North Carolina End-of-Course Tests of Mathematics NC Math 1 & NC Math 3

On July 8–11, 2019, a committee of 97 North Carolina educators participated in a multi-phase standard setting for the North Carolina tests of general mathematics in grades 3–8, NC Math 1, and NC Math 3; and for the NCEXTEND1 Mathematics tests in grades 3–8 and NC Math 1. The goal of the workshop was to identify cut scores that divide students into four achievement levels for general mathematics (*Not Proficient* through *Level 5*) and three achievement levels for NCEXTEND1 (*Not Proficient* through *Level 4*).

In August 2019, the State Board of Education (SBE) adopted college-and-career readiness Academic Achievement Standards and Academic Achievement Descriptors for the End-of-Grade (EOG) and End-of-Course (EOC) mathematics tests and their alternate assessments. Effective with the 2019-20 school year, the State will report four levels as follows:

Achievement Level	Meets On-Grade-Level Proficiency Standard	Meets Career-and-College Readiness Standard
Level 5	Yes	Yes
Level 4	Yes	Yes
Level 3	Yes	No
Not Proficient	No	No

NC Math 1 & NC Math 3 Achievement Level Ranges (Cut Scores)

Test	Grade	Not Proficient	Level 3	Level 4	Level 5
General Education Mathematics	NC Math 1	≤ 547	548-554	555-562	≥ 563
	NC Math 3	≤ 549	550-555	556-562	≥ 563

Mathematics Achievement Level Descriptors – NC Math 1

Level 5
*Students at Level 5 demonstrate **comprehensive** understanding of grade level content standards, are on track for career and college, and are prepared for advanced content at the next grade/course.*

Level 5 students can:
- Analyze and interpret how changing the parameters of the expression impacts the contextual situation;
- Use factoring to reveal solutions and zeros of quadratic equations, and analyze the relationship between the factors, zeros, and solution of a quadratic equation;
- Add and subtract quadratic and linear expressions, and multiply linear expressions, given a contextual situation;
- Compare zeros and solutions given an equation, table, or graph of a quadratic equation;
- Create, solve, and analyze problems that require creating linear, quadratic, or exponential equations and inequalities in one or two variables in context;
- Justify why replacing one equation in a system of linear equations with the sum of that equation and a multiple of the other produces a system with the same solutions;
- Create and compare explicit and recursive forms of arithmetic and geometric sequences;
- Compare key features of two different linear, exponential, or quadratic functions, given different representations;
- Use coordinates to compute perimeters and areas of polygons, and verify when a set of points produces a particular type of polygon in context;
- Determine and justify which representation best fits the data using residuals;
- Determine and justify which function best illustrates the data (linear/exponential).

Level 4
*Students at Level 4 demonstrate a **thorough** understanding of grade level content standards and are on track for career and college.*

Level 4 students can:
- Rewrite algebraic expressions in two or more variables with integer exponents using any combination of exponent properties;
- Interpret expressions and parts of expressions in terms of a context;
- Use factoring to reveal solutions and zeros of quadratic equations in the form $ax2 + bx + c$, where $|a| \neq 1$;
- Add and subtract quadratic and linear expressions, and multiply linear expressions;
- Determine the solutions of a quadratic equation *not* given in factored form;
- Model situations by creating systems of linear equations or inequalities;
- Solve formulas for a quantity of interest;
- Use mathematical reasoning to justify all steps in solving linear and quadratic equations;
- Solve quadratic equations in one variable by taking square roots and factoring;

