| NYS Plus Mathematics Learning Standards (Revised 2017) | | | | |
|---|---|---|---|---|
| Number and Quantity<br>The Complex Number System (N-CN) | | | | |
| | | **Standard Code** | **Standard** | **Additional Clarification/Examples** |
| **Cluster** | A. Perform arithmetic operations with complex numbers. | **N-CN.A.3+** | Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers. | |

| NYS Plus Mathematics Learning Standards (Revised 2017) | | | | |
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| **Number and Quantity**<br>**The Complex Number System (N-CN)** | | | | |
| | | **Standard Code** | **Standard** | **Additional Clarification/Examples** |
| **Cluster** | B. Represent complex numbers and their operations on the complex plane. | **N-CN.B.4+** | 4a. Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers), and convert between rectangular and polar forms of a given complex number.<br>4b. Determine whether rectangular or polar form is more efficient given the context. | |
| | | **N-CN.B.5+** | 5. Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. | e.g., $(-1 + \sqrt{3}\, i)^3 = 8$ because $(-1 + \sqrt{3}\, i)$ has modulus 2 and argument 120°. |
| | | **N-CN.B.6+** | 6a. Calculate the distance between two points in the complex plane.<br>6b. Find the midpoint of the segment whose endpoints are in the complex plane. | Note: Standard extends the distance and midpoint calculation from the Cartesian coordinate plane to the complete plane. |

| NYS Plus Mathematics Learning Standards (Revised 2017) | | | | |
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| Number and Quantity<br>The Complex Number System (N-CN) | | | | |
| | | **Standard Code** | **Standard** | **Additional Clarification/Examples** |
| **Cluster** | C. Use complex numbers in polynomial identities and equations. | **N-CN.C.8+** | Extend polynomial identities to the complex numbers. | e.g., rewrite $x^2 + 4$ as $(x + 2i)(x – 2i)$. |
| | | **N-CN.C.9+** | State the Fundamental Theorem of Algebra and use it to find roots of polynomials. | |

| NYS Plus Mathematics Learning Standards (Revised 2017) | | | | |
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| Number and Quantity<br>Vector and Matrix Quantities (N-VM) | | | | |
| | | **Standard Code** | **Standard** | **Additional Clarification/Examples** |
| **Cluster** | A. Represent and model with vector quantities. | **N-VM.A.1+** | Represent a vector analytically and geometrically. | e.g., rectangular form, polar form, unit form. |
| | | **N-VM.A.2+** | Find the magnitude and direction of a given vector. | |
| | | **N-VM.A.3+** | Solve problems using vectors analytically and geometrically. | e.g., velocity and forces. |

| NYS Plus Mathematics Learning Standards (Revised 2017) | | | | |
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| Number and Quantity<br>Vector and Matrix Quantities (N-VM) | | | | |
| | | **Standard Code** | **Standard** | **Additional Clarification/Examples** |
| **Cluster** | B. Perform operations on vectors. | **N-VM.B.4+** | Add and subtract vectors analytically and geometrically. | |
| | | **N-VM.B.5+** | Multiply a vector by a scalar analytically and geometrically. | |

| NYS Plus Mathematics Learning Standards (Revised 2017) | | | | |
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| Number and Quantity<br>Vector and Matrix Quantities (N-VM) | | | | |
| | | **Standard Code** | **Standard** | **Additional Clarification/Examples** |
| **Cluster** | C. Perform operations on matrices and use matrices in applications. | **N-VM.C.6+** | Use matrices to represent and model real world situations. | e.g., networks. |
| | | **N-VM.C.7+** | Multiply matrices by scalars. | |
| | | **N-VM.C.8+** | Add, subtract, and multiply matrices. | |
| | | **N-VM.C.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.C.11+** | Use matrices to perform linear transformations in the plane. | e.g., multiplying a vector by 2x2 matrix. |
| | | **N-VM.C.12+** | Calculate and interpret the determinant of a matrix. | e.g., calculating area. |

| NYS Plus Mathematics Learning Standards (Revised 2017) | | | | |
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| Algebra<br>Arithmetic with Polynomials and Rational Expressions (A-APR) | | | | |
| | | **Standard Code** | **Standard** | **Additional Clarification/Examples** |
| **Cluster** | C. Use polynomial identities to solve problems. | **A-APR.C.4+** | Prove polynomial identities and use them to describe numerical relationships. | e.g., the polynomial identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples. |
| | | **A-APR.C.5+** | Use the Binomial Theorem for the expansion of $(x + y)^n$ for a positive integer $n$. | |

