

Pre-Calculus

State Standard Number	State Standard Area/Description	Unit Name	Course Topic Description
A2.PS	Problem Solving		
0	Students will build new mathematical knowledge through problem solving.		
A2.PS.1	Use a variety of problem solving strategies to understand new mathematical content	Polynomial Functions	Roots of Polynomial Functions
A2.PS.2	Recognize and understand equivalent representations of a problem situation or a mathematical concept	Polynomial Functions	Roots of Polynomial Functions
0	Students will solve problems that arise in mathematics and in other contexts.		
A2.PS.3	Observe and explain patterns to formulate generalizations and conjectures	Covered throughout course	Covered throughout course
A2.PS.4	Use multiple representations to represent and explain problem situations (e.g., verbally, numerically, algebraically, graphically)	Covered throughout course	Covered throughout course
0	Students will apply and adapt a variety of appropriate strategies to solve problems.		
A2.PS.5	Choose an effective approach to solve a problem from a variety of strategies (numeric, graphic, algebraic)	Covered throughout course	Covered throughout course
A2.PS.6	Use a variety of strategies to extend solution methods to other problems	Covered throughout course	Covered throughout course

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A2.PS.7	Work in collaboration with others to propose, critique, evaluate, and value alternative approaches to problem solving	Covered throughout course	Covered throughout course
0	Students will monitor and reflect on the process of mathematical problem solving.		
A2.PS.8	Determine information required to solve the problem, choose methods for obtaining the information, and define parameters for acceptable solutions	Polynomial Functions	Roots of Polynomial Functions
A2.PS.9	Interpret solutions within the given constraints of a problem	Polynomial Functions	Roots of Polynomial Functions
A2.PS.10	Evaluate the relative efficiency of different representations and solution methods of a problem	Polynomial Functions	Roots of Polynomial Functions
A2.RP	Reasoning and Proof		
0	Students will recognize reasoning and proof as fundamental aspects of mathematics.		

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A2.RP.1	Support mathematical ideas using a variety of strategies		
0	Students will make and investigate mathematical conjectures.		
A2.RP.2	Investigate and evaluate conjectures in mathematical terms, using mathematical strategies to reach a conclusion		
A2.RP.3	Evaluate conjectures and recognize when an estimate or approximation is more appropriate than an exact answer		
A2.RP.4	Recognize when an approximation is more appropriate than an exact answer		
0	Students will develop and evaluate mathematical arguments and proofs.		
A2.RP.5	Develop, verify, and explain an argument, using appropriate mathematical ideas and language		
A2.RP.6	Construct logical arguments that verify claims or counterexamples that refute claims		

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A2.RP.7	Present correct mathematical arguments in a variety of forms		
A2.RP.8	Evaluate written arguments for validity		
0	Students will select and use various types of reasoning and methods of proof.		
A2.RP.9	Support an argument by using a systematic approach to test more than one case		
A2.RP.10	Devise ways to verify results, using counterexamples and informal indirect proof		
A2.RP.11	Extend specific results to more general cases		
A2.RP.12	Apply inductive reasoning in making and supporting mathematical conjectures		
A2.CM	Communication		

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0	Students will organize and consolidate their mathematical thinking through communication.		
A2.CM.1	Communicate verbally and in writing a correct, complete, coherent, and clear design (outline) and explanation for the steps used in solving a problem	Covered throughout course	Covered throughout course
A2.CM.2	Use mathematical representations to communicate with appropriate accuracy, including numerical tables, formulas, functions, equations, charts, graphs, and diagrams	Covered throughout course	Covered throughout course
0	Students will communicate their mathematical thinking coherently and clearly to peers, teachers, and others.		
A2.CM.3	Present organized mathematical ideas with the use of appropriate standard notations, including the use of symbols and other representations when sharing an idea in verbal and written form	Covered throughout course	Covered throughout course
A2.CM.4	Explain relationships among different representations of a problem	Covered throughout course	Covered throughout course
A2.CM.5	Communicate logical arguments clearly, showing why a result makes sense and why the reasoning is valid		
A2.CM.6	Support or reject arguments or questions raised by others about the correctness of mathematical work		

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0	Students will analyze and evaluate the mathematical thinking and strategies of others.		
A2.CM.7	Read and listen for logical understanding of mathematical thinking shared by other students	Covered throughout course	Covered throughout course
A2.CM.8	Reflect on strategies of others in relation to one's own strategy	Covered throughout course	Covered throughout course
A2.CM.9	Formulate mathematical questions that elicit, extend, or challenge strategies, solutions, and/or conjectures of others	Covered throughout course	Covered throughout course
0	Students will use the language of mathematics to express mathematical ideas precisely.		
A2.CM.10	Use correct mathematical language in developing mathematical questions that elicit, extend, or challenge other students' conjectures	Covered throughout course	Covered throughout course
A2.CM.11	Represent word problems using standard mathematical notation	Covered throughout course	Covered throughout course
A2.CM.12	Understand and use appropriate language, representations, and terminology when describing objects, relationships, mathematical solutions, and rationale	Covered throughout course	Covered throughout course

