Mathematics III

Conceptual Category *Algebra*

Domain *Arithmetic with Polynomials and Rational Expressions*

Cluster *Perform arithmetic operations on polynomials*

Pacing

Quarter 1

Standards

A.APR.1 Understand that polynomials form a system analogous to the integers; namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.

Learning Targets

I can:

- Apply the definition of an integer to explain why adding, subtracting, or multiplying two integers always produces an integer.
- Apply the definition of polynomial to explain why adding, subtracting, or multiplying two polynomials always produces a polynomial.
- Add and subtract polynomials.
- Multiply polynomials.

Content Elaborations

Mathematically proficient students:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Examples of Key Advances from Mathematics II

- Students begin to see polynomials as a system that has mathematical coherence, not just as a set of expressions of a specific type. An analogy to the integers can be made (including operations, factoring, etc.). Subsequently, polynomials can be extended to rational expressions, analogous to the rational numbers.
- The understandings that students have developed with linear, exponential and quadratic functions are extended to considering a much broader range of classes of functions.
- In statistics, students begin to look at the role of randomization in statistical design.

Fluency Recommendations

A/F Students should look at algebraic manipulation as a meaningful enterprise, in which they seek to understand the structure of an expression or equation and use properties to transform it into forms that provide useful information (e.g., features of a function or solutions to an equation). This perspective will help students continue to usefully apply

Mathematics III

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Content Vocabulary • polynomial • closure property • integers	**Academic Vocabulary**
Formative Assessments • performance tasks • pretests • quizzes • interviews	**Summative Assessments** • MVP assessments • Teacher created assessments • PARCC
Resources • Mathematics Vision Project • Pearson Mathematics III • UCSMP • Ohio Model Curriculum	**Enrichment Strategies**
Integrations • Modeling projects	**Intervention Strategies**

Mathematics III

Conceptual Category *Algebra*

Domain *Arithmetic with Polynomials and Rational Expressions*

Cluster *Understand the relationship between zeros and factors of polynomials*

Pacing

Quarter 1

Standards

A.APR.2 Know and 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 $p(x)$.

Learning Targets

I can:

- Divide polynomials using long division and synthetic division and apply the Remainder Theorem to check the answer.
- Apply the Remainder Theorem to determine if a divisor $(x - a)$ is a factor of the polynomial $p(x)$.

A.APR.3 Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

Learning Targets

I can:

- Identify the zeros of factored polynomials.
- Identify the multiplicity of the zeros of a factored polynomial.
- Explain how the multiplicity of the zeros provides a clue as to how the graph will behave when it approaches and leaves the x-intercept.
- Sketch a rough graph using the zeros of a polynomial and other easily identifiable points such as the y-intercept.

Content Elaborations

Mathematically proficient students:

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2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics
5. Use appropriate tools strategically.
6. Attend to precision.
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Content Vocabulary • equivalent expression • polynomial • greatest common factor • perfect square trinomial • difference of two squares • nth root • principal root • radicand • index • rationalization • like radicals • rational exponent • closure property • integers • Remainder Theorem • long division • synthetic division • divisor • factor • relative maximum • relative minimum • zeros • polynomial function • factorization • x-intercept • y-intercept • multiplicity • multiple zero	**Academic Vocabulary**
Formative Assessments • performance tasks • pretests	**Summative Assessments** • MVP assessments • Teacher created assessments

• quizzes • interviews	• PARCC
Resources • Mathematics Vision Project • Pearson Mathematics III • UCSMP • Ohio Model Curriculum	**Enrichment Strategies**
Integrations • Modeling projects	**Intervention Strategies**

Mathematics III

Conceptual Category ***Algebra***

Domain ***Arithmetic with Polynomials and Rational Expressions***

Cluster ***Use polynomial identities to solve problems***

Pacing

Quarter 1

Standards

A.APR.4 Prove polynomial identities and use them to describe numerical relationships. *For example, the polynomial identity* $(x2 + y2)2 = (x2 - y2)2 + (2xy)2$ *can be used to generate Pythagorean triples.*

Learning Targets

I can:

- Verify polynomial identities (sums and differences of like powers).
- Factor polynomials completely by applying the polynomial identities.
- Use polynomial identities to describe numerical relationships.

Content Elaborations

Mathematically proficient students:

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2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics
5. Use appropriate tools strategically.
6. Attend to precision.
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Content Vocabulary • polynomial • polynomial identity • factor completely • Pythagorean triples	**Academic Vocabulary** • verify
Formative Assessments • performance tasks • pretests • quizzes • interviews	**Summative Assessments** • MVP assessments • Teacher created assessments • PARCC
Resources • Mathematics Vision Project • Pearson Mathematics III • UCSMP • Ohio Model Curriculum	**Enrichment Strategies**
Integrations • Modeling projects	**Intervention Strategies**

Mathematics III

Conceptual Category *Algebra*

Domain *Arithmetic with Polynomials and Rational Expressions*

Cluster *Rewrite rational expressions*

Pacing

Quarter 1

Standards

A.APR.6 Rewrite simple 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 $b(x)$, using inspection, long division, or, for the more complicated examples, a computer algebra system.

