Algebra 2 SJPS Curriculum

Name of Unit	Learning Goals	Knowledge & Skills
UNIT 1: Linear Equations & Functions	Students will be able to… • Understand the concept of a function and use function notation • Interpret functions that arise in applications in terms of the context • Analyze functions using different representations • Build a function that models a relationship between two quantities • Create equations that describe numbers or relationships • Solve equations and inequalities in one variable • Solve systems of equations • Represent and solve equations and inequalities graphically	
UNIT 2: Data Representation & Statistics	Students will be able to… • Perform operations on matrices and use matrices in applications. • Interpret linear models. • Differentiate between and use the different types of variations. • Understand independence and conditional probability and use them to interpret data. • Use the rules of probability to compute probabilities of compound events.	

	• Understand the use of permutations and combinations with data.	
UNIT 3: Non-Linear Functions	Students will be able to… • Perform arithmetic operations on polynomials • Understand the relationship between zeros and factors of polynomials • Rewrite rational expressions	
UNIT 4: Trigonometric Functions	Students will be able to… • Define trigonometric ratios and solve problems involving right triangles • Apply trigonometry to general triangles • Extend the domain of trigonometric functions using the unit circle • Model periodic phenomena with trigonometric functions	

Unit 1: Linear Equations & Functions

Unit overview: (Narrative description of unit purpose)

In earlier grades, students defined, evaluated, and compared functions in modeling relationships between quantities. In this module, students learn function notation and develop the concepts of domain and range. They explore many examples of functions, including sequences. They interpret functions given graphically, numerically, symbolically, and verbally, translate between representations, and understand the limitations of various representations. Students explore systems of equations and inequalities, and they find and interpret their solutions and model using linear programming. They interpret arithmetic sequences as linear functions. In building models of relationships between two quantities, students analyze the key features of a graph or table of a function.

Learning Goals:

Students will be able to…

- Understand the concept of a function and use function notation
- Interpret functions that arise in applications in terms of the context

- Analyze functions using different representations
- Build a function that models a relationship between two quantities
- Create equations that describe numbers or relationships
- Solve equations and inequalities in one variable
- Solve systems of equations
- Represent and solve equations and inequalities graphically

Instructional Strategies and Structures:

- Small group and large group discussion
- Individual and/or group problem solving
- Use technology tools to demonstrate and visualize relationships
- Construct viable arguments and critique the reasoning of others

Time Span: (Length of Unit)

45 days

Assessment: (Methods used for formative and summative)

- Bell Work
- Exit Slips
- In class discussions
- Homework
- Use of student response devices
- Quizzes & Test
- Common Semester Test

Vocabulary and Key Concepts

Linear	Variable	Function
Domain	Range	Expression
Equation	Explicit	Recursive
nth term	Sequence	System
Linear combination	Arithmetic sequence	Discrete
Inequality	Linear Programming	Step Function
Compound sentence	Linear combination	Elimination
Real Numbers	Rational Numbers	Integers
Whole Numbers	Feasible region	Vertex

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Union	Intersection	Parallel
Intersecting	Coincide	Relation
Formula	Input	Output
Mapping notation	Index	Slope
Regression Line	Correlation Coefficient	Consistent
Inconsistent	Closure	

Unit 1: Linear Equations & Functions

Common Core State Standards

Understand the concept of a function and use function notation

F-IF.1 Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If *f* is a function and x is an element of its domain, then *f(x)* denotes the output x. The graph of *f* is the graph of the equation y = *f(x)*.

F-IF.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.

F-IF.3 Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. *For example, the Fibonacci sequence is defined recursively by f(0) = f(1) = 1, f(n+1) = f(n) + f(n-1) for n ≥ 1.*

Interpret functions that arise in applications in terms of the context

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*.

F-IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*

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.

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Analyze functions using different representations

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.

F-IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

Build a function that models a relationship between two quantities

F-BF.1 Write a function that describes a relationship between two quantities.

a. Determine an explicit expression, a recursive process, or steps for calculation from a context.

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.*

F-BF.2 Write arithmetic sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.

Build a function that models a relationship between two quantities

F-BF.1 Write a function that describes a relationship between two quantities

a. Determine an explicit expression, a recursive process, or steps for calculation from a context.

F-BF.2 Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.

Create equations that describe numbers or relationships.

A-CED.1 Create equations and inequalities in one variable and use them to solve problems.

A-CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

A-CED.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods*.

A-CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V = IR to highlight resistance R*.

Solve equations and inequalities in one variable

A-REI.3 Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.

Solve systems of equations

A-REI.5 Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.

A-REI.6 Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

Represent and solve equations and inequalities graphically

A-REI.10 Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

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.

A-REI.12 Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

Unit 2: Data Representation & Statistics

Unit overview: (Narrative description of unit purpose)

In this module, students see how the visual displays and summary statistics they learned in earlier grades relate to different types of data and to probability distributions. They compute and interpret probabilities from those models for compound events, attending to mutually exclusive events, independent events, and conditional probability. Students will explore the different types of variations in relation to data models as well as represent data in matrices.