- Solve systems of equations using tables, graphs, and algebraic methods, and interpret the solutions;
- Graph the solutions to a linear inequality or a system of linear inequalities on a coordinate plane;
- Use the domain and range of a relation to determine whether the relation is or is not a function;
- Evaluate functions for inputs in the domain and interpret statements that use function notation in terms of a context;
- Recognize that arithmetic sequences have a range which is a subset of the range of a linear function and geometric sequences have a range which is a subset of the range of an exponential function;
- Interpret functions and key features of representations of functions in terms of a context;
- Calculate and interpret the average rate of change of a function over a specified interval;
- Analyze linear, exponential, and quadratic functions to show and identify key features;
- Compare key features of two of the same functions, given different representations;
- Build linear and exponential equations from a mathematical or real-world context, including combining two functions;
- Represent situations with recursive and explicit forms of arithmetic and geometric sequences, and translate between the two forms;
- Identify situations that can be modeled by linear and exponential functions, and justify the choice of function type to model the situation;
- Interpret the parameters of linear and exponential functions in terms of a context;
- Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, and verify when a set of points produces a particular type of triangle or quadrilateral;
- Use coordinates to determine whether two lines are parallel or perpendicular, and find the equation of parallel or perpendicular lines when given a line and a point not on the line;
- Use coordinates to find the midpoint and endpoints of line segments;
- Represent data with histograms and box plots using technology, and interpret the data in context;
- Compare the center and spread of different data sets, and interpret differences in shape, center, and spread in context;
- Represent data on a scatterplot, and describe the relationship between the variables;
- Fit a function to the appropriate model (linear/exponential) given a data set, and use fitted function to solve problems;
- Interpret the rate of change and intercept of a linear model, and interpolate and extrapolate to predict values;
- Analyze the relationship between two variables using correlation coefficients and residuals;
- Distinguish between association and causation.

Level 3
*Students at Level 3 demonstrate **sufficient** understanding of grade level content standards though some support may be needed to engage with content at the next grade/course.*

Level 3 students can:

- Rewrite algebraic expressions in two or more variables with integer exponents using one property of exponents;
- Interpret expressions in terms of a context;
- Use factoring, the quadratic equation, and graphing to reveal solutions and zeros of quadratic equations;
- Add and subtract quadratic and linear expressions;
- Determine the solutions of a quadratic equation given an equation in factored form;
- Create and solve linear, quadratic, or exponential equations and inequalities in one variable;
- Create and graph linear, quadratic, or exponential equations in two variables;
- Identify graphs of systems of equations that model a context;
- Use mathematical reasoning to justify all steps in solving linear equations;
- Solve linear equations and inequalities in one variable;
- Solve quadratic equations in one variable by taking square roots;
- Solve systems of equations using tables and graphs, and interpret the solutions;
- Justify how the graph of a two-variable equation represents the set of all solutions to the equation;
- Graph the solutions to a linear inequality on a coordinate plane;
- Identify the domain and range of a function;
- Evaluate functions for inputs in the domain;
- Recognize recursively and explicitly defined sequences as functions with a domain that is a subset of the integers;
- Interpret representations of functions in terms of a context;
- Calculate the average rate of change of any function over a specified interval;
- Analyze linear and exponential equations to show and identify key features;
- Compare key features of two exponential or quadratic functions given the same type of representation;
- Build linear and exponential equations from a mathematical or real-world context;
- Represent situations with recursive and explicit forms of arithmetic sequences;
- Identify situations that can be modeled by linear or exponential functions;
- Interpret the parameters of linear functions in terms of a context;
- Use coordinates to compute perimeters of polygons and areas of triangles and rectangles;
- Use coordinates to determine whether two lines are parallel or perpendicular;
- Use coordinates to find the midpoint of line segments;
- Represent data with histograms and box plots using technology;
- Compare the center and spread of different data sets;
- Examine the effects of extreme data points on shape, center, and/or spread;
- Represent data on a scatterplot;
- Fit a function to the appropriate model (linear/exponential) given a data set;
- Interpret the rate of change and intercept of a linear model, and interpolate to predict values;
- Analyze the relationship between two variables using correlation coefficients.

Not Proficient

*Students who are Not Proficient demonstrate **inconsistent** understanding of grade level content standards and will need support.*

Not Proficient students can:

- Rewrite algebraic expressions in one variable with whole-number exponents using one property of exponents;
- Identify parts of expressions;
- Determine the zeros of a quadratic given a quadratic in factored form;
- Add and subtract linear expressions;
- Determine the zeros of a quadratic equation by looking at a graph;
- Use linear equations and inequalities to solve problems;
- Solve linear equations in one variable;
- Solve systems of equations using tables and graphs;
- Understand that the graph of a two-variable equation represents the set of all solutions to the equation;
- Calculate the average rate of change of a linear function;
- Compare key features of two linear functions, given the same type of representation;
- Identify situations that can be modeled by linear functions;
- Determine the distance between two points on a line;
- Identify components of histograms and box plots;
- Calculate the mean and median of a data set;
- Identify extreme data points informally;
- Informally, find the line of best fit.

