Orange Public Schools

Office of Curriculum & Instruction

2020-2021 Mathematics Curriculum Guide

Applying Functions & Modelling

Unit 4: Polynomial Functions

April 10, 2021 – June 22, 2021

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Curriculum Map

A STORY OF UNITS (Yearlong Pacing Guide)				
Marking Period	MP 1 (9/9/20 – 11/13/20)	MP 2 (11/14/20- 1/30/21)	MP 3 (1/31/21-4/9/21)	MP 4 (4/10/21-6/22/21)
Unit Topic	Number systems & Linear Equation	Quadratic Relationships and solving quadratic equations	Exponential functions	Polynomial functions
Description	Create linear equations & inequalities to model situations given and solve related problems *Create systems of equations/inequalities to model real-life situations and solve problems; Identify types of functions with tables and graphs*	Identify quadratic functions; find key features for the graphs. Solve quadratic equations by using tables, and graphing and solving algebraically Interpret, write, and solve quadratic equations	Understand properties of exponents, create exponential functions, solve exponential functions	Solve polynomial functions, work on the operations of complex numbers, compare growth rates of different of functions

Unit Overview

Unit 4: Polynomial Functions

Overview

This course uses Mathematic Visions Project (MVP) as its primary resource. Unit 4 will focus on Module 3 Secondary Mathematics II and Module 3 from Secondary Mathematics III which can be accessed in our Dropbox or at the following URL:

- https://www.mathematicsvisionproject.org/secondary-mathematics-i.html

This course is designed to provide seniors with a problem-based math course that utilizes skills and concepts that will prepare them for college and/or careers. This unit will address the following topics that are part of the Essex County College MTH 100 Introductory College Mathematics course:

- Solve quadratic functions with non-real roots
- Work with the complex number system
- Solve polynomial functions

All dates (pacing calendar, assessments, due dates) are general recommendations based on this course meeting during an A-day. Dates and pacing may be adjusted slightly using teacher discretion, however all standards must be covered and all assessments must be given within the marking period.

The unit authentic assessment is a key component to this course. It applies skills and concepts taught in this unit to real world problems. Students will be expected to conduct their own research, do the majority of the work outside of class, put forth substantial effort, and submit each phase by the due date. Prior to introducing the project, teachers are required to complete the project themselves in order to gain a better understanding of the requirements and provide an exemplar for students when necessary.

Essential Questions

- What are exponents?
- What is the connection between exponents and radicals?
- What are the properties of exponents and how are they used?
- What is the quadratic formula and how is it used to solve quadratic equations?
- What are complex numbers?
- What is a polynomial function?
- What is the end behavior of a polynomial function?
- What is the Fundamental Theorem of Algebra and how is it applied?
- What is the Remainder Theorem and how is it applied?

Enduring Understandings

- Patterns can be used to represent functions, most commonly linear, quadratic, and exponential functions. Each function creates a different type of pattern that can be used to identify the type of function.
- There are multiple ways to solve for the roots of a polynomial functions; factoring, graphing, completing the square, quadratic formula, and division of polynomials
- Polynomial functions can have real and non-real roots
- The Fundamental Theorem of Algebra is used to identify the number of roots a polynomial has
- The remainder theorem is used to identify roots of a functions using long division of polynomials

Common Core State Standards

Number and Quantities – The Real Number System

1) N.RN.1: Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.*
2) N.RN.2: Rewrite expressions involving radicals and rational exponents using the properties of exponents.
3) N.RN.3: Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.

Number and Quantities – The Complex Number System

1) N.CN.1: Know there is a complex number *i* such that $i^2=-1$, and every complex number has the form *a + bi* with *a* and *b* real.
2) N.CN.2: Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.
3) N.CN.7: Solve quadratic equations with real coefficients that have complex solutions.
4) N.CN.8: Extend polynomial identities to the complex numbers. *For example, rewrite $x^2 + 4$ as (x+2i)(x-2i)*
5) N.CN.9: Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.

Algebra – Creating Equations

1) 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.*

Algebra – Seeing Structure in Expressions

1) A.SSE.1: Interpret expressions that represent a quantity in terms of its context.
2) A. SSE.3c: Use the properties of exponents to transform expressions for exponential functions. For example the expression 1.15^t can be rewritten as $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.

Algebra – Arithmetic with Polynomials and Rational expressions

1) 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.
2) 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 an only if (x-a) is a factor of p(x).
3) 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.
4) 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.

Algebra – Reasoning with Equations and Inequalities

1) A.REI.4: Solve quadratic equations in one variable
2) A.REI.7: Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example find the points of intersection between the line y=-3x and the circle $x^2 + y^2 = 3$

Functions – Interpreting Functions

1) 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.*

3) 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.
4) 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.
5) F.IF.8: Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function.
6) 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.

Functions – Building Functions

1) F.BF.1: Write a function that describes a relationship between two quantities.

