

Pennsylvania Tutorials are designed specifically for the Pennsylvania Core Standards and the Pennsylvania Academic Standards to prepare students for the Keystone Exams and the Pennsylvania System of School Assessment (PSSA).

Math Tutorials offer targeted instruction, practice and review designed to develop computational fluency, deepen conceptual understanding, and apply mathematical practices. They automatically identify and address learning gaps down to elementary-level content, using adaptive remediation to bring students to grade-level no matter where they start. Students engage with the content in an interactive, feedback-rich environment as they progress through standards-aligned modules. By constantly honing the ability to apply their knowledge in abstract and real world scenarios, students build the depth of knowledge and higher order skills required to demonstrate their mastery when put to the test.

In each module, the Learn It and Try It make complex ideas accessible to students through focused content, modeled logic and process, multi-modal representations, and personalized feedback as students reason through increasingly challenging problems. The Review It offers a high impact summary of key concepts and relates those concepts to students' lives. The Test It assesses students' mastery of the module's concepts, providing granular performance data to students and teachers after each attempt. To help students focus on the content most relevant to them, unit-level pretests and posttests can quickly identify where students are strong and where they're still learning.

### Unit 1: Exponential Equations, Functions, and Inequalities

- **EXPONENTIAL FUNCTIONS**

- CC.2.2.HS.C.5: Algebraic Concepts Functions Construct and compare linear, quadratic and exponential models to solve problems.
- CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.
- CC.2.2.HS.C.3: Algebraic Concepts Functions Write functions or sequences that model relationships between two quantities.
- CC.2.2.HS.D.7: Algebraic Concepts Algebra Create and graph equations or inequalities to describe numbers or relationships.

- **EXPONENTIAL GROWTH AND DECAY**

- CC.2.2.HS.C.5: Algebraic Concepts Functions Construct and compare linear, quadratic and exponential models to solve problems.
- CC.2.2.HS.C.6: Algebraic Concepts Functions Interpret functions in terms of the situation they model.

- CC.2.2.HS.C.3: Algebraic Concepts Functions Write functions or sequences that model relationships between two quantities.
- CC.2.2.HS.D.7: Algebraic Concepts Algebra Create and graph equations or inequalities to describe numbers or relationships.
- **SOLVING EXPONENTIAL EQUATIONS**
  - CC.2.2.HS.D.10: Algebraic Concepts Algebra Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
  - CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.
  - CC.2.2.HS.C.5: Algebraic Concepts Functions Construct and compare linear, quadratic and exponential models to solve problems.
- **SOLVING EXPONENTIAL INEQUALITIES**
  - CC.2.2.HS.D.7: Algebraic Concepts Algebra Create and graph equations or inequalities to describe numbers or relationships.
  - CC.2.2.HS.D.10: Algebraic Concepts Algebra Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
  - CC.2.2.HS.C.5: Algebraic Concepts Functions Construct and compare linear, quadratic and exponential models to solve problems.
  - CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.
  - CC.2.2.HS.C.6: Algebraic Concepts Functions Interpret functions in terms of the situation they model.
- **SUMS OF GEOMETRIC SEQUENCES**
  - CC.2.2.HS.C.3: Algebraic Concepts Functions Write functions or sequences that model relationships between two quantities.

## Unit 2: Logarithmic Expressions, Equations, and Functions

- **LOGARITHMIC FUNCTIONS**
  - CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.
  - CC.2.2.HS.C.4: Algebraic Concepts Functions Interpret the effects transformations have on functions and find the inverses of functions.
- **EVALUATING LOGARITHMIC EXPRESSIONS**
  - CC.2.2.HS.D.2: Algebraic Concepts Algebra Write expressions in equivalent forms to solve problems.
- **SOLVING LOGARITHMIC EQUATIONS**
  - CC.2.2.HS.D.10: Algebraic Concepts Algebra Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.

- CC.2.2.HS.D.7: Algebraic Concepts Algebra Create and graph equations or inequalities to describe numbers or relationships.

### Unit 3: Polynomials

- **ADDITION AND SUBTRACTION OF POLYNOMIALS**

- CC.2.2.HS.D.3: Algebraic Concepts Algebra Extend the knowledge of arithmetic operations and apply to polynomials.

- **MULTIPLICATION OF POLYNOMIALS**

- CC.2.2.HS.D.3: Algebraic Concepts Algebra Extend the knowledge of arithmetic operations and apply to polynomials.

- **DIVISION OF POLYNOMIALS**

- CC.2.2.HS.D.3: Algebraic Concepts Algebra Extend the knowledge of arithmetic operations and apply to polynomials.
- CC.2.2.HS.D.2: Algebraic Concepts Algebra Write expressions in equivalent forms to solve problems.

