

*The mission of Hermon High School is to prepare students for personal success in college, career, and community.*

## Precalculus with Honors option

### Instructor:

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This course is designed for students who have successfully completed Algebra II or Honors Algebra II. It includes an in depth study of relations and functions, graph theory, exponential and logarithmic functions, and trigonometry. Conic sections, matrices, and vectors will be studied, as time allows. Students who take this course are college bound students whose program of study will include advanced algebra study or calculus at the college level. Students electing to do the Honors option will be required to complete additional studies outside of the regular classroom requirements, but will be given ample opportunity for support with those studies. Students who complete this course will be prepared for Calculus, AP Calculus, or a college level advanced algebra or Calculus I course.

\*Students taking Honors Pre-Calculus option should register for Pre-Calculus and will have their transcript adjusted at the end of the year to reflect Honors Pre-Calculus 2 semesters/1 credit

### Unit 1 Functions and Their Graphs with Review of Fundamental

### Graduation Standards:

HS.M.1A Applies properties of real numbers and quantitative reasoning.

HS.M.2.A Solves polynomial, rational, radical, and transcendental equations & systems of equations.

HS.M.2B Understands and analyzes polynomial, rational, radical, and transcendental functions.

#### Summary

Part A- Functions: Students will first review connections between concepts of and the graphical display of functions. Students will communicate precisely regarding regions of increase, decrease, end behavior, extrema, domain, range, and other features of functions. Students will perform multiple transformations on parent functions. These understandings will be applied to graphing piecewise functions. Students will also perform operations and compositions of functions.

Part B- Review of Fundamental Skills: Through parallel lessons (part of each class) students will review properties of exponents, operations with polynomials. They will review simplifying rational and radical expressions. The class will spend time solving rational, radical, and absolute value equations.

Honors: Students will complete an independent study of basic set theory.

#### Performance Indicators Assessed in Unit

AR.A.1 Interpret the structure of expressions.

AR.A.12 Understand the concept of a function and use function notation.

AR.A.14 Analyze functions using different representations.

AR.A.15 Build a function that models a relationship between two quantities. ★

AR.A.16 Build new functions from existing functions.

	<p><i>Supporting:</i>  QR.A.1 Extend the properties of exponents to rational exponents.  QR.A.2 Use properties of rational and irrational numbers.  AR.A.3 Perform arithmetic operations on polynomials.  AR.A.5 (+) Use polynomial identities to solve problems.  AR.A.6 Rewrite rational expressions.  AR.A.9 Solve equations and inequalities in one variable.</p>	
Understandings:	Students will know...	Students will be able to...
<ul style="list-style-type: none"> <li>Mathematical ideas are often represented as functions where a certain input yields a related output.</li> <li>Every function has a domain that can be described in set-builder or interval notation.</li> <li>A graph conveys important information about a function, including finding extrema, areas of increase, areas of decrease, and continuity.</li> <li>Average rate of change between any two points on a graph is the slope of a line through those points.</li> <li>Parent functions can be transformed using a set of consistent rules.</li> <li>Operations can be performed on functions and composition of two functions can be useful.</li> <li>The inverse of a function or operation is used to ‘undo’ the function.</li> <li>HONORS:</li> <li>The accurate use and interpretation of symbols in set theory allow for precise descriptions of sets, partial sets, intersections and unions.</li> </ul>	<ul style="list-style-type: none"> <li>the differences between a relation and a function, their different representations.</li> <li>the basic parent functions, their features, and how to transform their graphs.</li> <li>vocabulary of functions: domain, range, intercepts, zeros, odd vs. even functions, line symmetry, point symmetry.</li> <li>limit notation for end behavior.</li> <li>that an inverse ‘undoes’ the original function, returning the input.</li> </ul> <p>REVIEW:</p> <ul style="list-style-type: none"> <li>exponents obey their own set of rules.</li> <li>factoring polynomials is an important step to working with functions efficiently.</li> <li>rational expressions can often be simplified and be made easier to understand/work with.</li> <li>radical expressions are similar to fractions in their needs for ‘like’ terms for addition and subtraction, therefore simplifying a radical is an important step.</li> <li>expressing radicals as rational exponents can be helpful when dealing with unlike indexed radicals.</li> </ul> <p>HONORS:</p> <ul style="list-style-type: none"> <li>how to find unions and intersections of sets and their complements.</li> </ul>	<ul style="list-style-type: none"> <li>find domain and range.</li> <li>find intercepts, zeros, critical points, intervals of increase and decrease.</li> <li>determine types of discontinuity.</li> <li>state end behavior.</li> <li>find types of symmetry in a relation.</li> <li>graph piecewise functions.</li> <li>perform operations with functions.</li> <li>find and verify inverse functions.</li> </ul> <p>REVIEW:</p> <ul style="list-style-type: none"> <li>Simplify exponents.</li> <li>simplify and factor polynomials expressions</li> <li>perform operations on polynomial expressions.</li> <li>.</li> <li>simplify rational expressions.</li> <li>perform operations on rational expressions.</li> <li>simplify radicals.</li> <li>perform operations on radical expressions.</li> </ul> <hr/> <p>PRACTICES:</p>