Functions – Linear, Quadratic, and Exponential Models

2) F.LE.3: Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.

Modifications

Special Education/ 504:	English Language Learners:
-Adhere to all modifications and health concerns stated in each IEP. -Give students a MENU options, allowing students to pick assignments from different levels based on difficulty. -Accommodate Instructional Strategies: reading aloud text, graphic organizers, one-on-one instruction, class website (Google Classroom), handouts, definition list with visuals, extended time -Allow students to demonstrate understanding of a problem by drawing the picture of the answer and then explaining the reasoning orally and/or writing , such as Read-Draw-Write -Provide breaks between tasks, use positive reinforcement, use proximity -Assure students have experiences that are on the Concrete- Pictorial- Abstract spectrum by using manipulatives -Common Core Approach to Differentiate Instruction: Students with Disabilities (pg 17-18) -Strategies for Students with 504 Plans	- Use manipulatives to promote conceptual understanding and enhance vocabulary usage - Provide graphic representations, gestures, drawings, equations, realia, and pictures during all segments of instruction - During ALEKS lessons, click on “Español” to hear specific words in Spanish - Utilize graphic organizers which are concrete, pictorial ways of constructing knowledge and organizing information - Use sentence frames and questioning strategies so that students will explain their thinking/ process of how to solve word problems - Utilize program translations (if available) for L1/ L2 students - Reword questions in simpler language - Make use of the ELL Mathematical Language Routines (click here for additional information) -Scaffolding instruction for ELL Learners -Common Core Approach to Differentiate Instruction: Students with Disabilities (pg 16-17)
Gifted and Talented:	**Students at Risk for Failure:**
- Elevated contextual complexity - Inquiry based or open ended assignments and projects - More time to study concepts with greater depth - Promote the synthesis of concepts and making real world connections - Provide students with enrichment practice that are imbedded in the curriculum such as:	- Assure students have experiences that are on the Concrete- Pictorial- Abstract spectrum - Modify Instructional Strategies, reading aloud text, graphic organizers, one-on-one instruction, class website (Google Classroom), inclusion of more visuals and manipulatives, Field Trips, Google Expeditions, Peer Support, one on one instruction - Assure constant parental/ guardian contact throughout the year with successes/ challenges

● Application / Conceptual Development ● Are you ready for more? - Common Core Approach to Differentiate Instruction: Students with Disabilities (pg. 20) - Provide opportunities for math competitions - Alternative instruction pathways available	- Provide academic contracts to students and guardians - Create an interactive notebook with samples, key vocabulary words, student goals/ objectives. - Always plan to address students at risk in your learning tasks, instructions, and directions. Try to anticipate where the needs will be and then address them prior to lessons. -Common Core Approach to Differentiate Instruction: Students with Disabilities (pg 19)

21st Century Life and Career Skills:

Career Ready Practices describe the career-ready skills that all educators in all content areas should seek to develop in their students. They are practices that have been linked to increase college, career, and life success. Career Ready Practices should be taught and reinforced in all career exploration and preparation programs with increasingly higher levels of complexity and expectation as a student advances through a program of study.

https://www.state.nj.us/education/cccs/2014/career/9.pdf

- **CRP1**. Act as a responsible and contributing citizen and employee.
- **CRP2**. Apply appropriate academic and technical skills.
- **CRP3**. Attend to personal health and financial well-being.
- **CRP4**. Communicate clearly and effectively and with reason.
- **CRP5**. Consider the environmental, social and economic impacts of decisions.
- **CRP6**. Demonstrate creativity and innovation.
- **CRP7**. Employ valid and reliable research strategies.
- **CRP8**. Utilize critical thinking to make sense of problems and persevere in solving them.
- **CRP9**. Model integrity, ethical leadership and effective management.
- **CRP10**. Plan education and career paths aligned to personal goals.
- **CRP11**. Use technology to enhance productivity.
- **CRP12**. Work productively in teams while using cultural global competence.

Students are given an opportunity to communicate with peers effectively, clearly, and with the use of technical language. They are encouraged to reason through experiences that promote critical thinking and emphasize the importance of perseverance. Students are exposed to various mediums of technology, such as digital learning, calculators, and educational websites.

Technology Standards:

All students will be prepared to meet the challenge of a dynamic global society in which they participate, contribute, achieve, and flourish through universal access to people, information, and ideas.

https://www.state.nj.us/education/cccs/2014/tech/

8.1 Educational Technology:

All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.

