****Study Resources for the *Praxis*® Mathematics: Content Knowledge Test (5161)****

The links below allow you to connect content topics  
 on this *Praxis*® test directly to free Khan Academy study resources.

| *Praxis* Mathematics: Content Knowledge (5161)  Content Topics | Study Resources |
| --- | --- |
| I. Number and Quality, Algebra, Functions, and Calculus | Lesson |
| Number and Quality | |
| Understands the properties of exponents |  |
| * 1. Understands the role of phonics and word analysis in literacy development | [Algebra I / Exponent properties review](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:rational-exponents-radicals/x2f8bb11595b61c86:exponent-properties-review/v/multiplying-and-dividing-powers-with-integer-exponents)  [Algebra 2 / Rational exponents](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:exp/x2ec2f6f830c9fb89:rational-exp/v/basic-fractional-exponents) |
| * 1. Demonstrate an understanding of the properties of exponential expressions | [Algebra I / Exponent properties review](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:rational-exponents-radicals/x2f8bb11595b61c86:exponent-properties-review/v/multiplying-and-dividing-powers-with-integer-exponents)  [Algebra 2 / Properties of exponents (rational exponents)](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:exp/x2ec2f6f830c9fb89:exp-properties/v/simplifying-exponent-expression-with-division) |
| * 1. Use the properties of exponents to rewrite expressions that have radicals or rational exponents | [Algebra I / Radicals](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:rational-exponents-radicals/x2f8bb11595b61c86:radicals/v/introduction-to-square-roots)  [Algebra I / Simplifying square roots](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:rational-exponents-radicals/x2f8bb11595b61c86:simplifying-square-roots/v/simplifying-square-roots-1)  [Algebra 2 / Evaluating exponents & radicals](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:exp/x2ec2f6f830c9fb89:eval-exp-rad/v/fractional-exponents-with-numerators-other-than-1)  [Algebra 2 / Equivalent forms of exponential expressions](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:exp/x2ec2f6f830c9fb89:equivalent-exp/v/simplifying-an-exponential-expression) |
| Understands the properties of rational and irrational numbers, and the interactions between those sets of numbers | [Algebra I / Irrational numbers](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:irrational-numbers/x2f8bb11595b61c86:irrational-numbers-intro/v/introduction-to-rational-and-irrational-numbers)  [Algebra I / Proofs concerning irrational numbers](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:irrational-numbers/x2f8bb11595b61c86:proofs-concerning-irrational-numbers/v/proof-that-square-root-of-2-is-irrational) |
| * 1. Recognize that the sum or product of two rational numbers is rational | [Algebra I / Sums and products of rational and irrational numbers](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:irrational-numbers/x2f8bb11595b61c86:sums-and-products-of-rational-and-irrational-numbers/v/sum-and-product-of-rational-numbers) |
| * 1. Recognize that the sum of a rational number and an irrational number is irrational | [Algebra I / Sums and products of rational and irrational numbers](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:irrational-numbers/x2f8bb11595b61c86:sums-and-products-of-rational-and-irrational-numbers/v/sum-and-product-of-rational-numbers) |
| * 1. Recognize that the product of a nonzero rational number and an irrational number is irrational | [Algebra I / Sums and products of rational and irrational numbers](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:irrational-numbers/x2f8bb11595b61c86:sums-and-products-of-rational-and-irrational-numbers/v/sum-and-product-of-rational-numbers) |
| * 1. Recognize that the sum or product of two irrational numbers can be rational or irrational | [Algebra I / Sums and products of rational and irrational numbers](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:irrational-numbers/x2f8bb11595b61c86:sums-and-products-of-rational-and-irrational-numbers/v/sum-and-product-of-rational-numbers) |
| Understands how to solve problems by reasoning quantitatively (e.g., dimensional analysis, reasonableness of solutions) |  |
| * 1. Use units as a way to understand problems and to guide the solution of multistep problems | [Algebra I / Rate conversion](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:working-units/x2f8bb11595b61c86:rate-conversion/v/dimensional-analysis-units-algebraically) |
| * 1. Choose and interpret units consistently in formulas | [Algebra I / Appropriate units](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:working-units/x2f8bb11595b61c86:appropriate-units/v/appropriate-units) |
| * 1. Choose and interpret the scale and the origin in graphs and data displays |  |
| * 1. Recognize the reasonableness of results within the context of a given problem | [Algebra I / Appropriate units](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:working-units/x2f8bb11595b61c86:appropriate-units/v/appropriate-units)  [Algebra I / Word problems with multiple units](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:working-units/x2f8bb11595b61c86:word-problems-multiple-units/v/can-a-squirrel-avoid-getting-run-over) |
| Understands the structure of the natural, integer, rational, real, and complex number systems and how the basic operations on numbers in these systems are performed |  |
| * 1. Solve problems using addition, subtraction, multiplication, and division of rational, irrational, and complex numbers | [Algebra I / Substitution and evaluating expressions](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:foundation-algebra/x2f8bb11595b61c86:substitute-evaluate-expression/v/evaluating-expressions-in-two-variables)  [Algebra I / Division by zero](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:foundation-algebra/x2f8bb11595b61c86:division-zero/v/why-dividing-by-zero-is-undefined)  [Algebra 2 / The imaginary unit i](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:complex/x2ec2f6f830c9fb89:imaginary/v/introduction-to-i-and-imaginary-numbers)  [Algebra 2 / Complex numbers introduction](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:complex/x2ec2f6f830c9fb89:complex-num/v/complex-number-intro)  [Algebra 2 / Adding and subtracting complex numbers](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:complex/x2ec2f6f830c9fb89:complex-add-sub/v/adding-complex-numbers)  [Algebra 2 / Multiplying complex numbers](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:complex/x2ec2f6f830c9fb89:complex-mul/a/multiplying-complex-numbers)  [Precalculus / What are the imaginary numbers?](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:complex/x9e81a4f98389efdf:imaginary-intro/v/introduction-to-i-and-imaginary-numbers)  [Precalculus / What are the complex numbers?](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:complex/x9e81a4f98389efdf:complex-intro/v/complex-number-intro)  [Precalculus / Adding and subtracting complex numbers](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:complex/x9e81a4f98389efdf:complex-add-sub/v/adding-complex-numbers)  [Precalculus / Multiplying complex numbers](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:complex/x9e81a4f98389efdf:complex-mul/a/multiplying-complex-numbers)  [Precalculus / Complex conjugates and dividing complex numbers](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:complex/x9e81a4f98389efdf:complex-div/v/complex-conjugates)  [Precalculus / Identities with complex numbers](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:complex/x9e81a4f98389efdf:complex-id/v/factoring-sums-of-squares) |
| * 1. Apply the order of operations | [Pre-algebra / Order of operations](https://www.khanacademy.org/math/pre-algebra/pre-algebra-arith-prop/pre-algebra-order-of-operations/v/introduction-to-order-of-operations) |
| * 1. Given operations on a number system, determine whether the properties (e.g., commutative, associative, distributive) hold |  |
| * 1. Compare, classify, and order real numbers |  |
| * 1. Simplify and approximate radicals | [Algebra I / Simplifying square roots](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:rational-exponents-radicals/x2f8bb11595b61c86:simplifying-square-roots/v/simplifying-square-roots-1)  [Algebra 2 / The imaginary unit i](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:complex/x2ec2f6f830c9fb89:imaginary/v/introduction-to-i-and-imaginary-numbers) |
| * 1. Find conjugates of complex numbers | [Precalculus / Complex conjugates and dividing complex numbers](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:complex/x9e81a4f98389efdf:complex-div/v/complex-conjugates) |
| * 1. Demonstrate an understanding of the properties of counting numbers (e.g., prime, composite, prime factorization, even, odd, factors, multiples) |  |
| Understands how to work with complex numbers when solving polynomial equations and rewriting polynomial expressions |  |
| * 1. Solve quadratic equations with real coefficients that have complex solutions | [Algebra I / The quadratic formula](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:quadratic-formula-a1/v/using-the-quadratic-formula)  [Algebra 2 / Quadratic equations with complex solutions](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:complex/x2ec2f6f830c9fb89:complex-eq/v/complex-roots-from-the-quadratic-formula) |
| * 1. Extend polynomial identities to the complex numbers (e.g., | [Algebra I / Special products of binomials](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratics-multiplying-factoring/x2f8bb11595b61c86:special-product-binomials/v/difference-of-squares-pattern-for-simple-binomials)  [Algebra 2 / Special products of polynomials](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-arithmetic/x2ec2f6f830c9fb89:special-products/v/poly-diff-of-squares)  [Algebra 2 / Polynomial identities](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-factor/x2ec2f6f830c9fb89:poly-identities/v/polynomial-identities-intro)  [Precalculus / Identities with complex numbers](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:complex/x9e81a4f98389efdf:complex-id/v/factoring-sums-of-squares) |
| * 1. Verify the fundamental theorem of algebra for quadratic polynomials | [Algebra I / The quadratic formula](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:quadratic-formula-a1/v/using-the-quadratic-formula)  [Algebra 2 / Quadratic equations with complex solutions](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:complex/x2ec2f6f830c9fb89:complex-eq/v/complex-roots-from-the-quadratic-formula) |
| Understands how to perform operations on matrices and how to use matrices in applications |  |
| * 1. Use matrices to represent and manipulate data | [Precalculus / Introduction to matrices](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:matrices/x9e81a4f98389efdf:mat-intro/v/introduction-to-the-matrix)  [Precalculus / Model real-world situations with matrices](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:matrices/x9e81a4f98389efdf:model-situations-with-matrices/v/data-in-matrices) |
| * 1. Multiply matrices by scalars to produce new matrices | [Precalculus / Multiplying matrices by scalars](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:matrices/x9e81a4f98389efdf:multiplying-matrices-by-scalars/v/scalar-multiplication)  [Precalculus / Properties of matrix addition & scalar multiplication](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:matrices/x9e81a4f98389efdf:properties-of-matrix-addition-and-scalar-multiplication/a/intro-to-zero-matrices) |
| * 1. Add, subtract, and multiply matrices of appropriate dimensions | [Precalculus / Adding and subtracting matrices](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:matrices/x9e81a4f98389efdf:adding-and-subtracting-matrices/v/matrix-addition-and-subtraction-1)  [Precalculus / Properties of matrix addition & scalar multiplication](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:matrices/x9e81a4f98389efdf:properties-of-matrix-addition-and-scalar-multiplication/a/intro-to-zero-matrices)  [Precalculus / Multiplying matrices by matrices](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:matrices/x9e81a4f98389efdf:multiplying-matrices-by-matrices/v/matrix-multiplication-intro) |
| * 1. Understand that matrix multiplication for square matrices is not a commutative operation but still satisfies the associative and distributive properties | [Precalculus / Properties of matrix multiplication](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:matrices/x9e81a4f98389efdf:properties-of-matrix-multiplication/v/defined-and-undefined-matrix-operations) |
| * 1. Understand the role played by zero, and identity matrices in matrix addition and multiplication | [Precalculus / Properties of matrix addition & scalar multiplication](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:matrices/x9e81a4f98389efdf:properties-of-matrix-addition-and-scalar-multiplication/a/intro-to-zero-matrices)  [Precalculus / Properties of matrix multiplication](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:matrices/x9e81a4f98389efdf:properties-of-matrix-multiplication/v/defined-and-undefined-matrix-operations) |
| * 1. Understand that the determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse | [Precalculus / The determinant of a 2x2 matrix](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:matrices/x9e81a4f98389efdf:determinant-of-2x2-matrix/v/finding-the-determinant-of-a-2x2-matrix)  [Precalculus / Introduction to matrix inverses](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:matrices/x9e81a4f98389efdf:intro-to-matrix-inverses/v/inverse-matrix-part-1)  [Precalculus / Finding the inverse of a matrix using its determinant](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:matrices/x9e81a4f98389efdf:finding-inverse-matrix-with-determinant/v/inverse-of-a-2x2-matrix)  [Precalculus / Practice finding the inverses of 2x2 matrices](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:matrices/x9e81a4f98389efdf:practice-finding-inverses-of-2x2-matrices/e/matrix_inverse_2x2) |
| * 1. Work with  matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area | [Precalculus / Matrices as transformations](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:matrices/x9e81a4f98389efdf:matrices-as-transformations/v/transforming-position-vector) |
| Understands how to solve problems involving ratios, proportions, averages, percents, and metric and traditional unit conversions |  |
| * 1. Apply the concept of a ratio and use ratio language and notation to describe a relationship between two quantities | [Pre-algebra / Intro to ratios](https://www.khanacademy.org/math/pre-algebra/pre-algebra-ratios-rates/pre-algebra-ratios-intro/v/ratios-intro) |
| * 1. Compute unit rates. | [Pre-algebra / Intro to rates](https://www.khanacademy.org/math/pre-algebra/pre-algebra-ratios-rates/pre-algebra-rates/v/introduction-to-rates) |
| * 1. Use ratio reasoning to convert rates | [Pre-algebra / Visualize ratios](https://www.khanacademy.org/math/pre-algebra/pre-algebra-ratios-rates/pre-algebra-visualize-ratios/v/ratios-and-double-number-lines)  [Pre-algebra / Ratio application](https://www.khanacademy.org/math/pre-algebra/pre-algebra-ratios-rates/pre-algebra-ratio-word-problems/v/ratios-on-coordinate-plane) |
| * 1. Solve problems involving scale factors |  |
| * 1. Recognize and represent proportional and inversely proportional relationships between two quantities | [Pre-algebra / Constant of proportionality](https://www.khanacademy.org/math/pre-algebra/pre-algebra-ratios-rates/pre-algebra-constant-of-proportionality/v/identifying-constant-of-proportionality-graphically)  [Pre-algebra / Identifying proportional relationships](https://www.khanacademy.org/math/pre-algebra/pre-algebra-ratios-rates/pre-algebra-proportional-rel/v/introduction-to-proportional-relationships)  [Pre-algebra / Writing & solving proportions](https://www.khanacademy.org/math/pre-algebra/pre-algebra-ratios-rates/pre-algebra-write-and-solve-proportions/v/find-an-unknown-in-a-proportion)  [Algebra (all content) / Direct and inverse variation](https://www.khanacademy.org/math/algebra-home/alg-rational-expr-eq-func/alg-direct-and-inverse-variation/v/direct-and-inverse-variation) |
| * 1. Use proportional relationships to solve multistep ratio, average, and percent problems | [Pre-algebra / Intro to percents](https://www.khanacademy.org/math/pre-algebra/pre-algebra-ratios-rates/pre-algebra-intro-percents/v/describing-the-meaning-of-percent)  [Pre-algebra / Percent, fraction, decimal conversions](https://www.khanacademy.org/math/pre-algebra/pre-algebra-ratios-rates/pre-algebra-percent-decimal-conversions/v/converting-decimals-to-percents-ex-1)  [Pre-algebra / Percent problems](https://www.khanacademy.org/math/pre-algebra/pre-algebra-ratios-rates/pre-algebra-percent-problems/v/finding-percentages-example)  [Pre-algebra / Percent word problems](https://www.khanacademy.org/math/pre-algebra/pre-algebra-ratios-rates/pre-algebra-percent-word-problems/v/solving-percent-problems-2) |
| * 1. Solve measurement and estimation problems involving time, length, temperature, volume, and mass in both the U.S. customary system and the metric system, where appropriate | [Algebra I / Rate conversion](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:working-units/x2f8bb11595b61c86:rate-conversion/v/dimensional-analysis-units-algebraically)  [Algebra I / Appropriate units](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:working-units/x2f8bb11595b61c86:appropriate-units/v/appropriate-units)  [Algebra I / Word problems with multiple units](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:working-units/x2f8bb11595b61c86:word-problems-multiple-units/v/can-a-squirrel-avoid-getting-run-over) |
| * 1. Convert units within the metric and customary systems | [Algebra I / Rate conversion](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:working-units/x2f8bb11595b61c86:rate-conversion/v/dimensional-analysis-units-algebraically)  [Algebra I / Appropriate units](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:working-units/x2f8bb11595b61c86:appropriate-units/v/appropriate-units)  [Algebra I / Word problems with multiple units](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:working-units/x2f8bb11595b61c86:word-problems-multiple-units/v/can-a-squirrel-avoid-getting-run-over) |
| Knows how to analyze both precision and accuracy in measurement situations |  |
| * 1. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. |  |
| * 1. Calculate or estimate absolute and relative error in the numerical answer to a problem |  |