	<ul style="list-style-type: none"><li>• how to determine the cardinality of a set.</li><li>• how to represent sets in rosters and venn diagrams.</li></ul>	<ul style="list-style-type: none"><li>• Make sense of problems and persevere in solving them.</li><li>• Use appropriate tools strategically.</li><li>• Attend to precision.</li><li>• Look for and make use of structure.</li></ul>
Unit 2	Polynomial & Rational Functions	
Graduation Standards:		
HS.GP.A - Clear and effective communicator HS.GP.C - Creative and practical problem solver HS.GP.E - Integrative and informed thinker		
Summary	<p>Part A-Polynomial and Rational Functions: This unit focuses on understanding the properties, graphing techniques, and algebraic operations associated with polynomial and rational functions. It begins with power functions as the foundation of radical functions and polynomial functions. It includes a review of solving radical equations with one and two radicals. Students will complete an accelerated review of polynomial functions, making use of the remainder and factor theorems, and finding complex zeros with quadratic formula. The study of polynomials ends with a focus on modeling real-world data with polynomial functions.</p> <p>We will then analyze and graph rational functions using key characteristics. They also examine the effect of horizontal and vertical asymptotes in rational functions. Also students will solve both polynomial and rational inequalities.</p> <p>Part B-Review of Fundamental Skills: Students will continue the review undertaken in unit 1. Students will practice techniques of solving quadratic equations, review concepts of imaginary numbers, solve absolute value equations, solve rational equations, and simple inequalities.</p> <p>HONORS: Students will explore the binomial theorem and Pascal’s Triangle.</p>	
Performance Indicators Assessed in Unit	AR.A.1 Interpret the structure of expressions. AR.A.4 Understand the relationship between zeros and factors of polynomials. AR.A.6 Rewrite rational expressions. AR.A.9 Solve equations and inequalities in one variable.	