### Unit 4: Graphs of Quadratic Functions

- **ANALYZING GRAPHS OF QUADRATIC FUNCTIONS**

- CC.2.2.HS.C.4: Algebraic Concepts Functions Interpret the effects transformations have on functions and find the inverses of functions.
- CC.2.2.HS.D.7: Algebraic Concepts Algebra Create and graph equations or inequalities to describe numbers or relationships.
- CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.
- CC.2.2.HS.C.5: Algebraic Concepts Functions Construct and compare linear, quadratic and exponential models to solve problems.
- CC.2.2.HS.C.6: Algebraic Concepts Functions Interpret functions in terms of the situation they model.
- CC.2.2.HS.D.10: Algebraic Concepts Algebra Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
- CC.2.2.HS.D.4: Algebraic Concepts Algebra Understand the relationship between zeros and factors of polynomials to make generalizations about functions and their graphs.

- **REPRESENTATIONS OF QUADRATIC FUNCTIONS**

- CC.2.2.HS.D.7: Algebraic Concepts Algebra Create and graph equations or inequalities to describe numbers or relationships.
- CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.
- CC.2.2.HS.C.5: Algebraic Concepts Functions Construct and compare linear, quadratic and exponential models to solve problems.

- CC.2.2.HS.C.6: Algebraic Concepts Functions Interpret functions in terms of the situation they model.
- CC.2.2.HS.C.3: Algebraic Concepts Functions Write functions or sequences that model relationships between two quantities.

### Unit 5: Solving Quadratic Equations

- **SOLVING QUADRATIC FUNCTIONS WITH FACTORING**

- CC.2.2.HS.C.3: Algebraic Concepts Functions Write functions or sequences that model relationships between two quantities.
- CC.2.2.HS.C.5: Algebraic Concepts Functions Construct and compare linear, quadratic and exponential models to solve problems.
- CC.2.2.HS.D.10: Algebraic Concepts Algebra Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
- CC.2.2.HS.D.4: Algebraic Concepts Algebra Understand the relationship between zeros and factors of polynomials to make generalizations about functions and their graphs.
- CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.
- CC.2.2.HS.D.7: Algebraic Concepts Algebra Create and graph equations or inequalities to describe numbers or relationships.
- CC.2.2.HS.D.3: Algebraic Concepts Algebra Extend the knowledge of arithmetic operations and apply to polynomials.

- **COMPLETING THE SQUARE**

- CC.2.2.HS.D.10: Algebraic Concepts Algebra Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
- CC.2.2.HS.D.2: Algebraic Concepts Algebra Write expressions in equivalent forms to solve problems.
- CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.
- CC.2.2.HS.C.5: Algebraic Concepts Functions Construct and compare linear, quadratic and exponential models to solve problems.

- **QUADRATIC FORMULA**

- CC.2.2.HS.D.10: Algebraic Concepts Algebra Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
- CC.2.2.HS.C.5: Algebraic Concepts Functions Construct and compare linear, quadratic and exponential models to solve problems.
- CC.2.1.HS.F.7: Numbers and Operations Number and Quantity Apply concepts of complex numbers in polynomial identities and quadratic equations to solve problems.
- CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.

## Unit 6: Factoring and Polynomial Identities

### • FACTORING SPECIAL CASES

- CC.2.2.HS.D.2: Algebraic Concepts Algebra Write expressions in equivalent forms to solve problems.
- CC.2.2.HS.D.5: Algebraic Concepts Algebra Use polynomial identities to solve problems.

### • FACTORING CUBIC POLYNOMIALS

- CC.2.2.HS.D.2: Algebraic Concepts Algebra Write expressions in equivalent forms to solve problems.
- CC.2.2.HS.D.5: Algebraic Concepts Algebra Use polynomial identities to solve problems.
- CC.2.2.HS.D.10: Algebraic Concepts Algebra Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.

### • FACTORING HIGHER-ORDER POLYNOMIALS

- CC.2.2.HS.D.4: Algebraic Concepts Algebra Understand the relationship between zeros and factors of polynomials to make generalizations about functions and their graphs.
- CC.2.2.HS.D.2: Algebraic Concepts Algebra Write expressions in equivalent forms to solve problems.
- CC.2.2.HS.D.5: Algebraic Concepts Algebra Use polynomial identities to solve problems.

### • POLYNOMIAL IDENTITIES

- CC.2.2.HS.D.5: Algebraic Concepts Algebra Use polynomial identities to solve problems.
- CC.2.2.HS.D.2: Algebraic Concepts Algebra Write expressions in equivalent forms to solve problems.