| Understands various ways to represent and compare very large and very small numbers  (e.g., scientific notation, orders of magnitude) |  |
| * 1. Represent and compare very large and very small numbers | [Pre-algebra / Scientific notation](https://www.khanacademy.org/math/pre-algebra/pre-algebra-exponents-radicals/pre-algebra-scientific-notation/v/scientific-notation) |
| Understands how to both estimate and perform calculations on very large and very small quantities |  |
| * 1. Use orders of magnitude to estimate very large and very small numbers |  |
| * 1. Perform calculations on numbers in scientific notation | [Pre-algebra / Computing with scientific notation](https://www.khanacademy.org/math/pre-algebra/pre-algebra-exponents-radicals/pre-algebra-computing-scientific-notation/v/scientific-notation-example-2) |
| Algebra |  |
| 1. **Understands how to write algebraic expressions in equivalent forms** |  |
| * 1. Use the structure of an expression to identify ways to rewrite it | [Algebra I / Combining like terms](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:foundation-algebra/x2f8bb11595b61c86:combine-like-terms/v/combining-like-terms)  [Algebra I / Introduction to equivalent expressions](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:foundation-algebra/x2f8bb11595b61c86:equivalent-expressions-intro/v/equivalent-algebraic-expressions-exercise)  [Algebra I / Factoring quadratics with difference of squares](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratics-multiplying-factoring/x2f8bb11595b61c86:factor-difference-squares/v/difference-of-squares-intro)  [Algebra 2 / Factoring using structure](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-factor/x2ec2f6f830c9fb89:factor-w-structure/v/id-quad-patterns)  [Algebra 2 / Factoring monomials](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-factor/x2ec2f6f830c9fb89:mono-factor/v/factor-high-deg-poly-intro)  [Algebra 2 / Factoring higher degree polynomials](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-factor/x2ec2f6f830c9fb89:factor-high-deg/v/factor-high-deg-poly) |
| * 1. Understand how to rewrite quadratic expressions for specific purposes (e.g., factoring/finding zeros, completing the square/finding maxima or minima). | [Algebra I / Factoring quadratics intro](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratics-multiplying-factoring/x2f8bb11595b61c86:factor-quadratics-intro/v/factoring-simple-quadratic-expression)  [Algebra I / Factoring quadratics by grouping](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratics-multiplying-factoring/x2f8bb11595b61c86:factor-quadratics-grouping/v/factor-by-grouping-and-factoring-completely)  [Algebra I / Factoring quadratics with difference of squares](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratics-multiplying-factoring/x2f8bb11595b61c86:factor-difference-squares/v/difference-of-squares-intro)  [Algebra I / Factoring quadratics with perfect squares](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratics-multiplying-factoring/x2f8bb11595b61c86:factor-perfect-squares/v/perfect-square-factorization-intro)  [Algebra I / Strategy in factoring quadratics](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratics-multiplying-factoring/x2f8bb11595b61c86:factor-quadratics-strategy/v/strategy-in-factoring-quadratics-1)  [Algebra I / Vertex form](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:vertex-form/v/vertex-form-intro)  [Algebra I / Completing the square](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:completing-square-quadratics/v/solving-quadratic-equations-by-completing-the-square)  [Algebra I / Quadratic standard form](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:standard-form-quadratic/v/ex3-completing-the-square)  [Algebra I / Features & forms of quadratic functions](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:quadratic-forms-features/v/rewriting-a-quadratic-function-to-find-roots-and-vertex) |
| * 1. Use the properties of exponents to rewrite expressions for exponential functions. | [Algebra I / Exponent properties review](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:rational-exponents-radicals/x2f8bb11595b61c86:exponent-properties-review/v/multiplying-and-dividing-powers-with-integer-exponents) |
| Understands how to perform arithmetic operations on polynomials |  |
| * 1. Add, subtract, and multiply polynomials | [Algebra I / Combining like terms](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:foundation-algebra/x2f8bb11595b61c86:combine-like-terms/v/combining-like-terms)  [Algebra I / Multiplying monomials by polynomials](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratics-multiplying-factoring/x2f8bb11595b61c86:multiply-monomial-polynomial/v/polynomials-intro)  [Algebra I / Multiplying binomials](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratics-multiplying-factoring/x2f8bb11595b61c86:multiply-binomial/v/area-model-for-multiplying-binomials)  [Algebra 2 / Intro to polynomials](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-arithmetic/x2ec2f6f830c9fb89:poly-intro/v/polynomials-intro)  [Algebra 2 / Adding and subtracting polynomials](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-arithmetic/x2ec2f6f830c9fb89:poly-add-sub/v/adding-and-subtracting-polynomials-1)  [Algebra 2 / Multiplying monomials by polynomials](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-arithmetic/x2ec2f6f830c9fb89:mono-by-poly/v/multiply-monomials-intro)  [Algebra 2 / Multiplying binomials by polynomials](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-arithmetic/x2ec2f6f830c9fb89:bi-by-poly/v/multiplying-polynomials-using-area-model)  [Precalculus / Adding and subtracting polynomials: two variables](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:polynomials/x9e81a4f98389efdf:two-var-poly-add-sub/v/example-adding-polynomials-with-multiple-variables) |
| Understands the relationship between zeros of polynomial functions (including their graphical representation) and factors of the related polynomial expressions |  |
| * 1. Know and apply the remainder theorem: for a polynomial  and a number *a*, the remainder on division by  is , so  if and only if  is a factor of . | [Algebra 2 / Polynomial Remainder Theorem](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-div/x2ec2f6f830c9fb89:remainder-theorem/v/polynomial-remainder-theorem)  [Precalculus / Polynomial division](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:polynomials/x9e81a4f98389efdf:polynomial-division/v/dividing-polynomials-with-remainders-example) |
| * 1. Use factorization to identify zeros of polynomials | [Algebra I / Introduction to factoring](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratics-multiplying-factoring/x2f8bb11595b61c86:intro-factoring/v/factors-and-divisibility-in-algebra)  [Algebra 2 / Dividing quadratics by linear factors](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-div/x2ec2f6f830c9fb89:quad-div-by-linear/v/polynomial-division)  [Algebra 2 / Dividing polynomials by linear factors](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-div/x2ec2f6f830c9fb89:poly-div-by-linear/v/poly-div-by-linear)  [Algebra 2 / Zeros of polynomials](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-graphs/x2ec2f6f830c9fb89:poly-zeros/v/polynomial-zeros-introduction) |
| * 1. Use zeros of a polynomial to construct a rough graph of the function defined by the polynomial. | [Algebra I / Solving and graphing with factored form](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:factored-form-quadratics/v/zero-product-property)  [Algebra 2 / Zeros of polynomials](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-graphs/x2ec2f6f830c9fb89:poly-zeros/v/polynomial-zeros-introduction)  [Algebra 2 / Positive and negative intervals of polynomials](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-graphs/x2ec2f6f830c9fb89:poly-intervals/v/polynomial-intervals)  [Algebra 2 / End behavior of polynomials](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-graphs/x2ec2f6f830c9fb89:poly-end-behavior/v/polynomial-end-behavior)  [Algebra 2 / Putting it all together](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-graphs/x2ec2f6f830c9fb89:poly-graphs-together/a/graphs-of-polynomials)  [Precalculus / The fundamental theorem of algebra](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:polynomials/x9e81a4f98389efdf:fta/v/fundamental-theorem-of-algebra-intro) |
| Understands how to use polynomial identities (e.g., difference of squares, sum and difference of cubes) to solve problems. |  |
| * 1. Apply the binomial theorem for the expansion of  in powers of *x* and *y* for a positive integer n. | [Precalculus / Adding and subtracting polynomials: two variables](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:polynomials/x9e81a4f98389efdf:two-var-poly-add-sub/v/example-adding-polynomials-with-multiple-variables)  [Precalculus / The binomial theorem](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:polynomials/x9e81a4f98389efdf:binomial/v/binomial-theorem) |
| Understands how to rewrite rational expressions and perform arithmetic operations on rational expressions |  |
| * 1. Rewrite simple rational expressions in different forms | [Algebra 2 / Cancelling common factors](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:rational/x2ec2f6f830c9fb89:cancel-common-factor/v/simplifying-rational-expressions-introduction) |
| * 1. Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression. | [Algebra 2 / Taking common factors](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-factor/x2ec2f6f830c9fb89:common-factor/v/algebraic-factoring-by-greatest-common-monomial-factor)  [Algebra 2 / Dividing quadratics by linear factors](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-div/x2ec2f6f830c9fb89:quad-div-by-linear/v/polynomial-division)  [Algebra 2 / Dividing polynomials by linear factors](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-div/x2ec2f6f830c9fb89:poly-div-by-linear/v/poly-div-by-linear) |
| * 1. Add, subtract, multiply, and divide rational expressions | [Algebra 2 / Dividing polynomials by x](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-div/x2ec2f6f830c9fb89:poly-div-by-x/v/polynomial-division-intro)  [Precalculus / Polynomial division](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:polynomials/x9e81a4f98389efdf:polynomial-division/v/dividing-polynomials-with-remainders-example)  [Algebra 2 / Multiplying and dividing rational expressions](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:rational/x2ec2f6f830c9fb89:rational-mul-div/v/multiplying-and-dividing-rational-expressions-monomial-numerator-denominator)  [Algebra 2 / Adding and subtracting rational expressions intro](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:rational/x2ec2f6f830c9fb89:rational-add-sub-intro/v/adding-and-subtracting-rational-expressions-with-like-denominators)  [Algebra 2 / Adding and subtracting rational expressions (factored)](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:rational/x2ec2f6f830c9fb89:rational-add-sub-factored/v/subtracting-rational-expressions-w-factored-denominators)  [Algebra 2 / Adding and subtracting rational expressions (not factored)](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:rational/x2ec2f6f830c9fb89:rational-add-sub-not-factored/v/adding-and-subtracting-rational-expressions-3) |
| Understands how to create equations and inequalities that describe relationships |  |
| * 1. Create equations and inequalities in one variable and use them to solve problems and graph solutions on the number line | [Algebra I / Linear equations with variables on both sides](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:solve-equations-inequalities/x2f8bb11595b61c86:linear-equations-variables-both-sides/v/why-we-do-the-same-thing-to-both-sides-multi-step-equations)  [Algebra I / Linear equations with parentheses](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:solve-equations-inequalities/x2f8bb11595b61c86:linear-equations-parentheses/v/solving-equations-with-the-distributive-property)  [Algebra I / Linear equations with unknown coefficients](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:solve-equations-inequalities/x2f8bb11595b61c86:linear-eqns-unknown-coefficients/v/linear-equations-with-unknown-coefficients)  [Algebra I / Multi-step inequalities](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:solve-equations-inequalities/x2f8bb11595b61c86:multistep-inequalities/v/multi-step-inequalities-3)  [Algebra 2 / Modeling with equations and inequalities](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:modeling/x2ec2f6f830c9fb89:eq-ineq-models/v/making-more-pizzas-to-spread-cost-per-pizza) |
| * 1. Create equations and inequalities in two or more variables to represent relationships between quantities, solve problems, and graph them on the coordinate plane with labels and scales | [Algebra I / Two-variable linear equations intro](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:linear-equations-graphs/x2f8bb11595b61c86:two-variable-linear-equations-intro/v/2-variable-linear-equations-graphs)  [Algebra I / Graphing two-variable inequalities](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:inequalities-systems-graphs/x2f8bb11595b61c86:graphing-two-variable-inequalities/v/graphing-inequalities)  [Algebra I / Slope](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:linear-equations-graphs/x2f8bb11595b61c86:slope/v/introduction-to-slope) |
| * 1. Represent constraints by equations, inequalities, or systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context | [Algebra I / Systems of equations word problems](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:systems-of-equations/x2f8bb11595b61c86:systems-of-equations-word-problems/v/ex-2-age-word-problem)  [Algebra I / Modeling with linear inequalities](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:inequalities-systems-graphs/x2f8bb11595b61c86:modeling-with-linear-inequalities/v/constructing-two-variable-linear-inequality-word-problem)  [Algebra 2 / Modeling with equations and inequalities](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:modeling/x2ec2f6f830c9fb89:eq-ineq-models/v/making-more-pizzas-to-spread-cost-per-pizza) |
| * 1. Rearrange formulas to highlight a quantity of interest (e.g., solve ) | [Algebra 2 / Manipulating formulas](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:modeling/x2ec2f6f830c9fb89:manipulating-formulas/v/example-of-solving-for-a-variable) |
| Understands how to justify the reasoning process used to solve equations, including analysis of potential extraneous solutions. |  |
| * 1. Explain each step in solving a simple equation | [Algebra I / Linear equations with variables on both sides](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:solve-equations-inequalities/x2f8bb11595b61c86:linear-equations-variables-both-sides/v/why-we-do-the-same-thing-to-both-sides-multi-step-equations)  [Algebra I / Linear equations with parentheses](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:solve-equations-inequalities/x2f8bb11595b61c86:linear-equations-parentheses/v/solving-equations-with-the-distributive-property) |
| * 1. Solve simple rational and radical equations in one variable, incorporating analysis of possible extraneous solutions | [Algebra 2 / Rational equations](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:eq/x2ec2f6f830c9fb89:rational-eq/v/rational-equation-intro)  [Algebra 2 / Square-root equations](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:eq/x2ec2f6f830c9fb89:sqrt-eq/v/extraneous-solutions-to-radical-equations)  [Algebra 2 / Extraneous solutions](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:eq/x2ec2f6f830c9fb89:extraneous-sol/v/extraneous-solutions)  [Algebra 2 / Cube-root equations](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:eq/x2ec2f6f830c9fb89:cbrt-eq/v/solving-radical-equations-2) |
| Understands how varied techniques (e.g., graphical, algebraic) are used to solve equations and inequalities in one variable |  |
| * 1. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters | [Algebra I / Linear equations with variables on both sides](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:solve-equations-inequalities/x2f8bb11595b61c86:linear-equations-variables-both-sides/v/why-we-do-the-same-thing-to-both-sides-multi-step-equations)  [Algebra I / Linear equations with parentheses](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:solve-equations-inequalities/x2f8bb11595b61c86:linear-equations-parentheses/v/solving-equations-with-the-distributive-property)  [Algebra I / Linear equations with unknown coefficients](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:solve-equations-inequalities/x2f8bb11595b61c86:linear-eqns-unknown-coefficients/v/linear-equations-with-unknown-coefficients)  [Algebra I / Multi-step inequalities](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:solve-equations-inequalities/x2f8bb11595b61c86:multistep-inequalities/v/multi-step-inequalities-3)  [Algebra I / Compound inequalities](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:solve-equations-inequalities/x2f8bb11595b61c86:compound-inequalities/v/compund-inequalities)  [Algebra I / Summary: Forms of two-variable linear equations](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:forms-of-linear-equations/x2f8bb11595b61c86:summary-forms-of-two-variable-linear-equations/v/slope-from-equation) |
| * 1. Use the method of completing the square to transform any quadratic equation in x into the equivalent form | [Algebra I / Completing the square](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:completing-square-quadratics/v/solving-quadratic-equations-by-completing-the-square) |
| * 1. Solve equations using a variety of methods (e.g., using graphs, using the quadratic formula, or factoring) | [Algebra I / Factoring quadratics intro](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratics-multiplying-factoring/x2f8bb11595b61c86:factor-quadratics-intro/v/factoring-simple-quadratic-expression)  [Algebra I / Factoring quadratics by grouping](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratics-multiplying-factoring/x2f8bb11595b61c86:factor-quadratics-grouping/v/factor-by-grouping-and-factoring-completely)  [Algebra I / Factoring quadratics with difference of squares](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratics-multiplying-factoring/x2f8bb11595b61c86:factor-difference-squares/v/difference-of-squares-intro)  [Algebra I / Factoring quadratics with perfect squares](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratics-multiplying-factoring/x2f8bb11595b61c86:factor-perfect-squares/v/perfect-square-factorization-intro)  [Algebra I / Strategy in factoring quadratics](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratics-multiplying-factoring/x2f8bb11595b61c86:factor-quadratics-strategy/v/strategy-in-factoring-quadratics-1)  [Algebra I / Solving quadratics by factoring](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:quadratics-solve-factoring/v/example-1-solving-a-quadratic-equation-by-factoring)  [Algebra I / The quadratic formula](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:quadratic-formula-a1/v/using-the-quadratic-formula)  [Precalculus / The fundamental theorem of algebra](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:polynomials/x9e81a4f98389efdf:fta/v/fundamental-theorem-of-algebra-intro)  [Precalculus / Solving equations by graphing](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:polynomials/x9e81a4f98389efdf:eq-graph/v/interpreting-equations-graphically-1) |
