

High School — Number and Quantity

Adopted 2017

Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them. **MP.1**

2. Reason abstractly and quantitatively. **MP.2**

3. Construct viable arguments and critique the reasoning of others. **MP.3**

4. Model with mathematics. **MP.4**

5. Use appropriate tools strategically. **MP.5**

6. Attend to precision. **MP.6**

7. Look for and make use of structure. **MP.7**

8. Look for and express regularity in repeated reasoning. **MP.8**

The Real Number System

- A. Extend the properties of exponents to rational exponents. **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. **N.RN.1**
 2. Rewrite expressions involving radicals and rational exponents using the properties of exponents. **N.RN.2**

- B. Use properties of rational and irrational numbers. **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. **N.RN.3**

Quantities

A. Reason quantitatively and use units to solve problems. 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. N.Q.1
 2. Define appropriate quantities for the purpose of descriptive modeling. N.Q.2
 3. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. N.Q.3
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The Complex Number System

A. Perform arithmetic operations with complex numbers. 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. N.CN.1
 2. Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. N.CN.2
 3. Find the conjugate of a complex number; use conjugates to find magnitudes and quotients of complex numbers. (+)N.CN.3
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B. Represent complex numbers and their operations on the complex plane. 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. (+)N.CN.4
 5. Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. (+)N.CN.5
 6. Calculate the distance between numbers in the complex plane as the magnitude of the difference, and the midpoint of a segment as the average of the numbers at its endpoints. (+)N.CN.6
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C. Use complex numbers in polynomial identities and equations. HSN-CN.C

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

A. Represent and model with vector quantities. 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 , $|v|$, $\|v\|$, . (+)N.VM.1
2. Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point. (+)N.VM.2
3. Solve problems involving velocity and other quantities that can be represented by vectors. (+)N.VM.3

B. Perform operations on vectors. HSN-VM.B

4. Add and subtract vectors. (+)N.VM.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. N.VM.4.A
 - b. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum. N.VM.4.B
 - 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. N.VM.4.C
5. Multiply a vector by a scalar (+)N.VM.5
 - a. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as $c\langle x, y \rangle = \langle cx, cy \rangle$. (+)N.VM.5.A
 - b. Compute the magnitude of a scalar multiple cv using $\|cv\| = |c|v$. Compute the direction of cv knowing that when $|c|v \neq 0$, the direction of cv is either along v (for $c > 0$) or against v (for $c < 0$). (+)N.VM.5.B

C. Perform operations on matrices, and use matrices in applications. HSN-VM.C

6. Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network. (+)N.VM.6
7. Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled. (+)N.VM.7
8. Add, subtract, and multiply matrices of appropriate dimensions. (+)N.VM.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. (+)N.VM.9
10. Understand that the zero and identity matrices play a role in matrix addition and multiplication analogous 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. (+)N.VM.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. (+)N.VM.11
12. Work with 2×2 matrices as transformations of the plane, and interpret the absolute value of the determinant in terms of area. (+)N.VM.12