Number Expressions N.NE

P.N.NE.A.1 Use the laws of exponents and logarithms to expand or collect terms in expressions; simplify expressions or modify them in order to analyze them or compare them.

1. I can use the law of exponents.

2. I can simplify expressions.

3. I can evaluate and rewrite logarithms.

P.N.NE.A.2 Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents

4. I can utilize inverse relationships.

P.N.NE.A.3 Classify real numbers and order real numbers that include transcendental expressions, including roots and fractions of π and e. expressions.

5. I can classify and order functions that are not finite, including e and pi.

P.N.NE.A.4 Simplify complex radical and rational expressions; discuss and display understanding that rational numbers are dense in the real numbers and the integers are not.

6. I can simplify complex expressions.

P.N.NE.A.5 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.

7. I can perform operations on rational expressions.

Complex Number System N.CN

P.N.CN.A.1 Perform arithmetic operations with complex numbers expressing answers in the form a + bi.

1. I can perform operations on complex numbers.

P.N.CN.A.2 Find the conjugate of a complex number; use conjugates to find moduli A. Perform complex and quotients of complex numbers. number arithmetic and understand the representation on the complex plane.

2. I can find conjugates of complex numbers and utilize those in solving problems.

P.N.CN.A.3 Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number.

3. I can graph complex numbers.

P.N.CN.A.4 Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. For example, (–1 +3 i) 3 = 8 because (–1 +3 i) has modulus 2 and argument 120°.

4. I can do transformations of complex graphs by utilizing operations.

P.N.CN.A.5 Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints.

5. I can find the distance and midpoint of numbers in a complex plane.

P.N.CN.B.6 Extend polynomial identities to the complex numbers. For example, rewrite x2 + 4 as (x + 2i)(x – 2i). P.N.CN.B.7 Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.

6. Use complex numbers in polynomial identities and equations.

Sequences and Series A.S

P.A.S.A.1 Demonstrate an understanding of sequences by representing them recursively and explicitly.

1. I can find any value in a sequence.

2. I can find the nth term in a sequence.

P.A.S.A.2 Use sigma notation to represent a series; expand and collect expressions in both finite and infinite settings.

3. I can use sigma notation to represent a series

4. I can express both finite and infinite sets of data

P.A.S.A.3 Derive and use the formulas for the general term and summation of finite or infinite arithmetic and geometric series, if they exist.

5. I can determine whether a given arithmetic or geometric series converges or diverges.

6. I can find the sum of a given geometric series (both infinite and finite).

7. I can find the sum of a finite arithmetic series.

P.A.S.A.4 Understand that series represent the approximation of a number when truncated; estimate truncation error in specific examples.

8. I can understand the truncating process in estimation.

P.A.S.A.5 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.

9. I can illustrate and explain Pascal's triangle.

10. I can apply the Binomial Theorem to expressions.

Parametric Equations A.PE

P.A.PE.A.1 Graph curves parametrically (by hand and with appropriate technology).

1. I can graph rational curves by hand.

P.A.PE.A.2 Eliminate parameters by rewriting parametric equations as a single equation.

2. I can rewrite parametric equations as one equation.

Conic Sections A.C

P.A.C.A.1 Display all of the conic sections as portions of a cone.

1. I can show a conic section as part of a cone.

P.A.C.A.2 Derive the equations of ellipses and hyperbolas given the foci,

2. I can derive an ellipse or hyperbola equation given the foci.

P.A.C.A.3 From an equation in standard form, graph the appropriate conic section: real-world ellipses, hyperbolas, circles, and parabolas. Demonstrate an understanding of the phenomena. Relationship between their standard algebraic form and the graphical characteristics.

3. I can graph a conic section.

4. I can use ellipses in real world scenarios.

5. I can use hyperbolas in real world scenarios.

6. I can use circle in real world scenarios.

7. I can use parabolas in real world scenarios.

P.A.C.A.4 Transform equations of conic sections to convert between general and standard form.

8. I can change forms of conic sections equations.

Building Functions F.BF

P.F.BF.A.1 Understand how the algebraic properties of an equation transform the geometric properties of its graph. For example, given a function, describe the transformation of the graph resulting from the manipulation of the algebraic properties of the equation (i.e., translations, stretches, reflections, and changes in periodicity and amplitude).

1. I can complete transformations on algebraic equations.

P.F.BF.A.2 Develop an understanding of functions as elements that can be operated upon to get new functions: addition, subtraction, multiplication, division, and composition of functions.

2. I can find composite functions.

3. I can perform operations on functions.

P.F.BF.A.3 Compose functions. For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.

4. I can compose functions.

P.F.BF.A.4 Construct the difference quotient for a given function and simplify the resulting expression.

5. I can use the difference quotient on functions.

P.F.B F.A.5 Find inverse functions (including exponential, logarithmic, and trigonometric).

6. I can calculate the inverse of a function.

7. I can verify that functions are inverses of each other.

P.F.BF.A.6 Explain why the graph of a function and its inverse are reflections of one another over the line $y = x$.

8. I can explain the relationship of inverse functions and show relationship graphically.

Interpreting Functions F.IF

P.F.IF.A.1 Determine whether a function is even, odd, or neither.

1. I can determine if a function is even, odd, or neither.

P.F.IF.A.2 Analyze qualities of exponential, polynomial, logarithmic, trigonometric, and rational functions and solve real-world problems that can be modeled with these functions (by hand and with appropriate technology).

2. I can solve real world problems involving various types of functions.

P.F.IF.A.4 Identify the real zeros of a function and explain the relationship between the real zeros and the x-intercepts of the graph of a function (exponential, polynomial, logarithmic, trigonometric, and rational).