| * 1. Use different methods (e.g., discriminant analysis, graphical analysis) to determine the nature of the solutions of a quadratic equation | [Algebra I / Intro to parabolas](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:intro-parabolas/v/parabolas-intro)  [Algebra I / Solving and graphing with factored form](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:factored-form-quadratics/v/zero-product-property)  [Algebra I / Solving by taking the square root](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:untitled-1082/v/simple-quadratic-equation)  [Algebra I / Vertex form](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:vertex-form/v/vertex-form-intro)  [Algebra I / The quadratic formula](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:quadratic-formula-a1/v/using-the-quadratic-formula)  [Algebra I / Quadratic standard form](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:standard-form-quadratic/v/ex3-completing-the-square)  [Algebra I / Features & forms of quadratic functions](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:quadratic-forms-features/v/rewriting-a-quadratic-function-to-find-roots-and-vertex) |
| * 1. Write complex solutions in the form . | [Algebra I / The quadratic formula](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:quadratic-formula-a1/v/using-the-quadratic-formula)  [Algebra 2 / The imaginary unit i](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:complex/x2ec2f6f830c9fb89:imaginary/v/introduction-to-i-and-imaginary-numbers) |
| Understands how varied techniques (e.g., graphical, algebraic, matrix) are used to solve systems of equations and inequalities |  |
| * 1. Explain why, when solving a system of two equations using the elimination method, replacing one or both equations with a scalar multiple produces a system with the same solutions as the solutions of the original system | [Algebra I / Equivalent systems of equations and the elimination method](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:systems-of-equations/x2f8bb11595b61c86:equivalent-systems-of-equations-and-the-elimination-method/v/king-s-cupcakes-solving-systems-by-elimination) |
| * 1. Solve a system consisting of two linear equations in two variables algebraically and graphically | [Algebra I / Introduction to systems of equations](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:systems-of-equations/x2f8bb11595b61c86:introduction-to-systems-of-equations/v/trolls-tolls-and-systems-of-equations)  [Algebra I / Solving systems of equations with substitution](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:systems-of-equations/x2f8bb11595b61c86:solving-systems-of-equations-with-substitution/v/solving-systems-with-substitution)  [Algebra I / Number of solutions to systems of equations](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:systems-of-equations/x2f8bb11595b61c86:number-of-solutions-to-systems-of-equations/v/inconsistent-systems-of-equations) |
| * 1. Solve a system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically | [Algebra 2 / Quadratic systems](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:eq/x2ec2f6f830c9fb89:quad-sys/v/line-and-parabola-system) |
| * 1. Represent a system of linear equations as a single matrix equation | [Precalculus / Representing linear systems of equations with augmented matrices](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:matrices/x9e81a4f98389efdf:representing-systems-with-matrices/a/representing-systems-with-matrices) |
| * 1. Find the inverse of a matrix if it exists, and use it to solve systems of linear equations | [Precalculus / Solving equations with inverse matrices](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:matrices/x9e81a4f98389efdf:solving-equations-with-inverse-matrices/v/matrix-equations-systems) |
| * 1. Explain why the *x*-coordinates of the intersection points of the graphs of  and  are the solutions of . | [Precalculus / Solving equations by graphing](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:polynomials/x9e81a4f98389efdf:eq-graph/v/interpreting-equations-graphically-1) |
| * 1. Find the solutions of  approximately (e.g., use technology to graph the functions, make tables of values, find successive approximations). Include cases where  and/or  are linear, polynomial, rational, absolute value, exponential, or logarithmic functions | [Precalculus / Solving equations by graphing](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:polynomials/x9e81a4f98389efdf:eq-graph/v/interpreting-equations-graphically-1) |
| * 1. 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 | [Algebra I / Checking solutions of two-variable inequalities](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:inequalities-systems-graphs/x2f8bb11595b61c86:checking-solutions-of-two-variable-inequalities/v/graphing-inequalities-1)  [Algebra I / Graphing two-variable inequalities](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:inequalities-systems-graphs/x2f8bb11595b61c86:graphing-two-variable-inequalities/v/graphing-inequalities) |
| Understands the properties of number systems under various operations |  |
| * 1. Given operations on algebraic expressions, determine whether the properties hold (e.g., commutative, associative, distributive) |  |
| Understands the concept of rate of change of nonlinear functions | [Algebra I / Average rate of change](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:functions/x2f8bb11595b61c86:average-rate-of-change/v/introduction-to-average-rate-of-change)  [Algebra I / Average rate of change word problems](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:functions/x2f8bb11595b61c86:average-rate-of-change-word-problems/v/average-rate-of-change-from-table-word-problem)  [Algebra 2 / Average rate of change of polynomials](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-arithmetic/x2ec2f6f830c9fb89:poly-avg-rate/v/avg-rate-of-change-of-polynomials) |
| * 1. Calculate and interpret the average rate of change of a function presented symbolically, numerically, or graphically over a specified interval |  |
| Understands the concepts of intercept(s) of a line and slope as a rate of change |  |
| * 1. Calculate and interpret the intercepts of a line | [Algebra I / x-intercepts and y-intercepts](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:linear-equations-graphs/x2f8bb11595b61c86:x-intercepts-and-y-intercepts/v/introduction-to-intercepts)  [Algebra I / Applying intercepts and slope](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:linear-equations-graphs/x2f8bb11595b61c86:applying-intercepts-and-slope/v/slope-intercepts-context) |
| * 1. Calculate and interpret the slope of a line presented symbolically, numerically, or graphically | [Algebra I / Slope](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:linear-equations-graphs/x2f8bb11595b61c86:slope/v/introduction-to-slope)  [Algebra I / Horizontal & vertical lines](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:linear-equations-graphs/x2f8bb11595b61c86:horizontal-vertical-lines/v/slope-of-a-line-3)  [Algebra I / Applying intercepts and slope](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:linear-equations-graphs/x2f8bb11595b61c86:applying-intercepts-and-slope/v/slope-intercepts-context)  [Algebra I / Intro to slope-intercept form](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:forms-of-linear-equations/x2f8bb11595b61c86:intro-to-slope-intercept-form/v/slope-intercept-form)  [Algebra I / Graphing slope-intercept equations](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:forms-of-linear-equations/x2f8bb11595b61c86:graphing-slope-intercept-equations/v/graphing-a-line-in-slope-intercept-form)  [Algebra I / Writing slope-intercept equations](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:forms-of-linear-equations/x2f8bb11595b61c86:writing-slope-intercept-equations/v/graphs-using-slope-intercept-form)  [Algebra I / Point-slope form](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:forms-of-linear-equations/x2f8bb11595b61c86:point-slope-form/v/idea-behind-point-slope-form)  [Algebra I / Standard form](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:forms-of-linear-equations/x2f8bb11595b61c86:standard-form/v/standard-form-for-linear-equations)  [Algebra I / Summary: Forms of two-variable linear equations](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:forms-of-linear-equations/x2f8bb11595b61c86:summary-forms-of-two-variable-linear-equations/v/slope-from-equation) |
| * 1. Estimate the rate of change of a linear function from a graph | [Algebra I / Applying intercepts and slope](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:linear-equations-graphs/x2f8bb11595b61c86:applying-intercepts-and-slope/v/slope-intercepts-context) |
| Understands how to find the zero(s) of functions |  |
| * 1. Uses a variety of techniques to find and analyze the zero(s) (real and complex) of functions | [Algebra 2 / Zeros of polynomials](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-graphs/x2ec2f6f830c9fb89:poly-zeros/v/polynomial-zeros-introduction)  [Algebra 2 / Solving equations by graphing](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:eq/x2ec2f6f830c9fb89:sol-eq-graph/v/equations-by-graphing)  [Precalculus / Solving equations by graphing](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:polynomials/x9e81a4f98389efdf:eq-graph/v/interpreting-equations-graphically-1) |
| Functions |  |
| 1. **Understands the function concept and the use of function notation** |  |
| * 1. Recognize that functions are sets of ordered pairs | [Algebra I / Recognizing functions](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:functions/x2f8bb11595b61c86:recognizing-functions/v/graphical-relations-and-functions) |
| * 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 | [Algebra I / Inputs and outputs of a function](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:functions/x2f8bb11595b61c86:inputs-and-outputs-of-a-function/v/finding-input-given-function-output-formula) |
| * 1. Use function notation, evaluate functions, and interpret statements that use function notation in terms of a context | [Algebra I / Evaluating functions](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:functions/x2f8bb11595b61c86:evaluating-functions/v/what-is-a-function)  [Algebra I / Functions and equations](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:functions/x2f8bb11595b61c86:functions-and-equations/v/difference-between-equations-and-functions)  [Algebra I / Interpreting function notation](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:functions/x2f8bb11595b61c86:interpreting-function-notation/v/interpreting-function-notation-example-1) |
| * 1. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers |  |
| Understands how to find the domain and range of a function and a relation |  |
| * 1. Identify the domain and range of a function or relation | [Algebra I / Introduction to the domain and range of a function](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:functions/x2f8bb11595b61c86:introduction-to-the-domain-and-range-of-a-function/v/introduction-to-interval-notation) |
| * 1. Determine the domain of a function from a function rule (e.g., , graph, set of ordered pairs, or table | [Algebra I / Determining the domain of a function](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:functions/x2f8bb11595b61c86:determining-the-domain-of-a-function/v/determine-values-domain) |
| Understands how function behavior is analyzed using different representations. (e.g., graphs, mappings, tables). |  |
| * 1. For a function that models a relationship between two quantities, interpret key features of graphs and tables (e.g., increasing/decreasing, maximum/minimum, periodicity) in terms of the quantities | [Algebra I / Maximum and minimum points](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:functions/x2f8bb11595b61c86:maximum-and-minimum-points/v/relative-minima-maxima)  [Algebra I / Intervals where a function is positive, negative, increasing, or decreasing](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:functions/x2f8bb11595b61c86:intervals-where-a-function-is-positive-negative-increasing-or-decreasing/v/increasing-decreasing-positive-and-negative-intervals)  [Algebra 2 / Interpreting features of functions](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:modeling/x2ec2f6f830c9fb89:interpreting-features/v/periodicity-of-algebraic-models) |
| * 1. Given a verbal description of a relation, sketch graphs that show key features of that relation | [Algebra I / Interpreting features of graphs](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:functions/x2f8bb11595b61c86:interpreting-features-of-graphs/v/interpreting-function-graphs-word-problems) |
| * 1. Graph functions (i.e., radical, piecewise, absolute value, polynomial, rational, logarithmic, trigonometric) expressed symbolically and identify key features of the graph | [Algebra I / Graphs of absolute value functions](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:absolute-value-piecewise-functions/x2f8bb11595b61c86:graphs-of-absolute-value-functions/v/shifting-absolute-value-graphs)  [Algebra I / Piecewise functions](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:absolute-value-piecewise-functions/x2f8bb11595b61c86:piecewise-functions/v/piecewise-function-example)  [Algebra I / Graphs of exponential growth](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:exponential-growth-decay/x2f8bb11595b61c86:graphs-of-exponential-growth/v/graphing-exponential-functions)  [Algebra I / Quadratic standard form](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:standard-form-quadratic/v/ex3-completing-the-square)  [Algebra I / Features & forms of quadratic functions](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:quadratic-forms-features/v/rewriting-a-quadratic-function-to-find-roots-and-vertex)  [Algebra I / Transforming quadratic functions](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:transform-quadratic-functions/v/shifting-and-scaling-parabolas)  [Algebra 2 / Putting it all together](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-graphs/x2ec2f6f830c9fb89:poly-graphs-together/a/graphs-of-polynomials)  [Algebra 2 / Graphs of square and cube root functions](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:transformations/x2ec2f6f830c9fb89:radical-graphs/v/graphing-square-and-cube-root)  [Algebra 2 / Graphs of exponential functions](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:transformations/x2ec2f6f830c9fb89:exp-graphs/v/transforming-exponential-graphs)  [Algebra 2 / Graphs of logarithmic functions](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:transformations/x2ec2f6f830c9fb89:log-graphs/v/comparing-exponential-logarithmic-functions)  [Algebra 2 / Graphs of sin(x), cos(x), and tan(x)](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:trig/x2ec2f6f830c9fb89:trig-graphs/v/we-graph-domain-and-range-of-sine-function)  [Algebra 2 / Graphing sinusoidal functions](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:trig/x2ec2f6f830c9fb89:graphing-sinusoid/e/graphs_of_sine_and_cosine)  [Algebra 2 / End behavior of rational functions](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:rational/x2ec2f6f830c9fb89:rational-end-behavior/v/end-behavior-of-rational-functions)  [Algebra 2 / Discontinuities of rational functions](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:rational/x2ec2f6f830c9fb89:discontinuities/v/discontinuities-of-rational-functions)  [Algebra 2 / Graphs of rational functions](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:rational/x2ec2f6f830c9fb89:rational-graphs/v/finding-asymptotes-example) |
| * 1. Write a function that is defined by an expression in different but equivalent forms to reveal different properties of the function (e.g., zeros, extreme values, symmetry of the graph) | [Algebra I / Solving and graphing with factored form](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:factored-form-quadratics/v/zero-product-property)  [Algebra I / Vertex form](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:vertex-form/v/vertex-form-intro) |
| * 1. Interpret the behavior of exponential functions (e.g., growth, decay) | [Algebra I / Exponential growth & decay](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:exponential-growth-decay/x2f8bb11595b61c86:exponential-decay/v/exponential-decay-intro) |
| * 1. Understand how to determine if a function is odd, even, or neither and any resulting symmetries | [Algebra 2 / Symmetry of functions](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:transformations/x2ec2f6f830c9fb89:symmetry/v/function-symmetry) |
| Understands how functions and relations are used to model relationships between quantities. |  |
| * 1. Write a function that relates two quantities | [Algebra I / Exponential vs. linear models](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:exponential-growth-decay/x2f8bb11595b61c86:exponential-vs-linear-models/v/linear-and-exponential-growth-from-data)  [Algebra 2 / Solving exponential models](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:logs/x2ec2f6f830c9fb89:exp-models/v/solving-exponential-model-word-problems-1)  [Algebra 2 / Modeling with rational functions](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:rational/x2ec2f6f830c9fb89:rational-models/v/dogs-cats-and-bears-in-a-pet-store-visual-argument) |
| * 1. Determine an explicit expression or a recursive process that builds a function from a context | [Algebra I / Exponential vs. linear models](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:exponential-growth-decay/x2f8bb11595b61c86:exponential-vs-linear-models/v/linear-and-exponential-growth-from-data)  [Algebra 2 / Solving exponential models](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:logs/x2ec2f6f830c9fb89:exp-models/v/solving-exponential-model-word-problems-1) |