Learning Targets

I can:

- Define rational expression.
- Determine the best method of simplifying the given rational expression (inspection, long division, computer algebra system).
- Simplify rational expressions by inspection.
- Simplify rational expressions using long division.
- Simplify complicated rational expressions using a computer algebra system.
- Write a rational expression $a(x)/b(x)$ where $a(x)$ is the dividend and $b(x)$ is the divisor in the form $q(x) + r(x)/b(x)$ where $q(x)$ is the quotient and $r(x)$ is the remainder.

Content Elaborations

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Content Vocabulary • rational expression • dividend • divisor • quotient • remainder • degree • inspection • long division • excluded value	**Academic Vocabulary** • simplify
Formative Assessments • performance tasks • pretests • quizzes • interviews	**Summative Assessments** • MVP assessments • Teacher created assessments • PARCC
Resources • Mathematics Vision Project • Pearson Mathematics III • UCSMP • Ohio Model Curriculum	**Enrichment Strategies**
Integrations • Modeling projects	**Intervention Strategies**

Mathematics III

Conceptual Category ***Algebra***

Domain ***Creating Equations***

Cluster ***Create equations that describe numbers or relationships***

Pacing

Quarters 1 and 2

Standards

A.CED.1 Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions and simple rational and exponential functions.

Learning Targets

I can:

- Identify the variables and quantities represented in a real-world problem.
- Determine the best model for the real-world problem (linear equation or inequality, quadratic equation or inequality, rational or exponential equation).
- Write, solve, and interpret equations that model real-world situations.

A.CED.2 Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

Learning Targets

I can:

- Write the equation that best models the problem.
- Set up coordinate axes using an appropriate scale and label the axes.
- Graph equations on coordinate axes with appropriate labels and scales.

A.CED.3 Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable in a modeling context. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.*

Learning Targets

I can:

Content Elaborations

Mathematically proficient students:

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- Determine the best models for the real-world problem.
- Write the system of equations and/or inequalities that best models the problem.
- Graph the system on coordinate axes with appropriate labels and scales.
- Interpret solutions in the context of the situation modeled and decide if they are reasonable.

A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law $V = IR$ to highlight resistance R.*

Learning Targets

I can:

- Solve formula for a specified variable.

their mathematical knowledge in a range of situations, whether their continued study leads them toward college or career readiness.

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F-BF.3 Students should understand the effects of parameter changes and be able to apply them to create a rule modeling the function.

Content Vocabulary

- linear
- quadratic
- rational
- exponential
- coordinate axes
- scale
- labels
- constraints
- systems of equations and inequalities

Academic Vocabulary

- constraints

Formative Assessments

- performance tasks
- pretests
- quizzes
- interviews

Summative Assessments

- MVP assessments
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Resources

- Mathematics Vision Project
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Enrichment Strategies

Integrations

- Modeling projects

Intervention Strategies

Mathematics III

Conceptual Category *Algebra*

Domain *Reasoning with Equations and Inequalities*

Cluster ***Understand solving equations as a process of reasoning and explain the reasoning***

Pacing

Quarter 2

Standards

A.REI.2 Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.

Learning Targets

I can:

- Define extraneous solution.
- Solve a rational equation in one variable.
- Determine which numbers cannot be solutions of a rational equation and explain why they cannot be solutions.
- Generate examples of rational equations with extraneous solutions.
- Solve a radical equation in one variable.
- Determine which numbers cannot be solutions of a radical equation and explain why they cannot be solutions.
- Generate examples of radical equations with extraneous solutions.

Content Elaborations

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Content Vocabulary • rational equation • radical equation • extraneous solution	**Academic Vocabulary**
Formative Assessments • performance tasks • pretests • quizzes • interviews	**Summative Assessments** • MVP assessments • Teacher created assessments • PARCC
Resources • Mathematics Vision Project • Pearson Mathematics III • UCSMP • Ohio Model Curriculum	**Enrichment Strategies**
Integrations • Modeling projects	**Intervention Strategies**

Mathematics III

Conceptual Category *Algebra*

Domain *Reasoning with Equations and Inequalities*

Cluster *Represent and solve equations and inequalities graphically*

Pacing

Quarter 2

Standards

A.REI.11 Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.

Learning Targets

I can:

- Explain that a point of intersection on the graph of a system of equations, $y = f(x)$ and $y = g(x)$, represents a solution to both equations.
- Infer that since $y = f(x)$ and $y = g(x)$, $f(x) = g(x)$ by the substitution property.
- Infer that the x-coordinate of the points of intersection for $y = f(x)$ and $y = g(x)$ are also solutions for $f(x) = g(x)$.
- Use a graphing calculator to determine the approximate solutions to a system of equations, $f(x)$ and $g(x)$.

