
Honors Elementary Analysis

Curriculum Guide

Scranton School District

Scranton, PA



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Honors Elementary Analysis

Prerequisite :

- Honors Algebra II/Trigonometry
- Be in compliance with the [SSD Honors and AP Criteria Policy](#)

Honors Elementary Analysis is an advanced course in mathematics. The major topics in this course are quadratic equations, coordinate geometry, polynomial algebra, theory of equations, inequalities, functions, exponents, advanced graphing techniques, conics, trigonometry and its applications, polar coordinates, vector operations, series, matrices, and probability. After successful completion of this course the students will be allowed to enroll in Honors Calculus I or AP Calculus if the Scranton School District Criteria for enrollment in Advanced Placement classes is met.

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Year-at-a-glance

Subject: Honors Elementary Analysis	Grade Level: 11,12	Date Completed: 2/5/15
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1st Quarter

Topic	Resources	CCSS
FUNDAMENTALS/REVIEW Linear Functions	Advanced Mathematics Text Chapter 1-1, 1-2, 1-3, 1-4, 1-8 Graphing Calculators	A1.2.2.1.3 HSA.REI.C.5 HSA.REI.C.6 HSF.BF.A.1 HSF.BF.A.1.a
THE COMPLEX NUMBER SYSTEM Perform arithmetic operations with complex numbers.	Advanced Mathematics Text Chapter 1-5 Graphing Calculators	HSN.CN.A.1 HSN.CN.A.2 HSN.CN.A.3
INTERPRETING FUNCTIONS Analyze functions using different representations.	Advanced Mathematics Text 1-1, 1-4, 1-6, 1-7 Chapter 2 (excluding 2-7) Chapter 3 (excluding 3-4) Graphing Calculators	HSF.IF.C.7 HSF.IF.C.7.a HSF.IF.C.7.c

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2nd Quarter

Topic	Resources	CCSS
<p>INTERPRETING FUNCTIONS</p> <p>Analyze functions using different representations.</p>	<p>Advanced Mathematics Text 4-1, 4-7 Chapter 5 Glossary (p.882)</p> <p>Graphing Calculators</p>	<p>HSF.IF.C.7.d HSF.IF.C.7.b A2.1.2.1.3 HSF.IF.C.7.e HSF.IF.C.8 HSF.BF.A.1 HSF.BF.A.1.a HSF.BF.A.1.b HSF.BF.A.1.c HSF.IF.C.8.a HSF.IF.C.8.b HSF.IF.C.9</p>
<p>BUILDING FUNCTIONS</p> <p>Build new functions from existing functions</p>	<p>Advanced Mathematics Text 4-2, 4-3, 4-4, 4-5 5-3, 5-4, 5-5, 5-6</p> <p>Graphing Calculators</p>	<p>HSF.BF.B.3 HSF.BF.B.4 HSF.BF.B.4.a HSF.BF.B.4.b HSF.BF.B.4.c HSF.BF.B.4.d HSF.BF.B.5</p>

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3rd Quarter

Topic	Resources	CCSS
TRIGONOMETRIC FUNCTIONS Extend the domain of trigonometric functions using the unit circle	Advanced Mathematics Text Chapter 7 Graphing Calculators	HSF.TF.A.1 HSF.TF.A.2 HSF.TF.A.3 HSF.TF.A.4
Model periodic phenomena with trigonometric functions	Advanced Mathematics Text 8-2, 8-3 Graphing Calculators	HSF.TF.B.5 HSF.TF.B.6 HSF.TF.B.7
Prove and apply trigonometric identities	Advanced Mathematics Text 8-1, 8-4, 8-5 Chapter 9 10-3 Graphing Calculators	HSF.TF.C.8
EXPRESSING GEOMETRIC PROPERTIES WITH EQUATIONS Translate between the geometric description and the equation for a conic section	Advanced Mathematics Text 6-1 to 6-5 Graphing Calculators	HSG.GPE.A.1 HSG.GPE.A.2 HSG.GPE.A.3 HSA.REI.C.7