| Understands how new functions are obtained from existing functions (e.g., compositions, transformations, inverses) |  |
| * 1. Describe how the graph of  is related to the graph of , where , , , or  for specific values of *k* (both positive and negative), and find the value of *k* given the graphs | [Algebra I / Transforming quadratic functions](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:quadratic-functions-equations/x2f8bb11595b61c86:transform-quadratic-functions/v/shifting-and-scaling-parabolas)  [Algebra 2 / Shifting functions](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:transformations/x2ec2f6f830c9fb89:shift/v/shifting-functions-intro)  [Algebra 2 / Reflecting functions](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:transformations/x2ec2f6f830c9fb89:reflect/v/reflecting-functions-intro)  [Algebra 2 / Scaling functions](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:transformations/x2ec2f6f830c9fb89:scale/v/scaling-functions-intro)  [Algebra 2 / Putting it all together](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:transformations/x2ec2f6f830c9fb89:trans-all-together/v/shifting-and-reflecting-functions) |
| * 1. Determine if a function has an inverse and write an expression for the inverse | [Algebra I / Intro to inverse functions](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:functions/x2f8bb11595b61c86:inverse-functions-intro/v/introduction-to-function-inverses)  [Precalculus / Invertible functions](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:composite/x9e81a4f98389efdf:invertible/v/determining-if-a-function-is-invertible) |
| * 1. Verify by composition if one function is the inverse of another | [Algebra I / Intro to inverse functions](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:functions/x2f8bb11595b61c86:inverse-functions-intro/v/introduction-to-function-inverses)  [Precalculus / Verifying inverse functions by composition](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:composite/x9e81a4f98389efdf:verifying-inverse/v/verifying-function-inverses-by-composition) |
| * 1. Given that a function *f* has an inverse, find values of the inverse function from a graph or a table of *f* | [Algebra I / Intro to inverse functions](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:functions/x2f8bb11595b61c86:inverse-functions-intro/v/introduction-to-function-inverses)  [Precalculus / Invertible functions](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:composite/x9e81a4f98389efdf:invertible/v/determining-if-a-function-is-invertible) |
| * 1. Given a noninvertible function, determine a largest possible domain of the function that produces an invertible function | [Precalculus / Invertible functions](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:composite/x9e81a4f98389efdf:invertible/v/determining-if-a-function-is-invertible) |
| * 1. Understand the inverse relationship between exponential and logarithmic functions and use this relationship to solve problems | [Algebra 2 / Introduction to logarithms](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:logs/x2ec2f6f830c9fb89:log-intro/v/logarithms)  [Algebra 2 / The constant e and the natural logarithm](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:logs/x2ec2f6f830c9fb89:e/v/e-through-compound-interest)  [Precalculus / Invertible functions](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:composite/x9e81a4f98389efdf:invertible/v/determining-if-a-function-is-invertible) |
| * 1. Combine standard function types using arithmetic operations | [Algebra 2 / Modeling with function combination](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:modeling/x2ec2f6f830c9fb89:model-comb/v/modeling-with-combined-functions) |
| * 1. Perform domain analysis on functions resulting from arithmetic operations |  |
| * 1. Compose functions algebraically, numerically, and graphically | [Precalculus / Composing functions](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:composite/x9e81a4f98389efdf:composing/v/function-composition)  [Precalculus / Modeling with composite functions](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:composite/x9e81a4f98389efdf:composite-modeling/v/modeling-with-composite-functions-examples) |
| * 1. Perform domain analysis on functions resulting from compositions |  |
| Understands differences between linear, quadratic, and exponential models, including how their equations are created and used to solve problems. |  |
| * 1. Understand that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. | [Algebra I / Exponential vs. linear growth](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:exponential-growth-decay/x2f8bb11595b61c86:exponential-vs-linear-growth/v/exponential-growth-functions) |
| * 1. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another | [Algebra I / Exponential vs. linear growth](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:exponential-growth-decay/x2f8bb11595b61c86:exponential-vs-linear-growth/v/exponential-growth-functions) |
| * 1. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another | [Algebra I / Exponential expressions](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:exponential-growth-decay/x2f8bb11595b61c86:exponential-expressions/v/exponential-expressions-word-problems-numerical)  [Algebra 2 / Interpreting the rate of change of exponential models](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:exp-model/x2ec2f6f830c9fb89:exp-change/v/interpreting-change-in-exponential-models)  [Algebra 2 / Advanced interpretation of exponential models](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:exp-model/x2ec2f6f830c9fb89:interpret-exp/v/interpreting-change-in-exponential-models-with-manipulation) |
| * 1. Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two ordered pairs (include reading these from a table). | [Algebra I / Exponential functions from tables & graphs](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:exponential-growth-decay/x2f8bb11595b61c86:exponential-functions-from-tables-graphs/v/writing-exponential-functions)  [Algebra 2 / Constructing exponential models according to rate of change](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:exp-model/x2ec2f6f830c9fb89:construct-exp/v/constructing-exponential-models)  [Algebra 2 / Advanced interpretation of exponential models](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:exp-model/x2ec2f6f830c9fb89:interpret-exp/v/interpreting-change-in-exponential-models-with-manipulation) |
| * 1. Observe that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. | [Algebra I / Exponential vs. linear growth over time](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:exponential-growth-decay/x2f8bb11595b61c86:exponential-vs-linear-growth-over-time/v/exponential-vs-linear-growth-over-time) |
| * 1. Express the solution to an exponential equation with base *b* as a logarithm (e.g., ,) | [Algebra 2 / Introduction to logarithms](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:logs/x2ec2f6f830c9fb89:log-intro/v/logarithms)  [Algebra 2 / The constant e and the natural logarithm](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:logs/x2ec2f6f830c9fb89:e/v/e-through-compound-interest)  [Algebra 2 / Properties of logarithms](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:logs/x2ec2f6f830c9fb89:log-prop/v/introduction-to-logarithm-properties)  [Algebra 2 / The change of base formula for logarithms](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:logs/x2ec2f6f830c9fb89:change-of-base/v/change-of-base-formula)  [Algebra 2 / Solving exponential equations with logarithms](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:logs/x2ec2f6f830c9fb89:exp-eq-log/v/exponential-equation) |
| * 1. Use technology to evaluate logarithms that have any base | [Algebra 2 / Introduction to logarithms](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:logs/x2ec2f6f830c9fb89:log-intro/v/logarithms)  [Algebra 2 / The constant e and the natural logarithm](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:logs/x2ec2f6f830c9fb89:e/v/e-through-compound-interest)  [Algebra 2 / Properties of logarithms](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:logs/x2ec2f6f830c9fb89:log-prop/v/introduction-to-logarithm-properties)  [Algebra 2 / The change of base formula for logarithms](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:logs/x2ec2f6f830c9fb89:change-of-base/v/change-of-base-formula) |
| * 1. Interpret the parameters in a linear or exponential function in terms of a context  (e.g., ) | [Algebra I / Exponential vs. linear models](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:exponential-growth-decay/x2f8bb11595b61c86:exponential-vs-linear-models/v/linear-and-exponential-growth-from-data)  [Algebra 2 / Solving exponential models](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:logs/x2ec2f6f830c9fb89:exp-models/v/solving-exponential-model-word-problems-1) |
| * 1. Use quantities that are inversely related to model phenomena |  |
| Understands how to construct the unit circle and how to use it to find values of trigonometric functions for all angle measures in their domains. |  |
| * 1. Understand radian measure (e.g., 1 radian is the measure of a central angle that subtends an arc with length equal to the length of the radius | [High school geometry / Introduction to radians](https://www.khanacademy.org/math/geometry/hs-geo-circles/hs-geo-radians-intro/v/introduction-to-radians)  [Algebra 2 / Rotation-by-radians-and-quadrants](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:trig/x2ec2f6f830c9fb89:radians/v/rotation-by-radians-and-quadrants) |
| * 1. Understand how the domains of trigonometric functions can be extended beyond 0 to 2π using the unit circle |  |
| * 1. Use special triangles (i.e., 30-60-90, 45-45-90) to determine geometrically the values of sine, cosine, and tangent for , , and . | [Algebra 2 / Trigonometric values of special angles](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:trig/x2ec2f6f830c9fb89:special-angles/v/solving-triangle-unit-circle) |
| * 1. Use reference angles to find the values of trigonometric functions at angles outside the interval 0 to . |  |
| * 1. Use the unit circle to explain symmetry and periodicity of trigonometric functions |  |
| Understands how periodic phenomena are modeled using trigonometric functions |  |
| * 1. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline | [Algebra 2 / Amplitude, midline and period](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:trig/x2ec2f6f830c9fb89:amp-mid-period/v/midline-amplitude-period)  [Algebra 2 / Transforming sinusoidal graphs](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:trig/x2ec2f6f830c9fb89:period/v/we-amplitude-and-period)  [Algebra 2 / Sinusoidal models](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:trig/x2ec2f6f830c9fb89:sinusoidal-models/v/modeling-with-shifted-trig-functions)  [Precalculus / Sinusoidal models](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:trig/x9e81a4f98389efdf:sinus-models/v/inverse-trig-with-model) |
| * 1. Understand how to restrict the domain of a trigonometric function so that its inverse can be constructed | [Precalculus / Invertible functions](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:composite/x9e81a4f98389efdf:invertible/v/determining-if-a-function-is-invertible)  [Precalculus / Inverse trigonometric functions](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:trig/x9e81a4f98389efdf:inverse-trig/v/inverse-trig-functions-arcsin) |
| * 1. Use inverse functions to solve trigonometric equations that arise in modeling contexts, and interpret them in terms of the context | [Precalculus / Inverse trigonometric functions](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:trig/x9e81a4f98389efdf:inverse-trig/v/inverse-trig-functions-arcsin) |
| Understands the application of trigonometric identities (e.g., Pythagorean, double angle, half angle, sum of angles, difference of angles). |  |
| * 1. Use Pythagorean identities (e.g., ) | [Algebra 2 / The Pythagorean identity](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:trig/x2ec2f6f830c9fb89:pythagorean-id/v/pythagorean-trig-identity-from-unit-circle) |
| * 1. Use trigonometric identities to rewrite expressions and solve equations | [Precalculus / Trigonometric identities](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:trig/x9e81a4f98389efdf:trig-id/v/trigonometry-unit-circle-symmetry)  [Precalculus / Angle addition identities](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:trig/x9e81a4f98389efdf:angle-addition/v/trigonometry-identity-review-fun)  [Precalculus / Using trigonometric identities](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:trig/x9e81a4f98389efdf:using-trig-id/v/sine-angle-addition-2) |
| * 1. Understand trigonometric identities in the context of equivalent graphs of trigonometric functions (e.g.,  and  are equivalent graphs) | [Algebra 2 / Transforming sinusoidal graphs](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:trig/x2ec2f6f830c9fb89:period/v/we-amplitude-and-period)  [Algebra 2 / Graphing sinusoidal functions](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:trig/x2ec2f6f830c9fb89:graphing-sinusoid/e/graphs_of_sine_and_cosine) |
| * 1. Prove Pythagorean identities (e.g., . | [Algebra 2 / The Pythagorean identity](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:trig/x2ec2f6f830c9fb89:pythagorean-id/v/pythagorean-trig-identity-from-unit-circle) |
| Knows how to interpret representations of functions of two variables (e.g., three-dimensional graphs, tables). |  |
| * 1. Interpret representations of functions of two variables |  |
| Understands how to solve equations (e.g., trigonometric, logarithmic, exponential). |  |
| * 1. Solve trigonometric, logarithmic, and exponential equations | [Algebra 2 / Solving exponential equations using properties of exponents](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:exp/x2ec2f6f830c9fb89:exp-eq-prop/v/solving-exponential-equations-with-exponent-properties)  [Algebra 2 / Solving exponential equations with logarithms](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:logs/x2ec2f6f830c9fb89:exp-eq-log/v/exponential-equation)  [Algebra 2 / Solving equations by graphing](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:eq/x2ec2f6f830c9fb89:sol-eq-graph/v/equations-by-graphing)  [Precalculus / Sinusoidal equations](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:trig/x9e81a4f98389efdf:sinus-eq/v/sine-solutions) |
| Calculus |  |
| 1. **Understands the meaning of a limit of a function and how to calculate limits of functions, determine when the limit does not exist, and solve problems using the properties of limits.** |  |
| * 1. Graphically analyze the limit of  as *x* approaches a fixed value from both left and right | [Differential calculus / Limits intro](https://www.khanacademy.org/math/differential-calculus/dc-limits/dc-limits-intro/v/introduction-to-limits-hd)  [Differential calculus / Estimating limits from graphs](https://www.khanacademy.org/math/differential-calculus/dc-limits/dc-limits-from-graphs/v/limits-from-graphs)  [Differential calculus / Limits at infinity](https://www.khanacademy.org/math/differential-calculus/dc-limits/dc-limits-at-infinity/v/introduction-to-limits-at-infinity) |
| * 1. Solve limit problems (e.g., a constant times a function, the sum of two functions, the product and quotient of two functions) using properties of limits, where all limits of the individual functions exist at the value that x is approaching | [Differential calculus / Properties of limits](https://www.khanacademy.org/math/differential-calculus/dc-limits/dc-limit-prop/v/limit-properties)  [Differential calculus / Limits by direct substitution](https://www.khanacademy.org/math/differential-calculus/dc-limits/dc-direct-substitution/v/limit-by-substitution)  [Differential calculus / Limits using algebraic manipulation](https://www.khanacademy.org/math/differential-calculus/dc-limits/dc-limits-algebraic/v/limit-example-1)  [Differential calculus / Strategy in finding limits](https://www.khanacademy.org/math/differential-calculus/dc-limits/dc-limit-strategy/v/flow-chart-of-limit-strategies)  [Differential calculus / L’Hôpital’s rule](https://www.khanacademy.org/math/differential-calculus/dc-context-app/dc-lhopital/v/introduction-to-l-hopital-s-rule)  [Differential calculus / L’Hôpital’s rule: composite exponential functions](https://www.khanacademy.org/math/differential-calculus/dc-context-app/dc-lhopital-composite-exp/v/tricky-lhopitals-rule-problem) |
| * 1. Analyze one-sided limits for various functions to see whether or not the limit exists | [Differential calculus / Estimating limits from graphs](https://www.khanacademy.org/math/differential-calculus/dc-limits/dc-limits-from-graphs/v/limits-from-graphs)  [Differential calculus / Estimating limits from tables](https://www.khanacademy.org/math/differential-calculus/dc-limits/dc-limits-from-tables/v/approximating-limit-from-table) |
| * 1. Recognize limits that do not exist, such as  and *.* | [Differential calculus / Estimating limits from graphs](https://www.khanacademy.org/math/differential-calculus/dc-limits/dc-limits-from-graphs/v/limits-from-graphs)  [Differential calculus / Estimating limits from tables](https://www.khanacademy.org/math/differential-calculus/dc-limits/dc-limits-from-tables/v/approximating-limit-from-table) |
| Understands the derivative of a function as a limit, as the slope of a line tangent to a curve, and as a rate of change. |  |
| * 1. Construct a function graph for a given function and a given point , and explain what happens to the succession of slopes of secant lines connecting  to  as *x* approaches *a*, from both the right side and the left side | [Differential calculus / Average vs. instantaneous rate of change](https://www.khanacademy.org/math/differential-calculus/dc-diff-intro/dc-diff-calc-intro/v/newton-leibniz-and-usain-bolt)  [Differential calculus / Secant lines](https://www.khanacademy.org/math/differential-calculus/dc-diff-intro/dc-secant-lines/v/slope-of-a-line-secant-to-a-curve) |
| * 1. State the limit definition of the derivative, and use it to find the derivative of a given function at a given value of *x* and to find the derivative function | [Differential calculus / Derivative definition](https://www.khanacademy.org/math/differential-calculus/dc-diff-intro/dc-derivative-intro/v/calculus-derivatives-1-new-hd-version)  [Differential calculus / Estimating derivatives](https://www.khanacademy.org/math/differential-calculus/dc-diff-intro/dc-estimate-derivatives/v/estimating-derivative-at-a-point) |