3. I can find the zeros of a function.

P.F.IF.A.5 Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax2+ c$.

4. I can name the different parts of a graph by the equation.

P.F.IF.A.6 Visually locate critical points on the graphs of functions and determine if each critical point is a minimum, a maximum, or point of inflection. Describe intervals where the function is increasing or decreasing and where different types of concavity occur.

5. I can find the critical points of a function.

6. I can find the minimum and maximum of a function.

7. I can find the points of inflection of a function.

8. I can find where a function is increasing or decreasing.

9. I can label concavity.

P.F.IF.A.7 Graph rational functions, identifying zeros, asymptotes (including slant), and holes (when suitable factorizations are available) and showing end-behavior.

9. I can graph rational functions.

10. I can identify asymptotes.

11. I can identify holes in a graph.

12. I can show end behavior of a graph.

P.F.IF.A.8 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 $n \geq 1$.

13. I can recognize that sequences are functions.

Trigonometric Functions F.TF

P.F.TF.A.1 Convert from radians to degrees and from degrees to radians.

1. I can convert radians to degrees.

2. I can convert degrees to radians.

P.F.TF.A.2 Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and use the unit circle to express the values of A

3. I can use special triangles to find trigonometric values.

P.F.TF.A.3 Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.

4. I can complete a unit circle.

5. I can explain the symmetry of the unit circle.

P.F.TF.A.4 Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.

6. I can find the amplitude of trig functions.

7. I can find the frequency of trig functions.

8. I can find the midline of trig functions.

Graphing Trigonometric Functions F.GT

P.F.GT.A.1 Interpret transformations of trigonometric functions.

1. I can interpret trigonometric transformations.

P.F.GT.A.2 Determine the difference made by choice of units for angle measurement when graphing a trigonometric function.

2. I can express unit differences for angle measure when graphing trig functions.

P.F.GT.A.3 Graph the six trigonometric functions and identify characteristics such as period, amplitude, phase shift, and asymptotes.

3. I can graph the six trigonometric functions.

4. I can find period of trig functions.

5. I can find amplitude of trig functions.

6. I can find phase shift and express relevance.

7. I can find asymptotes.

P.F.GT.A.4 Find values of inverse trigonometric expressions (including A. Model periodic compositions), applying appropriate domain and range restrictions. phenomena with trigonometric

8. I can find the values of inverse trig functions.

P.F.GT.A.5 Understand that restricting a trigonometric function to a domain on functions.

9. I can restrict the domain of trig functions.

P.F.GT.A.6 Determine the appropriate domain and corresponding range for each of the inverse trigonometric functions.

10. I can determine domain and range for inverse trig functions.

P.F.GT.A.7 Graph the inverse trigonometric functions and identify their key characteristics.

11. I can graph inverse trig functions and identify its parts.

P.F.GT.A.8 Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.

12. I can use inverse functions to solve trig equations.

Applied Trigonometry G.AT

P.G.AT.A.1 Use the definitions of the six trigonometric ratios as ratios of sides in a right triangle to solve problems about lengths of sides and measures of angles.

1. I can use the trigonometric ratios to solve right triangles.

2. I can use the law of sines.

3. I can use the law of cosines.

P.G.AT.A.2 Derive the formula A = 1/2 ab sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.

4. I can find the area of a triangle.

P.G.AT.A.3 Derive and apply the formulas for the area of sector of a circle.

5. I can use the formula for the area of a sector of a circle.

P.G.AT.A.4 Calculate the arc length of a circle subtended by a central angle.

6. I can calculate the arc length of a circle.

P.G.AT.A.5 Prove the Laws of Sines and Cosines and use them to solve problems.

7. I can use Law of Sines to solve problems.

8. I can use Law of Cosines to solve problems.

P.G.AT.A.6 Understand and apply the Law of Sines (including the ambiguous case) and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).

9. I can explain the ambiguous case.

10. I can find unknown measures in non-right triangles.

Trigonometric Identities G.TI

P.G.TI.A.1 Apply trigonometric identities to verify identities and solve equations. Identities include: Pythagorean, reciprocal, quotient, sum/difference, double-angle, and half-angle.

1. I can verify trigonometric identities involving Pythagorean, reciprocal, quotient, sum/difference, double-angle, and half-angle.

2. I can solve trigonometric equations Pythagorean, reciprocal, quotient, sum/difference, double-angle, and half-angle.

P.G.TI.A.2 Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.

3. I can prove and use the addition and subtraction formulas for trigonometric problems.

Polar Coordinates G.PC

P.G.PC.A.1 Graph functions in polar coordinates.

1. I can graph functions in polar coordinates.

P.G.PC.A.2 Convert between rectangular and polar coordinates.

2. I can convert between rectangular and polar coordinates.

P.G.PC.A.3 Represent situations and solve problems involving polar coordinates.

3. I can solve problems involving polar coordinates.

Model with Data S.MD

P.S.MD.A.1 Create scatter plots, analyze patterns, and describe relationships for bivariate data (linear, polynomial, trigonometric, or exponential) to model real-world phenomena and to make predictions.

1. I can use data to model real-world phenomena and make predictions.

P.S.MD.A.2 Determine a regression equation to model a set of bivariate data. Justify why this equation best fits the data.

2. I can model data and justify solutions using regression equations.

P.S.MD.A.3 Use a regression equation, modeling bivariate data, to make predictions. Identify possible considerations regarding the accuracy of predictions when interpolating or extrapolating.

3. I can use regression equations to make predictions.