

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.

1. EXPONENTIAL EQUATIONS, FUNCTIONS, AND INEQUALITIES

● EXPONENTIAL FUNCTIONS

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

● EXPONENTIAL GROWTH AND DECAY

- **CC.2.2.HS.C.5** Construct and compare linear, quadratic and exponential models to solve problems.
- **CC.2.2.HS.C.6** Interpret functions in terms of the situation they model.
- **CC.2.2.HS.C.3** Write functions or sequences that model relationships between two quantities.
- **CC.2.2.HS.D.7** Create and graph equations or inequalities to describe numbers or relationships.

● SOLVING EXPONENTIAL EQUATIONS

- **CC.2.2.HS.D.10** Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
- **CC.2.2.HS.C.2** Graph and analyze functions and use their properties to make connections between the different representations.
- **CC.2.2.HS.C.5** Construct and compare linear, quadratic and exponential models to solve problems.

● SOLVING EXPONENTIAL INEQUALITIES

- **CC.2.2.HS.D.7** Create and graph equations or inequalities to describe numbers or relationships.
- **CC.2.2.HS.D.10** Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
- **CC.2.2.HS.C.5** Construct and compare linear, quadratic and exponential models to solve problems.
- **CC.2.2.HS.C.2** Graph and analyze functions and use their properties to make connections between the different representations.
- **CC.2.2.HS.C.6** Interpret functions in terms of the situation they model.

- **SUMS OF GEOMETRIC SEQUENCES**

- **CC.2.2.HS.C.3** Write functions or sequences that model relationships between two quantities.

2. LOGARITHMIC EXPRESSIONS, EQUATIONS, AND FUNCTIONS

- **LOGARITHMIC FUNCTIONS**

- **CC.2.2.HS.C.2** Graph and analyze functions and use their properties to make connections between the different representations.
- **CC.2.2.HS.C.4** Interpret the effects transformations have on functions and find the inverses of functions.

- **EVALUATING LOGARITHMIC EXPRESSIONS**

- **CC.2.2.HS.D.2** Write expressions in equivalent forms to solve problems.

- **SOLVING LOGARITHMIC EQUATIONS**

- **CC.2.2.HS.D.10** Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
- **CC.2.2.HS.D.7** Create and graph equations or inequalities to describe numbers or relationships.

3. POLYNOMIALS

- **ADDITION AND SUBTRACTION OF POLYNOMIALS**

- **CC.2.2.HS.D.3** Extend the knowledge of arithmetic operations and apply to polynomials.

- **MULTIPLICATION OF POLYNOMIALS**

- **CC.2.2.HS.D.3** Extend the knowledge of arithmetic operations and apply to polynomials.

- **DIVISION OF POLYNOMIALS**

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

4. GRAPHS OF QUADRATIC FUNCTIONS

- **ANALYZING GRAPHS OF QUADRATIC FUNCTIONS**

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

- **CC.2.2.HS.C.3** Write functions or sequences that model relationships between two quantities.

5. SOLVING QUADRATIC EQUATIONS

● SOLVING QUADRATIC FUNCTIONS WITH FACTORING

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

● COMPLETING THE SQUARE

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

● QUADRATIC FORMULA

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

6. FACTORING AND POLYNOMIAL IDENTITIES

● FACTORING SPECIAL CASES

- **CC.2.2.HS.D.2** Write expressions in equivalent forms to solve problems.
- **CC.2.2.HS.D.5** Use polynomial identities to solve problems.

● FACTORING CUBIC POLYNOMIALS

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

● FACTORING HIGHER-ORDER POLYNOMIALS

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

● POLYNOMIAL IDENTITIES

- **CC.2.2.HS.D.5** Use polynomial identities to solve problems.

- **CC.2.2.HS.D.2** Write expressions in equivalent forms to solve problems.

7. COMPLEX NUMBERS

● COMPLEX NUMBERS

- **CC.2.1.HS.F.6** Extend the knowledge of arithmetic operations and apply to complex numbers.

● COMPLEX NUMBERS AND QUADRATIC FUNCTIONS

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

● POLYNOMIAL IDENTITIES AND COMPLEX NUMBERS

- **CC.2.2.HS.D.2** Write expressions in equivalent forms to solve problems.
- **CC.2.2.HS.D.5** Use polynomial identities to solve problems.
- **CC.2.1.HS.F.7** Apply concepts of complex numbers in polynomial identities and quadratic equations to solve problems.
- **CC.2.2.HS.D.10** Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.