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4th Quarter

Topic	Resources	CCSS
SEQUENCES AND SERIES Build a function that models a relationship between two quantities	Advanced Mathematics Text 13-1, 13-2, 13-3 Graphing Calculators	HSF.BF.A.2
USING PROBABILITY TO MAKE DECISIONS Calculate expected values and use them to solve problems	Advanced Mathematics Text 16-1, 16-2, 16-4, 16-6 Graphing Calculators	A2.2.3.2.1 A2.2.3.2.3 HSS.MD.A.2 HSS.MD.B.5.a
VECTOR QUANTITIES AND MATRICES Perform operations on vectors	Advanced Mathematics Text 12-1, 12-2 Graphing Calculators	HSN.VM.B.4 HSN.VM.B.4.a HSN.VM.B.4.b HSN.VM.B.4.c HSN.VM.B.5 HSN.VM.B.5.a
Perform operations on matrices and use matrices in applications	Advanced Mathematics Text 14-1, 14-2, 14-3, 14-4 Graphing Calculators	HSN.VM.C.6 HSN.VM.C.7 HSN.VM.C.8 HSN.VM.C.9 HSN.VM.C.10 HSA.REI.C.8 HSA.REI.C.9
REPRESENT COMPLEX NUMBERS AND THEIR OPERATIONS ON THE COMPLEX PLANE	Advanced Mathematics Text 11-1, 11-2 Graphing Calculators	HSN.CN.B.4
Final Exams and Reviews		

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THE COMPLEX NUMBER SYSTEM Perform arithmetic operations with complex numbers.	HSN.CN.A.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.	Advanced Mathematics Text 1-5 Graphing Calculators		3 days
	HSN.CN.A.2	Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.			
	HSN.CN.A.3	(+) Find the conjugate of a complex number.			

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<p>INTERPRETING FUNCTIONS</p> <p>Analyze functions using different representations.</p>	HSF.IF.C.7	Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.	<p>Advanced Mathematics Text 1-1, 1-4, 1-6, 1-7</p> <p>Chapter 2</p> <p>Chapter 3 (excluding 3-4)</p> <p>4-1, 4-7</p> <p>Chapter 5</p> <p>Glossary (p.882)</p> <p>Graphing Calculators</p>	45 days
	HSF.IF.C.7.a	Graph linear and quadratic functions and show intercepts, maxima, and minima.		
	HSF.IF.C.7.c	Solve and graph polynomial functions/inequalities, identifying zeros when suitable factorizations are available, and showing end behavior. <i>Use synthetic division.</i> <i>Apply the following theorems: remainder, factor, rational root, fundamental theorem of algebra, and complex conjugates.</i>		
	HSF.IF.C.7.d	(+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.		
	HSF.IF.C.7.b	Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.		
	A2.1.2.1.3	Simplify/evaluate expressions involving real exponents including multiplying with exponents, powers of powers, and powers of products		
	HSF.IF.C.7.e	Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.		
	HSF.IF.C.8	Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.		

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Analyze functions using different representations.	HSF.BF.A.1	Write a function that describes a relationship between two quantities.			
	HSF.BF.A.1.a	Determine an explicit expression, a recursive process, or steps for calculation from a context.			
	HSF.BF.A.1.b	Combine standard function types using arithmetic operations. <i>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.</i>			
	HSF.BF.A.1.c	(+) Compose functions. <i>For example, if $T(y)$ is the temperature in the atmosphere as a function of height, and $h(t)$ is the height of a weather balloon as a function of time, then $T(h(t))$ is the temperature at the location of the weather balloon as a function of time.</i>			
	HSF.IF.C.8.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.			
	HSF.IF.C.8.b	Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as $y = (1.02)^t$, $y = (0.97)^t$, $y = (1.01)12^t$, $y = (1.2)^t/10$, and classify them as representing exponential growth or decay.			
	HSF.IF.C.9	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). <i>For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.</i>			

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BUILDING FUNCTIONS Build new functions from existing functions	HSF.BF.B.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.	Advanced Mathematics Text 4-2, 4-3, 4-4, 4-5 5-3, 5-4, 5-5, 5-6 Graphing Calculators	30 days
	HSF.BF.B.4	Find inverse functions.		
	HSF.BF.B.4.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. <i>For example, $f(x) = 2x^3$ or $f(x) = (x+1)/(x-1)$ for $x \neq 1$.</i>		
	HSF.BF.B.4.b	(+) Verify by composition that one function is the inverse of another.		
	HSF.BF.B.4.c	(+) Read values of an inverse function from a graph or a table, given that the function has an inverse.		
	HSF.BF.B.4.d	(+) Produce an invertible function from a non-invertible function by restricting the domain.		
	HSF.BF.B.5	(+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.		