| Understands how to show that a particular function is continuous. |  |
| * 1. Apply the three steps (i.e.,  exists,  exists, and ) that are part of the definition of what it means for a function to be continuous at  to verify whether a given function is continuous at a given point | [Differential calculus / Types of discontinuities](https://www.khanacademy.org/math/differential-calculus/dc-limits/dc-discontinuities/v/types-of-discontinuities)  [Differential calculus / Continuity at a point](https://www.khanacademy.org/math/differential-calculus/dc-limits/dc-point-continuity/v/continuity-at-a-point)  [Differential calculus / Continuity over an interval](https://www.khanacademy.org/math/differential-calculus/dc-limits/dc-interval-continuity/v/continuity-over-an-interval)  [Differential calculus / Removing discontinuities](https://www.khanacademy.org/math/differential-calculus/dc-limits/dc-removing-discontinuity/v/defining-a-function-at-a-point-to-make-it-continuous) |
| Knows the relationship between continuity and differentiability |  |
| * 1. Give examples of functions that are continuous at  but not differentiable at , and explain why | [Differential calculus / Differentiability](https://www.khanacademy.org/math/differential-calculus/dc-diff-intro/dc-differentiability/v/differentiability) |
| Understands how to approximate derivatives and integrals numerically |  |
| * 1. Given a table of values, use the slope of a secant line to approximate a derivative. | [Differential calculus / Secant lines](https://www.khanacademy.org/math/differential-calculus/dc-diff-intro/dc-secant-lines/v/slope-of-a-line-secant-to-a-curve)  [Differential calculus / Estimating derivatives](https://www.khanacademy.org/math/differential-calculus/dc-diff-intro/dc-estimate-derivatives/v/estimating-derivative-at-a-point) |
| * 1. Use the midpoint rule, trapezoid rule, or other Riemann sums to find numerical approximations for integrals |  |
| Understands how and when to use standard differentiation and integration techniques |  |
| * 1. Use standard differentiation techniques | [Differential calculus / Power rule](https://www.khanacademy.org/math/differential-calculus/dc-diff-intro/dc-power-rule/v/power-rule)  [Differential calculus / Derivative rules: constant, sum, difference, and constant multiple](https://www.khanacademy.org/math/differential-calculus/dc-diff-intro/dc-basic-diff-rules/v/derivative-properties-and-polynomial-derivatives)  [Differential calculus / Combining the power rule with other derivative rules](https://www.khanacademy.org/math/differential-calculus/dc-diff-intro/dc-combine-power-rule-with-others/v/differentiating-polynomials-example)  [Differential calculus / Derivatives of cos(x), sin(x), 𝑒ˣ, and ln(x)](https://www.khanacademy.org/math/differential-calculus/dc-diff-intro/dc-more-diff-rules/v/derivatives-of-sinx-and-cosx)  [Differential calculus / Product rule](https://www.khanacademy.org/math/differential-calculus/dc-diff-intro/dc-product-rule/v/applying-the-product-rule-for-derivatives)  [Differential calculus / Quotient rule](https://www.khanacademy.org/math/differential-calculus/dc-diff-intro/dc-quotient-rule/v/quotient-rule)  [Differential calculus / Derivatives of tan(x), cot(x), sec(x), and csc(x)](https://www.khanacademy.org/math/differential-calculus/dc-diff-intro/dc-trig-derivatives/v/derivatives-of-tanx-and-cotx)  [Differential calculus / Chain rule](https://www.khanacademy.org/math/differential-calculus/dc-chain/dc-chain-rule/v/chain-rule-introduction)  [Differential calculus / More chain rule practice](https://www.khanacademy.org/math/differential-calculus/dc-chain/dc-more-chain-rule/v/exponential-functions-differentiation-intro)  [Differential calculus / Implicit differentiation](https://www.khanacademy.org/math/differential-calculus/dc-chain/dc-implicit-diff/v/implicit-differentiation-1)  [Differential calculus / Implicit differentiation (advanced examples)](https://www.khanacademy.org/math/differential-calculus/dc-chain/dc-implicit-diff-advanced/v/implicit-derivative-of-y-cos-5x-3y)  [Differential calculus / Differentiating inverse functions](https://www.khanacademy.org/math/differential-calculus/dc-chain/dc-inverse-func-diff/v/derivatives-of-inverse-functions)  [Differential calculus / Derivatives of inverse trigonometric functions](https://www.khanacademy.org/math/differential-calculus/dc-chain/dc-inverse-trig/v/derivative-inverse-sine)  [Differential calculus / Strategy in differentiating functions](https://www.khanacademy.org/math/differential-calculus/dc-chain/dc-diff-strategy/v/correcting-work-on-derivative-strategies)  [Differential calculus / Differentiation using multiple rules](https://www.khanacademy.org/math/differential-calculus/dc-chain/dc-diff-with-multiple-rules/v/differentiating-using-multiple-rules-strategy)  [Differential calculus / Disguised derivatives](https://www.khanacademy.org/math/differential-calculus/dc-chain/dc-disguised-derivatives/v/disguised-derivatives)  [Differential calculus / Logarithmic differentiation](https://www.khanacademy.org/math/differential-calculus/dc-chain/dc-logarithmic-diff/v/calculus-derivative-of-x-x-x) |
| * 1. Use standard integration techniques | [Integral calculus / Properties of definite integrals](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-integral-prop/v/negative-definite-integrals)  [Integral calculus / Reverse power rule](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-reverse-power-rule/v/indefinite-integrals-of-x-raised-to-a-power)  [Integral calculus / Indefinite integrals of common functions](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-common-indefinite-integrals/v/antiderivative-of-x-1)  [Integral calculus / Definite integrals of common functions](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-common-definite-integrals/v/reverse-power-rule-for-definite-integrals)  [Integral calculus / Integrating with u-substitution](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-u-sub/v/u-substitution)  [Integral calculus / Integrating using long division and completing the square](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-long-div/v/integral-partial-fraction)  [Integral calculus / Integrating using trigonometric identities](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-integration-with-trig-identities/v/using-trig-identity-to-use-u-substitution)  [Integral calculus / Trigonometric substitution](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-trig-substitution/v/introduction-to-trigonometric-substitution)  [Integral calculus / Integration by parts](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-integration-by-parts/v/deriving-integration-by-parts-formula)  [Integral calculus / Integrating using linear partial fractions](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-partial-frac/v/integration-with-partial-fractions)  [Integral calculus / Improper integrals](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-improper-integrals/v/introduction-to-improper-integrals) |
| * 1. Understand the relationship between position, velocity, and acceleration functions of a particle in motion | [Differential calculus / Straight-line motion](https://www.khanacademy.org/math/differential-calculus/dc-context-app/dc-linear-motion/v/one-dimensional-motion-with-calculus)  [Integral calculus / Straight-line motion](https://www.khanacademy.org/math/integral-calculus/ic-int-app/ic-linear-motion/v/motion-problems-with-integrals) |
| Understands how to analyze the behavior of a function (e.g., extrema, concavity, symmetry |  |
| * 1. Use the first and second derivatives to analyze the graph of a function | [Differential calculus / Second derivatives](https://www.khanacademy.org/math/differential-calculus/dc-chain/dc-second-derivatives/v/second-derivatives)  [Differential calculus / Intervals on which a function is increasing or decreasing](https://www.khanacademy.org/math/differential-calculus/dc-analytic-app/dc-increasing-decreasing/v/increasing-decreasing-intervals-given-the-function)  [Differential calculus / Relative (local) extrema](https://www.khanacademy.org/math/differential-calculus/dc-analytic-app/dc-first-derivative-test/v/relative-minima-maxima)  [Differential calculus / Absolute (global) extrema](https://www.khanacademy.org/math/differential-calculus/dc-analytic-app/dc-candidates-test/v/using-extreme-value-theorem)  [Differential calculus / Concavity and inflection points intro](https://www.khanacademy.org/math/differential-calculus/dc-analytic-app/dc-concavity-intro/v/concavity-concave-upwards-and-concave-downwards-intervals)  [Differential calculus / Analyzing concavity and inflection points](https://www.khanacademy.org/math/differential-calculus/dc-analytic-app/dc-analyze-concavity/v/analyzing-concavity-algebraically)  [Differential calculus / Second derivative test](https://www.khanacademy.org/math/differential-calculus/dc-analytic-app/dc-second-derivative-test/v/second-derivative-test)  [Differential calculus / Sketching curves](https://www.khanacademy.org/math/differential-calculus/dc-analytic-app/dc-sketching-curves/v/calculus-graphing-using-derivatives)  [Differential calculus / Connecting f, f', and f''](https://www.khanacademy.org/math/differential-calculus/dc-analytic-app/dc-connecting-func-derivative/v/calculus-based-justification-for-function-increasing) |
| Understands how to apply derivatives to solve problems (e.g., related rates, optimization) |  |
| * 1. Apply derivatives to solve problems | [Differential calculus / Introduction to related rates](https://www.khanacademy.org/math/differential-calculus/dc-context-app/dc-related-rates-intro/v/rates-of-change-between-radius-and-area-of-circle)  [Differential calculus / Solving related rates problems](https://www.khanacademy.org/math/differential-calculus/dc-context-app/dc-related-rates/e/related-rates)  [Differential calculus / Approximation with local linearity](https://www.khanacademy.org/math/differential-calculus/dc-context-app/dc-linearization/v/local-linearization-intro)  [Differential calculus / Solving optimization problems](https://www.khanacademy.org/math/differential-calculus/dc-analytic-app/dc-optimization/v/minimizing-sum-of-squares)  [Differential calculus / Analyzing implicit relations](https://www.khanacademy.org/math/differential-calculus/dc-analytic-app/dc-implicit-relations/v/implicit-curve-horizontal-tangent) |
| Understands the foundational theorems of calculus (e.g., fundamental theorems of calculus, mean value theorem, intermediate value theorem) |  |
| * 1. Solve problems using the foundational theorems of calculus | [Differential calculus / Intermediate value theorem](https://www.khanacademy.org/math/differential-calculus/dc-limits/dc-ivt/v/intermediate-value-theorem)  [Differential calculus / Mean value theorem](https://www.khanacademy.org/math/differential-calculus/dc-analytic-app/dc-mvt/v/mean-value-theorem-1)  [Differential calculus / Extreme value theorem and critical points](https://www.khanacademy.org/math/differential-calculus/dc-analytic-app/dc-evt/v/extreme-value-theorem) |
| * 1. Understand the relationship between differentiation and integration, including the role of the fundamental theorems of calculus | [Integral calculus / Fundamental theorem of calculus and accumulation functions](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-ftc-part-1/v/fundamental-theorem-of-calculus)  [Integral calculus / Interpreting the behavior of accumulation functions](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-connect-function-antiderivative/v/interpreting-behavior-of-antiderivative)  [Integral calculus / Fundamental theorem of calculus and definite integrals](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-ftc-part-2/v/connecting-the-first-and-second-fundamental-theorems-of-calculus) |
| * 1. Match graphs of functions with graphs of their derivatives or accumulations |  |
| * 1. Understand how to use differentiation and integration of a function to express rates of change and total change | [Differential calculus / Meaning of the derivative in context](https://www.khanacademy.org/math/differential-calculus/dc-context-app/dc-interpret-derivatives/v/interpreting-the-meaning-of-the-derivative-in-context)  [Differential calculus / Non-motion applications of derivatives](https://www.khanacademy.org/math/differential-calculus/dc-context-app/dc-derivative-apps/v/modeling-a-forgetting-curve) |
| * 1. Understand and calculate the average value of a function over an interval (i.e., mean value theorem of integrals). | [Integral calculus / Average value of a function](https://www.khanacademy.org/math/integral-calculus/ic-int-app/ic-avg-value/v/average-function-value-closed-interval) |
| Understands integration as a limit of Riemann sums | [Integral calculus / Approximation with Riemann sums](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-riemann-sums/v/simple-riemann-approximation-using-rectangles)  [Integral calculus / Summation notation review](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-summation-notation/v/sigma-notation-sum)  [Integral calculus / Riemann sums in summation notation](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-riemann-sums-summation-notation/v/generalizing-a-left-riemann-sum-with-equally-spaced-rectangles)  [Integral calculus / Defining integrals with Riemann sums](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-definite-integral-definition/v/riemann-sums-and-integrals) |
| * 1. Calculate a definite integral using a limit of Riemann sums. |  |
| Understands how to use integration to compute area, volume, distance, or other accumulation processes | [Integral calculus / Accumulations of change introduction](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-integral-calc-intro/v/introduction-to-integral-calculus)  [Integral calculus / Fundamental theorem of calculus and accumulation functions](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-ftc-part-1/v/fundamental-theorem-of-calculus)  [Integral calculus / Interpreting the behavior of accumulation functions](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-connect-function-antiderivative/v/interpreting-behavior-of-antiderivative)  [Integral calculus / Non-motion applications of integrals](https://www.khanacademy.org/math/integral-calculus/ic-int-app/ic-integral-apps/v/area-under-rate-net-change)  [Integral calculus / Area: vertical area between curves](https://www.khanacademy.org/math/integral-calculus/ic-int-app/ic-vertical-area/v/evaluating-simple-definite-integral)  [Integral calculus / Area: horizontal area between curves](https://www.khanacademy.org/math/integral-calculus/ic-int-app/ic-horizontal-area/v/area-between-curve-and-y-axis)  [Integral calculus / Area: curves that intersect at more than two points](https://www.khanacademy.org/math/integral-calculus/ic-int-app/ic-composite-area/e/area-between-curves-that-intersect-at-more-than-two-points)  [Integral calculus / Volume: squares and rectangles cross sections](https://www.khanacademy.org/math/integral-calculus/ic-int-app/ic-vol-squares-rect/v/volume-with-cross-sections-intro)  [Integral calculus / Volume: triangles and semicircles cross sections](https://www.khanacademy.org/math/integral-calculus/ic-int-app/ic-vol-tri-circle/v/volume-solid-semicircle-cross-section)  [Integral calculus / Volume: disc method (revolving around x- and y-axes)](https://www.khanacademy.org/math/integral-calculus/ic-int-app/ic-disc-method-axes/v/disk-method-around-x-axis)  [Integral calculus / Volume: disc method (revolving around other axes)](https://www.khanacademy.org/math/integral-calculus/ic-int-app/ic-disc-method-non-axes/v/disc-method-rotation-around-horizontal-line)  [Integral calculus / Volume: washer method (revolving around x- and y-axes)](https://www.khanacademy.org/math/integral-calculus/ic-int-app/ic-washer-method-axes/v/disc-method-washer-method-for-rotation-around-x-axis)  [Integral calculus / Volume: washer method (revolving around other axes)](https://www.khanacademy.org/math/integral-calculus/ic-int-app/ic-washer-method-non-axes/v/washer-method-rotating-around-non-axis) |
| * 1. Use integration techniques to compute area, volume, distance, or other accumulation processes |  |
| Knows how to determine the limits of sequences, if they exist. |  |
| * 1. Determine the limits of sequences when they exist |  |
| Is familiar with simple infinite series | [Algebra 2 / Geometric series](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-factor/x2ec2f6f830c9fb89:geo-series/v/geo-series-intro)  [Precalculus / Geometric series](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:series/x9e81a4f98389efdf:geo-series/v/geo-series-intro)  [Precalculus / Geometric series (with summation notation)](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:series/x9e81a4f98389efdf:geo-series-notation/v/sigma-notation-sum)  [Precalculus / Arithmetic series](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:series/x9e81a4f98389efdf:arith-series/v/sum-of-arithmetic-sequence-arithmetic-series)  [Integral calculus / Convergent and divergent infinite series](https://www.khanacademy.org/math/integral-calculus/ic-series/ic-series-intro/v/convergent-and-divergent-sequences)  [Integral calculus / Infinite geometric series](https://www.khanacademy.org/math/integral-calculus/ic-series/ic-geometric-series/v/evaluating-infinite-geometric-series)  [Integral calculus / nth-term test](https://www.khanacademy.org/math/integral-calculus/ic-series/ic-nth-term-test/v/divergence-test)  [Integral calculus / Integral test](https://www.khanacademy.org/math/integral-calculus/ic-series/ic-integral-test/v/integral-test-intuition)  [Integral calculus / Harmonic series and p-series](https://www.khanacademy.org/math/integral-calculus/ic-series/ic-p-series/v/harmonic-and-p-series)  [Integral calculus / Comparison tests](https://www.khanacademy.org/math/integral-calculus/ic-series/ic-comparison-tests/v/comparison-test)  [Integral calculus / Alternating series test](https://www.khanacademy.org/math/integral-calculus/ic-series/ic-alternating-series/v/alternating-series-test)  [Integral calculus / Ratio test](https://www.khanacademy.org/math/integral-calculus/ic-series/ic-ratio-test/v/ratio-test-convergence)  [Integral calculus / Absolute and conditional convergence](https://www.khanacademy.org/math/integral-calculus/ic-series/ic-absolute-conditional/v/conditional-and-absolute-convergence) |
