New York Mathematics - Next Generation

Algebra II

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

Extend the properties of exponents to rational exponents.

1. Explore how the meaning of rational exponents follows from extending the properties of integer exponents. AII_N.RN.1
2. Convert between radical expressions and expressions with rational exponents using the properties of exponents. AII_N.RN.2

The Complex Number System

Perform arithmetic operations with complex numbers.

1. Know there is a complex number i such that $i^2 = -1$, and every complex number has the form a + bi with a and b real. AII-N.CN.1
2. Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. AII-N.CN.2

Algebra

Seeing Structure in Expressions

Interpret the structure of expressions.

2. Recognize and use the structure of an expression to identify ways to rewrite it. AII-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. AII-A.SSE.3
    a. Factor quadratic expressions including leading coefficients other than 1 to reveal the zeros of the function it defines. AII-A.SSE.3.A
    c. Use the properties of exponents to rewrite exponential expressions. AII-A.SSE.3.C

Arithmetic with Polynomials and Rational Expressions

Understand the relationship between zeros and factors of polynomials.

2. Apply the Remainder Theorem: For a polynomial p(x) and a number a, the remainder on division by x – a is p(a), so p(a) = 0 if and only if (x – a) is a factor of p(x). AII-A.APR.2
3. Identify zeros of polynomial functions when suitable factorizations are available. AII-A.APR.3

Rewrite rational expressions.

6. Rewrite rational expressions in different forms: Write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x). AII-A.APR.6

Creating Equations

Create equations that describe numbers or relationships.

1. Create equations and inequalities in one variable to represent a real-world context. AII-A.CED.1

Reasoning with Equations and Inequalities

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

b. Explain each step when solving rational or radical equations 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. AII-A.REI.1.B

2. Solve rational and radical equations in one variable, identify extraneous solutions, and explain how they arise. AII-A.REI.2

Solve equations and inequalities in one variable. Write complex solutions in a + bi form.

4. Solve quadratic equations in one variable AII-A.REI.4

   b. Solve quadratic equations by: inspection, taking square roots, factoring, completing the square, the quadratic formula, and graphing. AII-A.REI.4.B

Solve systems of equations.

b. Solve a system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. AII-A.REI.7.B

Represent and solve equations and inequalities graphically.

11. Given the equations y = f(x) and y = g(x): AII-A.REI.11

    a. recognize that each x-coordinate of the intersection(s) is the solution to the equation f(x) = g(x); AII-A.REI.11.A

    b. find the solutions approximately using technology to graph the functions or make tables of values; AII-A.REI.11.B

    c. find the solution of $f(x) < g(x)$ or $f(x) \leq g(x)$ graphically; and AII-A.REI.11.C

    d. interpret the solution in context. AII-A.REI.11.D

Functions

Interpreting Functions

Understand the concept of a function and use function notation.

3. Recognize that a sequence is a function whose domain is a subset of the integers. AII-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: AII-F.IF.4
   a. interpret key features of graphs and tables in terms of the quantities; and AII-F.IF.4.A
   b. sketch graphs showing key features given a verbal description of the relationship. AII-F.IF.4.B

Analyze functions using different representations.

7. Graph functions and show key features of the graph by hand and using technology when appropriate. AII-F.IF.7
   c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. AII-F.IF.7.C
   e. Graph cube root, exponential and logarithmic functions, showing intercepts and end behavior; and trigonometric functions, showing period, midline, and amplitude. AII-F.IF.7.E
8. Write a function in different but equivalent forms to reveal and explain different properties of the function. AII-F.IF.8
   b. Use the properties of exponents to interpret exponential functions, and classify them as representing exponential growth or decay. AII-F.IF.8.B
9. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). AII-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. AII-F.BF.1
    a. Determine a function from context. Determine an explicit expression, a recursive process, or steps for calculation from a context. AII-F.BF.1.A
    b. Combine standard function types using arithmetic operations. AII-F.BF.1.B
2. Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms. AII-F.BF.2

Build new functions from existing functions. Include recognizing even and odd functions from their graphs.

b. Using f(x) + k, k f(x), f(kx), and f(x + k): AII-F.BF.3.B
    i. identify the effect on the graph when replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); AII-F.BF.3.B.I
    ii. find the value of k given the graphs; AII-F.BF.3.B.II
    iii. write a new function using the value of k; and AII-F.BF.3.B.III
    iv. use technology to experiment with cases and explore the effects on the graph. AII-F.BF.3.B.IV

a. Find the inverse of a one-to-one function both algebraically and graphically. AII-F.BF.4.A

a. Understand inverse relationships between exponents and logarithms algebraically and graphically. AII-F.BF.5.A

6. Represent and evaluate the sum of a finite arithmetic or finite geometric series, using summation (sigma) notation. AII-F.BF.6

7. Explore the derivation of the formulas for finite arithmetic and finite geometric series. Use the formulas to solve problems. AII-F.BF.7

Linear, Quadratic, and Exponential Models

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

2. Construct a linear or exponential function symbolically given:- a graph;- a description of the relationship; and- two input-output pairs (include reading these from a table). AII-F.LE.2

4. Use logarithms to solve exponential equations, such as ab^{ct} = d (where a, b, c, and d are real numbers and b > 0) and evaluate the logarithm using technology. AII-F.LE.4

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. AII-F.LE.5

Trigonometric Functions

Extend the domain of trigonometric functions using the unit circle.

1. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle. AII-F.TF.1
2. Apply concepts of the unit circle in the coordinate plane to calculate the values of the six trigonometric functions given angles in radian measure. AII-F.TF.2
4. Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions. AII-F.TF.4

Model periodic phenomena with trigonometric functions.

5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, horizontal shift, and midline. AII-F.TF.5

Prove and apply trigonometric identities.

8. Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$. Find the value of any of the six trigonometric functions given any other trigonometric function value and when necessary find the quadrant of the angle. AII-F.TF.8

Statistics and Probability

Interpreting Categorical and Quantitative Data

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

a. Recognize whether or not a normal curve is appropriate for a given data set. AII-S.ID.4.A

b. If appropriate, determine population percentages using a graphing calculator for an appropriate normal curve. AII-S.ID.4.B

Summarize, represent, and interpret data on two categorical and quantitative variables.

6. Represent bivariate data on a scatter plot, and describe how the variables' values are related. AII-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. AII-S.ID.6.A

Making Inferences and Justifying Conclusions

Understand and evaluate random processes underlying statistical experiments.

2. Determine if a value for a sample proportion or sample mean is likely to occur based on a given simulation. AII-S.IC.2

Make inferences and justify conclusions from sample surveys, experiments, and observational studies.

3. Recognize the purposes of and differences among surveys, experiments, and observational studies. Explain how randomization relates to each. AII-S.IC.3
4. Given a simulation model based on a sample proportion or mean, construct the 95% interval centered on the statistic (+/-two standard deviations) and determine if a suggested parameter is plausible. AII-S.IC.4

a. Use the tools of statistics to draw conclusions from numerical summaries. AII-S.IC.6.A

b. Use the language of statistics to critique claims from informational texts. AII-S.IC.6.B

Conditional Probability and the Rules of Probability

Understand independence and conditional probability and use them to interpret data.

1. 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"). AII-S.CP.1
4. Interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and calculate conditional probabilities. AII-S.CP.4

Use the rules of probability to compute probabilities of compound events in a uniform probability model.

7. Apply the Addition Rule, P(A or B) = P(A) + P(B) -P(A and B), and interpret the answer in terms of the model. AII-S.CP.7