New York Mathematics - Next Generation

Algebra I

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

Number and Quantity

The Real Number System

Use properties of rational and irrational numbers.

3. Use properties and operations to understand the different forms of rational and irrational numbers. AI-N.RN.3
   a. Perform all four arithmetic operations and apply properties to generate equivalent forms of rational numbers and square roots. AI-N.RN.3.A
   b. Categorize the sum or product of rational or irrational numbers.- The sum and 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.- The sum and product of two irrational numbers could be either rational or irrational. AI-N.RN.3.B

Quantities

Reason quantitatively and use units to solve problems.

1. Select quantities and use units as a way to: AI-N.Q.1
   a. interpret and guide the solution of multi-step problems; AI-N.Q.1.A
   b. choose and interpret units consistently in formulas; and AI-N.Q.1.B
   c. choose and interpret the scale and the origin in graphs and data displays. AI-N.Q.1.C
3. Choose a level of accuracy appropriate to limitations on measurement and context when reporting quantities. AI-N.Q.3

Seeing Structure in Expressions

Interpret the structure of expressions.

1. Interpret expressions that represent a quantity in terms of its context. AI-A.SSE.1
   a. Write the standard form of a given polynomial and identify the terms, coefficients, degree, leading coefficient, and constant term. AI-A.SSE.1.A
   b. Interpret expressions by viewing one or more of their parts as a single entity. AI-A.SSE.1.B
2. Recognize and use the structure of an expression to identify ways to rewrite it. AI-A.SSE.2

Write expressions in equivalent forms to reveal their characteristics.

3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. AI-A.SSE.3
   c. Use the properties of exponents to rewrite exponential expressions. AI-A.SSE.3.C

Arithmetic with Polynomials and Rational Expressions

Perform arithmetic operations on polynomials.

1. Add, subtract, and multiply polynomials and recognize that the result of the operation is also a polynomial. This forms a system analogous to the integers. AI-A.APR.1

Understand the relationship between zeros and factors of polynomials.

3. Identify zeros of polynomial functions when suitable factorizations are available. AI-A.APR.3

Creating Equations

Create equations that describe numbers or relationships.

1. Create equations and inequalities in one variable to represent a real-world context. AI-A.CED.1
2. Create equations and linear inequalities in two variables to represent a real-world context. AI-A.CED.2
3. Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. AI-A.CED.3
4. Rewrite formulas to highlight a quantity of interest, using the same reasoning as in solving equations. AI-A.CED.4

Reasoning with Equations and Inequalities

Understand solving equations as a process of reasoning and explain the reasoning.

a. Explain each step when solving a linear or quadratic equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method. AI-A.REI.1.A

Solve equations and inequalities in one variable.

3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. AI-A.REI.3
4. Solve quadratic equations in one variable. AI-A.REI.4
    a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Understand that the quadratic formula is a derivative of this process. AI-A.REI.4.A
    b. Solve quadratic equations by: inspection, taking square roots, factoring, completing the square, the quadratic formula, and graphing.Recognize when the process yields no real solutions. AI-A.REI.4.B

Solve systems of equations.

a. Solve systems of linear equations in two variables both algebraically and graphically. AI-A.REI.6.A

a. Solve a system, with rational solutions, consisting of a linear equation and a quadratic equation (parabolas only) in two variables algebraically and graphically. AI-A.REI.7.A

Represent and solve equations and inequalities graphically.

10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane. AI-A.REI.10
11. Given the equations $y = f(x)$ and $y = g(x)$: AI-A.REI.11
    a. recognize that each x-coordinate of the intersection(s) is the solution to the equation $f(x) = g(x)$; AI-A.REI.11.A
    b. find the solutions approximately using technology to graph the functions or make tables of values; and AI-A.REI.11.B
    c. interpret the solution in context. AI-A.REI.11.C
12. Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes. AI-A.REI.12

Functions

Interpreting Functions

Understand the concept of a function and use function notation.

1. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of fcorresponding to the input x. The graph of f is the graph of the equation y = f(x). AI-F.IF.1
2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. AI-F.IF.2
3. Recognize that a sequence is a function whose domain is a subset of the integers. AI-F.IF.3

Interpret functions that arise in applications in terms of the context.

4. For a function that models a relationship between two quantities: AI-F.IF.4
   a. interpret key features of graphs and tables in terms of the quantities; and AI-F.IF.4.A
   b. sketch graphs showing key features given a verbal description of the relationship. AI-F.IF.4.B
5. Determine the domain of a function from its graph and, where applicable, identify the appropriate domain for a function in context. AI-F.IF.5
6. Calculate and interpret the average rate of change of a function over a specified interval. AI-F.IF.6

Analyze functions using different representations.

7. Graph functions and show key features of the graph by hand and by using technology where appropriate. AI-F.IF.7
   a. Graph linear, quadratic, and exponential functions and show key features. AI-F.IF.7.A
   b. Graph square root, and piecewise-defined functions, including step functions and absolute value functions and show key features. AI-F.IF.7.B
8. Write a function in different but equivalent forms to reveal and explain different properties of the function. AI-F.IF.8
   a. For a quadratic function, use an algebraic process to find zeros, maxima, minima, and symmetry of the graph, and interpret these in terms of context. AI-F.IF.8.A
9. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). AI-F.IF.9

Building Functions

Build a function that models a relationship between two quantities.

1. Write a function that describes a relationship between two quantities. AI-F.BF.1
    a. Determine a function from context. Define a sequence explicitly or steps for calculation from a context. AI-F.BF.1.A

Build new functions from existing functions.

a. Using f(x) + k, k f(x), and f(x + k):- identify the effect on the graph when replacing f(x) by f(x) + k, k f(x), and f(x + k) for specific values of k (both positive and negative);- find the value of k given the graphs;- write a new function using the value of k; and - use technology to experiment with cases and explore the effects on the graph. AI-F.BF.3.A

Linear, Quadratic, and Exponential Models

Construct and compare linear, quadratic, and exponential models and solve problems.

1. Distinguish between situations that can be modeled with linear functions and with exponential functions. AI-F.LE.1
    a. Justify that a function is linear because it grows by equal differences over equal intervals, and that a function is exponential because it grows by equal factors over equal intervals. AI-F.LE.1.A
    b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another, and therefore can be modeled linearly. AI-F.LE.1.B
    c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another, and therefore can be modeled exponentially. AI-F.LE.1.C
2. Construct a linear or exponential function symbolically given:- graph;- description of the relationship;- two input-output pairs (include reading these from a table). AI-F.LE.2
3. Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function AI-F.LE.3

Interpret expressions for functions in terms of the situation they model.

5. Interpret the parameters in a linear or exponential function in terms of a context. AI-F.LE.5

Statistics and Probability

Interpreting Categorical and Quantitative Data

Summarize, represent, and interpret data on a single count or measurement variable.

1. Represent data with plots on the real number line (dot plots, histograms, and box plots). AI-S.ID.1
2. Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (inter-quartile range, sample standard deviation) of two or more different data sets. AI-S.ID.2
3. Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). AI-S.ID.3
5. Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data. AI-S.ID.5
6. Represent bivariate data on a scatter plot, and describe how the variables' values are related. AI-S.ID.6
    a. Fit a function to real-world data; use functions fitted to data to solve problems in the context of the data. AI-S.ID.6.A

Interpret linear models.

7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. AI-S.ID.7
8. Calculate (using technology) and interpret the correlation coefficient of a linear fit. AI-S.ID.8
9. Distinguish between correlation and causation. AI-S.ID.9