A. **Technology Operations and Concepts:** Students demonstrate a sound understanding of technology concepts, systems and operations.
B. **Creativity and Innovation:** Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.
C. **Communication and Collaboration:** Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.
D. **Digital Citizenship:** Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.
E. **Research and Information Fluency:** Students apply digital tools to gather, evaluate, and use of information.
F. **Critical thinking, problem solving, and decision making:** Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming:

All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

A. **The Nature of Technology: Creativity and Innovation-** Technology systems impact every aspect of the world in which we live.
B. **Technology and Society:** Knowledge and understanding of human, cultural, and societal values are fundamental when designing technological systems and products in the global society.
C. **Design:** The design process is a systematic approach to solving problems.
D. **Abilities in a Technological World:** The designed world in a product of a design process that provides the means to convert resources into products and systems.
E. **Computational Thinking: Programming-** Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge.

Interdisciplinary Connections:	
English Language Arts:	
ELA.LITERACY.RI-9-10.4	Determine the meaning of words and phrases as they are used in a text, including figurative, connotative, and technical meanings; analyze the cumulative impact of specific word choices on meaning and tone (e.g., how the language of a court opinion differs from that of a newspaper).
NJSLS..ELA-LITERACY.SL.9-10.4	Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.
NJSLS..ELA-LITERACY.W.9-10.2.A	Introduce a topic; organize complex ideas, concepts, and information to make important connections and distinctions; include formatting (e.g., headings), graphics (e.g., figures, tables), and multimedia when useful to aiding comprehension.

Pacing Guide

Overview			
Lesson	Topic	NJSLS	Suggesting Pacing
1	Experimenting with Exponents	N.RN.1	2 days
2	Radicals and Exponents	N.RN.1	2 day
3	Properties of Exponents	N.RN.1, N.RN.2, F.IF.8, A.SSE.3	2 days
4	Converting between exponents and radicals	N.RN.1, N.RN.2	2 days
5	Using the Quadratic Formula	A.REI.4, A.CED.4,	2 day
6	Solving Quadratic Equations	A.REI.4, A.REI.7, A.CED.4	2 days
7	Complex Numbers	A.REI.4, N.CN.7, N.CN.8, N.CR.9	2 days
8	Working with Real and Complex Numbers	N.RN.3 N.CN.1, N.CN.2, N.CN.7, N.CN.8, A.APR.1	4 days
9	Comparing Growth Rates of Different Types of Functions	F.BF.1, F.LE.3, A.SSE.1, F.IF.4,	2 days
10	End Behavior	F.IF.6, F.IF.7, F.IF.9	2 days
11	Arithmetic with Polynomials	A.APR.1, F.BF.1	2 days
12	Applying Fundamental Theorem of Algebra	A.APR.3, A.APR.5, N.CN.8, N.CN.9, F.IF.4, F.IF.7	2 days
13	Using Remainder Theorem	A.APR.2, A.APR.3, N.CN.9 F.IF.7	2 days
14	Polynomial Functions	A.APR.2, A.APR.3, N.CR.9, F.IF.7	2 days

Summary:

30 days on new content (14 lessons/topics)
1 task days
1 review day
2 test days
2 Benchmark day

36 days in Unit 1

Calendar

Please complete the pacing calendar based on the suggested pacing.

April 2021						
Sun	Mon	Tue	Wed	Thu	Fri	Sat

May 2021						
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**

June 2021						
Sun	Mon	Tue	Wed	Thu	Fri	Sat

Assessment Framework

Assessment	Assignment Type	Grading	Source	Estimated in-class time	When?
Diagnostic Assessment *Unit 1 Diagnostic*	Summative Assessment	Traditional	Curriculum created – see Dropbox	1 Period	Beginning of unit
Performance Tasks (Authentic Assessments)	Authentic	Rubric	NJ state portfolio task	1 period each task	
Check Point 1	Formative Assessment	Traditional	Teacher Created	½ - 1 period	As needed
End of Unit Assessment *Unit 1 Assessment*	Summative Assessment	Traditional	Curriculum created – distributed at end of unit	2 Periods	After Module 2
Quizzes	Formative Assessment	Rubric or Traditional	Teacher created	< ½ block	Varies (at least 3 quizzes throughout the Unit)
Exit Ticket	Formative Assessment	Vary	Teacher created	3-5 minutes	Daily

Benchmark Assessment Window: 6/1/21 – 6/14/21

Lesson 1: Experimenting with Exponents

Objectives

- Using multiplicative patterns SWBAT work _____ to identify the pattern and use exponents to represent the pattern for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

- MP 2: Reason abstractly and quantitatively
- MP 7: Look for and make use of structure
- MP 8: Look for and express regularity in repeated reasoning

Vocabulary

- Exponent, radical, exponential equation, multiplicative pattern, rational exponents

Common Misconceptions/struggles

- Difficulties identifying multiplicative patterns
- Miswriting exponents as radical (i.e. $b^{n/1} = \sqrt[n]{b}$)
- Confusion between meanings of additive and multiplicative patterns