	AR.A.11 Represent and solve equations and inequalities graphically. AR.A.14 Analyze functions using different representations. AR.A.15 Build a function that models a relationship between two quantities. ★ AR.A.16 Build new functions from existing functions. <i>Supporting:</i> QR.A.1 Extend the properties of exponents to rational exponents. QR.A.2 Use properties of rational and irrational numbers. QR.A.4 (+) Perform arithmetic operations with complex numbers. AR.A.2 Write expressions in equivalent forms to reveal information and to solve problems. ★ AR.A.3 Perform arithmetic operations on polynomials.		
Understandings:	Students will know...	Students will be able to...	
<ul style="list-style-type: none"><li>Solutions to equations correspond to the zeros of the function.</li><li>Complex roots are not represented on the real plane.</li><li>Domains of power and radical functions are limited by radicand, while polynomials are defined for all reals.</li><li>Analysis of an algebraic representation of polynomial, radical, or rational functions leads to easy to identify landmarks of the graph.</li><li>Polynomial inequalities are easily solved with the knowledge of graph characteristics.</li></ul> <p>REVIEW:</p> <ul style="list-style-type: none"><li>Rational exponents allow us to work with radicals with unlike indices more efficiently.</li><li>Factoring complex expressions and finding zeros allows us to identify important characteristics of functions.</li><li>Solving rational equations involves paying special attention to the allowed domain.</li></ul> <p>HONORS:</p>	<ul style="list-style-type: none"><li>how to graph basic power functions.</li><li>how to find zeros of polynomial and rational functions.</li><li>how to graph polynomial and rational functions.</li><li>how to use synthetic and long division with polynomials to reveal features of graphs.</li><li>the benefits of the polynomial theorems.</li><li>how to use graphing knowledge and sign charts to assist in solving nonlinear inequalities.</li><li>Descartes’ rule of signs and upper and lower bounds tests for zeros of polynomials.</li></ul> <p>REVIEW:</p> <ul style="list-style-type: none"><li>the process of completing the square and its connection to the quadratic formula.</li></ul> <p>HONORS:</p> <ul style="list-style-type: none"><li>the structure of Pascal’s triangle</li><li>the structure of binomial expansion</li></ul>	<ul style="list-style-type: none"><li>find zeros of polynomial and rational functions.</li><li>graph polynomial and rational functions.</li><li>use synthetic and long division to reveal features of graphs.</li><li>apply the remainder and factor theorems.</li></ul> <p>REVIEW:</p> <ul style="list-style-type: none"><li>solve quadratic equations using factoring, quadratic formula, or completing the square techniques.</li><li>how to compute with complex numbers.</li><li>solve for specified variables in equations.</li><li>solve radical equations.</li><li>solve rational equations.</li><li>work with rational exponents efficiently.</li></ul> <p>PRACTICES:</p> <ul style="list-style-type: none"><li>Make sense of problems and persevere in solving them.</li><li>Reason abstractly and quantitatively.</li></ul>	

<ul style="list-style-type: none"><li>● Pascal’s triangle contains many mathematical patterns.</li><li>● Using pascal’s triangle is an efficient way to expand powers of binomials.</li></ul>	<ul style="list-style-type: none"><li>● applications of binomial expansion</li></ul>	<ul style="list-style-type: none"><li>● Model with mathematics.</li><li>● Use appropriate tools strategically.</li><li>● Attend to precision.</li><li>● Look for and make use of structure.</li><li>● Look for and express regularity in repeated reasoning.</li></ul>
Unit 3	Exponential and Logarithmic Functions	
Graduation Standards:		
HS.M.1A Applies properties of real numbers and quantitative reasoning. HS.M.1B Performs operations with complex numbers, vectors, and matrices (STEM) HS.M.2.A Solves polynomial, rational, radical, and transcendental equations & systems of equations. HS.M.2B Understands and analyzes polynomial, rational, radical, and transcendental functions.		
Summary	Students explore exponential functions, their properties, growth/decay behavior, and real-world applications. They also study logarithmic functions as the inverse of exponentials, including evaluating expressions, solving equations, and understanding logarithmic scales. Graphing techniques and applications in various fields are incorporated to deepen understanding. This unit serves as a foundation for advanced mathematical concepts and applications. HONORS: Students will work with complex numbers, representing & combining them on the complex plane as vector quantities.	
Performance Indicators Assessed in Unit	QR.A.9 (+) Perform operations on matrices and use matrices in applications. AR.A.16 Build new functions from existing functions. AR.A.17 Construct and compare linear, quadratic, and exponential models and solve problems. ★ AR.A.18 Interpret expressions for function in terms of the situation they model. ★ <i>Supporting:</i> QR.A.1 Extend the properties of exponents to rational exponents. AR.A.1 Interpret the structure of expressions. AR.A.2 Write expressions in equivalent forms to reveal information and to solve problems. ★ AR.A.8 Understand solving equations as a process of reasoning and explain the reasoning. AR.A.11 Represent and solve equations and inequalities graphically.	