Content Elaborations

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Content Vocabulary • x-coordinate • intersection • solution • linear function • polynomial function • rational function • absolute value function • exponential function • logarithmic function • system of equations • substitution property • sum of cubes • difference of cubes	**Academic Vocabulary**
Formative Assessments • performance tasks • pretests • quizzes • interviews	**Summative Assessments** • MVP assessments • Teacher created assessments • PARCC
Resources • Mathematics Vision Project • Pearson Mathematics III • UCSMP • Ohio Model Curriculum	**Enrichment Strategies**

Mathematics III

Integrations	Intervention Strategies
• Modeling projects	

Mathematics III

Conceptual Category ***Algebra***

Domain ***Seeing Structures in Expressions***

Cluster ***Interpret the structure of expressions***

Pacing

Quarter 1

Standards

A.SSE.1 Interpret expressions that represent a quantity in terms of its context.

a. Interpret parts of an expression, such as terms, factors, and coefficients.

b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret* $P(1+r)n$ *as the product of* P *and a factor not depending on* P.

Learning Targets

I can:

- Define expression, term, factor, and coefficient.
- Interpret the real-world meaning of the terms, factors, coefficients of an expression in terms of their units.
- Group the parts of an expression differently in order to better interpret their meaning.

A.SSE.2 Use the structure of an expression to identify ways to rewrite it. *For example, see* $x4 - y4$ *as* $(x2)2 - (y2)2$*, thus recognizing it as a difference of squares that can be factored as* $(x2 - y2)(x2 + y2)$.

Learning Targets

I can:

- Look for and identify clues in the structure of expressions in order to rewrite it another way.
- Explain why equivalent expressions are equivalent.
- Apply models for factoring and multiplying polynomials to rewrite expressions.

Content Elaborations

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Content Vocabulary • expression • term • factor • coefficient • equivalent • equivalent expression • polynomial • greatest common factor • perfect square trinomial • difference of two squares • nth root • principal root • radicand • index • rationalization • like radicals • rational exponent	**Academic Vocabulary**
Formative Assessments • performance tasks • pretests • quizzes • interviews	**Summative Assessments** • MVP assessments • Teacher created assessments • PARCC
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Mathematics III

• UCSMP • Ohio Model Curriculum	
Integrations • Modeling projects	**Intervention Strategies**

Mathematics III

Conceptual Category ***Algebra***

Domain ***Seeing Structures in Expressions***

Cluster ***Write expressions in equivalent forms to solve problems***

Pacing

Quarter 1

Standards

A.SSE.4 Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems. *For example, calculate mortgage payments.*

Learning Targets

I can:

- Look for and identify clues in the structure of expressions in order to rewrite it another way.
- Explain why equivalent expressions are equivalent.
- Apply models for factoring and multiplying polynomials to rewrite expressions.
- Apply models for factoring and multiplying polynomials to rewrite expressions.
- Define a geometric series and common ratio.
- Derive the formula for the sum of a finite geometric series.
- Express the sum of a finite geometric series.
- Calculate the sum of a finite geometric series.
- Recognize real-world scenarios that are modeled by geometric sequences.
- Use the formula for the sum of a finite geometric series to solve real-world problems.

Content Elaborations

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Mathematics III

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Content Vocabulary • finite geometric series • geometric sequence	**Academic Vocabulary** • derive
Formative Assessments • performance tasks • pretests • quizzes • interviews	**Summative Assessments** • MVP assessments • Teacher created assessments • PARCC
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Mathematics III

Conceptual Category ***Functions***

Domain ***Building Functions***

Cluster ***Build a function that models a relationship between two quantities***

Pacing

Quarter 2

Standards

F.BF.1(b) Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential and relate these functions to the model.*

Learning Targets

I can:

- Recall the parent functions.
- Apply transformations to equations of parent functions.
- Combine different parent functions (adding, subtracting, multiplying, and/or dividing) to write a function that describes a real-world problem.

Content Elaborations

Mathematically proficient students:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Examples of Key Advances from Mathematics II

- Students begin to see polynomials as a system that has mathematical coherence, not just as a set of expressions of a specific type. An analogy to the integers can be made (including operations, factoring, etc.). Subsequently, polynomials can be extended to rational expressions, analogous to the rational numbers.
- The understandings that students have developed with linear, exponential and quadratic functions are extended to considering a much broader range of classes of functions.
- In statistics, students begin to look at the role of randomization in statistical design.