NJSLS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
N.RN.1: Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.*	***Review*** • The *structure* of patterns and quantities can be used to create variable expressions • A function can be represent graphically, with a table, or with a function rule (equation) ***New*** • Exponential functions are made up of multiplicative patterns • The definition for rational exponents is $b^{1/n} = \sqrt[n]{b}$	***Review*** • Writing an equation given a pattern • Creating a table from a given pattern • Graphing a function from a table ***New*** • Identify multiplicative patterns • Using exponents to represent multiplicative patterns • Simplify exponents • Convert between exponents and radicals	MVP 2 3.1	2 Periods	3.1 set #5, 14

Lesson Analysis

Lesson 2: Radicals and Exponents

Objectives

- Using geometric patterns SWBAT work _____ to explore the role of positive and negative exponents and the connection that fractional factors have on geometric patterns for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

- MP 2: Reasoning abstractly and quantitatively
- MP 7: Look for and make use of structure

Vocabulary

- Arithmetic mean, geometric mean, rational exponents, integer exponents, radicals

Common Misconceptions/struggles

- Not using properties of exponents correctly while working with exponents
- Difficulty writing equations from given word problems

NJSLS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
N.RN.1: Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.*	***Review*** • Equations can represent real life scenarios • Equations provide ways to algebraically solve real life problems ***New*** • Arithmetic patterns are additive patterns while geometric patterns are multiplicative patterns • Patterns are made up of constant factors that are used to move between whole number values	***Review*** • Writing an equation given a problem scenario • Evaluating functions • Finding solutions to problems using a written equation ***New*** • Simplifying radicals • Using exponents to represent multiplicative patterns • Using arithmetic and geometric means to continue a sequence	MVP 2 3.2	2 Periods	3.2 Set #15 & 18

Lesson 3: Properties of Exponents

Objectives

- Using rational exponents SWBAT work _____ to use properties of exponents to write equivalent exponential expressions for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

- MP 2: Reasoning abstractly and quantitatively
- MP 7: Look for and make use of structure
- MP 9: Look for and express regularity in repeated reasoning

Vocabulary

- Rational exponents, exponential expressions, rules of exponents

Common Misconceptions/struggles

- Not using properties of exponents correctly while working with exponents
- Difficulty writing equations from given word problems
- Miswriting exponents as radical (i.e. $b^{n/1} = \sqrt[n]{b}$)

NJSLS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
N.RN.1: Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.* N.RN.2: Rewrite expressions involving radicals and rational exponents using the properties of exponents. F.IF.8: Write a function defined by an expression in different but equivalent forms to	***Review*** • Exponential functions are made up of multiplicative patterns • The definition for rational exponents is $b^{1/n} = \sqrt[n]{b}$ • Properties of exponents include rules on how to add, subtract, multiply, and divide exponents ***New*** • Exponential expressions can often be written with multiple equivalent versions using properties of exponents	***Review*** • Identify rational exponents • Identify rules of exponents ***New*** • Use properties of exponents to write equivalent forms of exponential equations • Simplify exponential equations	MVP 2 3.3	2 Periods	3.3 set #11 & 17

reveal and explain different properties of the function. A. SSE.3c: Use the properties of exponents to transform expressions for exponential functions. For example the expression 1.15^t can be rewritten as $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.					

Lesson 4: Converting Between Exponents and Radicals

Objectives

- Using properties of exponents SWBAT work _____ to convert between exponents and radicals and solve equations with rational exponents for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

- MP 2: Reasoning abstractly and quantitatively
- MP 4: Model with mathematics
- MP 7: Look for and make use of structure

Vocabulary

- Radicals, rational exponents, factored form, x-intercepts, y-intercepts

Common Misconceptions/struggles

- Miswriting exponents as radical (i.e. $b^{n/1} = \sqrt[n]{b}$)
- Not isolating the exponential expression first when solving for equations with exponents

NJSLS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
N.RN.1: Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define $5^{1/3}$ to be the cube root of 5 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5.* N.RN.2: Rewrite expressions involving radicals and rational exponents using the properties of exponents.	***Review*** • The definition for rational exponents is $b^{1/n} = \sqrt[n]{b}$ • Properties of exponents include rules on how to add, subtract, multiply, and divide exponents ***New*** • Exponential expressions can often be written with multiple equivalent versions using properties of exponents • When solving equations with exponents perform order of operations backwards and use the definition of rational exponents to get the variable by itself	***Review*** • Writing a quadratic equation in factored form • Converting between exponent and radical form • Identifying and using properties of exponents • Simplifying exponential expressions ***New*** • Convert between exponential and radical expressions • Solve exponential equations using properties of exponents	MVP 2 3.4	2 Periods	3.4 Set #20 & 22

Lesson 5: Using the Quadratic Formula

Objectives

- Using the quadratic formula SWBAT work _____ to solve quadratic functions for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 2: Reason abstractly and quantitatively
- MP 4: Model with Mathematics

