

# High School — Number and Quantity

Adopted 2011

## Standards for Mathematical Practice

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

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

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

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

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

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

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

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- 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](#)

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- 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

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### 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

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**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  $2 \times 2$  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](#)