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Content Vocabulary • quantity • function • parent function • transformation • composition of functions	**Academic Vocabulary**
Formative Assessments • performance tasks • pretests • quizzes • interviews	**Summative Assessments** • MVP assessments • Teacher created assessments • PARCC
Resources • Mathematics Vision Project • Pearson Mathematics III • UCSMP • Ohio Model Curriculum	**Enrichment Strategies**

Mathematics III

Integrations	Intervention Strategies
• Modeling projects	

Mathematics III

Conceptual Category *Functions*

Domain *Building Functions*

Cluster *Build new functions from existing functions*

Pacing

Quarter 2

Standards

F.BF.3 Identify the effect on the graph of replacing $f(x)$ by $(x)+k$, $k\,f(x)$, $f(kx)$, and $f(x+k)$ for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Learning Targets

I can:

- Explain why $f(x)+k$ translates the original graph of $f(x)$ up k units and why $f(x)-k$ translates the original graph of $f(x)$ down k units.
- Explain why $f(x+k)$ translates the original graph of $f(x)$ left k units and why $f(x-k)$ translates the original graph of $f(x)$ right k units.
- Explain why $kf(x)$ vertically stretches or shrinks the graph of $f(x)$ by a factor of k and predict whether a given value of k will cause a stretch or a shrink.
- Explain why $f(kx)$ horizontally stretches or shrinks the graph of $f(x)$ by a factor of $1/k$ and predict whether a given value of k will cause a stretch or a shrink.
- Describe the transformation that changed a graph of $f(x)$ into a different graph when given pictures of the pre-image and image.
- Determine the value of k given the graph of a transformed function.
- Graph the listed transformations when given a graph of $f(x)$ and a value of k $(f(x)\pm k, f(x\pm k), kf(x)$, and $f(kx)$.
- Use a graphing calculator to generate examples of functions with different k values.
- Analyze the similarities and differences between functions with different k values.
- Recognize from a graph if the function is even or odd.
- Explain that a function is even when $f(-x)=f(x)$ and its graph has

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y-axis symmetry.
- Explain that a function is odd when $f(-x) = f(x)$ and its graph has 180° rotational symmetry.

F.BF.4 Find inverse functions. Solve an equation of the form $f(x) = c$ for a simple function f that has an inverse and write an expression for the inverse. *For example, $f(x) = 2x3$ for $x > 0$ or $f(x) = (x + 1)/(x - 1)$ for $x \neq 1$.*

Learning Targets

I can:
- Define the inverse of a function.
- Write the inverse of a function by solving $f(x) = c$ for x.
- Explain that after solving $f(x) = c$ for x, c can be considered the input and x can be considered the output.
- Write the inverse of a function in standard notation by replacing the x in my inverse equation with y and replacing the c in my inverse equation with an x.

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F-BF.3 Students should understand the effects of parameter changes and be able to apply them to create a rule modeling the function.

Content Vocabulary
- inverse
- function
- composition of functions
- horizontal line test
- domain
- invertible
- one-to-one function

Academic Vocabulary

Formative Assessments
- performance tasks
- pretests
- quizzes
- interviews

Summative Assessments
- MVP assessments
- Teacher created assessments
- PARCC

Resources
- Mathematics Vision Project
- Pearson Mathematics III
- UCSMP
- Ohio Model Curriculum

Enrichment Strategies

Mathematics III

Integrations	Intervention Strategies
• Modeling projects	

Mathematics III

Conceptual Category ***Functions***

Domain ***Interpreting Functions***

Cluster ***Interpret functions that arise in applications in terms of a context***

Pacing

Quarter 2

Standards

F.IF.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.

Learning Targets

I can:

- Distinguish rational and radical equations based on equations, tables, and verbal descriptions.
- Identify key features such as intercepts; intervals where the function is increasing, decreasing, positive, or negative.
- Use key features of a rational, square root, cube root, polynomial, logarithmic, and trigonometric function to sketch a graph.
- Interpret key features in terms of context.

F.IF.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function $h(n)$ gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*

Learning Targets

I can:

- Identify appropriate values for the domain of a function based on context.
- Identify the domain of a function from the graph. $(K, S\ (n))$ gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the

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function.

F.IF.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.

Learning Targets

I can:

- Calculate the rate of change over a given interval for rational, square root, cube root, polynomial, logarithmic, and trigonometric functions within a context.
- Calculate the rate of change when presented as an equation or table.
- Estimate the rate of change from a graph.

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Content Vocabulary

- asymptote
- removable
- discontinuity
- increasing
- decreasing
- interval
- intercept
- maximum
- minimum
- symmetry
- end behavior
- rational
- discrete
- domain range
- function
- independent variable
- dependent variable
- discrete
- continuous
- average rate of change
- secant line
- delta

Academic Vocabulary

- periodicity

Formative Assessments

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Mathematics III

Resources	Enrichment Strategies
• Mathematics Vision Project • Pearson Mathematics III • UCSMP • Ohio Model Curriculum	
Integrations • Modeling projects	**Intervention Strategies**

Mathematics III

Conceptual Category ***Functions***

Domain ***Interpreting Functions***

Cluster ***Analyze functions using different representations***

Pacing

Quarters 2 and 3

Standards

F.IF.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.

e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.