Vocabulary

- Quadratic formula, quadratic functions

Common Misconceptions/struggles

- Correctly writing the quadratic formula
- Using signs correctly when solving using quadratic formula
- Simplify the expression under the radical first before evaluating the radical

NJSLS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
A.REI.4: Solve quadratic equations in one variable 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.*	***Review*** • Standard form of a quadratic equation helps you to identify or can be written from knowing values for a, b, and c and the y –intercept ***New*** • Quadratic formula is a method to solving quadratic equations that can be used for all types of quadratic equations • Understanding how the quadratic formula derives from standard form of a quadratic equation	***Review*** • Graph quadratic functions • Identify key features of quadratic equations • Write an equation from a given graph ***New*** • Identify quadratic formula • Use quadratic formula to solve quadratic function	MVP 2 3.5	2 Periods	3.5 Set #12 & 15

Lesson 6: Solving Quadratic Equations

Objectives

- Using different forms of quadratic equations SWBAT work _____ to solve quadratic equations using multiple methods for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

- MP 2: Reason abstractly and quantitatively
- MP 3: Construct viable arguments and critique the reasoning of others
- MP 4: Model with Mathematics
- MP 6: Attend to precision

Vocabulary

- Factoring, quadratic formula, completing the square

Common Misconceptions/struggles

- Trying to use methods for solving that don't match to the form the equation is in
- Trying to use factoring to solve non factorable equations or equations with non real solutions
- Using signs correctly when solving using quadratic formula
- Simplify the expression under the radical first before evaluating the radicals

NJSLS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
A.REI.4: Solve quadratic equations in one variable A.REI.7: Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example find the points of intersection between the line y=-3x and the circle $x^2 + y^2 = 3$ 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.*	***Review*** • Standard form of a quadratic equation helps you to identify or can be written from knowing values for a, b, and c and the y –intercept • There are multiple ways to solve and represent quadratic functions ***New*** • Equations can be changed around into different forms in order to use multiple methods to solve quadratic equations • Changing forms of quadratic equations provide opportunities to solve equations according to individual strengths	***Review*** • Write a quadratic equation and graph it given a real life problem • Solve systems of Equations • Solve quadratic equations ***New*** • Use multiple methods of solving quadratic equations • Change forms of quadratic equations • Identify limitations of certain methods for solving quadratic equations	MVP 2 3.6 & 3.7	2 Periods	3.6 Set #12 and 3.7 # 11, 12, and 13

Lesson 7: Complex Numbers

Objectives

- Using the Fundamental Theorem of Algebra SWBAT work _____ to identify and solve quadratic equations with non real roots for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 2: Reason abstractly and quantitatively
- MP 8: Look for and express regularity in repeated reasoning

Vocabulary

- Quadratic functions, roots, real numbers, non real numbers, complex numbers, multiplicity

Common Misconceptions/struggles

- Trying to use methods for solving that don't match to the form the equation is in
- Trying to use factoring to solve non factorable equations or equations with non real solutions
- Using signs correctly when solving using quadratic formula
- Simplify the expression under the radical first before evaluating the radicals

NJSLS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
A.REI.4: Solve quadratic equations in one variable N.CN.7: Solve quadratic equations with real coefficients that have complex solutions. N.CN.8: Extend polynomial identities to the complex numbers. *For example, rewrite x^2 + 4 as (x+2i)(x-2i)* N.CN.9: Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.	***Review*** • Changing forms of quadratic equations provide opportunities to solve equations according to individual strengths • Equations can be changed around into different forms in order to use multiple methods to solve quadratic equations ***New*** • The Fundamental Theorem of Algebra identifies how many roots a function has	***Review*** • Simplifying radicals • Write equations from tables and graph the function • Identify key features of a quadratic graph • Identify limitations of certain methods for solving quadratic equations ***New*** • Identify the type of roots a quadratic function has • Solve quadratic equations using multiple methods • Identify when a quadratic equation has non real roots	MVP 2 3.8	2 Periods	Set 3.8 #8, 13, and 27

Lesson 8: Working with Real and Complex Numbers

Objectives

- Using imaginary numbers SWBAT work _____ to identify the type of roots an equation has and make conjectures about manipulating rational and irrational numbers for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 2: Reason abstractly and quantitatively
- MP 5: Use appropriate tools strategically
- MP 7: Look for and make use of structure

Vocabulary

- Irrational numbers, rational numbers, complex numbers, imaginary numbers

Common Misconceptions/struggles

- Trying to use methods for solving that don't match to the form the equation is in
- Trying to use factoring to solve non factorable equations or equations with non real solutions
- Using signs correctly when solving using quadratic formula
- Simplify the expression under the radical first before evaluating the radicals