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<p>TRIGONOMETRIC FUNCTIONS</p> <p>Extend the domain of trigonometric functions using the unit circle</p>	<p>HSF.TF.A.1</p> <p>HSF.TF.A.2</p> <p>HSF.TF.A.3</p> <p>HSF.TF.A.4</p>	<p>Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.</p> <p>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.</p> <p><i>Graph all 6 trigonometric functions including transformations of sine, cosine, and tangent functions.</i></p> <p>(+) Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and use the unit circle to express the values of sine, cosine, and tangent for x, $\pi + x$, and $2\pi - x$ in terms of their values for x, where x is any real number.</p> <p>(+) Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.</p>	<p>Advanced Mathematics Text Chapter 7</p> <p>Graphing Calculators</p>		<p>34 days</p>
<p>Model periodic phenomena with trigonometric functions</p>	<p>HSF.TF.B.5</p> <p>HSF.TF.B.6</p> <p>HSF.TF.B.7</p>	<p>Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.</p> <p>(+) Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.</p> <p>(+) Use inverse functions to solve trigonometric equations; evaluate the solutions using technology.</p>	<p>Advanced Mathematics Text 8-2, 8-3</p> <p>Graphing Calculators</p>		

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<p>Prove and apply trigonometric identities</p>	<p>HSF.TF.C.8</p>	<p>Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle.</p> <p><i>Simplify trigonometric expressions/prove and solve trigonometric equations</i></p> <p><i>Use the Law of Sines and Law of Cosines to find unknown parts of a triangle</i></p> <p><i>Prove the following formulas for sine and cosine and use them to solve problems: sum and difference, double angle, and half angle.</i></p>	<p>Advanced Mathematics Text 8-1, 8-4, 8-5</p> <p>Chapter 9</p> <p>10-1, 10-3</p> <p>Graphing Calculators</p>		
<p>EXPRESSING GEOMETRIC PROPERTIES WITH EQUATIONS</p> <p>Translate between the geometric description and the equation for a conic section</p>	<p>HSG.GPE.A.1</p> <p>HSG.GPE.A.2</p> <p>HSG.GPE.A.3</p> <p>HSA.REI.C.7</p>	<p>Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation.</p> <p>Derive the equation of a parabola given a focus and directrix.</p> <p>(+) Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.</p> <p>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 $x^2 + y^2 = 3$.</p> <p><i>Solve systems of second degree equations.</i></p>	<p>Advanced Mathematics Text 6-1 to 6-7</p> <p>Graphing Calculators</p>		<p>10 days</p>

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<p>SEQUENCES AND SERIES</p> <p>Build a function that models a relationship between two quantities</p>	<p>HSF.BF.A.2</p>	<p>Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.</p>	<p>Advanced Mathematics Text 13-1, 13-2, 13-3 Graphing Calculators</p>		<p>5 days</p>
<p>USING PROBABILITY TO MAKE DECISIONS</p> <p>Calculate expected values and use them to solve problems</p>	<p>A2.2.3.2.1</p> <p>A2.2.3.2.3</p> <p>HSS.MD.A.2</p> <p>HSS.MD.B.5.a</p>	<p>Use Combinations, permutations, and The Fundamental Counting Principle to solve problems.</p> <p>Use probability for independent, dependent, or compound events to predict outcomes.</p> <p>(+) Calculate the expected value of a random variable; interpret it as the mean of the probability distribution.</p> <p>Find the expected payoff for a game of chance. <i>For example, find the expected winnings from a state lottery ticket or a game at a fast-food restaurant.</i></p>	<p>Advanced Mathematics Text 16-1, 16-2, 16-4, 16-6 Graphing Calculators</p>		<p>10 days</p>

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<p>VECTOR QUANTITIES AND MATRICES</p> <p>Perform operations on vectors</p>	HSN.VM.B.4	(+) Add and subtract vectors.	<p>Advanced Mathematics Text 12-1, 12-2</p> <p>Graphing Calculators</p>	<p>13 days</p>
	HSN.VM.B.4.a	Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.		
	HSN.VM.B.4.b	Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.		
	HSN.VM.B.4.c	Understand vector subtraction $v - w$ as $v + (-w)$, where $-w$ is the additive inverse of w , with the same magnitude as w and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise.		
	HSN.VM.B.5	(+) Multiply a vector by a scalar.		
	HSN.VM.B.5.a	Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as $c(v_x, v_y) = (cv_x, cv_y)$.		

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Perform operations on matrices and use matrices in applications	HSN.VM.C.6	(+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.	Advanced Mathematics Text 14-1, 14-2, 14-3, 14-4 Graphing Calculators		
	HSN.VM.C.7	(+) Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.			
	HSN.VM.C.8	(+) Add, subtract, and multiply matrices of appropriate dimensions.			
	HSN.VM.C.9	(+) Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.			
	HSN.VM.C.10	(+) Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.			
	HSA.REI.C.8	(+) Represent a system of linear equations as a single matrix equation in a vector variable.			
	HSA.REI.C.9	(+) Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3×3 or greater).			
REPRESENT COMPLEX NUMBERS AND THEIR OPERATIONS ON THE COMPLEX PLANE	HSN.CN.B.4	(+) Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.	Advanced Mathematics Text 11-1, 11-2 Graphing Calculators		5 days

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Final Exams and Reviews					10 days
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Please note: (+) Indicates content used in additional courses beyond Algebra II.