Learning Targets

I can:

- Graph functions stated in F.IF.7 (b) and (e) by hand, given an equation.
- Use technology to graph functions stated in F.IF.7 (b) and (e) for more complicated cases.
- Find and interpret key features of functions stated in F.IF.7 (b) and (e).

F.IF.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.

a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

b. Use the properties of exponents to interpret expressions for exponential functions. *For example, identify percent rate of change in functions such as* $y = (1.02)5$, $y = (0.97)5$, $y = (1.01)12t$, $y = (1.2)t/10$, *and classify them as representing exponential growth or decay.*

Learning Targets

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I can:

- Write an equivalent form of a function defined by an expression for functions given in F.IF.7 (b) and (e) as well as simple rational functions.
- Identify zeros, transformations, points of discontinuity and asymptotes when suitable factorizations are available.
- Use properties of logarithms to write equivalent forms.
- Transition between equivalent forms to identify desired key features.

F.IF.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.*

Learning Targets

I can:

- Compare properties of two functions, where one is represented algebraically, graphically, numerically, in tables, or by verbal descriptions and the other is modeled using a different representation. (R)

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Content Vocabulary

- square root, zeros, extreme value
- intercept
- asymptote
- end behavior
- average rate of change
- intervals of increase or decrease
- discontinuity
- domain
- range
- period
- midline
- amplitude
- frequency
- transformation
- point of discontinuity
- asymptote (vertical, horizontal, oblique)

Academic Vocabulary

Mathematics III

• maximum • minimum • end behavior, cube root • piecewise • logarithmic • step function • absolute value • discrete • continuous • discontinuous • axis of symmetry	
Formative Assessments • performance tasks • pretests • quizzes • interviews	**Summative Assessments** • MVP assessments • Teacher created assessments • PARCC
Resources • Mathematics Vision Project • Pearson Mathematics III • UCSMP • Ohio Model Curriculum	**Enrichment Strategies**
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Mathematics III

Conceptual Category ***Functions***	
Domain ***Linear, Quadratic, and Exponential Models***	
Cluster ***Construct and compare linear, quadratic, and exponential models and solve problems***	**Pacing** **Quarter 3**

Standards

F.LE.4 For exponential models, express as a logarithm the solution to $abct = d$ where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.

Learning Targets

I can:

- Define exponential function and logarithmic function.
- Write an exponential equation $a \cdot b^{ct} = d$ in logarithmic form $\log_b(d/a) = ct$ and solve it for t.
- Explain using the properties of exponentials and logarithms why $a \cdot b^{ct} = d$ and $\log_b(d/a) = ct$ are equivalent.
- Use powers of 2 or 10 to estimate the value of $\log_2(x)$ or $\log_{10}(x)$.
- Use a calculator to evaluate a logarithm with a base of 10 or e.
- Apply the change of base formula to evaluate the logarithm with a base of 2 using a calculator.

Content Elaborations

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Content Vocabulary • exponential function • logarithmic function • logarithmic form • base • change of base	**Academic Vocabulary** • evaluate
Formative Assessments • performance tasks • pretests • quizzes • interviews	**Summative Assessments** • MVP assessments • Teacher created assessments • PARCC
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Mathematics III

Integrations	Intervention Strategies
• Modeling projects	

Mathematics III

Conceptual Category *Functions*

Domain *Trigonometric Functions*

Cluster *Extend the domain of trigonometric functions using the unit circle*

Pacing

Quarter 3

Standards

F.TF.1 Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle.

Learning Targets

I can:

- Define unit circle, central angle, and intercepted arc.
- Define the radian measure of an angle.

F.TF.2 Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.

Learning Targets

I can:

- Define a radian and unit circle.
- Identify the cosine and sine of an angle when given a graph of the unit circle with the coordinates labeled.
- Explain why the unit circle definitions of cosine and sine allow for negative values.
- Define and identify co-terminal angles when given a radian measure.

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Content Vocabulary • radian • central angle • intercepted arch • length • unit circle • co-terminal angle • trigonometric function	**Academic Vocabulary**
Formative Assessments • performance tasks • pretests • quizzes • interviews	**Summative Assessments** • MVP assessments • Teacher created assessments • PARCC
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Mathematics III

Integrations	Intervention Strategies
• Modeling projects	

Mathematics III

Conceptual Category ***Functions***

Domain ***Trigonometric Functions***

Cluster ***Model periodic phenomena with trigonometric functions***

Pacing

Quarter 3

Standards

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

Learning Targets

I can:

- Define amplitude, frequency, and midline of a trigonometric function.
- Explain the connection between frequency and period.
- Recognize real-world situations that can be modeled with a periodic function by finding critical information.
- Write function notation for the trigonometric function that models a problem situation.

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Mathematics III

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Content Vocabulary • amplitude • frequency • midline • trigonometric function • periodic function	**Academic Vocabulary**
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Mathematics III

Conceptual Category *Geometry*

Domain *Geometric Measurement and Dimension*

Cluster ***Visualize the relation between two-dimensional and three-dimensional objects***

Pacing

Quarter 4

Standards

G.GMD.4 Identify the shapes of two-dimensional cross-sections of three-dimensional objects, and identify three-dimensional objects generated by rotations of two-dimensional objects.