## Unit 7: Complex Numbers

### • COMPLEX NUMBERS

- CC.2.1.HS.F.6: Numbers and Operations Number and Quantity Extend the knowledge of arithmetic operations and apply to complex numbers.

### • COMPLEX NUMBERS AND QUADRATIC FUNCTIONS

- CC.2.1.HS.F.6: Numbers and Operations Number and Quantity Extend the knowledge of arithmetic operations and apply to complex numbers.
- CC.2.1.HS.F.7: Numbers and Operations Number and Quantity Apply concepts of complex numbers in polynomial identities and quadratic equations to solve problems.
- CC.2.2.HS.D.7: Algebraic Concepts Algebra Create and graph equations or inequalities to describe numbers or relationships.
- CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.
- CC.2.2.HS.C.3: Algebraic Concepts Functions Write functions or sequences that model relationships between two quantities.

### • POLYNOMIAL IDENTITIES AND COMPLEX NUMBERS

- CC.2.2.HS.D.2: Algebraic Concepts Algebra Write expressions in equivalent forms to solve problems.

- CC.2.2.HS.D.5: Algebraic Concepts Algebra Use polynomial identities to solve problems.
- CC.2.1.HS.F.7: Numbers and Operations Number and Quantity Apply concepts of complex numbers in polynomial identities and quadratic equations to solve problems.
- CC.2.2.HS.D.10: Algebraic Concepts Algebra Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.

### Unit 8: Radical Expressions, Equations, and Functions

#### • ANALYZING GRAPHS OF SQUARE ROOT FUNCTIONS

- CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.
- CC.2.2.HS.C.4: Algebraic Concepts Functions Interpret the effects transformations have on functions and find the inverses of functions.
- CC.2.2.HS.D.7: Algebraic Concepts Algebra Create and graph equations or inequalities to describe numbers or relationships.

#### • SOLVING SQUARE ROOT EQUATIONS

- CC.2.2.HS.D.10: Algebraic Concepts Algebra Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
- CC.2.2.HS.D.7: Algebraic Concepts Algebra Create and graph equations or inequalities to describe numbers or relationships.
- CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.
- CC.2.2.HS.C.6: Algebraic Concepts Functions Interpret functions in terms of the situation they model.

### Unit 9: Rational Expressions, Equations, and Functions

#### • OPERATIONS WITH RATIONAL EXPRESSIONS

- CC.2.1.HS.F.1: Numbers and Operations Number and Quantity Apply and extend the properties of exponents to solve problems with rational exponents.

#### • ANALYZING GRAPHS OF RATIONAL FUNCTIONS

- CC.2.2.HS.D.7: Algebraic Concepts Algebra Create and graph equations or inequalities to describe numbers or relationships.
- CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.

#### • SOLVING RATIONAL EQUATIONS

- CC.2.2.HS.D.10: Algebraic Concepts Algebra Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
- CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.

- CC.2.2.HS.D.6: Algebraic Concepts Algebra Extend the knowledge of rational functions to rewrite in equivalent forms.
- **MODELING SITUATIONS WITH RATIONAL FUNCTIONS**
- CC.2.2.HS.D.6: Algebraic Concepts Algebra Extend the knowledge of rational functions to rewrite in equivalent forms.
- CC.2.2.HS.C.3: Algebraic Concepts Functions Write functions or sequences that model relationships between two quantities.
- CC.2.2.HS.C.4: Algebraic Concepts Functions Interpret the effects transformations have on functions and find the inverses of functions.
- CC.2.2.HS.D.7: Algebraic Concepts Algebra Create and graph equations or inequalities to describe numbers or relationships.
- CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.
- CC.2.2.HS.C.6: Algebraic Concepts Functions Interpret functions in terms of the situation they model.

## Unit 10: Nonlinear Functions

- **LINEAR VERSUS NONLINEAR FUNCTIONS**
- CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.
- CC.2.2.HS.C.5: Algebraic Concepts Functions Construct and compare linear, quadratic and exponential models to solve problems.
- CC.2.2.HS.C.6: Algebraic Concepts Functions Interpret functions in terms of the situation they model.
- **INVERSE FUNCTIONS**
- CC.2.2.HS.C.4: Algebraic Concepts Functions Interpret the effects transformations have on functions and find the inverses of functions.
- **ABSOLUTE VALUE FUNCTIONS**
- CC.2.2.HS.D.10: Algebraic Concepts Algebra Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
- CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.
- **GRAPHS OF POLYNOMIAL FUNCTIONS**
- CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.
- CC.2.2.HS.D.7: Algebraic Concepts Algebra Create and graph equations or inequalities to describe numbers or relationships.

