HIGH SCHOOL

Algebra II (Semester 1)

Mathematical Practices

The Standards for Mathematical Practice are essential in the extension of mathematical thinking. Students develop these habits of mind through specific, intentional experiences of writing, reading, talking, and reasoning that connect mathematics to their daily lives and career situations. All of the Standards are important for all quality math courses:

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

Advanced algebraic concepts require abstract thought and a strong basis of functional understanding. Students are expected to be knowledgeable with linear systems and quadratic equations, subjects covered thoroughly in Algebra I. Algebra II students will begin their coursework with quadratic equations, including further extensions into graphing, solving, and rewriting the equations multiple ways.

<table>
<tr><td colspan="3">Content Area: Algebra</td></tr>
<tr><td colspan="3">Fluency 1: Quadratic Equations
Using the complex number system to solve for imaginary roots in quadratics.
Completing the square is an alternative method to rewrite and solve quadratic equations.
Understanding that there exists a family of parent graphs and their characteristics must be memorized.</td></tr>
<tr><td>Standards</td><td>Strands</td><td>Goals and Performance Objectives</td></tr>
<tr><td>HSF.BF.3</td><td>2 Quadratic Functions
3 Quad Eq & Complex #'s</td><td>Identify the effect on the graph by replacing f(x) by f(x)+k, k f(x), f(kx), f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs.</td></tr>
<tr><td>HSA.CED.1</td><td>2 Quadratic Functions
3 Quad Eq & Complex #'s</td><td>Create equations and inequalities in one variabel and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential</td></tr>
</table>

		functions
HSA.CED.2	2 Quadratic Functions 3 Quad Eq & Complex #'s	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
HS.APR.3	2 Quadratic Functions 3 Quad Eq & Complex #'s	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.
HSF.IF.4	2 Quadratic Functions 3 Quad Eq & Complex #'s	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.
HSF.IF.7	2 Quadratic Functions 3 Quad Eq & Complex #'s	Graph equations and show intercepts, end behavior, maxima & minima.
HSF.IF.8	2 Quadratic Functions 3 Quad Eq & Complex #'s	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.9	2 Quadratic Functions 3 Quad Eq & Complex #'s	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
HSA.REI.4	2 Quadratic Functions 3 Quad Eq & Complex #'s	Solve quadratic equations by inspection, taking 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+bi for real numbers a and b.
HSA.REI.7	2 Quadratic Functions 3 Quad Eq & Complex #'s	Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically.
HSN.CN.1	2 Quadratic Functions 3 Quad Eq & Complex #'s	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 as real numbers.
HSN.CN.2	2 Quadratic Functions 3 Quad Eq & Complex #'s	Use the relation $i^2 = -1$, and the commutative, associative, and distributive properties to add, multiply, and subtract complex numbers.
HSN.CN.7	2 Quadratic Functions 3 Quad Eq & Complex #'s	Solve quadratic equations with real coefficients that have complex solutions.

HSN.GPE.2	2 Quadratic Functions 3 Quad Eq & Complex #'s	Derive the equation of a parabola given a focus and directrix.

It is critical for students to be able to simplify rational expressions once they begin Calculus. Rational expressions are an extension of the simple fractional rules and operations in a more abstract method.

Fluency 2: Rational Expressions

- Rational expressions can be simplified through factoring.
- Rational expressions can be solved through arithmetic operations, but may contain extraeneous solutions.

Standards	**Strand**	**Goals and Performance Objectives**
HS.SSE.2	7 Rational Functions	Use the structure of an expression to identify ways to rewrite it.
HS.APR.1	7 Rational Functions	Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication
HS.APR.6	7 Rational Functions	Rewrite simple rational expressions indifferent forms: where a(x), b(x), q(x), and r(x) are polynomials with degree of r(x) less than the degree of b(x) using inspection, long division, or, for more complicated examples, a computer algebra system.
HS.APR.7	7 Rational Functions	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.

Techniques to solve quadratic equations can be extended to polynomial equations. This area of advanced algebra is extremely important to melding the abstract algebra concepts to the graphical representation of polynomial functions. Students need to recognize and use the Fundamental Theorem of Algebra in this section.

Fluency 3: Polynomial Functions

- Factoring techniques can be used to solve for polynomial zeros.
- Synthetic and long division can be used to find roots of polynomial expressions.
- Graphing polynomial equations given roots and critical points.
- Identifying types of roots in a polynomial equation.

Standards	**Strand**	**Goals and Performance Objectives**

HSA.REI.1	4 Polynomial Functions	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.
HSA.APR.2	4 Polynomial Functions	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).
HSA.APR.4	4 Polynomial Functions	Prove polynomial identities and use them to describe numerical relationships.
HSA.APR.5	4 Polynomial Functions	Know and apply the Binomial Theorem for the expansion of $(x + y)^n$; in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example, by Pascal's triangle.
HSN.RN.1	4 Polynomial Functions	Know the Fundamental Theorem of Algebra; Show that it is true for quadratic and other polynomials.

Rewriting algebraic expressions is taught in Algebra 2 to aid in finding solutions to equations that are difficult to solve in their original form. Transferring radical equations into rational exponents is a necessary skill for Pre-Calculus.

