North Carolina Mathematics

Math II: Grades 9, 10, 11, 12

Adopted 2016

Number and Quantity

The Real Number System

1. Explain how expressions with rational exponents can be rewritten as radical expressions. NC.M2.N-RN.1
2. Rewrite expressions with radicals and rational exponents into equivalent expressions using the properties of exponents. NC.M2.N-RN.2

The Real Number System

3. Use the properties of rational and irrational numbers to explain why:
the sum or product of two rational numbers is rational;
the sum of a rational number and an irrational number is irrational;
the product of a nonzero rational number and an irrational number is irrational. NC.M2.N-RN.3

The Complex Number System

1. Know there is a complex number i such that $i^2 = -1$, and every complex number has the form a + bi where a and b are real numbers. NC.M2.N-CN.1

Algebra

Seeing Structure in Expressions

1. Interpret expressions that represent a quantity in terms of its context. NC.M2.A-SSE.1
    a. Identify and interpret parts of a quadratic, square root, inverse variation, or right triangle trigonometric expression, including terms, factors, coefficients, radicands, and exponents. NC.M2.A-SSE.1.A
    b. Interpret quadratic and square root expressions made of multiple parts as a combination of single entities to give meaning in terms of a context. NC.M2.A-SSE.1.B
3. Write an equivalent form of a quadratic expression by completing the square, where a is an integer of a quadratic expression, $ax^2 + bx + c$, to reveal the maximum or minimum value of the function the expression defines. NC.M2.A-SSE.3

Arithmetic with Polynomial and Rational Expressions

1. Extend the understanding that operations with polynomials are comparable to operations with integers by adding, subtracting, and multiplying polynomials. NC.M2.A-APR.1

Creating Equations

1. Create equations and inequalities in one variable that represent quadratic, square root, inverse variation, and right triangle trigonometric relationships and use them to solve problems. NC.M2.A-CED.1
2. Create and graph equations in two variables to represent quadratic, square root and inverse variation relationships between quantities. NC.M2.A-CED.2
3. Create systems of linear, quadratic, square root, and inverse variation equations to model situations in context. NC.M2.A-CED.3

Reasoning with Equations and Inequalities

1. Justify a chosen solution method and each step of the solving process for quadratic, square root and inverse variation equations using mathematical reasoning. NC.M2.A-REI.1
2. Solve and interpret one variable inverse variation and square root equations arising from a context, and explain how extraneous solutions may be produced. NC.M2.A-REI.2
4. Solve for all solutions of quadratic equations in one variable. NC.M2.A-REI.4
   a. Understand that the quadratic formula is the generalization of solving $ax^2 + bx + c$ by using the process of completing the square. NC.M2.A-REI.4.A
   b. Explain when quadratic equations will have non-real solutions and express complex solutions as $a \pm bi$ for real numbers a and b. NC.M2.A-REI.4.B
7. Use tables, graphs, and algebraic methods to approximate or find exact solutions of systems of linear and quadratic equations, and interpret the solutions in terms of a context. NC.M2.A-REI.7
11. Extend the understanding that the x-coordinates of the points where the graphs of two square root and/or inverse variation equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$ and approximate solutions using graphing technology or successive approximations with a table of values. NC.M2.A-REI.11

Functions

Interpreting Functions

1. Extend the concept of a function to include geometric transformations in the plane by recognizing that:
the domain and range of a transformation function f are sets of points in the plane;
the image of a transformation is a function of its pre-image. `NC.M2.F-IF.1`
2. Extend the use of function notation to express the image of a geometric figure in the plane resulting from a translation, rotation by multiples of 90 degrees about the origin, reflection across an axis, or dilation as a function of its pre-image. `NC.M2.F-IF.2`
4. Interpret key features of graphs, tables, and verbal descriptions in context to describe functions that arise in applications relating two quantities, including: domain and range, rate of change, symmetries, and end behavior. `NC.M2.F-IF.4`
7. Analyze quadratic, square root, and inverse variation functions by generating different representations, by hand in simple cases and using technology for more complicated cases, to show key features, including: domain and range; intercepts; intervals where the function is increasing, decreasing, positive, or negative; rate of change; maximums and minimums; symmetries; and end behavior. `NC.M2.F-IF.7`
8. Use equivalent expressions to reveal and explain different properties of a function by developing and using the process of completing the square to identify the zeros, extreme values, and symmetry in graphs and tables representing quadratic functions, and interpret these in terms of a context. `NC.M2.F-IF.8`
9. Compare key features of two functions (linear, quadratic, square root, or inverse variation functions) each with a different representation (symbolically, graphically, numerically in tables, or by verbal descriptions). `NC.M2.F-IF.9`

Building Functions

1. Write a function that describes a relationship between two quantities by building quadratic functions with real solution(s) and inverse variation functions given a graph, a description of a relationship, or ordered pairs (include reading these from a table). `NC.M2.F-BF.1`
3. Understand the effects of the graphical and tabular representations of a linear, quadratic, square root, and inverse variation function f with $k \cdot f(x)$, $f(x) + k$, $f(x + k)$ for specific values of k (both positive and negative). `NC.M2.F-BF.3`