| * 1. Determine if simple infinite series converge or diverge | [Algebra 2 / Geometric series](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-factor/x2ec2f6f830c9fb89:geo-series/v/geo-series-intro)  [Precalculus / Geometric series](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:series/x9e81a4f98389efdf:geo-series/v/geo-series-intro)  [Precalculus / Geometric series (with summation notation)](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:series/x9e81a4f98389efdf:geo-series-notation/v/sigma-notation-sum)  [Precalculus / Arithmetic series](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:series/x9e81a4f98389efdf:arith-series/v/sum-of-arithmetic-sequence-arithmetic-series)  [Integral calculus / Convergent and divergent infinite series](https://www.khanacademy.org/math/integral-calculus/ic-series/ic-series-intro/v/convergent-and-divergent-sequences) |
| * 1. Find the sum of a simple infinite series if it exists | [Algebra 2 / Geometric series](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:poly-factor/x2ec2f6f830c9fb89:geo-series/v/geo-series-intro)  [Precalculus / Geometric series](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:series/x9e81a4f98389efdf:geo-series/v/geo-series-intro)  [Precalculus / Geometric series (with summation notation)](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:series/x9e81a4f98389efdf:geo-series-notation/v/sigma-notation-sum)  [Precalculus / Arithmetic series](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:series/x9e81a4f98389efdf:arith-series/v/sum-of-arithmetic-sequence-arithmetic-series)  [Integral calculus / Convergent and divergent infinite series](https://www.khanacademy.org/math/integral-calculus/ic-series/ic-series-intro/v/convergent-and-divergent-sequences) |
| * 1. Find the partial sum of a simple infinite series | [Integral calculus / Approximation with Riemann sums](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-riemann-sums/v/simple-riemann-approximation-using-rectangles)  [Integral calculus / Summation notation review](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-summation-notation/v/sigma-notation-sum)  [Integral calculus / Riemann sums in summation notation](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-riemann-sums-summation-notation/v/generalizing-a-left-riemann-sum-with-equally-spaced-rectangles)  [Integral calculus / Defining integrals with Riemann sums](https://www.khanacademy.org/math/integral-calculus/ic-integration/ic-definite-integral-definition/v/riemann-sums-and-integrals) |
| **II. Geometry, Probability and Statistics, and Discrete Mathematics** | Lesson |
| 1. **Geometry** |  |
| 1. **Understands transformations in a plane** |  |
| * 1. Know precise definitions of angle, circle, line segment, perpendicular lines, and parallel lines | [High school geometry / Intro to Euclidean geometry](https://www.khanacademy.org/math/geometry/hs-geo-foundations/hs-geo-intro-euclid/v/euclid-as-the-father-of-geometry)  [High school geometry / Circle basics](https://www.khanacademy.org/math/geometry/hs-geo-circles/hs-geo-circle-basics/v/language-and-notation-of-the-circle) |
| * 1. Represent transformations in the plane | [High school geometry / Introduction to rigid transformations](https://www.khanacademy.org/math/geometry/hs-geo-transformations/hs-geo-transformations-intro/v/introduction-to-transformations) |
| * 1. Describe transformations as functions that take points in the plane as inputs, and give other points as outputs | [High school geometry / Introduction to rigid transformations](https://www.khanacademy.org/math/geometry/hs-geo-transformations/hs-geo-transformations-intro/v/introduction-to-transformations) |
| * 1. Recognize whether a transformation preserves distance and angle measure | [High school geometry / Translations](https://www.khanacademy.org/math/geometry/hs-geo-transformations/hs-geo-translations/v/translating-points)  [High school geometry / Rotations](https://www.khanacademy.org/math/geometry/hs-geo-transformations/hs-geo-rotations/v/rotating-points)  [High school geometry / Reflections](https://www.khanacademy.org/math/geometry/hs-geo-transformations/hs-geo-reflections/v/reflecting-points) |
| * 1. Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that map it onto itself | [High school geometry / Rigid transformations overview](https://www.khanacademy.org/math/geometry/hs-geo-transformations/hs-geo-rigid-transformations-overview/v/finding-measures-using-rigid-transformations)  [High school geometry / Symmetry](https://www.khanacademy.org/math/geometry/hs-geo-transformations/hs-geo-symmetry/v/axis-of-symmetry) |
| * 1. Develop definitions of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments | [High school geometry / Properties & definitions of transformations](https://www.khanacademy.org/math/geometry/hs-geo-transformations/hs-geo-transformations-definitions/v/sequences-of-transformations) |
| * 1. Given a geometric figure and a rotation, reflection, or translation, draw the transformed figure | [High school geometry / Rigid transformations overview](https://www.khanacademy.org/math/geometry/hs-geo-transformations/hs-geo-rigid-transformations-overview/v/finding-measures-using-rigid-transformations) |
| * 1. Specify a sequence of transformations that will map a given figure onto another figure | [High school geometry / Rigid transformations overview](https://www.khanacademy.org/math/geometry/hs-geo-transformations/hs-geo-rigid-transformations-overview/v/finding-measures-using-rigid-transformations)  [High school geometry / Properties & definitions of transformations](https://www.khanacademy.org/math/geometry/hs-geo-transformations/hs-geo-transformations-definitions/v/sequences-of-transformations) |
| Understands how to prove geometric theorems such as those about lines and angles, triangles, and parallelograms |  |
| * 1. Prove theorems about lines and angles | [High school geometry / Angles](https://www.khanacademy.org/math/geometry/hs-geo-foundations/hs-geo-angles/v/measuring-angles-in-degrees) |
| * 1. Prove theorems about triangles | [High school geometry / Theorems concerning triangle properties](https://www.khanacademy.org/math/geometry/hs-geo-congruence/hs-geo-congruence-theorems/v/proof-sum-of-measures-of-angles-in-a-triangle-are-180)  [High school geometry / Proofs of general theorems that use triangle congruence](https://www.khanacademy.org/math/geometry/hs-geo-congruence/hs-geo-triangle-theorems/v/congruent-triangle-proof-example)  [High school geometry / Angle bisector theorem](https://www.khanacademy.org/math/geometry/hs-geo-similarity/hs-geo-angle-bisector-theorem/v/angle-bisector-theorem-proof)  [High school geometry / Pythagorean theorem proofs](https://www.khanacademy.org/math/geometry/hs-geo-trig/hs-geo-pythagorean-proofs/v/garfield-s-proof-of-the-pythagorean-theorem)  [High school geometry / Polygons](https://www.khanacademy.org/math/geometry/hs-geo-foundations/hs-geo-polygons/v/proof-sum-of-measures-of-angles-in-a-triangle-are-180) |
| * 1. Prove theorems about parallelograms | [High school geometry / Theorems concerning quadrilateral properties](https://www.khanacademy.org/math/geometry/hs-geo-congruence/hs-geo-quadrilaterals-theorems/v/proof-opposite-sides-of-parallelogram-congruent)  [High school geometry / Polygons](https://www.khanacademy.org/math/geometry/hs-geo-foundations/hs-geo-polygons/v/proof-sum-of-measures-of-angles-in-a-triangle-are-180) |
| Understands how geometric constructions are made with a variety of tools and methods |  |
| * 1. Recognize formal geometric constructions | [High school geometry / Constructing bisectors of lines & angles](https://www.khanacademy.org/math/geometry/hs-geo-congruence/hs-geo-bisectors/v/constructing-a-perpendicular-bisector-using-a-compass-and-straightedge) |
| * 1. Explain how formal geometric constructions are made (e.g., an equilateral triangle, a square, a regular hexagon inscribed in a circle). | [High school geometry / Constructing bisectors of lines & angles](https://www.khanacademy.org/math/geometry/hs-geo-congruence/hs-geo-bisectors/v/constructing-a-perpendicular-bisector-using-a-compass-and-straightedge)  [High school geometry / Inscribed shapes problem solving](https://www.khanacademy.org/math/geometry/hs-geo-circles/hs-geo-inscribed-shapes/v/right-triangles-inscribed-in-circles-proof)  [High school geometry / Constructing regular polygons inscribed in circles](https://www.khanacademy.org/math/geometry/hs-geo-circles/hs-geo-inscribed-polygons/v/constructing-square-inscribed-in-circle)  [High school geometry / Constructing circumcircles & incircles](https://www.khanacademy.org/math/geometry/hs-geo-circles/hs-geo-circum-in-circles/v/constructing-circle-inscribing-triangle) |
| Understands congruence and similarity in terms of transformations |  |
| * 1. Use geometric descriptions of rigid motions to transform figures and to predict the effect of a given rigid motion on a given figure | [High school geometry / Rigid transformations overview](https://www.khanacademy.org/math/geometry/hs-geo-transformations/hs-geo-rigid-transformations-overview/v/finding-measures-using-rigid-transformations) |
| * 1. Verify the properties of dilations given by a center and a scale factor | [High school geometry / Dilations](https://www.khanacademy.org/math/geometry/hs-geo-transformations#hs-geo-dilations) |
| * 1. Given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent | [High school geometry / Transformations & congruence](https://www.khanacademy.org/math/geometry/hs-geo-congruence/hs-geo-trans-and-congruence/v/testing-congruence-by-transformations-example) |
| * 1. Given two figures, use the definition of similarity in terms of dilations to decide if the figures are similar | [High school geometry / Definitions of similarity](https://www.khanacademy.org/math/geometry/hs-geo-similarity/hs-geo-similarity-definitions/v/testing-similarity-through-transformations) |
| * 1. Explain how the criteria for triangle congruence (e.g., ASA, SAS, HL) follow from the definition of congruence in terms of rigid motions | [High school geometry / Triangle congruence](https://www.khanacademy.org/math/geometry/hs-geo-congruence/hs-geo-triangle-congruence/v/congruent-triangles-and-sss) |
| * 1. Use the properties of similarity transformations to establish the AA criterion for two triangles to be similar | [High school geometry / Introduction to triangle similarity](https://www.khanacademy.org/math/geometry/hs-geo-similarity/hs-geo-triangle-similarity-intro/v/similar-triangle-basics)  [High school geometry / Solving similar triangles](https://www.khanacademy.org/math/geometry/hs-geo-similarity/hs-geo-solving-similar-triangles/e/solving_similar_triangles_1) |
| * 1. Use congruence and similarity criteria for triangles to solve problems and to prove relationships in geometric figures | [High school geometry / Theorems concerning triangle properties](https://www.khanacademy.org/math/geometry/hs-geo-congruence/hs-geo-congruence-theorems/v/proof-sum-of-measures-of-angles-in-a-triangle-are-180)  [High school geometry / Working with triangles](https://www.khanacademy.org/math/geometry/hs-geo-congruence/hs-geo-working-with-triangles/v/figuring-out-all-the-angles-for-congruent-triangles-example)  [High school geometry / Proofs of general theorems that use triangle congruence](https://www.khanacademy.org/math/geometry/hs-geo-congruence/hs-geo-triangle-theorems/v/congruent-triangle-proof-example)  [High school geometry / Solving problems with similar & congruent triangles](https://www.khanacademy.org/math/geometry/hs-geo-similarity/hs-geo-similar-and-congruent-triangles/v/finding-area-using-similarity-and-congruence)  [High school geometry / Solving modeling problems with similar & congruent triangles](https://www.khanacademy.org/math/geometry/hs-geo-similarity/hs-geo-similar-and-congruent-triangles-modeling/v/goldren-ratio-and-rembrandt-s-self-portrait) |
| Understands how trigonometric ratios are defined in right triangles |  |
| * 1. 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. | [High school geometry / Introduction to the trigonometric ratios](https://www.khanacademy.org/math/geometry/hs-geo-trig/hs-geo-trig-ratios-intro/v/basic-trigonometry)  [High school geometry / Trigonometric ratios & similarity](https://www.khanacademy.org/math/geometry/hs-geo-trig/hs-geo-trig-ratios-similarity/v/similarity-to-define-sine-cosine-and-tangent)  [Algebra 2 / Unit circle introduction](https://www.khanacademy.org/math/algebra2/x2ec2f6f830c9fb89:trig/x2ec2f6f830c9fb89:unit-circle/v/unit-circle-definition-of-trig-functions-1) |
| * 1. Explain and use the relationship between the sine and cosine of complementary angles | [High school geometry / Introduction to the trigonometric ratios](https://www.khanacademy.org/math/geometry/hs-geo-trig/hs-geo-trig-ratios-intro/v/basic-trigonometry)  [High school geometry / Sine & cosine of complementary angles](https://www.khanacademy.org/math/geometry/hs-geo-trig/hs-geo-complementary-angles/v/showing-relationship-between-cosine-and-sine-of-complements) |
| * 1. Use trigonometric ratios and the Pythagorean theorem to solve right triangles in applied problems | [High school geometry / Pythagorean theorem](https://www.khanacademy.org/math/geometry/hs-geo-trig/hs-geo-pyth-theorem/v/the-pythagorean-theorem)  [High school geometry / Solving for a side in a right triangle using the trigonometric ratios](https://www.khanacademy.org/math/geometry/hs-geo-trig/hs-geo-solve-for-a-side/v/example-trig-to-solve-the-sides-and-angles-of-a-right-triangle)  [High school geometry / Solving for an angle in a right triangle using the trigonometric ratios](https://www.khanacademy.org/math/geometry/hs-geo-trig/hs-geo-solve-for-an-angle/a/inverse-trig-functions-intro)  [High school geometry / Modeling with right triangles](https://www.khanacademy.org/math/geometry/hs-geo-trig/hs-geo-modeling-with-right-triangles/v/angle-to-aim-to-get-alien) |
| Understands how trigonometry is applied to general triangles |  |
| * 1. Derive the formula  for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side and use it to solve problems | [High school geometry / Law of sines](https://www.khanacademy.org/math/geometry/hs-geo-trig/hs-geo-law-of-sines/v/law-of-sines)  [High school geometry / Solving general triangles](https://www.khanacademy.org/math/geometry/hs-geo-trig/hs-geo-solving-general-triangles/v/law-of-cosines-word-problem) |
| * 1. Apply the law of sines and the law of cosines to find unknown measurements in triangles. | [High school geometry / Law of sines](https://www.khanacademy.org/math/geometry/hs-geo-trig/hs-geo-law-of-sines/v/law-of-sines)  [High school geometry / Law of cosines](https://www.khanacademy.org/math/geometry/hs-geo-trig/hs-geo-law-of-cosines/v/law-of-cosines-example)  [High school geometry / Solving general triangles](https://www.khanacademy.org/math/geometry/hs-geo-trig/hs-geo-solving-general-triangles/v/law-of-cosines-word-problem) |
| Understands and applies theorems about circles. |  |
| * 1. Identify and describe relationships among inscribed angles, radii, and chords | [High school geometry / Arc measure](https://www.khanacademy.org/math/geometry/hs-geo-circles/hs-geo-arc-measures/v/intro-arc-measure)  [High school geometry / Inscribed shapes problem solving](https://www.khanacademy.org/math/geometry/hs-geo-circles/hs-geo-inscribed-shapes/v/right-triangles-inscribed-in-circles-proof) |
| * 1. Prove properties of angles for a quadrilateral inscribed in a circle | [High school geometry / Arc length (from degrees)](https://www.khanacademy.org/math/geometry/hs-geo-circles/hs-geo-arc-length-deg/v/length-of-an-arc-that-subtends-a-central-angle)  [High school geometry / Arc length (from radians)](https://www.khanacademy.org/math/geometry/hs-geo-circles/hs-geo-arc-length-rad/v/arc-length-as-fraction-of-circumference)  [High school geometry / Inscribed angles](https://www.khanacademy.org/math/geometry/hs-geo-circles/hs-geo-inscribed-angles/v/inscribed-angles-exercise-example)  [High school geometry / Inscribed shapes problem solving](https://www.khanacademy.org/math/geometry/hs-geo-circles/hs-geo-inscribed-shapes/v/right-triangles-inscribed-in-circles-proof) |
| * 1. Construct a tangent line from a point outside a given circle to the circle. | [High school geometry / Properties of tangents](https://www.khanacademy.org/math/geometry/hs-geo-circles/hs-geo-tangents/v/proving-radius-is-perpendicular-to-tangent-line)  [High school geometry / Constructing a line tangent to a circle](https://www.khanacademy.org/math/geometry/hs-geo-circles/hs-geo-constructing-tangents/v/constructing-a-tangent-line-using-compass-and-straightedge) |
| Understands arc length and area measurements of sectors of circles |  |
| * 1. Derive and use the fact that the length of the arc intercepted by a central angle is proportional to the circumference | [High school geometry / Arc measure](https://www.khanacademy.org/math/geometry/hs-geo-circles/hs-geo-arc-measures/v/intro-arc-measure) |
| * 1. Derive and use the formula for the area of a sector | [High school geometry / Sectors](https://www.khanacademy.org/math/geometry/hs-geo-circles/hs-geo-sectors/v/area-of-a-sector-given-a-central-angle) |
| Knows how to translate between a geometric description (e.g., focus, asymptotes, directrix) and an equation for a conic section |  |
| * 1. Derive and use the equation of a circle of given center and radius | High school geometry / Standard equation of a circle  [Precalculus / The features of a circle](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:conics/x9e81a4f98389efdf:circ-features/v/graphing-circles-from-features)  [Precalculus / Standard equation of a circle](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:conics/x9e81a4f98389efdf:circ-standard-eq/v/radius-and-center-for-a-circle-equation-in-standard-form) |
| * 1. Complete the square to find the center and radius of a circle given by an equation in standard form | [High school geometry / Expanded equation of a circle](https://www.khanacademy.org/math/geometry/hs-geo-circles/hs-geo-circle-expanded-equation/v/completing-the-square-to-write-equation-in-standard-form-of-a-circle)  [Precalculus / Expanded equation of a circle](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:conics/x9e81a4f98389efdf:circ-expanded-eq/v/completing-the-square-to-write-equation-in-standard-form-of-a-circle)  [Precalculus / Identifying conic sections from their equations](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:conics/x9e81a4f98389efdf:id-conics/v/conic-identification-3) |
| * 1. Derive the equation of a parabola given a focus and directrix | [Precalculus / Introduction to conic sections](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:conics/x9e81a4f98389efdf:conics-intro/v/introduction-to-conic-sections)  [Precalculus / Focus and directrix of a parabola](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:conics/x9e81a4f98389efdf:parab-focus-directrix/v/focus-and-directrix-introduction)  [Precalculus / Identifying conic sections from their equations](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:conics/x9e81a4f98389efdf:id-conics/v/conic-identification-3) |