Learning Goals:

Students will be able to…

- Perform operations on matrices and use matrices in applications.
- Interpret linear models.
- Differentiate between and use the different types of variations.
- Understand independence and conditional probability and use them to interpret data.
- Use the rules of probability to compute probabilities of compound events.

- Understand the use of permutations and combinations with data.

Instructional Strategies and Structures:

- Small group and large group discussion
- Individual and/or group problem solving
- Use technology tools to demonstrate and visualize relationships
- Construct viable arguments and critique the reasoning of others

Time Span: (Length of Unit)

45 days

Assessment: (Methods used for formative and summative)

- Bell Work
- Exit Slips
- In class discussions
- Homework
- Use of student response devices
- Quizzes & Tests
- Common Semester Test

Vocabulary and Key Concepts

Matrix	Scalar Multiplication	Element
Row	Column	Dimension (size)
Probability	Odds	Permutation
Combination	Events	Dependent events
Independent events	Identity Matrix	Constant
Variation	Direct variation	Inverse variation
Joint variation	Combined variation	Best Fit
Correlation Coefficient	R-value	Conditional Probability

Unit 2: Data Representation & Statistics

Common Core State Standards

Perform operations on matrices and use matrices in applications.

N-VM.6 (+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.

N-VM.7 (+) Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.

N-VM.8 (+) Add, subtract, and multiply matrices of appropriate dimensions.

Interpret linear models

S-ID.7 Interpret the slope (rate of change) and the intercept (constant term)of a linear model in the context of the data.

S-ID.8 Compute (using technology) and interpret the correlation coefficient of a linear fit.

Understand independence and conditional probability and use them to interpret data

S-CP.1 Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes, or as unions, intersections, or complements of other events ("or," "and," "not").

S-CP.2 Understand that two events *A* and *B* are independent if the probability of *A* and *B* occurring together is the product of their probabilities, and use this characterization to determine if they are independent.

S-CP.3 Understand the conditional probability of *A* given *B* as *P*(*A* and *B*)/*P*(*B*), and interpret independence of *A* and *B* as saying that the conditional probability of *A* given *B* is the same as the probability of *A*, and the conditional probability of *B* given *A* is the same as the probability of *B*.

S-CP.4 Construct and interpret 2-way frequency tables of data when 2 catagories are associated with each object being classified. Use the 2-way table as a sample space to decide if events are independent and to approximate conditional probabilities.

S-CP.5 Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations.

Use the rules of probability to compute probabilities of compound events

S-CP.6 Find the conditional probability of *A* given *B* as the fraction of *B*'s outcomes that also belong to *A*, and interpret the answer in terms of the model.

S-CP.7 Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in terms of the model.

S-CP.8 Apply the general multiplication rule in a uniform probability model, P(A and B)=P(A)P(B|A) = P(B)P(A|B), and interpret the answer in terms of the model.

S-CP.9 (+) Use permutations and combinations to compute probabilities of compound events and solve problems.

Unit 3: Non-Linear Functions

Unit overview: (Narrative description of unit purpose)

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In this module students synthesize and generalize what they have learned about a variety of function families. They will explore and solve radical, rational, quadratic, power, exponential and logarithmic functions. They notice, by looking for general methods in repeated calculations, that the transformations on a quadratic graph always have the same effect regardless of the type of the underlying function. These observations lead to students to conjecture and construct general principles about how the graph of a function changes after applying a function transformation to that function. Students identify appropriate types of functions to model a situation, they adjust parameters to improve the model, and they compare models by analyzing appropriateness of fit and making judgments about the domain over which a model is a good fit. Students identify zeros of quadratic functions, including complex zeros of quadratic polynomials. Students analyze the key features of a graph or table of a polynomial function and relate those features back to the two quantities in the problem that the function is modeling.

Learning Goals:

Students will be able to…

- Perform arithmetic operations on polynomials
- Understand the relationship between zeros and factors of polynomials
- Rewrite rational expressions

Instructional Strategies and Structures:

- Small group and large group discussion
- Individual and/or group problem solving
- Use technology tools to demonstrate and visualize relationships
- Construct viable arguments and critique the reasoning of others

Time Span: (Length of Unit)

45 days

Assessment: (Methods used for formative and summative)

- Bell Work
- Exit Slips
- In class discussions
- Homework
- Use of student response devices
- Quizzes & Test
- Common Semester Test

Vocabulary and Key Concepts

Quadratic	Standard form	Absolute Value
Square Root	Irrational Number	Axis of Symmetry

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Minimum	Maximum	Imaginary Number
Complex Number	Complex Conjugate	Discriminant
Root	Base	Exponent
Power	Squaring	Cubing
Compound	Interest	Principle
Effective Yield	Geometric Sequence	Radical Notation
Composition	Inverse	Radical
Geometric Mean	Conjugate	Extraneous Solution
Growth	Decay	Half-life
Continuous compounding	Common Logarithm	Natural Logarithm

Unit 3:Non-Linear Functions

Common Core State Standards

Reason quantitatively and use units to solve problems.