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A2.CM.13	Draw conclusions about mathematical ideas through decoding, comprehension, and interpretation of mathematical visuals, symbols, and technical writing	Covered throughout course	Covered throughout course
A2.CN	Connections		
0	Students will recognize and use connections among mathematical ideas.		
A2.CN.1	Understand and make connections among multiple representations of the same mathematical idea	Covered throughout course	Covered throughout course
A2.CN.2	Understand the corresponding procedures for similar problems or mathematical concepts	Covered throughout course	Covered throughout course
0	Students will understand how mathematical ideas interconnect and build on one another to produce a coherent whole.		
A2.CN.3	Model situations mathematically, using representations to draw conclusions and formulate new situations	Covered throughout course	Covered throughout course
A2.CN.4	Understand how concepts, procedures, and mathematical results in one area of mathematics can be used to solve problems in other areas of mathematics	Covered throughout course	Covered throughout course

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A2.CN.5	Understand how quantitative models connect to various physical models and representations		
0	Students will recognize and apply mathematics in contexts outside of mathematics.		
A2.CN.6	Recognize and apply mathematics to situations in the outside world	Exponents and Logarithms	Exponential Functions
A2.CN.7	Recognize and apply mathematical ideas to problem situations that develop outside of mathematics	Exponents and Logarithms	Exponential Functions
A2.CN.8	Develop an appreciation for the historical development of mathematics		
A2.R	Representation		
0	Students will create and use representations to organize, record, and communicate mathematical ideas.		
A2.R.1	Use physical objects, diagrams, charts, tables, graphs, symbols, equations, or objects created using technology as representations of mathematical concepts	Conic Sections	Covered throughout unit

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A2.R.2	Recognize, compare, and use an array of representational forms		
A2.R.3	Use representation as a tool for exploring and understanding mathematical ideas		
0	Students will select, apply, and translate among mathematical representations to solve problems.		
A2.R.4	Select appropriate representations to solve problem situations		
A2.R.5	Investigate relationships among different representations and their impact on a given problem		
0	Students will use representations to model and interpret physical, social, and mathematical phenomena.		
A2.R.6	Use mathematics to show and understand physical phenomena (e.g., investigate sound waves using the sine and cosine functions)		
A2.R.7	Use mathematics to show and understand social phenomena (e.g., interpret the results of an opinion poll)		

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A2.R.8	Use mathematics to show and understand mathematical phenomena (e.g., use random number generator to simulate a coin toss)		
A2.N	Number Sense and Operations		
0	Students will understand meanings of operations and procedures, and how they relate to one another.		
0	Operations		
A2.N.1	Evaluate numerical expressions with negative and/or fractional exponents, without the aid of a calculator (when the answers are rational numbers)	Polynomial Functions	Radical and Rational Functions
A2.N.2	Perform arithmetic operations (addition, subtraction, multiplication, division) with expressions containing irrational numbers in radical form	Polynomial Functions	Radical and Rational Functions
A2.N.3	Perform arithmetic operations with polynomial expressions containing rational coefficients		
A2.N.4	Perform arithmetic operations on irrational expressions	Polynomial Functions	Radical and Rational Functions

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A2.N.5	Rationalize a denominator containing a radical expression		
A2.N.6	Write square roots of negative numbers in terms of i		
A2.N.7	Simplify powers of i	Polar Coordinates	Operations with Complex Numbers
A2.N.8	Determine the conjugate of a complex number	Polar Coordinates	Operations with Complex Numbers
A2.N.9	Perform arithmetic operations on complex numbers and write the answer in the form $a + bi$ Note: This includes simplifying expressions with complex denominators.	Polar Coordinates	Operations with Complex Numbers
A2.N.10	Know and apply sigma notation	Discrete Mathematics	Sequences and Series
A2.A	Algebra		
0	Students will represent and analyze algebraically a wide variety of problem solving situations.		

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0	Equations and Inequalities		
A2.A.1	Solve absolute value equations and inequalities involving linear expressions in one variable		
A2.A.2	Use the discriminant to determine the nature of the roots of a quadratic equation	Polynomial Functions	Quadratic Functions
A2.A.3	Solve systems of equations involving one linear equation and one quadratic equation algebraically Note: This includes rational equations that result in linear equations with extraneous roots.		
A2.A.4	Solve quadratic inequalities in one and two variables, algebraically and graphically		
A2.A.5	Use direct and inverse variation to solve for unknown values		
A2.A.6	Solve an application which results in an exponential function	Exponents and Logarithms	Exponential Functions
0	Students will perform algebraic procedures accurately.		