| * 1. Derive and use the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from a point on the curve to the foci is constant | [Precalculus / Introduction to conic sections](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:conics/x9e81a4f98389efdf:conics-intro/v/introduction-to-conic-sections)  [Precalculus / Center and radii of an ellipse](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:conics/x9e81a4f98389efdf:ellipse-center-radii/v/conic-sections-intro-to-ellipses)  [Precalculus / Foci of an ellipse](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:conics/x9e81a4f98389efdf:ellipse-foci/v/foci-of-an-ellipse)  [Precalculus / Introduction to hyperbolas](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:conics/x9e81a4f98389efdf:hyperb-intro/v/conic-sections-intro-to-hyperbolas)  [Precalculus / Foci of a hyperbola](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:conics/x9e81a4f98389efdf:hyperb-foci/v/foci-of-a-hyperbola)  [Precalculus / Hyperbolas not centered at the origin](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:conics/x9e81a4f98389efdf:non-origin-hyperb/v/conic-sections-hyperbolas-3)  [Precalculus / Identifying conic sections from their equations](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:conics/x9e81a4f98389efdf:id-conics/v/conic-identification-3) |
| Understands how to use coordinate geometry to algebraically prove simple geometric theorems |  |
| * 1. Use coordinates to prove simple geometric theorems algebraically | [High school geometry / Distance and midpoints](https://www.khanacademy.org/math/geometry/hs-geo-analytic-geometry/hs-geo-distance-and-midpoints/v/distance-formula) |
| * 1. Prove the slope criteria for parallel and perpendicular lines, and use parallel and perpendicular lines to solve geometric problems | [High school geometry / Parallel & perpendicular lines on the coordinate plane](https://www.khanacademy.org/math/geometry/hs-geo-analytic-geometry/hs-geo-parallel-perpendicular-lines/v/parallel-and-perpendicular-lines-intro)  [High school geometry / Equations of parallel & perpendicular lines](https://www.khanacademy.org/math/geometry/hs-geo-analytic-geometry/hs-geo-parallel-perpendicular-eq/v/parallel-lines) |
| * 1. Find the point on a directed line segment between two given points that partitions the segment in a given ratio | [High school geometry / Dividing line segments](https://www.khanacademy.org/math/geometry/hs-geo-analytic-geometry/hs-geo-dividing-segments/v/finding-a-point-part-way-between-two-points) |
| * 1. Use coordinates to compute perimeters of polygons and areas of triangles and quadrilaterals | [High school geometry / Problem solving with distance on the coordinate plane](https://www.khanacademy.org/math/geometry/hs-geo-analytic-geometry/hs-geo-dist-problems/v/area-of-trapezoid-on-coordinate-plane) |
| Understands how perimeter, area, surface area, and volume formulas are used to solve problems |  |
| * 1. Give an informal argument for the formulas for the circumference of a circle, area of a circle, volume of a cylinder, pyramid, and cone | [High school geometry / Area](https://www.khanacademy.org/math/geometry/hs-geo-foundations/hs-geo-area/v/perimeter-and-area-basics)  [High school geometry / Solid geometry intro](https://www.khanacademy.org/math/geometry/hs-geo-solids/hs-geo-solids-intro/v/solid-geometry-volume) |
| * 1. Use the perimeter and area of geometric shapes to solve problems | [High school geometry / Area](https://www.khanacademy.org/math/geometry/hs-geo-foundations/hs-geo-area/v/perimeter-and-area-basics) |
| * 1. Use the surface area and volume of prisms, cylinders, pyramids, cones, and spheres to solve problems | [High school geometry / Area](https://www.khanacademy.org/math/geometry/hs-geo-foundations/hs-geo-area/v/perimeter-and-area-basics) |
| Knows how to visualize relationships (e.g., cross section, nets, rotations) between two-dimensional and three-dimensional objects |  |
| * 1. Identify the shapes of two-dimensional cross sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects | [High school geometry / 2D vs. 3D objects](https://www.khanacademy.org/math/geometry/hs-geo-solids/hs-geo-2d-vs-3d/v/vertical-slice-of-rectangular-pyramid) |
| * 1. Use two-dimensional representations of three-dimensional objects to visualize and solve problems. | [High school geometry / Area](https://www.khanacademy.org/math/geometry/hs-geo-foundations/hs-geo-area/v/perimeter-and-area-basics) |
| Knows how to apply geometric concepts in real-world situations |  |
| * 1. Use geometric shapes, their measures, and their properties to describe objects |  |
| * 1. Apply concepts of density based on area and volume in modeling situations | [High school geometry / Density](https://www.khanacademy.org/math/geometry/hs-geo-solids/hs-geo-density/v/density-example-blimp) |
| * 1. Apply geometric methods to solve design problems |  |
| Understands the properties of parallel and perpendicular lines, triangles, quadrilaterals, polygons, and circles and how they can be used in problem solving |  |
| * 1. Solve problems involving parallel, perpendicular, and intersecting lines | [High school geometry / Angles](https://www.khanacademy.org/math/geometry/hs-geo-foundations/hs-geo-angles/v/measuring-angles-in-degrees) |
| * 1. Apply angle relationships (e.g., supplementary, vertical, alternate interior) to solve problems | [High school geometry / Angles](https://www.khanacademy.org/math/geometry/hs-geo-foundations/hs-geo-angles/v/measuring-angles-in-degrees) |
| * 1. Solve problems that involve medians, midpoints, and altitudes | [High school geometry / Polygons](https://www.khanacademy.org/math/geometry/hs-geo-foundations/hs-geo-polygons/v/proof-sum-of-measures-of-angles-in-a-triangle-are-180)  [High school geometry / Proofs of general theorems that use triangle congruence](https://www.khanacademy.org/math/geometry/hs-geo-congruence/hs-geo-triangle-theorems/v/congruent-triangle-proof-example) |
| * 1. Solve problems involving special triangles (e.g., isosceles, equilateral, right) | [High school geometry / Special right triangles](https://www.khanacademy.org/math/geometry/hs-geo-trig/hs-geo-special-right-triangles/v/45-45-90-triangles)  [High school geometry / Polygons](https://www.khanacademy.org/math/geometry/hs-geo-foundations/hs-geo-polygons/v/proof-sum-of-measures-of-angles-in-a-triangle-are-180)  [High school geometry / Working with triangles](https://www.khanacademy.org/math/geometry/hs-geo-congruence/hs-geo-working-with-triangles/v/figuring-out-all-the-angles-for-congruent-triangles-example) |
| * 1. Know geometric properties of various quadrilaterals (e.g., parallelograms, trapezoids) | [High school geometry / Polygons](https://www.khanacademy.org/math/geometry/hs-geo-foundations/hs-geo-polygons/v/proof-sum-of-measures-of-angles-in-a-triangle-are-180)  [High school geometry / Theorems concerning quadrilateral properties](https://www.khanacademy.org/math/geometry/hs-geo-congruence/hs-geo-quadrilaterals-theorems/v/proof-opposite-sides-of-parallelogram-congruent) |
| * 1. Know relationships among quadrilateral | [High school geometry / Polygons](https://www.khanacademy.org/math/geometry/hs-geo-foundations/hs-geo-polygons/v/proof-sum-of-measures-of-angles-in-a-triangle-are-180) |
| * 1. Solve problems involving angles and diagonals | [High school geometry / Angles](https://www.khanacademy.org/math/geometry/hs-geo-foundations/hs-geo-angles/v/measuring-angles-in-degrees)  [High school geometry / Theorems concerning quadrilateral properties](https://www.khanacademy.org/math/geometry/hs-geo-congruence/hs-geo-quadrilaterals-theorems/v/proof-opposite-sides-of-parallelogram-congruent) |
| * 1. Solve problems involving polygons with more than four sides | [High school geometry / Polygons](https://www.khanacademy.org/math/geometry/hs-geo-foundations/hs-geo-polygons/v/proof-sum-of-measures-of-angles-in-a-triangle-are-180) |
| 1. Probability and Statistics |  |
| 1. **Understands how to summarize, represent, and interpret data collected from measurements on a single variable (e.g., box plots, dot plots, normal distributions** |  |
| * 1. Represent data with plots on the real number line (e.g., dot plots, histograms, and box plots). | [Statistics and probability / Displaying quantitative data with graphs](https://www.khanacademy.org/math/statistics-probability/displaying-describing-data/quantitative-data-graphs/v/ways-to-represent-data)  [Statistics and probability / More on data displays](https://www.khanacademy.org/math/statistics-probability/displaying-describing-data/more-on-data-displays/v/u08-l1-t2-we2-reading-line-graphs)  [Statistics and probability / Box and whisker plots](https://www.khanacademy.org/math/statistics-probability/summarizing-quantitative-data/box-whisker-plots/v/box-and-whisker-plot-exercise-example)  [High school statistics / Displays of distributions](https://www.khanacademy.org/math/probability/data-distributions-a1/displays-of-distributions/v/frequency-tables-and-dot-plots)  [High school statistics / Box and whisker plots](https://www.khanacademy.org/math/probability/data-distributions-a1/box--whisker-plots-a1/v/constructing-a-box-and-whisker-plot) |
| * 1. Use statistics appropriate to the shape of the data distribution to compare center  (e.g., median, mean) and spread (e.g., interquartile range, standard deviation) of two or more different data sets. | [Statistics and probability / Describing and comparing distributions](https://www.khanacademy.org/math/statistics-probability/displaying-describing-data/comparing-features-distributions/v/shapes-of-distributions)  [Statistics and probability / Measuring center in quantitative data](https://www.khanacademy.org/math/statistics-probability/summarizing-quantitative-data/mean-median-basics/v/statistics-intro-mean-median-and-mode)  [Statistics and probability / Interquartile range (IQR)](https://www.khanacademy.org/math/statistics-probability/summarizing-quantitative-data/interquartile-range-iqr/v/calculating-interquartile-range-iqr)  [Statistics and probability / Variance and standard deviation of a population](https://www.khanacademy.org/math/statistics-probability/summarizing-quantitative-data/variance-standard-deviation-population/v/range-variance-and-standard-deviation-as-measures-of-dispersion)  [Statistics and probability / Other measures of spread](https://www.khanacademy.org/math/statistics-probability/summarizing-quantitative-data/other-measures-of-spread/v/range-and-mid-range)  [High school statistics / Summarizing center of distributions (central tendency)](https://www.khanacademy.org/math/probability/data-distributions-a1/summarizing-center-distributions/v/statistics-intro-mean-median-and-mode)  [High school statistics / Summarizing spread of distributions](https://www.khanacademy.org/math/probability/data-distributions-a1/summarizing-spread-distributions/v/calculating-interquartile-range-iqr)  [High school statistics / Comparing distributions](https://www.khanacademy.org/math/probability/data-distributions-a1/comparing-distributions/v/comparing-swim-times-at-the-olympics) |
| * 1. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of outliers | [Statistics and probability / More on mean and median](https://www.khanacademy.org/math/statistics-probability/summarizing-quantitative-data/more-mean-median/e/calculating-the-mean-from-various-data-displays) |
| * 1. Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages, and recognize that there are data sets for which such a procedure is not appropriate | [Statistics and probability / Variance and standard deviation of a sample](https://www.khanacademy.org/math/statistics-probability/summarizing-quantitative-data/variance-standard-deviation-sample/v/sample-variance)  [Statistics and probability / More on standard deviation](https://www.khanacademy.org/math/statistics-probability/summarizing-quantitative-data/more-on-standard-deviation/v/another-simulation-giving-evidence-that-n-1-gives-us-an-unbiased-estimate-of-variance) |
| * 1. Estimate areas under the normal curve | [Statistics and probability / Percentiles](https://www.khanacademy.org/math/statistics-probability/modeling-distributions-of-data/percentiles/v/calculating-percentile)  [Statistics and probability / Z-scores](https://www.khanacademy.org/math/statistics-probability/modeling-distributions-of-data/z-scores/v/ck12-org-normal-distribution-problems-z-score)  [Statistics and probability / Effects of linear transformations](https://www.khanacademy.org/math/statistics-probability/modeling-distributions-of-data/effects-of-linear-transformations/v/how-parameters-change-as-data-is-shifted-and-scaled)  [Statistics and probability / Density curves](https://www.khanacademy.org/math/statistics-probability/modeling-distributions-of-data/density-curve/v/density-curves)  [Statistics and probability / Normal distributions and the empirical rule](https://www.khanacademy.org/math/statistics-probability/modeling-distributions-of-data/normal-distributions-library/v/ck12-org-normal-distribution-problems-qualitative-sense-of-normal-distributions)  [Statistics and probability / Normal distribution calculations](https://www.khanacademy.org/math/statistics-probability/modeling-distributions-of-data/normal-distribution-calculation/v/z-table-for-proportion-below)  [Statistics and probability / More on normal distributions](https://www.khanacademy.org/math/statistics-probability/modeling-distributions-of-data/more-on-normal-distributions/v/introduction-to-the-normal-distribution)  [High school statistics / Normal distributions](https://www.khanacademy.org/math/probability/normal-distributions-a2/normal-distributions-a2ii/v/ck12-org-normal-distribution-problems-empirical-rule) |
| Understands how to summarize, represent, and interpret data collected from measurements on two variables, either categorical or quantitative (e.g., scatterplots, time series) |  |
| * 1. Summarize and interpret categorical data for two categories in two-way frequency tables (e.g., joint, marginal, conditional relative frequencies | [Statistics and probability / Two-way tables](https://www.khanacademy.org/math/statistics-probability/analyzing-categorical-data/two-way-tables-for-categorical-data/v/two-way-frequency-tables-and-venn-diagrams)  [Statistics and probability / Distributions in two-way tables](https://www.khanacademy.org/math/statistics-probability/analyzing-categorical-data/distributions-in-two-way-tables/v/marginal-distribution-and-conditional-distribution)  [High school statistics / Two-way frequency tables](https://www.khanacademy.org/math/probability/two-way-tables-categorical-data-a1/two-way-frequency-tables/a/two-way-frequency-tables)  [High school statistics / Two-way relative frequency tables](https://www.khanacademy.org/math/probability/two-way-tables-categorical-data-a1/two-way-relative-frequency-tables/v/two-way-relative-frequency-tables) |
| * 1. Recognize possible associations and trends in the data | [Statistics and probability / Introduction to scatterplots](https://www.khanacademy.org/math/statistics-probability/describing-relationships-quantitative-data/introduction-to-scatterplots/v/constructing-scatter-plot)  [High school statistics / Creating and interpreting scatterplots](https://www.khanacademy.org/math/probability/scatterplots-a1/creating-interpreting-scatterplots/v/constructing-scatter-plot) |
| * 1. Represent data for two quantitative variables on a scatterplot, and describe how the variables are related. | [Statistics and probability / Introduction to scatterplots](https://www.khanacademy.org/math/statistics-probability/describing-relationships-quantitative-data/introduction-to-scatterplots/v/constructing-scatter-plot) |
| Understands how to create and interpret linear regression models (e.g., rate of change, intercepts, correlation coefficient |  |
| * 1. Use technology to fit a function to data (i.e., linear regression) | [Statistics and probability / Introduction to trend lines](https://www.khanacademy.org/math/statistics-probability/describing-relationships-quantitative-data/introduction-to-trend-lines/v/fitting-a-line-to-data)  [High school statistics / Estimating with trend lines](https://www.khanacademy.org/math/probability/scatterplots-a1/estimating-trend-lines/v/estimating-the-line-of-best-fit-exercise) |
| * 1. Use functions fitted to data to solve problems in the context of the data | [Statistics and probability / Introduction to trend lines](https://www.khanacademy.org/math/statistics-probability/describing-relationships-quantitative-data/introduction-to-trend-lines/v/fitting-a-line-to-data) |
| * 1. Assess the fit of a function by plotting and analyzing residuals | [Statistics and probability / Least-squares regression equations](https://www.khanacademy.org/math/statistics-probability/describing-relationships-quantitative-data/regression-library/v/introduction-to-residuals-and-least-squares-regression)  [Statistics and probability / Assessing the fit in least-squares regression](https://www.khanacademy.org/math/statistics-probability/describing-relationships-quantitative-data/assessing-the-fit-in-least-squares-regression/v/residual-plots)  [Statistics and probability / More on regression](https://www.khanacademy.org/math/statistics-probability/describing-relationships-quantitative-data/more-on-regression/v/squared-error-of-regression-line) |
| * 1. Interpret the slope and the intercept of a regression line in the context of the data. | [Statistics and probability / Least-squares regression equations](https://www.khanacademy.org/math/statistics-probability/describing-relationships-quantitative-data/regression-library/v/introduction-to-residuals-and-least-squares-regression) |
| * 1. Compute and interpret a correlation coefficient | [Statistics and probability / Correlation coefficients](https://www.khanacademy.org/math/statistics-probability/describing-relationships-quantitative-data/scatterplots-and-correlation/v/correlation-coefficient-intuition-examples) |
| * 1. Distinguish between correlation and causation | [Statistics and probability / correlation-and-causality](https://www.khanacademy.org/math/statistics-probability/designing-studies/sampling-and-surveys/v/correlation-and-causality?modal=1)  [High school statistics / Creating and interpreting scatterplots](https://www.khanacademy.org/math/probability/scatterplots-a1/creating-interpreting-scatterplots/v/constructing-scatter-plot) |
| Understands statistical processes and how to evaluate them |  |
