North Dakota Mathematics Standards

Grades 9, 10

Adopted 2023

Ninth and Tenth Grades

Math Attributes

Problem-Solving

P. Learners can analyze, execute, critique, and adapt approaches and solutions when problem-solving in novel situations. 9-10.MA.P

Connections

C. Learners can create connections within and across concepts, using supporting evidence to interpret how they originate, extend, and relate to other learning, ideas, and life experiences. 9-10.MA.C

Reasoning and Proof

R. Learners can reason logically, citing evidence to critique and explain what they see, think, and conclude through exploration, generalization, and validation. 9-10.MA.R

Number and Operations

1. Explain how the definition of rational exponents follows from extending the properties of integer exponents; rewrite simple expressions involving radicals and rational exponents using the properties of exponents. 9-10.NO.1
2. Perform basic operations on simple radical expressions to write a simplified equivalent expression. 9-10.NO.2
3. Choose and interpret the scale and the units in graphs and data displays. 9-10.NO.3
4. Define appropriate quantities and units for the purpose of descriptive modeling. 9-10.NO.4
5. Choose a level of accuracy or precision appropriate to limitations on measurement when reporting quantities. 9-10.NO.5

Algebraic Reasoning

1. Use the structure of an expression (i.e., quadratic and exponential) to identify ways to rewrite it. 9-10.AR.1
2. Rearrange formulas to isolate a quantity or variable(s) of interest using the same reasoning as in solving equations. 9-10.AR.2
3. Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear, quadratic, and exponential functions. 9-10.AR.3

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4. Create linear and exponential equations in two or more variables to represent relationships between quantities. Graph equations on coordinate axes with appropriate labels and scales. 9-10.AR.4
5. Justify each step in solving a linear equation that may or may not have a solution. 9-10.AR.5
6. Solve linear equations and inequalities (to include compound inequalities) in one variable. 9-10.AR.6
7. Solve a system of linear equations graphically and algebraically. Create and solve a system of linear equations in context. 9-10.AR.7
8. Graph the solution set to a two-variable system of linear inequalities. bCreate and graph the solution set to a two-variable system of linear inequalities in context. 9-10.AR.8
9. Solve absolute value equations and inequalities in one or two variables. 9-10.AR.9
10. Solve quadratic equations in one variable by inspection (e.g., for $x^2 = 49$) taking square roots, the quadratic formula, and factoring, as appropriate to the initial form of the equation. 9-10.AR.10
11. Add, subtract, and multiply polynomials. 9-10.AR.11

Functions

1. Determine whether a relationship is a function given a table, graph, or words, identifying x as an element of the domain and f(x) as an element in the range. Determine the domain and range of a function in context. 9-10.AR.F.1
2. Use function notation, evaluate functions for inputs in their domains and interpret statements that use function notation in context. 9-10.AR.F.2
3. Sketch the key features (to include intercepts, maximums, minimums, and lines of symmetry, where applicable) of linear, exponential, and quadratic functions modeling the relationship between two quantities using tables, graphs, written descriptions, and equations. 9-10.AR.F.3
4. Relate the domain of a linear, quadratic, or exponential function to its graph and, where applicable, to the quantitative relationship it describes. 9-10.AR.F.4
5. Calculate and interpret the rate of change of linear, quadratic, or exponential functions (presented algebraically or as a table) over specified intervals. Estimate the rate of change from a graph. 9-10.AR.F.5
6. Write a function defined by an expression in different but equivalent forms to reveal and explain the different properties of the function. 9-10.AR.F.6
    a. Use appropriate forms of linear, quadratic, and exponential functions to show zeros, extreme values, and symmetry (where applicable) and interpret them in context. 9-10.AR.F.6.A
    b. Use the properties of an exponential function to classify it as growth or decay. 9-10.AR.F.6.B

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7. Compare key features of two linear, exponential, or quadratic functions, each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). 9-10.AR.F.7
8. Identify situations that can be modeled with linear, quadratic, and exponential functions. Justify the most appropriate model for a situation based on the rate of change over equal intervals. Include situations in which a quantity grows or decays. 9-10.AR.F.8
9. Identify the effect of transformations on the graph of a linear, absolute value, or quadratic function by replacing f(x) with af(x), f(x - h), and f(x) + k, for specific values of a, h, and k (both positive and negative). Find the value of a, h, and k given the graph of the function. 9-10.AR.F.9
10. Find the inverse of a linear function and describe the relationship between the domain, range, and graph of the function and its inverse in context. 9-10.AR.F.10
11. Interpret the parameters in a linear, quadratic, or exponential function in context. 9-10.AR.F.11
12. Identify, using graphs or tables, the solution(s) to linear and exponential functions f(x) = g(x) as x-value(s) that result in equivalent y-values. 9-10.AR.F.12

Geometry and Measurement

1. Know precise definitions and notations of angle, circle, perpendicular line, parallel line, and line segment based on the undefined notions of point, line, and plane. 9-10.GM.1
2. Represent transformations in the plane. Describe transformations as functions taking points in the plane as inputs and giving other points as outputs. Compare transformations that preserve distance and angle to those that do not (i.e., rigid versus non-rigid motion). 9-10.GM.2
3. Describe the rotations and reflections of a triangle, rectangle, parallelogram, trapezoid, or regular polygon that map each figure onto itself or another figure. 9-10.GM.3
4. Develop or verify the characteristics of rotations, reflections, and translations in angles, circles, perpendicular lines, parallel lines, and line segments. 9-10.GM.4
5. Draw the image of a figure that has undergone a series of transformations [rotation(s), reflection(s), or translation(s)] of a geometric figure using a variety of methods (e.g., graph paper, tracing paper, or geometry software). 9-10.GM.5
6. Predict the effect of a specified rigid motion on a given figure using geometric descriptions of rigid motions. Determine whether two figures are congruent using the definition of congruence in terms of rigid motions. 9-10.GM.6
7. Use the definition of congruence, based on rigid motions, to show two triangles are congruent if and only if their corresponding sides and corresponding angles are congruent. 9-10.GM.7
8. Prove two triangles are congruent using the congruence theorems. 9-10.GM.8
9. Prove and apply theorems about lines and angles. 9-10.GM.9
10. Prove and apply theorems about triangles. 9-10.GM.10