NJSLS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
N.RN.3: Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational. N.CN.1: Know there is a complex number *i* such that i^2=-1, and every complex number has the form *a + bi* with *a* and *b* real. N.CN.2: Use the relation i^2 = -1 and the commutative, associative, and distributive properties to add, subtract, and	***Review*** • Finding area of a figure with side lengths that include irrational numbers help to make conjectures about the nature of irrational numbers when combined with other irrational numbers or rational numbers ***New*** • Imaginary numbers are irrational numbers, complex numbers are numbers that include an imaginary term and a real term • The discriminant is the part of the quadratic formula underneath the radical; simplifying the discriminant identifies the type of roots the	***Review*** • Find perimeter and area of given figures • Identify non real numbers • Identify real number subcategories • Make conjectures about arithmetic performed on real numbers ***New*** • Identify imaginary numbers • Identify the discriminant of a quadratic function and use it to identify the types of roots an equation has • Simplify radical expressions using "i" • Make conjectures about arithmetic performed on non real numbers • Perform arithmetic on polynomial expressions	MVP 2: 3.9 & 3.10	4 Periods	3.9 Set #34, 38 and 3.10 #8, 12

multiply complex numbers. N.CN.7: Solve quadratic equations with real coefficients that have complex solutions. N.CN.8: Extend polynomial identities to the complex numbers. *For example, rewrite x^2 + 4 as (x+2i)(x-2i)* N.CN.9: Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials 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.	equation will have without fully solving for the equation • The imaginary number "i" equals √-1				

Lesson 9: Comparing Growth Rates of Different Types of Functions

Objectives

- Using linear, quadratic, and cubic functions SWBAT work _____ to identify and compare the rates of change for each type of function for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

- MP 2: Reason abstractly and quantitatively
- MP 4: Model with mathematics
- MP 7: Look for and make use of structure

Vocabulary

- Polynomial functions, degree, cubic functions, rate of change, end behavior, extremes

Common Misconceptions/struggles

- Combing like terms with different exponents
- Incorrect work with signs when combining polynomial s (i.e. not distributing the sign over every term of the function)
- Difficulty understanding the idea of infinity when talking about behavior of a function

NJLSL	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
F.BF.1: Write a function that describes a relationship between two quantities. F.LE.3: Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. A.SSE.1: Interpret expressions that represent a quantity in terms of its context. 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	***Review*** • Rate of change is slope of a function between specific points • Linear functions are the only function to have a constant rate of change throughout the entire function ***New*** • The highest degree of a function identifies the type of function it is • Ordering functions with different x-values can help to understand the functions behavior including rate of change and end behavior	***Review*** • Identify rate of change for linear and quadratic functions • Identify types of equations for linear and quadratic equations ***New*** • Identify the degree of a given function • Order expressions according to the nature of its x-values • Combine equations of different functions • Compare rates of change and end behavior of different polynomial functions	MVP 3: 3.1 & 3.2	2 Periods	3.1 Set #22, 23, 24, 25 3.1 # 10, 11, and 12

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.*					

Lesson 10: End Behavior

Objectives

- Using multiple representations SWBAT work _____ to understand and analyze end behavior for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 4: Model with mathematics
- MP 7: Look for and make use of structure

Vocabulary

- Polynomial functions, end behavior, degree

Common Misconceptions/struggles

- Difficulty understanding the idea of infinity when talking about behavior of a function
- Misidentifying end behavior when identifying end behavior from only an equation

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
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. 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. 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.	***Review*** • The highest degree of a function identifies the type of function • Each form of a function provides a different key feature of information that can help graph the function • Graphs can be used to visually identify end behavior of different functions ***New*** • End behavior is the nature of a function as it moves towards infinity in the left and right directions	***Review*** • Identify the type of function using the degree of different functions • Identify different forms of linear and quadratic functions • Graph different functions and identify end behavior ***New*** • Identify end behavior of different functions from its equation • Compare end behavior of different functions	MVP 3: 3.3	1 block	Set 3.3 #10, 14, and 17

Lesson 11: Arithmetic with Polynomials

Objectives

- Using graphs SWBAT work _____ to add, subtract, and multiply polynomials for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 4: Model with mathematics
- MP 6: Attend to precision

Vocabulary

- Polynomial function, linear function, quadratic graph

Common Misconceptions/struggles

- Difficulty with distributive property
- Mistakes made in identifying like terms
- Graphing difficulties

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
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. F.BF.1: Write a function that describes a relationship between two quantities.	***Review*** • You can combine polynomial functions algebraically by combining like terms and simplifying expressions ***New*** • Combining two linear functions creates another linear, combining a linear plus a quadratic creates another quadratic, the product of two linear functions creates a quadratic • To combine polynomials on a graph, graph both original functions on the same coordinate plane as well as the solution	***Review*** • Graph polynomial functions • Simplify expressions • Solve quadratic equations • Combine polynomial functions algebraically using addition subtraction, and multiplication ***New*** • Combine polynomial functions with addition, subtraction, and multiplication using graphs • Identify key features of polynomial functions	MVP 3: 3.4	1 block	Set 3.4 #12 & 15