Geometry

Congruence

2. Experiment with transformations in the plane.
Represent transformations in the plane.
Compare rigid motions that preserve distance and angle measure (translations, reflections, rotations) to transformations that do not preserve both distance and angle measure (e.g. stretches, dilations).
Understand that rigid motions produce congruent figures while dilations produce similar figures. `NC.M2.G-CO.2`
3. Given a triangle, quadrilateral, or regular polygon, describe any reflection or rotation symmetry i.e., actions that carry the figure onto itself. Identify center and angle(s) of rotation symmetry. Identify line(s) of reflection symmetry. `NC.M2.G-CO.3`
4. Verify experimentally properties of rotations, reflections, and translations in terms of angles, circles, perpendicular lines, parallel lines, and line segments. `NC.M2.G-CO.4`
5. Given a geometric figure and a rigid motion, find the image of the figure. Given a geometric figure and its image, specify a rigid motion or sequence of rigid motions that will transform the pre-image to its image. `NC.M2.G-CO.5`
6. Determine whether two figures are congruent by specifying a rigid motion or sequence of rigid motions that will transform one figure onto the other. `NC.M2.G-CO.6`
7. Use the properties of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent. `NC.M2.G-CO.7`
8. Use congruence in terms of rigid motion. Justify the ASA, SAS, and SSS criteria for triangle congruence. Use criteria for triangle congruence (ASA, SAS, SSS, HL) to determine whether two triangles are congruent. `NC.M2.G-CO.8`
9. Prove theorems about lines and angles and use them to prove relationships in geometric figures including:
Vertical angles are congruent.
When a transversal crosses parallel lines, alternate interior angles are congruent.
When a transversal crosses parallel lines, corresponding angles are congruent.
Points are on a perpendicular bisector of a line segment if and only if they are equidistant from the endpoints of the segment.
Use congruent triangles to justify why the bisector of an angle is equidistant from the sides of the angle. `NC.M2.G-CO.9`
10. Prove theorems about triangles and use them to prove relationships in geometric figures including:
The sum of the measures of the interior angles of a triangle is 180º.
An exterior angle of a triangle is equal to the sum of its remote interior angles.
The base angles of an isosceles triangle are congruent.
The segment joining the midpoints of two sides of a triangle is parallel to the third side and half the length. `NC.M2.G-CO.10`

Similarity, Right Triangles, and Trigonometry

1. Verify experimentally the properties of dilations with given center and scale factor: NC.M2.G-SRT.1
   a. When a line segment passes through the center of dilation, the line segment and its image lie on the same line. When a line segment does not pass through the center of dilation, the line segment and its image are parallel. NC.M2.G-SRT.1.A
   b. The length of the image of a line segment is equal to the length of the line segment multiplied by the scale factor. NC.M2.G-SRT.1.B
   c. The distance between the center of a dilation and any point on the image is equal to the scale factor multiplied by the distance between the dilation center and the corresponding point on the pre-image. NC.M2.G-SRT.1.C
   d. Dilations preserve angle measure. NC.M2.G-SRT.1.D
2. Understand similarity in terms of transformations. NC.M2.G-SRT.2
   a. Determine whether two figures are similar by specifying a sequence of transformations that will transform one figure into the other. NC.M2.G-SRT.2.A
   b. Use the properties of dilations to show that two triangles are similar when all corresponding pairs of sides are proportional and all corresponding pairs of angles are congruent. NC.M2.G-SRT.2.B
3. Use transformations (rigid motions and dilations) to justify the AA criterion for triangle similarity. NC.M2.G-SRT.3
4. Use similarity to solve problems and to prove theorems about triangles. Use theorems about triangles to prove relationships in geometric figures.
A line parallel to one side of a triangle divides the other two sides proportionally and its converse.
The Pythagorean Theorem NC.M2.G-SRT.4
6. Verify experimentally that the side ratios in similar right triangles are properties of the angle measures in the triangle, due to the preservation of angle measure in similarity. Use this discovery to develop definitions of the trigonometric ratios for acute angles. NC.M2.G-SRT.6
8. Use trigonometric ratios and the Pythagorean Theorem to solve problems involving right triangles in terms of a context. NC.M2.G-SRT.8
12. Develop properties of special right triangles (45-45-90 and 30-60-90) and use them to solve problems. NC.M2.G-SRT.12

Statistics and Probability

Making Inference and Justifying Conclusions

2. Use simulation to determine whether the experimental probability generated by sample data is consistent with the theoretical probability based on known information about the population. NC.M2.S-IC.2

Conditional Probability and the Rules for Probability

1. Describe events as subsets of the outcomes in a sample space using characteristics of the outcomes or as unions, intersections and complements of other events. NC.M2.S-CP.1

3. Develop and understand independence and conditional probability. NC.M2.S-CP.3

   a. Use a 2-way table to develop understanding of the conditional probability of A given B (written P(A|B)) as the likelihood that A will occur given that B has occurred. That is, P(A|B) is the fraction of event B's outcomes that also belong to event A. NC.M2.S-CP.3.A

   b. Understand that event A is independent from event B if the probability of event A does not change in response to the occurrence of event B. That is P(A|B)=P(A). NC.M2.S-CP.3.B

4. Represent data on two categorical variables by constructing a two-way frequency table of data. Interpret the two-way table as a sample space to calculate conditional, joint and marginal probabilities. Use the table to decide if events are independent. NC.M2.S-CP.4

5. Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations NC.M2.S-CP.5

6. Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in context. NC.M2.S-CP.6

7. Apply the Addition Rule, P(A or B) = P(A) + P(B) – P(A and B), and interpret the answer in context. NC.M2.S-CP.7

8. Apply the general Multiplication Rule P(A and B) = P(A)P(B|A) = P(B)P(A|B), and interpret the answer in context. Include the case where A and B are independent: P(A and B) = P(A) P(B). NC.M2.S-CP.8