Learning Targets

I can:

- Identify the two-dimensional shapes created from the cross-sections of three-dimensional objects.
- Rotate two-dimensional objects and identify the three-dimensional objects created by the rotation.

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Content Vocabulary • cross-section • rotation	**Academic Vocabulary**
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Mathematics III

Conceptual Category *Geometry*

Domain *Modeling with Geometry*

Cluster *Apply geometric concepts in modeling situations*

Pacing

Quarter 4

Standards

G.MG.1 Use geometric shapes, their measures, and their properties to describe objects (e.g., modeling a tree trunk or a human torso as a cylinder).

Learning Targets

I can:

- Use geometric shapes to deconstruct objects or situations.
- Use cross-sections (G.GMD.4) to deconstruct three-dimensional objects.
- Use measures of appropriate two- and three-dimensional shapes to estimate the measures of complex objects taking into account any overlap that may occur.

G.MG.2 Apply concepts of density based on area and volume in modeling situations (e.g., persons per square mile, BTUs per cubic foot).

Learning Targets

I can:

- Understand density as a ratio.
- Differentiate between area and volume densities, their units, and situations in which they are appropriate (i.e., area, density is ideal for measuring population density spread out over land, and the concentration of oxygen in their air is best measured with volume density).

G.MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

Learning Targets

I can:

- Construct and deconstruct complex 3-dimensional shapes (G.MG.1).

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• Find appropriate measures of complex 2- and 3-dimensional shapes (G.MG.1).	their mathematical knowledge in a range of situations, whether their continued study leads them toward college or career readiness. **M** Seeing mathematics as a tool to model real-world situations should be an underlying perspective in everything students do, including writing algebraic expressions, creating functions, creating geometric models, and understanding statistical relationships. This perspective will help students appreciate the importance of mathematics as they continue their study of it. **N-Q** In particular, students should recognize that much of mathematics is concerned with understanding quantities and their relationships. They should pick appropriate units for quantities being modeled, using them as a guide to understand a situation, and be attentive to the level of accuracy that is reported in a solution. **F-BF.3** Students should understand the effects of parameter changes and be able to apply them to create a rule modeling the function.
Content Vocabulary • area • volume • surface area • perimeter • circumference • circle • rectangle • triangle • cylinder • cone • sphere • pyramid • prism, density, maximize • minimize • optimize • constraints	**Academic Vocabulary**
Formative Assessments • performance tasks • pretests • quizzes • interviews	**Summative Assessments** • MVP assessments • Teacher created assessments • PARCC
Resources • Mathematics Vision Project • Pearson Mathematics III	**Enrichment Strategies**

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Integrations • Modeling projects	**Intervention Strategies**

Mathematics III

Conceptual Category ***Statistics and Probability***

Domain ***Making Inferences and Justifying Conclusions***

Cluster ***Understand and evaluate random processes underlying statistical experiments***

Pacing

Quarter 2

Standards

S.IC.1 Understand statistics as a process for making inferences about population parameters based on a random sample from that population.

Learning Targets

I can:

- Explain that statistics is a process for making inferences about population parameters or characteristics.
- Explain that statistical inferences about population characteristics are based on random samples from that population.

S.IC.2 Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?*

Learning Targets

I can:

- Use various specified data generating processes/models.
- Recognize data that various models produce.
- Identify data or discrepancies that provide the basis for rejecting a statistical model.
- Decide if a specified model is consistent with results from a given data generating process.

Content Elaborations

Mathematically proficient students:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Examples of Key Advances from Mathematics II

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Content Vocabulary • inference • population parameter • random sample • population • statistics theoretical probability • experimental probability • simulation • model • event	**Academic Vocabulary** • parameters
Formative Assessments • performance tasks • pretests • quizzes • interviews	**Summative Assessments** • MVP assessments • Teacher created assessments • PARCC

Mathematics III

Resources	Enrichment Strategies
• Mathematics Vision Project • Pearson Mathematics III • UCSMP • Ohio Model Curriculum	
Integrations	**Intervention Strategies**
• Modeling projects	

Mathematics III

Conceptual Category ***Statistics and Probability***

Domain ***Making Inferences and Justifying Conclusions***

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

Pacing

Quarter 2

Standards

S.IC.3 Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

Learning Targets

I can:

- Recognize the purpose of surveys, experiments, and observational studies in making statistical inferences and justifying conclusions.
- Explain how randomization relates to each of these methods of data collection.
- Recognize the differences among surveys, experiments, and observational studies in making statistical inferences and justifying conclusions.

S.IC.4 Use data from a sample survey to estimate a population mean or proportion; develop a margin of error through the use of simulation models for random sampling.