Fluency 4: Rational and Radical Functions • Rewriting rational and radical expressions is necessary to solve equations.		
Standards	**Strand**	**Goals and Performance Objectives**
HSA.REI.A.2	5 Rational Exponents & Radical Functions	Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise
HSN.RN.A.1	5 Rational Exponents & Radical Functions	Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for the notation for radicals in terms of rational exponents.
HSN.RN.A.2	5 Rational Exponents & Radical Functions	Rewrite expressions involving radicals and rational exponents using the properties of exponents.

The ability to recognize function graphs by their characteristics is essential for advanced mathematics. Learning to find the inverses of algebraic functions leads to the work in logarithmic and exponential equations.

Fluency 5: Functions

- Arithmetical operations are used on functions.
- Composition of functions is a crucial key to the derivative in calculus
- Finding inverses for functions and verifying their existence is an important step to the use of logarithms/exponents

Standards	**Strand**	**Goals and Performance Objectives**
HSF.BF.A.1b	5 Rational Exponents & Radical Functions	Combine standard functions types using arithmetic operations.
HSF.BF.A.1c	5 Rational Exponents & Radical Functions	Compose functions.
HSF.BF.B.4a	5 Rational Exponents & Radical Functions	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.
HSF.BF.B.4b	5 Rational Exponents & Radical Functions	Verify by composition that one function is the inverse of another.
HSF.BF.B.4c	5 Rational Exponents & Radical Functions	Read values of an inverse function from a graph or a table, given that the function has an inverse.

Further applications of inverse functions are used in the study of logarithms and exponential expressions. Students need to be able to solve and graph both logarithmic and exponential equations.

Fluency 6: Exponential and Logarithmic Functions

- Solve exponential equations using one-to-one property
- Convert exponential equations into logarithmic equations
- Graph exponential/logarithmic equations

• Solve logarithmic equations • Use logarithms and exponents to model real-life applications, such as growth and decay examples.		
Standards	**Strand**	**Goals and Performance Objectives**
HSA.SSE.B.3c	6 Exponential & Logarithmic Functions	Use the properties of exponents to transform expressions for exponential functions.
HSF.LE.A.2	6 Exponential & Logarithmic Functions	Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (including reading these from a table)
HSF.LE.A.4	6 Exponential & Logarithmic Functions	For exponential models, express as a logarithm the solutions to an exponential equation; evaluate the logarithm using technology.
HSF.LE.B.5	6 Exponential & Logarithmic Functions	Interpret the parameters in a linear or exponential function in terms of a context.
HSF.IF.C8b	6 Exponential & Logarithmic Functions	Use the properties of exponents to interpret expressions for exponential functions.

Trigonometry (Semester 2)

Trigonometry is used to solve and model periodic functions. Students will be expected to use ratios of the sides of a right triangle as well as the angles associated with circular trigonometry.

Content Area: Trigonometry		
Fluency 1: Right Triangle Trigonometry • Use trigonometric ratios - SOH/CAH/TOA - to solve for missing sides or angles in a right triangle. • Identify and use the special right triangles' identities. • Use trigonometric ratios to solve real - life examples of right triangle work.		
Standards	**Strand**	**Goals and Performance Objectives**
HSF.TF.A.3	9 Trigonometric Ratios & Functions	Use special triangles to determine geometrically the values of sine, cosine, tangent for pi/3, pi/4, and pi/6.
HSF.TF.B.7	9 Trigonometric Ratios & Functions	Use inverse functions to solve trigonometric equations that arise in modeling context; evaluate the solutions using technology, and interpret them in terms of the context.
HSG.SRT.8	9 Trigonometric Ratios & Functions	Use trigonometric ratios and the Pythagoren Theorem to solve right triangles in applied problems.

Trigonometry can be applied to general triangles by using Law of Sines and Law of Cosines. Students will also learn how to use various area problems on general triangles.

Fluency 2: Analytical Geometry • Use Law of Sines and Law of Cosines to solve for oblique triangles • Find the area of oblique triangles		
Standards	**Strand**	**Goals and Performance Objectives**
HSG.SRT.D.9	9.7 Geometry book	Derive the formula $A=\frac{1}{2}$ ab sin C for the area of a triangle by drawing an auxiliary line

		from the vertex perpendicular to the opposite side.
HSG.SRT.D.10	9.7 Geometry book	Prove the Law of Cosines and Sines and use them to solve problems.
HSG.SRT.D.11	9.7 Geometry book	Understand and apply the Law of Sines and Law of Cosines to find unknown measurements in right and non-right triangles (e.g. surveying problems, resultant forces)

Unit Circle Trigonometry plays a vital role in Calculus. Students need to be able to circumvent the unit circle with ease and understanding, which includes finding reference angles, coterminal angles; and easily convert degrees to radians.

Fluency 3: Unit Circle Trigonometry

- Use unit circle for solve for any angle
- Use function notation to graph a periodic function, including modeling of real-life applications
- Convert measure of radian and degrees using unit circle

Standards	**Strand**	**Goals and Performance Objectives**
HSF.TF.A.1	9 Trigonometric Ratios & Functions	Understand radian measure of an angles as the length of the arc on the unit circle subtended by the angle
HSF.TF.A.2	9 Trigonometric Ratios & Functions	Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measure of angles traversed counterclockwise around the unit circle.
HSF.TF.B.5	9 Trigonometric Ratios & Functions	Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.