	AR.A.9 Solve equations and inequalities in one variable. AR.A.15 Build a function that models a relationship between two quantities. ★		
Understandings:	Students will know...	Students will be able to...	
<ul style="list-style-type: none"><li>Exponential functions show exponential growth or decay based on the base and exponent.</li><li>Logarithmic functions are the inverse of exponential functions, enabling solving exponential equations.</li><li>Exponential and logarithmic functions are interconnected and can be converted between different forms.</li><li>Graphing exponential functions involves identifying initial value, growth/decay rate, and asymptotic behavior.</li><li>Graphing logarithmic functions requires understanding logarithmic scales and transformations.</li><li>Real-world applications include population growth, investments, decay, and logarithmic measurements.</li><li>Accurate calculations and graphical analysis are essential for application and interpretation.</li></ul> <p>HONORS:</p> <ul style="list-style-type: none"><li>Complex numbers represent a vector on the complex plane.</li><li>Absolute value, modulus, argument of a complex number.</li></ul>	<ul style="list-style-type: none"><li>Exponential notation and properties.</li><li>Growth and decay models and graphs.</li><li>Evaluating and simplifying exponential expressions, solving exponential equations.</li><li>Compound interest and continuous growth.</li><li>Logarithmic notation, properties, functions and their graphs.</li><li>Evaluating and simplifying logarithmic expressions and solving logarithmic equations.</li><li>Inverse functions and their relationship to exponential and logarithmic functions.</li><li>Converting between exponential and logarithmic forms.</li><li>Logarithmic scales and applications. Logarithmic applications, such as pH calculations or measuring sound intensity.</li><li>Graphing exponential and logarithmic functions with transformations.</li></ul> <p>HONORS:</p> <ul style="list-style-type: none"><li>How to find absolute value, modulus, &amp; argument of a complex number</li></ul>	<ul style="list-style-type: none"><li>Understand the properties and behavior of exponential and logarithmic functions, including their definitions, domain, range, and asymptotic behavior.</li><li>Evaluate, simplify, and perform operations with exponential and logarithmic expressions, including solving exponential and logarithmic equations.</li><li>Graph exponential and logarithmic functions, including transformations, identifying key features such as asymptotes, intercepts, and behavior near these points.</li><li>Recognize and apply the relationship between exponential and logarithmic functions, converting between different forms.</li><li>Solve real-world problems involving exponential growth, decay, compound interest, and logarithmic scales, applying appropriate mathematical models and calculations.</li></ul>	

	<ul style="list-style-type: none"><li>How to perform operations with complex numbers.</li></ul>	<ul style="list-style-type: none"><li>Analyze and interpret data represented by exponential and logarithmic functions, making predictions and drawing conclusions.</li><li>Use exponential and logarithmic functions to solve practical problems in fields such as finance, population growth, biology, physics, and engineering.</li></ul> <hr/> <p><b>Practices:</b></p> <ul style="list-style-type: none"><li>Make sense of problems and persevere in solving them.</li><li>Reason abstractly and quantitatively.</li><li>Model with mathematics.</li><li>Use appropriate tools strategically.</li><li>Attend to precision.</li><li>Look for and make use of structure.</li></ul>
Unit 4	Trigonometry	
Graduation Standards:		
HS.M.1A Applies properties of real numbers and quantitative reasoning. HS.M.2.A Solves polynomial, rational, radical, and transcendental equations & systems of equations. HS.M.2B Understands and analyzes polynomial, rational, radical, and transcendental functions.		
Summary	In this unit students will review trigonometric ratios as they relate to right triangles. Students will extend their knowledge of trig ratios to rotations of the unit circle using degrees and radians and then learn to graph the trig functions in the coordinate plane. Trig functions will be used to model periodic functions and inverse	