Learning Targets

I can:

- Define margin of error.
- Explain the connection of margin of error to variation within a data set or population.
- Use a simulation model to generate data for random sampling, assuming certain population parameters or characteristics.
- Use data from a sample survey to estimate a population mean or proportion.
- Interpret the data generated by a simulation model for random sampling in terms of the context of simulation models.

Content Elaborations

Mathematically proficient students:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics
5. Use appropriate tools strategically.
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- Develop a margin of error, assuming certain population parameters or characteristics, through the use of simulation models for random sampling.

S.IC.5 Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant.

Learning Targets

I can:

- Determine if the difference between two parameters is significant, using an established level of significance.
- Use data from a randomized experiment to compare two treatments.
- Choose appropriate methods to simulate a randomized experiment.
- Establish a reasonable level of significance.

S.IC.6 Evaluate reports based on data.

Learning Targets

I can:

- Define the characteristics of experimental design via control, randomization, and replication.
- Evaluate experimental study design, how data was gathered, and what analysis (numerical or graphical) was used.
- Draw conclusions based on graphical and numerical summaries.
- Write or present a summary of a data-based report addressing the sampling techniques used, inferences made, and any flaws or biases.

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F-BF.3 Students should understand the effects of parameter changes and be able to apply them to create a rule modeling the function.

Content Vocabulary

- sample
- survey
- experiment
- observational study
- randomization
- population mean
- sample mean
- population proportion
- mean
- treatment
- simulation
- standard deviation
- histogram
- extreme
- parameters
- significant

Academic Vocabulary

• sample proportion • sample survey • margin of error • simulation model • random sampling • confidence interval • report • variables • quantitative • categorical • bias • inferences	
Formative Assessments • performance tasks • pretests • quizzes • interviews	**Summative Assessments** • MVP assessments • Teacher created assessments • PARCC
Resources • Mathematics Vision Project • Pearson Mathematics III • UCSMP • Ohio Model Curriculum	**Enrichment Strategies**
Integrations • Modeling projects	**Intervention Strategies**

Mathematics III

Conceptual Category ***Statistics and Probability***	
Domain ***Interpreting Categorical and Quantitative Data***	
Cluster ***Summarize, represent, and interpret data on a single count or measurement variable***	**Pacing** **Quarter 2**
Standards **S.ID.4 Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages. Recognize that there are data sets for which such a procedure is not appropriate. Use calculators, spreadsheets, and tables to estimate areas under the normal curve.** **Learning Targets** **I can:** • Describe the characteristics of a normal distribution. • Use a calculator, spreadsheet, and table to estimate areas under the normal curve. • Use the mean and standard deviation of a data set to fit it to a normal distribution. • Use a normal distribution to estimate population percentages. • Recognize that there are data sets for which such a procedure is not appropriate.	**Content Elaborations** ***Mathematically proficient students:*** 1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning. **Examples of Key Advances from Mathematics II** • Students begin to see polynomials as a system that has mathematical coherence, not just as a set of expressions of a specific type. An analogy to the integers can be made (including operations, factoring, etc.). Subsequently, polynomials can be extended to rational expressions, analogous to the rational numbers. • The understandings that students have developed with linear, exponential and quadratic functions are extended to considering a much broader range of classes of functions. • In statistics, students begin to look at the role of randomization in statistical design. **Fluency Recommendations** **A/F** Students should look at algebraic manipulation as a meaningful enterprise, in which they seek to understand the structure of an expression or equation and use properties to transform it into forms that provide useful information (e.g., features of a function or solutions to an

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Content Vocabulary • mean • standard deviation • data set • Z-score • normal distribution • 68-95-99 rule • percent • population • univariate • symmetric • distribution • normal curve	**Academic Vocabulary**
Formative Assessments • performance tasks • pretests • quizzes • interviews	**Summative Assessments** • MVP assessments • Teacher created assessments • PARCC
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Mathematics III

Integrations	Intervention Strategies
• Modeling projects	

Mathematics III

Conceptual Category *Algebra*

Domain *Arithmetic with Polynomials and Rational Expressions*

Cluster *Use polynomial identities to solve problems*

Pacing

Quarter 1

Standards

A.APR.5 (+) Know and apply the Binomial Theorem for the expansion of $(x + y)n$ in powers of x and y for a positive integer n, where x and y are any numbers, with coefficients determined for example by Pascal's Triangle.

Learning Targets

I can:

- Apply the combination formula $n\ C\ k$, to n items taken k at a time.
- Write the binomial expansion of $(a + b)^n$ by applying the Binomial Theorem.
- Generate Pascal's Triangle to find the coefficients of a binomial expansion.