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0	Variables and Expressions		
A2.A.7	Factor polynomial expressions completely, using any combination of the following techniques: common factor extraction, difference of two perfect squares, quadratic trinomials	Polynomial Functions	Quadratic Functions
A2.A.8	Apply the rules of exponents to simplify expressions involving negative and/or fractional exponents	Exponents and Logarithms	Properties of Exponents/Exponential Functions
A2.A.9	Rewrite algebraic expressions that contain negative exponents using only positive exponents	Exponents and Logarithms	Properties of Exponents/Exponential Functions
A2.A.10	Rewrite algebraic expressions with fractional exponents as radical expressions		
A2.A.11	Rewrite algebraic expressions in radical form as expressions with fractional exponents		
A2.A.12	Evaluate exponential expressions, including those with base e	Exponents and Logarithms	Properties of Exponents/Exponential Functions
A2.A.13	Simplify radical expressions		

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A2.A.14	Perform addition, subtraction, multiplication and division of radical expressions		
A2.A.15	Rationalize denominators involving algebraic radical expressions		
A2.A.16	Perform arithmetic operations with rational expressions and rename to lowest terms		
A2.A.17	Simplify complex fractional expressions	Polynomial Functions	Rational Functions
A2.A.18	Evaluate logarithmic expressions in any base	Exponents and Logarithms	Logarithmic Functions
A2.A.19	Apply the properties of logarithms to rewrite logarithmic expressions in equivalent forms	Exponents and Logarithms	Logarithmic Functions
0	Equations and Inequalities		
A2.A.20	Determine the sum and product of the roots of a quadratic equation by examining its coefficients		

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A2.A.21	Determine the quadratic equation, given the sum and product of its roots		
A2.A.22	Solve radical equations	Polynomial Functions	Radical Functions
A2.A.23	Solve rational equations and inequalities	Polynomial Functions	Rational Functions
A2.A.24	Know and apply the technique of completing the square	Polynomial Functions	Quadratic Functions
A2.A.25	Solve quadratic equations, using the quadratic formula	Polynomial Functions	Quadratic Functions
A2.A.26	Find the solution to polynomial equations of higher degree that can be solved using factoring and/or the quadratic formula	Polynomial Functions	Quadratic Functions
A2.A.27	Solve exponential equations with and without common bases	Exponents and Logarithms	Exponential Functions
A2.A.28	Solve a logarithmic equation by rewriting as an exponential equation	Exponents and Logarithms	Logarithmic Functions

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0	Students will recognize, use, and represent algebraically patterns, relations, and functions.		
0	Patterns, Relations, and Functions		
A2.A.29	Identify an arithmetic or geometric sequence and find the formula for its n th term	Discrete Mathematics	Sequences and Series
A2.A.30	Determine the common difference in an arithmetic sequence	Discrete Mathematics	Sequences and Series
A2.A.31	Determine the common ratio in a geometric sequence	Discrete Mathematics	Sequences and Series
A2.A.32	Determine a specified term of an arithmetic or geometric sequence	Discrete Mathematics	Sequences and Series
A2.A.33	Specify terms of a sequence, given its recursive definition	Discrete Mathematics	Sequences and Series
A2.A.34	Represent the sum of a series, using sigma notation	Discrete Mathematics	Sequences and Series

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A2.A.35	Determine the sum of the first n terms of an arithmetic or geometric series	Discrete Mathematics	Sequences and Series
A2.A.36	Apply the binomial theorem to expand a binomial and determine a specific term of a binomial expansion	Discrete Mathematics	Sequences and Series
A2.A.37	Define a relation and function		
A2.A.38	Determine when a relation is a function		
A2.A.39	Determine the domain and range of a function from its equation		
A2.A.40	Write functions in functional notation		
A2.A.41	Use functional notation to evaluate functions for given values in the domain		
A2.A.42	Find the composition of functions		

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A2.A.43	Determine if a function is one-to-one, onto, or both		
A2.A.44	Define the inverse of a function		
A2.A.45	Determine the inverse of a function and use composition to justify the result		
A2.A.46	Perform transformations with functions and relations: $f(x + a)$, $f(x) + a$, $f(-x)$, $-f(x)$, $af(x)$		
0	Coordinate Geometry		
A2.A.47	Determine the center-radius form for the equation of a circle in standard form	Conic Sections	Circles
A2.A.48	Write the equation of a circle, given its center and a point on the circle	Conic Sections	Circles
A2.A.49	Write the equation of a circle from its graph	Conic Sections	Circles