Lesson 12: Applying Fundamental Theorem of Algebra

Objectives

- Using the Fundamental Theorem of Algebra SWBAT work _____ to identify key features of polynomial functions including end behavior, roots, and multiplicity for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 4: Model with mathematics
- MP 7: Look for and make use of structure

Vocabulary

- Polynomial function, Fundamental Theorem of Algebra, binomial expansion

Common Misconceptions/struggles

- Difficulty with distributive property
- Multiply an exponent times each term of an expression instead of expanding the expression
- Difficulty understanding the difference between degree and multiplicity

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check
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. 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. N.CN.8: Extend polynomial identities to the complex numbers. *For example, rewrite $x^2 + 4$ as (x+2i)(x-2i)* N.CN.9: Know the Fundamental Theorem of Algebra; show that it	***Review*** • Binomial expressions can be written with exponents or written out in expanded form as individual factors ***New*** • The highest degree of a function is also the number of roots a function will always have • Multiplicity describes how the function behaves at each root	***Review*** • Graph factored forms of a function • Expand binomial expressions • Multiply polynomials • Factor polynomials • Simplify expressions ***New*** • Identify patterns of binomial expansion • Identify the relationship between the degree and number of roots of a function • Identify key features of polynomial functions	MVP 3: 3.5 & 3.6	1 block	Set 3.5 #6, 7 & Set 3.6 #14

is true for quadratic polynomials 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.* 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.					

Lesson 13: Using Remainder Theorem

Objectives

- Using the remainder theorem SWBAT work _____ to divide polynomial functions and identify roots of a polynomial for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 6: Attend to precision
- MP 7: Look for and make use of structure

Vocabulary

- Polynomial function, remainder theorem, roots, factors

Common Misconceptions/struggles

- Difficulties graphing
- Difficulties using long division strategy (i.e., mistakes with signs, not carrying each term down before each step, not using distributive property during multiplication step)

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
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 an only if (x-a) is a factor of 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. N.CN.9: Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials 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.	***Review*** • The highest degree of a function is also the number of roots a function will always have • Multiplicity describes how the function behaves at each root ***New*** • The remainder theorem says that if a polynomial divided by a binomial has no remainder then the binomial is a root of the polynomial	***Review*** • Identify key features of a polynomial function • Factor polynomial functions • Graph polynomial functions • Write polynomial equations given the roots of a function ***New*** • Identify remainder theorem • Use remainder theorem to divide polynomials • Identify roots of a polynomials by dividing polynomials	MVP 3: 3.7	1 block	Set 3.7 #12 & 13

Lesson 14: Polynomial Functions

Objectives

- Using all information learned in this module SWBAT work _____ to show understanding of polynomial functions by factoring, graphing, and solving functions for at least _____ out of _____ correct on the daily exit slip.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 4: Model with mathematics
- MP 5: Use appropriate tools strategically
- MP 7: Look for and make use of structure

Vocabulary

- Polynomial functions, remainder theorem, Fundamental Theorem of Algebra, factors, roots

Common Misconceptions/struggles

- Difficulties graphing
- Difficulty with distributive property
- Difficulty understanding the difference between degree and multiplicity

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
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 an only if (x-a) is a factor of 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. N.CN.9: Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials	***Review*** • Multiple representations can be used to represent the same function (i.e table, graph, equation) • The Fundamental Theorem of Algebra is used to identify the number of roots a polynomial has • The remainder theorem is used to identify roots of a functions using long division of polynomials ***New*** • All key features of a polynomial function are used to graph functions • There are multiple strategies that can be used to find the zeros of polynomial functions	***Review*** • Identify key features of polynomial functions • Graph polynomials functions • Write out polynomial functions given key information ***New*** • Put all information learned about polynomial functions together	MVP 3: 3.8	1 block	Set 3.8 #10, 12, & 13

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.					

5 Practices for Orchestrating Productive Mathematics Discussions	
Practice	Description/ Questions
1. Anticipating	What strategies are students likely to use to approach or solve a challenging high-level mathematical task? How do you respond to the work that students are likely to produce? Which strategies from student work will be most useful in addressing the mathematical goals?
2. Monitoring	Paying attention to what and how students are thinking during the lesson. Students working in pairs or groups Listening to and making note of what students are discussing and the strategies they are using Asking students questions that will help them stay on track or help them think more deeply about the task. (Promote productive struggle)
3. Selecting	This is the process of deciding the *what* and the *who* to focus on during the discussion.
4. Sequencing	What order will the solutions be shared with the class?
5. Connecting	Asking the questions that will make the mathematics explicit and understandable. Focus must be on mathematical meaning and relationships; making links between mathematical ideas and representations.

Ideal Math Block

The following outline is the department approved ideal math block for grades 9-12.

