

High School — Number and Quantity

Adopted 2010

Standards for Mathematical Practice

1. **Make sense of problems and persevere in solving them.** [CCSS.MATH.PRACTICE.MP1](#)

2. **Reason abstractly and quantitatively.** [CCSS.MATH.PRACTICE.MP2](#)

3. **Construct viable arguments and critique the reasoning of others.** [CCSS.MATH.PRACTICE.MP3](#)

4. **Model with mathematics.** [CCSS.MATH.PRACTICE.MP4](#)

5. **Use appropriate tools strategically.** [CCSS.MATH.PRACTICE.MP5](#)

6. **Attend to precision.** [CCSS.MATH.PRACTICE.MP6](#)

7. **Look for and make use of structure.** [CCSS.MATH.PRACTICE.MP7](#)

8. **Look for and express regularity in repeated reasoning.** [CCSS.MATH.PRACTICE.MP8](#)

The Real Number System

- A. Extend the properties of exponents to rational exponents.** [CCSS.MATH.CONTENT.HSN-RN.A](#)
 1. Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. [CCSS.MATH.CONTENT.HSN-RN.A.1](#)
 2. Rewrite expressions involving radicals and rational exponents using the properties of exponents. [CCSS.MATH.CONTENT.HSN-RN.A.2](#)

- B. Use properties of rational and irrational numbers.** [CCSS.MATH.CONTENT.HSN-RN.B](#)
 3. Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational. [CCSS.MATH.CONTENT.HSN-RN.B.3](#)

Quantities

A. Reason quantitatively and use units to solve problems. CCSS.MATH.CONTENT.HSN-Q.A

1. Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. CCSS.MATH.CONTENT.HSN-Q.A.1
 2. Define appropriate quantities for the purpose of descriptive modeling. CCSS.MATH.CONTENT.HSN-Q.A.2
 3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. CCSS.MATH.CONTENT.HSN-Q.A.3
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The Complex Number System

A. Perform arithmetic operations with complex numbers. CCSS.MATH.CONTENT.HSN-CN.A

1. Know there is a complex number i such that $i^2 = -1$, and every complex number has the form $a + bi$ with a and b real. CCSS.MATH.CONTENT.HSN-CN.A.1
 2. Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. CCSS.MATH.CONTENT.HSN-CN.A.2
 3. (+) Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers. CCSS.MATH.CONTENT.HSN-CN.A.3
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B. Represent complex numbers and their operations on the complex plane. CCSS.MATH.CONTENT.HSN-CN.B

4. (+) Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and explain why the rectangular and polar forms of a given complex number represent the same number. CCSS.MATH.CONTENT.HSN-CN.B.4
 5. (+) Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. CCSS.MATH.CONTENT.HSN-CN.B.5
 6. (+) Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints. CCSS.MATH.CONTENT.HSN-CN.B.6
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C. Use complex numbers in polynomial identities and equations. CCSS.MATH.CONTENT.HSN-CN.C

7. Solve quadratic equations with real coefficients that have complex solutions. CCSS.MATH.CONTENT.HSN-CN.C.7
 8. (+) Extend polynomial identities to the complex numbers. CCSS.MATH.CONTENT.HSN-CN.C.8
 9. (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials. CCSS.MATH.CONTENT.HSN-CN.C.9
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Vector and Matrix Quantities

A. Represent and model with vector quantities. CCSS.MATH.CONTENT.HSN-VM.A

1. (+) Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments, and use appropriate symbols for vectors and their magnitudes (e.g., v , $|v|$, $\|v\|$, v). CCSS.MATH.CONTENT.HSN-VM.A.1
2. (+) Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point. CCSS.MATH.CONTENT.HSN-VM.A.2
3. (+) Solve problems involving velocity and other quantities that can be represented by vectors. CCSS.MATH.CONTENT.HSN-VM.A.3

B. Perform operations on vectors. CCSS.MATH.CONTENT.HSN-VM.B

4. (+) Add and subtract vectors. CCSS.MATH.CONTENT.HSN-VM.B.4
 - a. Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes. CCSS.MATH.CONTENT.HSN-VM.B.4A
 - b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum. CCSS.MATH.CONTENT.HSN-VM.B.4B
 - c. Understand vector subtraction $v - w$ as $v + (-w)$, where $-w$ is the additive inverse of w , with the same magnitude as w and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order, and perform vector subtraction component-wise. CCSS.MATH.CONTENT.HSN-VM.B.4C
5. (+) Multiply a vector by a scalar. CCSS.MATH.CONTENT.HSN-VM.B.5
 - a. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as $c\langle v_x, v_y \rangle = \langle cv_x, cv_y \rangle$. CCSS.MATH.CONTENT.HSN-VM.B.5A
 - b. Compute the magnitude of a scalar multiple cv using $\|cv\| = |c|v$. Compute the direction of cv knowing that when $|c| \neq 0$, the direction of cv is either along v (for $c > 0$) or against v (for $c < 0$). CCSS.MATH.CONTENT.HSN-VM.B.5B

C. Perform operations on matrices and use matrices in applications. [CCSS.MATH.CONTENT.HSN-VM.C](#)

6. (+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network. [CCSS.MATH.CONTENT.HSN-VM.C.6](#)
7. (+) Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled. [CCSS.MATH.CONTENT.HSN-VM.C.7](#)
8. (+) Add, subtract, and multiply matrices of appropriate dimensions. [CCSS.MATH.CONTENT.HSN-VM.C.8](#)
9. (+) Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties. [CCSS.MATH.CONTENT.HSN-VM.C.9](#)
10. (+) Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse. [CCSS.MATH.CONTENT.HSN-VM.C.10](#)
11. (+) Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors. [CCSS.MATH.CONTENT.HSN-VM.C.11](#)
12. (+) Work with 2×2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area. [CCSS.MATH.CONTENT.HSN-VM.C.12](#)