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A2.A.50	Approximate the solution to polynomial equations of higher degree by inspecting the graph		
A2.A.51	Determine the domain and range of a function from its graph		
A2.A.52	Identify relations and functions, using graphs		
A2.A.53	Graph exponential functions of the form $y = b$ to the power x for positive values of b , including $b = e$	Exponents and Logarithms	Exponential Functions
A2.A.54	Graph logarithmic functions, using the inverse of the related exponential function	Exponents and Logarithms	Logarithmic Functions
0	Trigonometric Functions		
A2.A.55	Express and apply the six trigonometric functions as ratios of the sides of a right triangle		
A2.A.56	Know the exact and approximate values of the sine, cosine, and tangent of 0° , 30° , 45° , 60° , 90° , 180° , and 270° angles		

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A2.A.57	Sketch and use the reference angle for angles in standard position		
A2.A.58	Know and apply the co-function and reciprocal relationships between trigonometric ratios		
A2.A.59	Use the reciprocal and co-function relationships to find the value of the secant, cosecant, and cotangent of 0° , 30° , 45° , 60° , 90° , 180° , and 270° angles		
A2.A.60	Sketch the unit circle and represent angles in standard position		
A2.A.61	Determine the length of an arc of a circle, given its radius and the measure of its central angle		
A2.A.62	Find the value of trigonometric functions, if given a point on the terminal side of angle theta		
A2.A.63	Restrict the domain of the sine, cosine, and tangent functions to ensure the existence of an inverse function		
A2.A.64	Use inverse functions to find the measure of an angle, given its sine, cosine, or tangent		

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A2.A.65	Sketch the graph of the inverses of the sine, cosine, and tangent functions		
A2.A.66	Determine the trigonometric functions of any angle, using technology		
A2.A.67	Justify the Pythagorean identities		
A2.A.68	Solve trigonometric equations for all values of the variable from 0° to 360°		
A2.A.69	Determine amplitude, period, frequency, and phase shift, given the graph or equation of a periodic function		
A2.A.70	Sketch and recognize one cycle of a function of the form $y = A\sin Bx =$ or $y = A\cos Bx$		
A2.A.71	Sketch and recognize the graphs of the functions $y = \sec(x)$, $y = \csc(x)$, $y = \tan(x)$, and $y = \cot(x)$		
A2.A.72	Write the trigonometric function that is represented by a given periodic graph		

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A2.A.73	Solve for an unknown side or angle, using the Law of Sines or the Law of Cosines		
A2.A.74	Determine the area of a triangle or a parallelogram, given the measure of two sides and the included angle		
A2.A.75	Determine the solution(s) from the SSA situation (ambiguous case)		
A2.A.76	Apply the angle sum and difference formulas for trigonometric functions		
A2.A.77	Apply the double-angle and half-angle formulas for trigonometric functions		
A2.M	Measurement		
0	Students will determine what can be measured and how, using appropriate methods and formulas.		
0	Units of Measurement		

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A2.M.1	Define radian measure		
A2.M.2	Convert between radian and degree measures		
A2.S	Statistics and Probability		
0	Students will collect, organize, display, and analyze data.		
0	Collection of Data		
A2.S.1	Understand the differences among various kinds of studies (e.g., survey, observation, controlled experiment)		
A2.S.2	Determine factors which may affect the outcome of a survey		
0	Organization and Display of Data		

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A2.S.3	Calculate measures of central tendency with group frequency distributions		
A2.S.4	Calculate measures of dispersion (range, quartiles, interquartile range, standard deviation, variance) for both samples and populations		
A2.S.5	Know and apply the characteristics of the normal distribution		
0	Students will make predictions that are based upon data analysis.		
0	Predictions from Data		
A2.S.6	Determine from a scatter plot whether a linear, logarithmic, exponential, or power regression model is most appropriate		
A2.S.7	Determine the function for the regression model, using appropriate technology, and use the regression function to interpolate and extrapolate from the data		
A2.S.8	Interpret within the linear regression model the value of the correlation coefficient as a measure of the strength of the relationship		

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0	Students will understand and apply concepts of probability.		
0	Probability		
A2.S.9	Differentiate between situations requiring permutations and those requiring combinations		
A2.S.10	Calculate the number of possible permutations ($n P r$) of n items taken r at a time		
A2.S.11	Calculate the number of possible combinations ($n C r$) of n items taken r at a time		
A2.S.12	Use permutations, combinations, and the Fundamental Principle of Counting to determine the number of elements in a sample space and a specific subset (event)		
A2.S.13	Calculate theoretical probabilities, including geometric applications		
A2.S.14	Calculate empirical probabilities		

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A2.S.15	Know and apply the binomial probability formula to events involving the terms exactly, at least, and at most		
A2.S.16	Use the normal distribution as an approximation for binomial probabilities		