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| **Cluster** | D. Rewrite rational expressions. | **A-APR.D.7+** | Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions. | |

| NYS Plus Mathematics Learning Standards (Revised 2017) | | | | |
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| Algebra<br>Reasoning with Equations and Inequalities (A-REI) | | | | |
| | | **Standard Code** | **Standard** | **Additional Clarification/Examples** |
| **Cluster** | C. Solve systems of equations. | **A-REI.C.6b+** | 6b. Solve systems of linear equations in three variables. | |
| | | **A-REI.C.8+** | Represent a system of linear equations as a single matrix equation in a vector variable. | |
| | | **A-REI.C.9+** | Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3 × 3 or greater). | |

| NYS Plus Mathematics Learning Standards (Revised 2017) | | | | |
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| Functions<br>Interpreting Functions (F-IF) | | | | |
| | | **Standard Code** | **Standard** | **Additional Clarification/Examples** |
| **Cluster** | C. Analyze functions using different representations. | **F-IF.C.7d+** | Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available. ★ | |

| NYS Plus Mathematics Learning Standards (Revised 2017) | | | | |
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| Functions<br>Building Functions (F-BF) | | | | |
| | | **Standard Code** | **Standard** | **Additional Clarification/Examples** |
| **Cluster** | A. Build a function that models a relationship between two quantities. | **F-BF.A.1c+** | Compose functions and state resulting domain. ★ | Note: The domain of a resulting composition function could differ from the domains of the individual functions.<br><br>e.g., if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time. |

| NYS Plus Mathematics Learning Standards (Revised 2017) | | | | |
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| Functions<br>Building Functions (F-BF) | | | | |
| | | **Standard Code** | **Standard** | **Additional Clarification/Examples** |
| **Cluster** | B. Build new functions from existing functions. | **F-BF.B.3c+** | 3c. Determine algebraically whether or not a function is even or odd. | Note: Graphic determination is an expectation of Algebra II (F-BF.B.3b). |
| | | **F-BF.B.4b+** | Verify by composition that one function is the inverse of another. | |
| | | **F-BF.B.4c+** | Given the graph or table of an invertible function, determine coordinates of its inverse. | |
| | | **F-BF.B.4d+** | Determine an invertible function from a non-invertible function by restricting the domain. | e.g., Inverse trigonometric functions. See F.TF.B.6(+). |
| | | **F-BF.B.5b+** | 5b. Use inverse relationships to solve problems involving logarithms and exponents. | |
| | | **F-BF.B.5c+** | 5c. Apply the properties of logarithms to rewrite logarithmic expressions in equivalent forms and solve logarithmic equations. | |

| NYS Plus Mathematics Learning Standards (Revised 2017) | | | | |
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| Functions<br>Trigonometric Functions (F-TF) | | | | |
| | | **Standard Code** | **Standard** | **Additional Clarification/Examples** |
| **Cluster** | A. Extend the domain of trigonometric functions using the unit circle. | **F-TF.A.3+** | Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and use the unit circle to express the values of sine, cosines, and tangent for $x$, $\pi + x$, and $2\pi - x$ in terms of their values for $x$, where $x$ is any real number. | |

| NYS Plus Mathematics Learning Standards (Revised 2017) | | | | |
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| Functions<br>Trigonometric Functions (F-TF) | | | | |
| | | **Standard Code** | **Standard** | **Additional Clarification/Examples** |
| **Cluster** | B. Model periodic phenomena with trigonometric functions. | **F-TF.B.6+** | Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed. | |
| | | **F-TF.B.7+** | Solve trigonometric equations:<br>• analytically with inverse functions and<br>• graphically with technology<br>and interpret solutions in terms of the context. ★ | |

| | | **Standard Code** | **Standard** | **Additional Clarification/Examples** |
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| **Cluster** | C. Prove and apply trigonometric identities. | **F-TF.C.9+** | Prove the sum and difference formulas for sine, cosine, and tangent and use them to solve problems. | |

| NYS Plus Mathematics Learning Standards (Revised 2017) | | | | |
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| Geometry<br>Similarity, Right Triangles and Trigonometry (G-SRT) | | | | |
| | | **Standard Code** | **Standard** | **Additional Clarification/Examples** |
| | D. Apply trigonometry to general triangles. | **G-SRT.D.10+** | Prove the Law of Sines and the Law of Cosines and apply in all cases, including the ambiguous case. | |
| | | **G-SRT.D.11+** | Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles. | e.g., surveying problems or problems that involve resultant forces. |