| * 1. Understand statistics as a process for making inferences about population parameters based on a random sample from that population | [Statistics and probability / Statistical questions](https://www.khanacademy.org/math/statistics-probability/designing-studies/statistics-overview/v/understanding-statistical-questions) |
| * 1. Decide if a specified model is consistent with results from a given data-generating process (e.g., using simulation | [Statistics and probability / Experimental probability](https://www.khanacademy.org/math/statistics-probability/probability-library/experimental-probability-lib/v/experimental-probability)  [Statistics and probability / Randomness, probability, and simulation](https://www.khanacademy.org/math/statistics-probability/probability-library/randomness-probability-and-simulation/v/experimental-versus-theoretical-probability-simulation) |
| Understands how to make inferences and justify conclusions from samples, experiments, and observational studies |  |
| * 1. Recognize the purposes of and differences among samples, experiments, and observational studies, and explain how randomization relates to each | [Statistics and probability / Sampling and observational studies](https://www.khanacademy.org/math/statistics-probability/designing-studies/sampling-and-surveys/v/reasonable-samples)  [Statistics and probability / Sampling methods](https://www.khanacademy.org/math/statistics-probability/designing-studies/sampling-methods-stats/v/probability-decisions)  [Statistics and probability / Types of studies (experimental vs. observational)](https://www.khanacademy.org/math/statistics-probability/designing-studies/types-studies-experimental-observational/v/types-of-statistical-studies)  [Statistics and probability / Experiments](https://www.khanacademy.org/math/statistics-probability/designing-studies/experiments-stats-library/v/introduction-to-experiment-design)  [High school statistics / Samples and surveys](https://www.khanacademy.org/math/probability/study-design-a1/samples-surveys/v/reasonable-samples)  [High school statistics / Observational studies and experiments](https://www.khanacademy.org/math/probability/study-design-a1/observational-studies-experiments/v/types-statistical-studies) |
| * 1. Use data from a sample to estimate a population mean or proportion |  |
| * 1. Use data from a randomized experiment to compare two treatments |  |
| * 1. Use results of simulations to decide if differences between parameters are significant |  |
| * 1. Evaluate reports based on data |  |
| Understands the concepts of independence and conditional probability and how to apply these concepts to data |  |
| * 1. Describe events as subsets of a sample space using characteristics of the outcomes, or as unions, intersections, or complements of other events | [Precalculus / Venn diagrams and the addition rule](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:prob-comb/x9e81a4f98389efdf:addition-rule-prob-precalc/v/probability-with-playing-cards-and-venn-diagrams)  [Statistics and probability / Basic theoretical probability](https://www.khanacademy.org/math/statistics-probability/probability-library/basic-theoretical-probability/v/basic-probability)  [Statistics and probability / Probability using sample spaces](https://www.khanacademy.org/math/statistics-probability/probability-library/probability-sample-spaces/v/events-and-outcomes-3)  [Statistics and probability / Basic set operations](https://www.khanacademy.org/math/statistics-probability/probability-library/basic-set-ops/v/intersection-and-union-of-sets)  [High school statistics / Probability basics](https://www.khanacademy.org/math/probability/probability-geometry/probability-basics/v/basic-probability) |
| * 1. Understand that two events, *A* and *B*, are independent if and only if | [Precalculus / Compound probability of independent events using the multiplication rule](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:prob-comb/x9e81a4f98389efdf:compound-probability-of-ind-events-using-mult-rule/v/compound-probability-of-independent-events)  [Precalculus / Dependent events](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:prob-comb/x9e81a4f98389efdf:dependent-events-precalc/v/introduction-to-dependent-probability)  [Statistics and probability / Multiplication rule for independent events](https://www.khanacademy.org/math/statistics-probability/probability-library/multiplication-rule-independent/v/compound-sample-spaces)  [Statistics and probability / Multiplication rule for dependent events](https://www.khanacademy.org/math/statistics-probability/probability-library/multiplication-rule-dependent/v/introduction-to-dependent-probability)  [High school statistics / Multiplication rule for independent events](https://www.khanacademy.org/math/probability/probability-geometry/multiplication-rule-independent-events/v/compound-probability-of-independent-events)  [High school statistics / Multiplication rule for dependent events](https://www.khanacademy.org/math/probability/probability-geometry/multiplication-rule-dependent-events/v/introduction-to-dependent-probability) |
| * 1. Understand the conditional probability of *A* given *B* as , and interpret independence of *A* and *B* as saying that  and | [Statistics and probability / Conditional probability and independence](https://www.khanacademy.org/math/statistics-probability/probability-library/conditional-probability-independence/v/calculating-conditional-probability) |
| * 1. Recognize and explain the concepts of conditional probability and independence | [Statistics and probability / Conditional probability and independence](https://www.khanacademy.org/math/statistics-probability/probability-library/conditional-probability-independence/v/calculating-conditional-probability) |
| Understands how to compute probabilities of simple events, probabilities of compound events, and conditional probabilities |  |
| * 1. Calculate probabilities of simple and compound events | [Precalculus / Basic probability](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:prob-comb/x9e81a4f98389efdf:basic-prob-precalc/v/basic-probability)  [Statistics and probability / Basic theoretical probability](https://www.khanacademy.org/math/statistics-probability/probability-library/basic-theoretical-probability/v/basic-probability) |
| * 1. Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities | [High school statistics / Conditional probability](https://www.khanacademy.org/math/probability/probability-geometry/conditional-probability-geo/a/conditional-probability-using-two-way-tables) |
| * 1. Find , and interpret it in terms of a given model. | [High school statistics / Conditional probability](https://www.khanacademy.org/math/probability/probability-geometry/conditional-probability-geo/a/conditional-probability-using-two-way-tables) |
| * 1. Apply the addition rule, and interpret it in terms of a given model | [Precalculus / Venn diagrams and the addition rule](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:prob-comb/x9e81a4f98389efdf:addition-rule-prob-precalc/v/probability-with-playing-cards-and-venn-diagrams)  [Statistics and probability / Addition rule](https://www.khanacademy.org/math/statistics-probability/probability-library/addition-rule-lib/v/probability-with-playing-cards-and-venn-diagrams)  [High school statistics / Addition rule for probability](https://www.khanacademy.org/math/probability/probability-geometry/addition-rule-for-probability/v/probability-with-playing-cards-and-venn-diagrams) |
| * 1. Apply the general multiplication rule in a uniform probability model, , and interpret it in terms of a given model |  |
| * 1. Calculate probabilities using the binomial probability distribution | [Precalculus / Permutations](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:prob-comb/x9e81a4f98389efdf:combinatorics-precalc/v/factorial-and-counting-seat-arrangements)  [Precalculus / Combinations](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:prob-comb/x9e81a4f98389efdf:combinations/v/introduction-to-combinations)  [Precalculus / Probability using combinatorics](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:prob-comb/x9e81a4f98389efdf:prob-combinatorics-precalc/v/probability-using-combinations)  [Statistics and probability / Counting principle and factorial](https://www.khanacademy.org/math/statistics-probability/counting-permutations-and-combinations/counting-principle-factorial/v/tree-diagram-to-count-outcomes)  [Statistics and probability / Permutations](https://www.khanacademy.org/math/statistics-probability/counting-permutations-and-combinations/permutation-lib/v/permutation-formula)  [Statistics and probability / Combinations](https://www.khanacademy.org/math/statistics-probability/counting-permutations-and-combinations/combinations-lib/v/introduction-to-combinations)  [Statistics and probability / Combinatorics and probability](https://www.khanacademy.org/math/statistics-probability/counting-permutations-and-combinations/combinatorics-probability/v/probability-using-combinations)  [High school statistics / Counting with permutations](https://www.khanacademy.org/math/probability/probability-geometry/counting-permutations/v/counting-pot-and-flower-scenarios)  [High school statistics / Counting with combinations](https://www.khanacademy.org/math/probability/probability-geometry/counting-combinations/v/introduction-to-combinations)  [High school statistics / Probability with counting, permutations, combinations](https://www.khanacademy.org/math/probability/probability-geometry/probability-counting-permutations-combinations/v/events-and-outcomes-3) |
| Knows how to make informed decisions using probabilities and expected values |  |
| * 1. Define a random variable for a quantity of interest by assigning a numerical value to each event in a sample space, and graph the corresponding probability distribution using the same graphical displays as for data distributions | [Statistics and probability / Discrete random variables](https://www.khanacademy.org/math/statistics-probability/random-variables-stats-library/random-variables-discrete/v/random-variables) |
| * 1. Calculate the expected value of a random variable, and interpret it as the mean of the probability distribution | [Statistics and probability / Discrete random variables](https://www.khanacademy.org/math/statistics-probability/random-variables-stats-library/random-variables-discrete/v/random-variables)  [High school statistics / Expected value](https://www.khanacademy.org/math/probability/probability-geometry/expected-value-geo/a/expected-value-basic) |
| * 1. Develop a probability distribution for a random variable, defined for a sample space in which theoretical probabilities can be calculated, and find the expected value | [High school statistics / Expected value](https://www.khanacademy.org/math/probability/probability-geometry/expected-value-geo/a/expected-value-basic) |
| * 1. Develop a probability distribution for a random variable, defined for a sample space in which probabilities are assigned empirically, and find the expected value. | [High school statistics / Expected value](https://www.khanacademy.org/math/probability/probability-geometry/expected-value-geo/a/expected-value-basic) |
| * 1. Weigh the possible outcomes of a decision by assigning probabilities to payoff values and finding expected values | [Statistics and probability / More on expected value](https://www.khanacademy.org/math/statistics-probability/random-variables-stats-library/expected-value-lib/v/term-life-insurance-and-death-probability)  [High school statistics / Expected value](https://www.khanacademy.org/math/probability/probability-geometry/expected-value-geo/a/expected-value-basic) |
| * 1. Analyze decisions and strategies using probability concepts (e.g., fairness). |  |
| Understands how to use simulations to construct experimental probability distributions and to make informal inferences about theoretical |  |
| * 1. Given the results of simulations, construct experimental probability distributions | [High school statistics / Simulation and randomness](https://www.khanacademy.org/math/probability/probability-geometry/simulation-randomness/a/simulations-and-randomness-random-digit-tables) |
| * 1. Given the results of simulations, make informal inferences about theoretical probability distributions. | [High school statistics / Simulation and randomness](https://www.khanacademy.org/math/probability/probability-geometry/simulation-randomness/a/simulations-and-randomness-random-digit-tables) |
| Understands how to find probabilities involving finite sample spaces and independent trials |  |
| * 1. Use the fundamental counting principle to find probabilities involving finite sample spaces and independent trials | [Statistics and probability / Counting principle and factorial](https://www.khanacademy.org/math/statistics-probability/counting-permutations-and-combinations/counting-principle-factorial/v/tree-diagram-to-count-outcomes)  [Statistics and probability / Permutations](https://www.khanacademy.org/math/statistics-probability/counting-permutations-and-combinations/permutation-lib/v/permutation-formula)  [Statistics and probability / Combinations](https://www.khanacademy.org/math/statistics-probability/counting-permutations-and-combinations/combinations-lib/v/introduction-to-combinations)  [Statistics and probability / Combinatorics and probability](https://www.khanacademy.org/math/statistics-probability/counting-permutations-and-combinations/combinatorics-probability/v/probability-using-combinations) |
| 1. Discrete Mathematics |  |
| 1. **Understands sequences (e.g., arithmetic, recursively defined, geometric).** |  |
| * 1. Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms | [Algebra I / Constructing arithmetic sequences](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:sequences/x2f8bb11595b61c86:constructing-arithmetic-sequences/v/recursive-formula-for-arithmetic-sequence)  [Algebra I / Constructing geometric sequences](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:sequences/x2f8bb11595b61c86:constructing-geometric-sequences/v/explicit-and-recursive-formulas-for-geometric-sequences)  [Precalculus / Arithmetic sequences](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:series/x9e81a4f98389efdf:arith-seq/v/explicit-and-recursive-definitions-of-sequences)  [Precalculus / Geometric sequences](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:series/x9e81a4f98389efdf:geo-seq/v/geometric-sequences-introduction) |
| * 1. Evaluate, extend, or algebraically represent rules that involve number patterns | [Algebra I / Introduction to arithmetic sequences](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:sequences/x2f8bb11595b61c86:introduction-to-arithmetic-sequences/v/explicit-and-recursive-definitions-of-sequences)  [Algebra I / Introduction to geometric sequences](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:sequences/x2f8bb11595b61c86:introduction-to-geometric-sequences/v/geometric-sequences-introduction)  [Algebra I / General sequences](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:sequences/x2f8bb11595b61c86:general-sequences/v/recursive-formulas-for-sequences) |
| * 1. Explore patterns in order to make conjectures, predictions, or generalizations | [Algebra I / Modeling with sequences](https://www.khanacademy.org/math/algebra/x2f8bb11595b61c86:sequences/x2f8bb11595b61c86:modeling-with-sequences/v/modeling-situations-with-arithmetic-and-geometric-sequences) |
| Is familiar with how recursion can be used to model various phenomena |  |
| * 1. Find values of functions defined recursively, and understand how recursion can be used to model various phenomena |  |
| * 1. Convert between recursive and closed-form expressions for a function, where possible |  |
| Has knowledge of equivalence relations |  |
| * 1. Determine whether a binary relation on a set is reflexive, symmetric, or transitive |  |
| * 1. Determine whether a relation is an equivalence relation |  |
| Understands the differences between discrete and continuous representations (e.g., data, functions) and how each can be used to model various phenomena |  |
| * 1. Understand the differences between discrete and continuous representations (e.g., data, functions |  |
| * 1. Understand how discrete and continuous representations can be used to model various phenomena. |  |
| Understands basic terminology and symbols of logic |  |
| * 1. Understand the basic terminology of logic |  |
| * 1. Understand the symbols of logic |  |
| * 1. Use logic to evaluate the truth of statements |  |
| * 1. Use logic to evaluate the equivalence of statements (e.g., statement and contrapositive |  |
| Understands how to use counting techniques such as the multiplication principle, permutations, and combinations |  |
| * 1. Use counting techniques to solve problems | [Precalculus / Permutations](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:prob-comb/x9e81a4f98389efdf:combinatorics-precalc/v/factorial-and-counting-seat-arrangements)  [Precalculus / Combinations](https://www.khanacademy.org/math/precalculus/x9e81a4f98389efdf:prob-comb/x9e81a4f98389efdf:combinations/v/introduction-to-combinations)  [Statistics and probability / Counting principle and factorial](https://www.khanacademy.org/math/statistics-probability/counting-permutations-and-combinations/counting-principle-factorial/v/tree-diagram-to-count-outcomes)  [Statistics and probability / Permutations](https://www.khanacademy.org/math/statistics-probability/counting-permutations-and-combinations/permutation-lib/v/permutation-formula)  [Statistics and probability / Combinations](https://www.khanacademy.org/math/statistics-probability/counting-permutations-and-combinations/combinations-lib/v/introduction-to-combinations)  [High school statistics / Counting with permutations](https://www.khanacademy.org/math/probability/probability-geometry/counting-permutations/v/counting-pot-and-flower-scenarios)  [High school statistics / Counting with combinations](https://www.khanacademy.org/math/probability/probability-geometry/counting-combinations/v/introduction-to-combinations) |
| Understands basic set theory (e.g., unions, differences, Venn diagrams). |  |
| * 1. Solve problems using basic set theory (i.e., union, intersection, complement, difference | [Statistics and probability / Basic set operations](https://www.khanacademy.org/math/statistics-probability/probability-library/basic-set-ops/v/intersection-and-union-of-sets) |
| * 1. Use Venn diagrams to answer questions about sets. | [Statistics and probability / Basic set operations](https://www.khanacademy.org/math/statistics-probability/probability-library/basic-set-ops/v/intersection-and-union-of-sets) |