Mathematics Achievement Level Descriptors – NC Math 3

Level 5

*Students at Level 5 demonstrate **comprehensive** understanding of grade level content standards, are on track for career and college, and are prepared for advanced content at the next grade/course.*

Level 5 students can:
- Apply the fundamental theorem of Algebra to justify the number and types of solutions for polynomial functions;
- Rewrite piecewise, absolute value, polynomial, exponential, and rational expressions to interpret terms, factors, coefficients, and exponents in context;
- Apply the relationship among factors of polynomial expressions, solutions of polynomial equations, and zeros of polynomial functions using the remainder theorem;
- Rewrite rational expressions requiring more than one arithmetic operation;
- Analyze noncontinuous functions to identify key features;
- Justify the effect of replacing $f(x)$ with $kf(x)$, $f(x) + k$, $f(x + k)$, and $f(kx)$;
- Justify why two functions are inverses;
- Use different centers of triangles in contextual situations;
- Construct a proof of a theorem about parallelograms in different formats;
- Construct a proof of a theorem about circles in different formats (flow chart, t-chart, paragraph);
- Interpret the radian measure of an angle as a unitless measure and use linear measures to find angle measures;
- Recognize any equation of a circle, and find the center and radius and other points on the circle;
- Apply geometric concepts to model and solve design and optimization modeling problems;
- Determine how changes in sample size or population parameters can affect the margin of error and differences between distinct populations;
- Make appropriate judgments on the context of graphical displays of data.

Level 4

*Students at Level 4 demonstrate a **thorough** understanding of grade level content standards and are on track for career and college.*

Level 4 students can:
- Determine the number and potential types of solutions for polynomial functions;
- Interpret piecewise, absolute value, polynomial, exponential, and rational expressions and parts of these expressions in terms of a context;
- Use equivalent forms of exponential expressions to reveal rates based on different intervals of the domain;
- Apply the remainder theorem;
- Rewrite simple rational expressions in different forms;
- Divide rational expressions;

- Solve problems that require creating absolute value, polynomial, exponential, and rational equations and inequalities in one variable. Justify solution methods and steps of the solving process;
- Create and graph absolute value, polynomial, and exponential equations in two variables;
- Create and graph rational equations in two variables;
- Represent contextual situations by creating a system of equations, and approximate solutions using technology;
- Use mathematical reasoning to justify all steps in solving equations;
- Solve and interpret one-variable rational equations, and explain extraneous solutions;
- Understand trigonometric ratios as functions of angle measure;
- Interpret statements that use function notation in terms of a context;
- Interpret functions and key features, including periodicity or discontinuities, given various representations in context;
- Analyze continuous piecewise functions to identify key features;
- Compare key features of two different functions given with different representations;
- Build polynomial and exponential functions with real solutions from a mathematical or real-world context, including combining standard function types with arithmetic;
- Recognize the effect of replacing $f(x)$ with $kf(x)$, $f(x) + k$, $f(x + k)$, and $f(kx)$;
- Find the inverse function for linear, quadratic, and exponential equations;
- Compare end behavior of functions, and show that a quantity increasing exponentially eventually exceeds a quantity increasing as a polynomial function;
- Use logarithms to express solutions to equations, and evaluate logarithms using technology;
- Interpret the relationship between sine and cosine and radian measure of an angle;
- Verify properties of the centers of triangles;
- Complete a proof of theorems about parallelograms;
- Complete a proof of theorems about circles;
- Interpret the relationship between arc length and central angle measure as the radian measure of an angle;
- Find arc lengths and areas of sectors of circles in contextual problems;
- Find the center and radius of a circle given in standard form;
- Use volume formulas to solve multistep problems in context;
- Identify cross sections of three-dimensional objects and three-dimensional objects formed by rotating two-dimensional objects;
- Apply geometric concepts to model and solve contextual problems;
- Identify when to use sample surveys, experiments, and observational studies and how randomization applies in each;
- Use simulations to estimate margins of error and to analyze differences between samples from distinct populations;
- Identify sources of data, designs of studies, and the ways data are graphically displayed in articles and websites.