| NYS Plus Mathematics Learning Standards (Revised 2017) | | | | |
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| Geometry<br>Circles (G-C) | | | | |
| | | **Standard Code** | **Standard** | **Additional Clarification/Examples** |
| **Cluster** | A. Understand and apply theorems about circles. | **G-C.A.4+** | Construct a tangent line from a point outside a given circle to the circle. | |

| NYS Plus Mathematics Learning Standards (Revised 2017) | | | | |
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| Geometry<br>Expressing Geometric Properties with Equations (G-GPE) | | | | |
| | | **Standard Code** | **Standard** | **Additional Clarification/Examples** |
| **Cluster** | A. Translate between the geometric description and the equation for a conic section. | **G-GPE.A.2+** | 2. Explore the relationship among the parabola, focus, and directrix and use the equation to model a real-life situation, using technology as appropriate. ★ | |
| | | **G-GPE.A.3+** | 3a. Derive the equations of ellipses and hyperbolas given the foci.<br>3b. Use these equations to model real life situations. ★ | |

| NYS Plus Mathematics Learning Standards (Revised 2017) | | | | |
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| Geometry<br>Geometric Measurement and Dimension (G-GMD) | | | | |
| | | **Standard Code** | **Standard** | **Additional Clarification/Examples** |
| **Cluster** | A. Explain volume formulas and use them to solve problems. | **G-GMD.A. 2+** | Give an informal argument using Cavalieri's principle for the formulas for the volume of a sphere and other solid figures. | |

| NYS Plus Mathematics Learning Standards (Revised 2017) | | | | |
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| Statistics and Probability ★<br>Interpreting Categorical and Quantitative Data (S-ID) | | | | |
| | | **Standard Code** | **Standard** | **Additional Clarification/Examples** |
| **Cluster** | B. Summarize, represent, and interpret data on two categorical and quantitative variables. | **S-ID.B.6b+** | Informally assess the fit of a function by plotting and analyzing residuals. | |

| NYS Plus Mathematics Learning Standards (Revised 2017) | | | | |
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| Statistics and Probability ★<br>Conditional Probability and the Rules of Probability (S-CP) | | | | |
| | | **Standard Code** | **Standard** | **Additional Clarification/Examples** |
| **Cluster** | B. Use the rules of probability to compute probabilities of compound events in a uniform probability model. | **S-CP.B.9+** | Solve problems using permutations and combinations to compute probabilities of compound events. | |

| NYS Plus Mathematics Learning Standards (Revised 2017) | | | | |
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| **Statistics and Probability ★**<br>**Using Probability to Make Decisions (S-MD)** | | | | |
| | | **Standard Code** | | **Additional Clarification/Examples** |
| **Cluster** | A. Calculate expected values and use them to solve problems. | **S-MD.A.1+** | 1a. Define a random variable for a quantity of interest.<br>1b. Graph a probability distribution for a discrete random variable based on either empirical or theoretical probabilities. | |
| | | **S-MD.A.2+** | Calculate and interpret the expected value of a random variable. | e.g., find the theoretical probability distribution for the number of correct answers obtained by guessing on all five questions of a multiple-choice test where each question has four choices, and find the expected grade under various grading schemes.<br><br>e.g., find a current data distribution on the number of TV sets per household in the United States, and calculate the expected number of sets per household. How many TV sets would you expect to find in 100 randomly selected households? |

| NYS Plus Mathematics Learning Standards (Revised 2017) | | | | |
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| Statistics and Probability<br>Using Probability to Make Decisions (S-MD) | | | | |
| | | **Standard Code** | **Standard** | **Additional Clarification/Examples** |
| **Cluster** | B. Use probability to evaluate outcomes of decisions. | **S-MD.B.5+** | Use expected values from probability distributions to evaluate and compare the outcomes of decisions. | e.g., compare a high-deductible versus a low-deductible automobile insurance policy using various, but reasonable, chances of having a minor or a major accident. |
| | | **S-MD.B.6+** | Use probabilities to make fair decisions. | e.g., determine if a decision-making strategy produces equally probable outcomes. |
| | | **S-MD.B.7+** | Using probability concepts, evaluate decisions and strategies. | e.g., make decisions based on the most favorable outcome. |