California Mathematics

Algebra II

Number and Quantity N

N-CN. The Complex Number System N-CN

Use complex numbers in polynomial identities and equations.

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

8 (+) Extend polynomial identities to the complex numbers. For example, rewrite x2 + 4 as (x + 2i)(x – 2i). N-CN.8

9 +) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials. N-CN.9

Perform arithmetic operations with complex numbers.

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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.1

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

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

Algebra A

A-SSE. Seeing Structure in Expressions A-SSE

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Interpret the structure of expressions.

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

   a Interpret parts of an expression, such as terms, factors, and coefficients. A-SSE.1.A

   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.1.B

2 Use the structure of an expression to identify ways to rewrite it. A-SSE.2

Write expressions in equivalent forms to solve problems.

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. A-SSE.4

A-APR. Arithmetic with Polynomials and Rational Expressions A-APR

Perform arithmetic operations on polynomials.

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. A-APR.1

Understand the relationship between zeros and factors of polynomials.

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), so p(a) = 0 if and only if (x – a) is a factor of p(x). A-APR.2

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. A-APR.3

Use polynomial identities to solve problems.

4 Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity (x2 + y2) 2 = (x2 – y2) 2 + (2xy)2 can be used to generate Pythagorean triples. A-APR.4

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.12 A-APR.5

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Rewrite rational expressions.

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.6

7 (+) 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. A-APR.7

A-CED. Creating Equations A-CED

Create equations that describe numbers or relationships.

1 Create equations and inequalities in one variable including ones with absolute value and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions A-CED.1

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

3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. A-CED.3

4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. A-CED.4

A-REI. Reasoning with Equations and Inequalities A-REI

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

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

Solve equations and inequalities in one variable.

3.1 Solve one-variable equations and inequalities involving absolute value, graphing the solutions and interpreting them in context. A-REI.3.1

Represent and solve equations and inequalities graphically.

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. A-REI.11

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Fu **. Interpreting Functions** F-IF

Interpret functions that arise in applications in terms of the context.

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.4

5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. F-IF.5

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. F-IF.6

Analyze functions using different representations.

7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. F-IF.7

- b Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions F-IF.7.B
- c Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. F-IF.7.C
- e Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. F-IF.7.E

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

9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). F-IF.9

F-BF. Building Functions F-BF

Build a function that models a relationship between two quantities.

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

- 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.1.B

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Build new functions from existing functions.

3 Identify the effect on the graph of replacing f(x) by f(x) + k, kf(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.3

4 Find inverse functions. F-BF.4

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) =2x3 or f(x) = (x + 1)/(x − 1) for x ≠ 1. F-BF.4.A

F-LE. Linear, Quadratic, and Exponential Models F-LE

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

4 For exponential models, express as a logarithm the solution to abct = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology. ⊠ [Logarithms as solutions for exponentials] F-LE.4

4.1 Prove simple laws of logarithms. F-LE.4.1

4.2 Use the definition of logarithms to translate between logarithms in any base. F-LE.4.2

4.3 Understand and use the properties of logarithms to simplify logarithmic numeric expressions and to identify their approximate values. F-LE.4.3

F-TF. Trigonometric Functions F-TF

Extend the domain of trigonometric functions using the unit circle.

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

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. F-TF.2

2.1 Graph all 6 basic trigonometric functions. F-TF.2.1

Model periodic phenomena with trigonometric functions.

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

Prove and apply trigonometric identities.

8 Prove the Pythagorean identity sin2 (θ) + cos2 (θ) = 1 and use it to find sin(θ), cos(θ), or tan(θ) given sin(θ), cos(θ), or tan(θ) and the quadrant of the angle. F-TF.8

Translate between the geometric description and the equation for a conic section.

Given a quadratic equation of the form ax2 + by2 + cx + dy + e = 0, use the method for completing the square to put the equation into standard form; identify whether the graph of the equation is a circle, ellipse, parabola, or hyperbola and graph the equation. [In Algebra II, this standard addresses only circles and parabolas. G-GPE.3.1

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Statistics and Probability S

S-ID. Interpreting Categorical and Quantitative Data S-ID

Summarize, represent, and interpret data on a single count or measurement variable.

4 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve. S-ID.4

S-IC. Making Inferences and Justifying Conclusions S-IC

Understand and evaluate random processes underlying statistical experiments.

1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population. S-IC.1

2 Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model? S-IC.2

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Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each. S-IC.3

4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling. S-IC.4

5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. S-IC.5

6 Evaluate reports based on data. S-IC.6

S-MD. Using Probability to Make Decisions S-MD

Use probability to evaluate outcomes of decisions.

6 (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator). S-MD.6

7 (+) Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game). S-MD.7