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11. Prove and apply theorems about parallelograms. 9-10.GM.11
12. Make basic geometric constructions (e.g., segment, angle, bisectors, parallel and perpendicular lines) with a variety of tools and methods. 9-10.GM.12
13. Apply basic constructions to create polygons such as equilateral triangles, squares, and regular hexagons inscribed in circles. 9-10.GM.13
14. Verify experimentally and justify the properties of dilations given by a center and a scale factor. 9-10.GM.14
15. Use transformations to decide if two given figures are similar. Apply the meaning of similarity for triangles as the equality of all corresponding pairs of angles and the proportionality of all corresponding pairs of sides. 9-10.GM.15
16. Prove similarity theorems about triangles. 9-10.GM.16
17. Apply knowledge of congruence and similarity criteria for triangles to solve problems and to prove relationships in various geometric figures. 9-10.GM.17
18. Recognize how the properties of similar right triangles allow the trigonometric ratios to be defined and determine the sine, cosine, and tangent of an acute angle in a right triangle. 9-10.GM.18
19. Explain and use the relationship between the sine and cosine of complementary angles. 9-10.GM.19
20. Solve applied problems involving right triangles using trigonometric ratios, the Pythagorean Theorem, and special right triangles (30°-60°-90° and 45°-45°-90°). 9-10.GM.20
21. Solve unknown sides and angles of non-right triangles using the Laws of Sines and Cosines. 9-10.GM.21
22. Apply theorems about relationships between line segments and circles or angles and circles formed by radii, diameter, secants, tangents, and chords to find unknown lengths or angles. 9-10.GM.22
23. Construct the incenter and circumcenter of a triangle. Relate the incenter and circumcenter to the inscribed and circumscribed circles. 9-10.GM.23
24. Construct a tangent line from a point outside a given circle to the circle. 9-10.GM.24
25. Explain and use the formulas for arc length and area of sectors of circles. 9-10.GM.25
26. Recognize that the radian measure of an angle is the ratio of the length of the arc to the length of the radius of a circle. 9-10.GM.26
27. Develop and verify the slope criteria for parallel and perpendicular lines. Apply the slope criteria for parallel and perpendicular lines to solve problems. 9-10.GM.27
28. Verify simple geometric theorems algebraically using coordinates. Verify algebraically, using coordinates, that a given set of points produces a particular type of triangle or quadrilateral. 9-10.GM.28
29. Determine the midpoint or endpoint of a line segment using coordinates. Find the point on a directed line segment between two given points that partitions the segment in a given ratio. 9-10.GM.29

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30. Compute perimeters of polygons and areas of triangles, parallelograms, trapezoids, and kites using coordinates. 9-10.GM.30
31. Explain derivations of the formulas for the circumference of a circle, area of a circle, and volume of a cylinder, pyramid, and cone. 9-10.GM.31
32. Calculate the surface area for prisms, cylinders, pyramids, cones, and spheres to solve problems. 9-10.GM.32
33. Know and apply volume formulas for prisms, cylinders, pyramids, cones, and spheres to solve problems. 9-10.GM.33
34. Identify the shapes of two-dimensional cross-sections of three-dimensional objects and identify three-dimensional objects generated by rotations of two-dimensional objects. 9-10.GM.34
35. Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot). 9-10.GM.35
36. Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; scaling a model). 9-10.GM.36

Data, Probability, and Statistics

1. Represent data with plots on the real number line (dot plots, histograms, and box plots). 9-10.DPS.1
2. Compare the center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets using statistics appropriate to the shape of the data distribution. 9-10.DPS.2
3. Represent data on two quantitative variables on a scatter plot and describe how the variables are related. 9-10.DPS.3
    a. Fit a linear function to the data (with or without technology) if appropriate. 9-10.DPS.3.A
    b. Compute (using technology) and interpret the correlation coefficient of a linear fit. 9-10.DPS.3.B
    c. Interpret the meaning of the slope and y-intercept of the linear model in context. 9-10.DPS.3.C
    d. Interpolate and extrapolate the linear model to predict values. 9-10.DPS.3.D
4. Distinguish between correlation and causation. 9-10.DPS.4
5. Describe events as subsets of a sample space (the set of outcomes) using characteristics (or categories) of the outcomes or as unions, intersections, or complements of other events ("or," "and," "not"). 9-10.DPS.5
6. Recognize that event A is independent of event B if the probability of event A does not change in response to the occurrence of event B. Apply the formula P(A and B) = P(A)·P(B) given that events A and B are independent. 9-10.DPS.6

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7. Recognize that the conditional probability of an event A given B is the probability that event A will occur given the knowledge that event B has already occurred. Calculate the conditional probability of A given B and interpret the answer in context. 9-10.DPS.7
8. Apply the formula P(A or B) = P(A) + P(B) – P(A and B) and interpret the answer in context. 9-10.DPS.8
9. Determine the number of outcomes using permutations and combinations in context. 9-10.DPS.9
10. Construct and interpret two-way frequency tables of data for two categorical variables. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. 9-10.DPS.10