Content Elaborations

Mathematically proficient students:

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Mathematics III

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Content Vocabulary • Binomial Theorem • binomial expansion • Pascal's Triangle • combinations • coefficient	**Academic Vocabulary** • expansion
Formative Assessments • performance tasks • pretests • quizzes • interviews	**Summative Assessments** • MVP assessments • Teacher created assessments • PARCC
Resources • Mathematics Vision Project • Pearson Mathematics III • UCSMP • Ohio Model Curriculum	**Enrichment Strategies**
Integrations • Modeling projects	**Intervention Strategies**

Mathematics III

Conceptual Category *Algebra*

Domain *Arithmetic with Polynomials and Rational Expressions*

Cluster *Rewrite rational expressions*

Pacing

Quarter 1

Standards

A.APR.7 (+) Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.

Learning Targets

I can:

- Apply the definition of a rational number to explain why adding, subtracting, multiplying, or dividing two rational numbers always produce a rational number.
- Apply the definition of a rational expression to explain why adding, subtracting, multiplying, or dividing two rational expressions always produce a rational expression.
- Add and subtract rational expressions.
- Multiply and divide rational expressions.

Content Elaborations

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Content Vocabulary • closure property • rational numbers • rational expression • complex fraction	**Academic Vocabulary** • analogous
Formative Assessments • performance tasks • pretests • quizzes • interviews	**Summative Assessments** • MVP assessments • Teacher created assessments • PARCC
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Mathematics III

Conceptual Category ***Number and Quantity***

Domain ***The Complex Number System***

Cluster ***Use complex numbers in polynomial identities and equations***

Pacing

Quarter 1

Standards

N.CN.8 (+) Extend polynomial identities to the complex numbers. *For example, rewrite* $x2 + 4$ *as* $(x + 2i)(x - 2i)$.

Learning Targets

I can:

- Write the factors of polynomials using complex numbers.
- Use complex numbers to rewrite a sum of squares, $a\text{^}2 + b\text{^}2$ as the product of a complex number and its conjugate.
- Show that factored quadratics have real coefficients when written in standard form.

N.CN.9 (+) Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.

Learning Targets

I can:

- Explain the Fundamental Theorem of Algebra in my own words by using simple polynomials and their graphs.
- Use the Linear Factorization Theorem to demonstrate that a quadratic polynomial, $f(x) = a_2(x - c_1)(x - c_2)$, has two linear factors under the set of complex numbers.
- Solve a quadratic equation in factored form for its zeros even if the zeros are complex.

Content Elaborations

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Content Vocabulary • complex number • polynomial • real number • factor • sum of squares • Fundamental Theorem of Algebra • Linear Factorization Theorem • quadratic • linear	**Academic Vocabulary**
Formative Assessments • performance tasks • pretests • quizzes • interviews	**Summative Assessments** • MVP assessments • Teacher created assessments • PARCC
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Mathematics III

Conceptual Category *Geometry*

Domain *Similarity, Right Triangles, and Trigonometry*

Cluster *Apply trigonometry to general triangles*

Pacing

Quarter 3

Standards

G.SRT.9 (+) Derive the formula $A = 1/2\ ab\ sin(C)$ for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.

Learning Targets

I can:

- Calculate the area of a triangle given two sides and the included angle. (SAS).

G.SRT.10 (+) Prove the Laws of Sines and Cosines and use them to solve problems.

Learning Targets

I can:

- Use trigonometry to find side lengths and angles of triangles.
- Derive the Laws of Sines and Cosines.
- Apply the Laws of Sines and Cosines to solve word problems.

G.SRT.11 (+) Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).

Learning Targets

I can:

- Determine when to use the Law of Sines (ASA, AAS, SSA) or the Law of Cosines (SAS, SSS).
- Apply the Laws of Sines and Cosines to solve problems.

Content Elaborations

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Content Vocabulary • vertex • perpendicular • altitude • Laws of Sines and Cosines • right triangle • Pythagorean Theorem • triangle inequality • ASA • AAS • SSA • SAS • SSS • Law of Cosines • Law of Sines	**Academic Vocabulary** • resultant
Formative Assessments • performance tasks • pretests • quizzes • interviews	**Summative Assessments** • MVP assessments • Teacher created assessments • PARCC
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Integrations	Intervention Strategies
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Mathematics III

Conceptual Category ***Statistics and Probability***

Domain ***Using Probability to Make Decisions***

Cluster ***Use probability to evaluate outcomes of decisions***

Pacing

Quarter 2

Standards

S.MD.6 (+) Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).

Learning Targets

I can:

- Compute theoretical and experimental probabilities.
- Recall previous understandings of probability.
- Use probabilities to make fair decisions.

S.MD.7 (+) Analyze decisions and strategies, using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).

Learning Targets

I can:

- Recall previous understandings of probability.
- Analyze decisions and strategies using probability concepts.
- Analyze the available strategies, recommend a strategy, and defend my choice.

Content Elaborations

Mathematically proficient students:

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Content Vocabulary • sample space • probability • event • simulation • fair	**Academic Vocabulary**
Formative Assessments • performance tasks • pretests • quizzes • interviews	**Summative Assessments** • MVP assessments • Teacher created assessments • PARCC
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