N-Q.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

N-Q.2 Define appropriate quantities for the purpose of descriptive modeling.

N-Q.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

Perform arithmetic operations with complex numbers.

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.

N-CN.2 Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

N-CN.3 (+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.

Use complex numbers in polynomial identities and equations.

N-CN.7 Solve quadratic equations with real coefficients that have complex solutions.

Extend the properties of exponents to rational exponents.

N-RN.1 Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a

notation for radicals in terms of rational exponents. *For example, we define* $5^{1/3}$ *to be the cube root of 5 because we want* $(5^{1/3})^3 = 5^{(1/3)3}$ *to hold, so* $(5^{1/3})^3$ *must equal 5*.

N-RN.2 Rewrite expressions involving radicals and rational exponents using the properties of exponents.

Interpret the structure of expressions

A-SSE.1 Interpret expressions that represent a quantity in terms of its context.

a. Interpret parts of an expression, such as terms, factors, and coefficients.

b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret P(1+ r)^n as the product of P and a factor not depending on P.*

A-SSE.2 Use the structure of an expression to identify ways to 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* $(x^2 - y^2)(x^2 + y^2)$.

Write expressions in equivalent forms to solve problems

A-SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.

c. Use the properties of exponents to transform expressions for exponential functions. *For example the expression* 1.15^t *can be rewritten as* $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ *to reveal the approximate equivalent monthly interest rate if the annual rate is 15%*.

A-SSE.4 Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. *For example calculate mortgage payments*.

Perform arithmetic operations on polynomials

A-APR.1 Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication;add,subtract, and multiply polynomials.

Understand the relationship between zeros and factors of polynomials

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) = 0 if and only if (x-a) is a factor of p(x).

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.

Use polynomial identities to solve problems

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.

Rewrite rational expressions

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.

A-APR.7 Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by nonzerorational expression;add, subtract, multiply, and divide rational expressions.

Create equations that describe numbers or relationships

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.*

Understand solving equations as a process of reasoning and explain the reasoning

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.

A-REI.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Solve equations and inequalities in one variable

A-REI.4 Solve quadratic equations in one variable

a. Use the method of completing the square to transform any quadratric 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.

b. 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.

Solve systems of equations

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 $x^2 + y^2 = 3$.*

Represent and solve equations and inequalities graphically

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.

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Analyze functions using different representations

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.

e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

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 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.*

F-IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically 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.*

Build new functions from existing functions

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.*

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* $x \neq 1$.

b. (+) Verify by composition that one function is the inverse of another.

c. (+) Read values of an inverse function from a graph or a table, given that the function has an inverse.

F-BF.5 (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.

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. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.

c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.

Construct and compare linear, quadratic, and exponential models and solve problems

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).

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.

F-LE.4 For exponential models, express as a logarithm the solution to $ab^{ct} = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.

Interpret expressions for functions in terms of the situation they model

F-LE.5 Interpret the parameters in a linear or exponential function in terms of a context.

Unit 4: **Trigonometric Functions**

Unit overview: (Narrative description of unit purpose)

Building on their previous work with functions, and on their work with trigonometric ratios and circles in Geometry, students apply trigonometric ratios to find missing measures of general (not necessarily right) triangles. Students then extend trigonometric functions to all (or most) real numbers. To reinforce their understanding of these functions, students begin building fluency with the values of sine, cosine, and tangent at π/6, π/4, π/3, π/2, etc. Students make sense of periodic phenomena as they model with trigonometric functions.

Learning Goals:

Students will be able to…

- Define trigonometric ratios and solve problems involving right triangles
- Apply trigonometry to general triangles
- Extend the domain of trigonometric functions using the unit circle
- Model periodic phenomena with trigonometric functions

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Instructional Strategies and Structures:

- Small group and large group discussion
- Individual and/or group problem solving
- Use technology tools to demonstrate and visualize relationships
- Construct viable arguments and critique the reasoning of others

Time Span: (Length of Unit)

45 days

Assessment: (Methods used for formative and summative)

- Bell Work
- Exit Slips
- In class discussions
- Homework
- Use of student response devices
- Quizzes & Test
- Common Semester Test

Vocabulary and Key Concepts

sine	cosine	tangent
inverse functions	angle of elevation	angle of depression
unit circle	period	radian
Law of Cosines	Law of Sines	

Unit 4:Trigonometric Functions

Common Core State Standards

Define trigonometric ratios and solve problems involving right triangles

G-SRT.6 Understand that by similarity, side ratios in right triangles are properties of the angles in the triangle, leading to definitions of trigonometric ratios for acute angles.

G-SRT.7 Explain and use the relationship between the sine and cosine of complementary angles.

G-SRT.8 Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Apply trigonometry to general triangles

G-SRT.11 (+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).

Extend the domain of trigonometric functions using the unit circle

F-TF.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.

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.

Model periodic phenomena with trigonometric functions

F-TF.5 Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.

Prove and apply trigonometric identities

F-TF.8 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.