8. RADICAL EXPRESSIONS, EQUATIONS, AND FUNCTIONS

● ANALYZING GRAPHS OF SQUARE ROOT FUNCTIONS

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

● SOLVING SQUARE ROOT EQUATIONS

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

9. RATIONAL EXPRESSIONS, EQUATIONS, AND FUNCTIONS

● OPERATIONS WITH RATIONAL EXPRESSIONS

- **CC.2.1.HS.F.1** Apply and extend the properties of exponents to solve problems with rational exponents.

● ANALYZING GRAPHS OF RATIONAL FUNCTIONS

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

● SOLVING RATIONAL EQUATIONS

- **CC.2.2.HS.D.10** Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.

- **CC.2.2.HS.C.2** Graph and analyze functions and use their properties to make connections between the different representations.
- **CC.2.2.HS.D.6** Extend the knowledge of rational functions to rewrite in equivalent forms.

- **MODELING SITUATIONS WITH RATIONAL FUNCTIONS**

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

10. NONLINEAR FUNCTIONS

- **LINEAR VERSUS NONLINEAR FUNCTIONS**

- **CC.2.2.HS.C.2** Graph and analyze functions and use their properties to make connections between the different representations.
- **CC.2.2.HS.C.5** Construct and compare linear, quadratic and exponential models to solve problems.
- **CC.2.2.HS.C.6** Interpret functions in terms of the situation they model.

- **INVERSE FUNCTIONS**

- **CC.2.2.HS.C.4** Interpret the effects transformations have on functions and find the inverses of functions.

- **ABSOLUTE VALUE FUNCTIONS**

- **CC.2.2.HS.D.10** Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
- **CC.2.2.HS.C.2** 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** Graph and analyze functions and use their properties to make connections between the different representations.
- **CC.2.2.HS.D.7** Create and graph equations or inequalities to describe numbers or relationships.
- **CC.2.2.HS.C.4** Interpret the effects transformations have on functions and find the inverses of functions.

11. TRIGONOMETRY

- **RADIANS AND THE UNIT CIRCLE**

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

- **TRIGONOMETRIC FUNCTIONS**

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

12. PARENT FUNCTIONS AND TRANSFORMATIONS

- **PARENT FUNCTIONS**

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

- **T TRANSFORMATIONS OF PARENT FUNCTIONS**

- **CC.2.2.HS.C.4** Interpret the effects transformations have on functions and find the inverses of functions.

- **MULTIPLE T TRANSFORMATIONS OF PARENT FUNCTIONS**

- **CC.2.2.HS.C.4** Interpret the effects transformations have on functions and find the inverses of functions.

13. WORKING WITH FUNCTIONS

- **ARITHMETIC OPERATIONS ON FUNCTIONS**

- **CC.2.2.HS.D.3** Extend the knowledge of arithmetic operations and apply to polynomials.
- **CC.2.2.HS.C.1** Use the concept and notation of functions to interpret and apply them in terms of their context.
- **CC.2.2.HS.C.2** Graph and analyze functions and use their properties to make connections between the different representations.
- **CC.2.2.HS.C.3** Write functions or sequences that model relationships between two quantities.
- **CC.2.2.HS.C.6** Interpret functions in terms of the situation they model.

- **MULTIPLE REPRESENTATIONS OF FUNCTIONS**

- **CC.2.2.HS.C.2** Graph and analyze functions and use their properties to make connections between the different representations.
- **CC.2.2.HS.C.5** Construct and compare linear, quadratic and exponential models to solve problems.
- **CC.2.2.HS.C.6** Interpret functions in terms of the situation they model.

- **SOLVING THREE-VARIABLE SYSTEMS OF LINEAR EQUATIONS**

- **CC.2.2.HS.D.10** Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.

- **SYSTEMS OF NONLINEAR EQUATIONS**

- **CC.2.2.HS.D.10** Represent, solve, and interpret equations/inequalities and systems of equations/inequalities algebraically and graphically.
- **CC.2.2.HS.C.5** Construct and compare linear, quadratic and exponential models to solve problems.

14. STATISTICS AND PROBABILITY

- **ANALYZING STATISTICAL SAMPLES**

- **CC.2.4.HS.B.5** Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.

- **EXPERIMENTAL AND OBSERVATIONAL DESIGN**

- **CC.2.4.HS.B.4** Recognize and evaluate random processes underlying statistical experiments.
- **CC.2.4.HS.B.5** Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.

- **SCATTERPLOTS**

- **CC.2.4.HS.B.2** Summarize, represent, and interpret data on two categorical and quantitative variables.
- **CC.2.4.HS.B.3** Analyze linear models to make interpretations based on the data.

- **CONCLUSIONS IN DATA**

- **CC.2.4.HS.B.4** *Recognize and evaluate random processes underlying statistical experiments.*

- **NORMAL DISTRIBUTION**

- **CC.2.4.HS.B.5** *Make inferences and justify conclusions based on sample surveys, experiments, and observational studies.*