Level 3

Students at Level 3 demonstrate sufficient understanding of grade level content standards, though some support may be needed to engage with content at the next grade/course.

Level 3 students can:
- Determine the number of solutions for polynomial functions;
- Interpret piecewise, absolute value, polynomial, exponential, and rational expression in terms of a context;
- Write equivalent expressions for piecewise, absolute value, polynomial (degree 3 or higher), and rational expressions (with linear denominator);
- Determine factors of polynomial expressions, solutions of polynomial equations, and zeros of polynomial functions;
- Rewrite simple rational expressions in different forms where the simplified form has a remainder of zero;
- Add and subtract rational expressions with linear denominators;
- Multiply rational expressions;
- Create absolute value, polynomial, exponential, and rational equations and inequalities in one variable;
- Create and graph absolute value and exponential equations in two variables;
- Create systems of equations and inequalities that model a context;
- Use mathematical reasoning to justify all steps in solving absolute value, polynomial, and exponential equations;
- Solve and interpret one-variable rational equations;
- Approximate solutions using graphing technology or a table of values;
- Evaluate piecewise functions for inputs in the domain;
- Interpret key features of functions given various representations in context;
- Analyze absolute value, polynomial, exponential, and trigonometric functions to identify key features;
- Compare key features of two functions of the same type given with different representations;
- Build polynomial and exponential functions with real solutions from a mathematical or real-world context;
- Recognize the effect of replacing $f(x)$ with $kf(x)$, $f(x) + k$, and $f(x + k)$ for absolute value, polynomial, exponential, and trigonometric functions;
- Find the inverse function for a linear or quadratic equation;
- Compare end behavior of different function types;
- Evaluate logarithms using technology;
- Find radian measure;
- Interpret the parameters of a sine function;
- Interpret key features of the function in terms of a context;
- Find the centers of triangles;
- Provide statements or reasons to complete parallelogram proofs;
- Solve problems about parallelograms and other two-dimensional figures;
- Provide statements or reasons to complete circle proofs;
- Solve problems about circles;
- Find arc lengths and areas of sectors of circles in mathematical problems;

- Determine the radius given the equation of a circle;
- Calculate the volumes of prisms, cylinders, pyramids, cones, and spheres to solve problems;
- Identify cross sections of three-dimensional objects;
- Use geometric concepts to model situations;
- Identify when to use sample surveys, experiments, and observational studies;
- Use simulation to estimate proportions and margins of error;
- Identify sources of data and the ways data are displayed in articles and websites.

Not Proficient
*Students who are Not Proficient demonstrate **inconsistent** understanding of grade level content standards and will need support.*

Not Proficient students can:
- Determine the number of real solutions for polynomial functions from a graph;
- Identify piecewise, absolute value, polynomial, exponential, and rational expressions;
- Write equivalent expressions;
- Find factors, find zeros, or find solutions of quadratic expressions;
- Add and subtract rational expressions with common linear denominators;
- Create and solve linear and quadratic equations and inequalities in one variable;
- Create and graph exponential equations in two variables;
- Identify systems of equations and inequalities that model a context;
- Find the points of intersection of the graphs of two equations;
- Interpret key features of functions given a graph in context;
- Analyze graphs of absolute value, polynomial, and exponential functions to identify key features;
- Compare key features of two functions of the same type given with the same representation;
- Build a quadratic function with real solutions from a mathematical or real-world context;
- Find the inverse of a function represented by a table or set of ordered pairs;
- Compare end behavior of the same function types;
- Identify the parameters of a sine function;
- Arrange statements and reasons of a parallelogram proof to create a logical order of statements;
- Arrange statements and reasons of a circle proof to create a logical order of statements;
- Demonstrate that arc length is proportional to radius;
- Derive the equation of a circle given the center and the radius;
- Calculate the volumes of prisms and cylinders;
- Use geometric shapes, measures, and properties to model real-life objects;
- Recognize the difference between sample surveys, experiments, and observational studies;
- Use simulation to estimate population means or proportions;
- Identify sources of data.