- CC.2.2.HS.C.4: Algebraic Concepts Functions Interpret the effects transformations have on functions and find the inverses of functions.

### Unit 11: Trigonometry

- **RADIANS AND THE UNIT CIRCLE**

- CC.2.2.HS.C.7: Algebraic Concepts Functions Apply radian measure of an angle and the unit circle to analyze the trigonometric functions.
- CC.2.3.HS.A.9: Geometry Geometry Extend the concept of similarity to determine arc lengths and areas of sectors of circles.
- CC.2.3.HS.A.7: Geometry Geometry Apply trigonometric ratios to solve problems involving right triangles.

- **TRIGONOMETRIC FUNCTIONS**

- CC.2.2.HS.C.8: Algebraic Concepts Functions Choose trigonometric functions to model periodic phenomena and describe the properties of the graphs.
- CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.
- CC.2.2.HS.C.4: Algebraic Concepts Functions Interpret the effects transformations have on functions and find the inverses of functions.
- CC.2.2.HS.C.9: Algebraic Concepts Functions Prove the Pythagorean identity and use it to calculate trigonometric ratios.

### Unit 12: Parent Functions and Transformations

- **PARENT FUNCTIONS**

- CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.
- CC.2.2.HS.D.7: Algebraic Concepts Algebra Create and graph equations or inequalities to describe numbers or relationships.

- **TRANSFORMATIONS OF PARENT FUNCTIONS**

- CC.2.2.HS.C.4: Algebraic Concepts Functions Interpret the effects transformations have on functions and find the inverses of functions.

- **MULTIPLE TRANSFORMATIONS OF PARENT FUNCTIONS**

- CC.2.2.HS.C.4: Algebraic Concepts Functions Interpret the effects transformations have on functions and find the inverses of functions.

### Unit 13: Working with Functions

- **ARITHMETIC OPERATIONS ON FUNCTIONS**

- CC.2.2.HS.D.3: Algebraic Concepts Algebra Extend the knowledge of arithmetic operations and apply to polynomials.

- CC.2.2.HS.C.1: Algebraic Concepts Functions Use the concept and notation of functions to interpret and apply them in terms of their context.
- CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.
- CC.2.2.HS.C.3: Algebraic Concepts Functions Write functions or sequences that model relationships between two quantities.
- CC.2.2.HS.C.6: Algebraic Concepts Functions Interpret functions in terms of the situation they model.
- **MULTIPLE REPRESENTATIONS OF FUNCTIONS**
  - CC.2.2.HS.C.2: Algebraic Concepts Functions Graph and analyze functions and use their properties to make connections between the different representations.
  - CC.2.2.HS.C.5: Algebraic Concepts Functions Construct and compare linear, quadratic and exponential models to solve problems.
  - CC.2.2.HS.C.6: Algebraic Concepts Functions Interpret functions in terms of the situation they model.
- **SOLVING THREE-VARIABLE SYSTEMS OF LINEAR EQUATIONS**
  - CC.2.2.HS.D.10: Algebraic Concepts Algebra Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
- **SYSTEMS OF NONLINEAR EQUATIONS**
  - CC.2.2.HS.D.10: Algebraic Concepts Algebra Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
  - CC.2.2.HS.C.5: Algebraic Concepts Functions Construct and compare linear, quadratic and exponential models to solve problems.

#### Unit 14: Statistics and Probability

- **ANALYZING STATISTICAL SAMPLES**
  - CC.2.4.HS.B.5: Measurement, Data, and Probability Statistics and Probability Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
- **EXPERIMENTAL AND OBSERVATIONAL DESIGN**
  - CC.2.4.HS.B.4: Measurement, Data, and Probability Statistics and Probability Recognize and evaluate random processes underlying statistical experiments.
  - CC.2.4.HS.B.5: Measurement, Data, and Probability Statistics and Probability Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
- **SCATTERPLOTS**
  - CC.2.4.HS.B.2: Measurement, Data, and Probability Statistics and Probability Summarize, represent, and interpret data on two categorical and quantitative variables.
  - CC.2.4.HS.B.3: Measurement, Data, and Probability Statistics and Probability Analyze linear models to make interpretations based on the data.

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- **CONCLUSIONS IN DATA**

- CC.2.4.HS.B.4: Measurement, Data, and Probability Statistics and Probability Recognize and evaluate random processes underlying statistical experiments.

- **NORMAL DISTRIBUTION**

- CC.2.4.HS.B.5: Measurement, Data, and Probability Statistics and Probability Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.
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