	<p>trigonometric functions will be investigated. Once comfortable with trigonometric functions, students will learn and verify basic trigonometric identities and solve trig equations.</p> <p>Honors: Students will work with polar coordinates, extending their study of complex numbers from the previous honors unit.</p>		
Performance Indicators Assessed in Unit	<p>AR.A.18 Interpret expressions for function in terms of the situation they model.</p> <p>AR.A.19 Extend the domain of trigonometric functions using the unit circle.</p> <p>AR.A.20 Model periodic phenomena with trigonometric functions.</p> <p>AR.A.21 Prove and apply trigonometric identities.</p> <p><i>Supporting:</i></p> <p>AR.A.13 Interpret functions that arise in applications in terms of the context.</p> <p>AR.A.14 Analyze functions using different representations.</p> <p>AR.A.15 Build a function that models a relationship between two quantities.</p> <p>AR.A.16 Build new functions from existing functions.</p>		
Understandings:	Students will know...	Students will be able to...	
<ul style="list-style-type: none"> <li>• Trigonometric functions relate angles to ratios of side lengths and connect angles in right triangles to their values.</li> <li>• The unit circle extends trigonometric functions beyond right triangles.</li> <li>• Trigonometric functions are periodic and have graphical representations.</li> <li>• Trigonometric ratios solve problems involving triangles and real-world applications.</li> <li>• Laws of sine and cosine solve problems with non-right triangles.</li> <li>• Trigonometric identities and formulas simplify and solve equations.</li> <li>• Radian measure relates to degree measure.</li> <li>• Inverse trigonometric functions solve equations and find angles.</li> <li>• Trigonometric functions have specific properties and characteristics and their graphs</li> </ul>	<ul style="list-style-type: none"> <li>• Radian measure conversion to degrees</li> <li>• Unit circle measures and coordinates</li> <li>• graphs of basic trig functions,</li> <li>• inverse trig functions and their limited domains</li> <li>• Trig identities</li> <li>• sine, cosine, tangent, secant, cosecant, cotangent ratios, and their graphs.</li> <li>• Inverse trig functions &amp; their graphs</li> <li>• reference angles of rotations</li> <li>• features of the unit circle.</li> <li>• Features of sinusoidal graphs-amplitude, period, phase shift, frequency of a period function, transformations of trig functions</li> <li>• what it means to verify a trig identity</li> </ul> <p>HONORS:</p>	<ul style="list-style-type: none"> <li>• Solve multi-step conversion factor problems.</li> <li>• Discern characteristics of 3-way transformations of sine and graphs.</li> <li>• Find exact values of known angles (deg &amp; radians) of unit circle.</li> <li>• Create trig function to model real-world phenomena involving several transformations.</li> <li>• Find 6 trig ratios of angles within full rotation, given point.</li> <li>• Apply arc length and areas of sectors in problem solving.</li> <li>• Apply the Law of Sines, Law of Cosines.</li> <li>• Verify a trig identity</li> <li>• Simplify a trig expression</li> <li>• Solve a trig equation for a range of values</li> </ul>	

