.3	Use special triangles to determine geometrically the values of sine, cosine, tangent for π/3, π/4, and π/6, and use the unit circle to express the values of sine, cosine, and tangent for π-x, π+x, and 2π-x in terms of their values for x, where x is any real number.

HS.F-TF4	Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.
HS.F-TF.5	Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.

UNIT 7: TRIGONOMETRY, INVERSE FUNCTIONS, AND RELATIONS

Functions: Interpreting Functions (F-IF)

HS.F-TF.6	Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.
HS.f-TF.7	Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.

UNIT 8: TRIGONOMETRY, IDENTITIES

Functions: Trigonometric Functions (F-TF)

HS.F-TF4	Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.
HS.F-TF.8	Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle.

UNIT 9: TRIGONOMETY, SOLVING

Algebra: Reasoning with Equations and Inequalities (A-REI)

HS.A-REI.1	Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

Functions: Trigonometric Functions (F-TF)

HS.F-TF.9	Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.

UNIT 10: SYSTEMS OF LINEAR AND NON-LINEAR EQUATIONS AND INEQUALITIES

Algebra: Reasoning with Equations and Inequalities (A-REI)

HS.A-REI.6	Solve systems of linear equations exactly and approximately (with graphs), focusing on pairs of linear equations in two variables.
HS.A-REI.7	Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. *For example, find the points of intersection between the line $y = -3x$ and the circle $x^2 + y^2 = 3$.*
HS.A-REI.11	Explain why the *x*-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

STANDARDS FOR MATHEMATICAL PRACTICE

HS.MP.1	Make sense of problems and persevere in solving them.
HS.MP.2	Reason abstractly and quantitatively.
HS.MP.3	Construct viable arguments and critique the reasoning of others.
HS.MP.4	Model with mathematics.
HS.MP.5	Use appropriate tools strategically.
HS.MP.6	Attend to precision.
HS.MP.7	Look for and make use of structure.
HS.MP.8	Look for an express regularity in repeated reasoning.