<p>follow previously learned transformation rules.</p> <p>HONORS:</p> <ul style="list-style-type: none"> <li>Complex numbers can be represented in polar form, expressed in terms of angles and distances to locate the point.</li> <li>Graphs of polar equations have symmetries and patterns that can be discerned from the equation.</li> </ul>	<ul style="list-style-type: none"> <li>How to convert complex numbers from polar to rectangular form .</li> <li>How to graph basic polar functions</li> </ul>	
Unit 5	Matrices	
Summary	<p>The precalculus unit on systems of equations and matrices provides students with a comprehensive understanding of how to represent, manipulate, and solve systems of linear equations using matrix operations. Students learn to convert systems of equations into augmented matrices and apply elementary row operations to transform them into reduced row-echelon form, facilitating the identification of unique solutions, infinitely many solutions, or inconsistency (as time allows.)</p>	
Performance Indicators Assessed in Unit	<p>HS.M.1A Applies properties of real numbers and quantitative reasoning.</p> <p>HS. M.1B Performs operations with complex numbers, vectors, and matrices</p> <p>HS.M.2.A Solves polynomial, rational, radical, and transcendental equations &amp; systems of equations.</p> <p><i>Supporting:</i></p> <p>AR.A.1 Interpret the structure of expressions.</p> <p>AR.A.2 Write expressions in equivalent forms to reveal information and to solve problems.</p> <p>AR.A.7 Create equations and/or inequalities that describe numbers or relationships.</p>	
Understandings:	Students will know...	Students will be able to...
<ul style="list-style-type: none"> <li>Systems of equations can be represented in matrix form using augmented matrices..</li> <li>Matrices can be manipulated using elementary row operations, which preserve the solutions of the corresponding system of equations.</li> <li>The process of solving a system of equations using matrices involves applying elementary row operations to the</li> </ul>	<ul style="list-style-type: none"> <li>Radian measure conversion to degrees</li> <li>Unit circle measures and coordinates</li> <li>graphs of basic trig functions,</li> <li>inverse trig functions and their limited domains</li> <li>Trig identities</li> <li>sine, cosine, tangent, secant, cosecant,</li> </ul>	<ul style="list-style-type: none"> <li>Solve multi-step conversion factor problems.</li> <li>Discern characteristics of 3-way transformations of sine and graphs.</li> <li>Find exact values of known angles (deg &amp; radians) of unit circle.</li> <li>Create trig function to model real-world</li> </ul>

<p>augmented matrix until it is in reduced row-echelon form. This form allows us to easily read off the solutions to the system.</p> <ul style="list-style-type: none"> <li>• Systems can be consistent, with one solution or infinitely many solutions, or inconsistent, with no solution.</li> </ul>	<p>cotangent ratios, and their graphs.</p> <ul style="list-style-type: none"> <li>• Inverse trig functions &amp; their graphs</li> <li>• reference angles of rotations</li> <li>• features of the unit circle.</li> <li>• Features of sinusoidal graphs-amplitude, period, phase shift, frequency of a period function, transformations of trig functions</li> <li>• what it means to verify a trig identity</li> </ul>	<p>phenomena involving several transformations.</p> <ul style="list-style-type: none"> <li>• Find 6 trig ratios of angles within full rotation, given point.</li> <li>• Apply arc length and areas of sectors in problem solving.</li> <li>• Apply the Law of Sines, Law of Cosines.</li> <li>• Verify a trig identity</li> <li>• Simplify a trig expression</li> <li>• Solve a trig equation for a range of values</li> </ul>
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### **Summative Assessments/Retake**

- Summative assessments will count as 70% of the grade.
- Students have the opportunity to retake summative assessments.
- The student must submit a retake form to the teacher within five (5) school days of the date that the summative assessment score is reported to the student.
- The highest score a student can receive on a retake or late assessment is a 75.
- The score achieved on a retake will replace the current score (even if the score is lower).
- If a student is making up a test from an absence, that assessment will be graded up to 100.

### **Make-up Work**

Upon their return to school from an absence, it is the student's responsibility to secure make-up work from their teacher. The due date of the missed work will be one additional class period for each day of absence from that class or at the discretion of the teacher.

### **Grading of Formative Assessments**

- Formative assessments will count as 30% of the grade.
- Formative assessments may be scored on either a 0-100 scale or a 0-4 scale.
- The 0-4 scale will be represented in Power School as 4=100, 3=87, 2=77, and 1=67.
- The method of scoring of formative assessments will be determined by assignment.

### **Finals / Midterms**

An end of course Final Exam will be conducted, making up 10% of the students overall grade.