1) Do Now (7-10 min)
    a. Serves as review from last class' or of prerequisite material
    b. Provides multiple entry points so that it is accessible by all students and quickly scaffolds up

2) Starter/Launch (5-10 min)
    a. Designed to introduce the lesson
    b. Uses concrete or pictorial examples
    c. Attempts to bridge the gap between grade level deficits and rigorous, on grade level content
    d. Provides multiple entry points so that it is accessible by all students and quickly scaffolds up

3) Mini-Lesson /Task(15-20 min)
    a. Design varies based on content
    b. May include an investigative approach, direct instruction approach, whole class discussion led approach, etc.
    c. Includes CFU's
    d. Anticipates misconceptions and addresses common mistakes

4) Guided Practice (25-30 min)
    a. Design varies based on content
    b. May include partner work, group work/project, experiments, investigations, game based activities, etc.

5) Independent Practice (7-10 min)
    a. Provides students an opportunity to work/think independently

6) Closure (5-10 min)
    a. Connects lesson/activities to big ideas
    b. Allows students to reflect and summarize what they have learned
    c. May occur after the activity or independent practice depending on the content and objective

7) DOL (5 min)
    a. Exit ticket

Ideal Math Block with Intervention Stations

Whole Group Instruction	50 min	INSTRUCTION (Grades 9 – 12) Daily Routine: Mathematical Content or Language Routine Anchor Task: Anticipate, Monitor, Select, Sequence, Connect Collaborative Work* Guided Practice Independent Work (Demonstration of Student Thinking)		TOOLS Manipulatives RESOURCES Agile Mind
Rotation Stations (Student Notebooks & Chromebooks Needed)	1-2X 35 min	STATION 1: Focus on current Grade Level Content STUDENT EXPLORATION* Independent or groups of 2-3 Emphasis on MP's 3, 6 (Reasoning and Precision) And MP's 1 & 4 (Problem Solving and Application) TOOLS/RESOURCES Agile Mind Math Journals	STATION 2: Focus on Student Needs TECH STATION Independent TOOLS/ RESOURCES Khan Academy Approved Digital Provider Fluency Practice	TEACHER STATION: Focus on Grade Level Content; heavily scaffolded to connect deficiencies TARGETED INSTRUCTION 4 – 5 Students TOOLS/ RESOURCES Agile Homework Manipulatives
	5 min	INSTRUCTION Exit Ticket (Demonstration of Student Thinking) TOOLS/RESOURCES Notebooks or Exit Ticket Slips		

Extended Constructed Response (ECR)

Math Department ECR Protocol

ECR Protocol

(Extended Constructed Response)

Issuing

- Moving forward ECR'S will be disseminated by the first of each month and collected by the end of each month
- Method of Issuing: email and post on the website

Dissemination

- Teachers can elect to print copies for each student or use the Smartboard to project the ECR. (Note: Student work will be included in Student Portfolios)
- Students should be given up to 30 minutes depending on the complexity of the ECR
- Assure appropriate testing environment
- ECR should be completed independently

Scoring

- Conversion tables are available in the *Assessment & Data in Mathematics Bulletin* for genesis inputting purposes
- ECR's will count as Authentic Assessments
- Naming Protocol "Course Month ECR" (ex: Grade 6 October ECR)

Collection

- ECR's will be collected & kept in student portfolios
- Student work will be reviewed during CPT's

Link of Unit 1 ECRs
https://www.dropbox.com/sh/q03j0a1vmoaq3ce/AACOv1vpS3-p7G7V7_xpTBcla?dl=0

ECR Conversion Chart

Points	Genesis Conversion	Points	Genesis Conversion	Points	Genesis Conversion
0	55	0	55	0	55
1	59	1	69	1	69
2	69	2	79	2	89
3	79	3	89	3	100
4	89	4	100		
5	100				

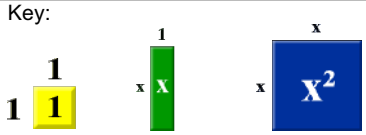
Sample of ECR Scoring Rubric

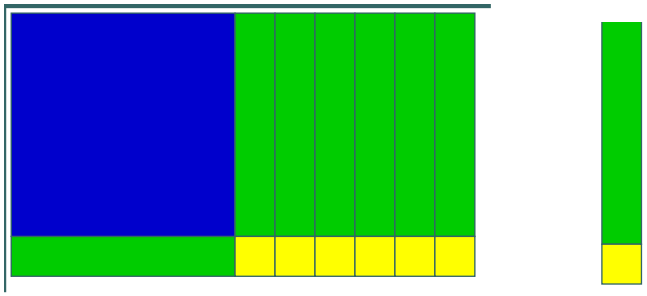
Part A	
Score	Description
3	Student response includes the following 3 elements. Modeling component: 2 pts * Valid equation * Logical work to find the price per ticket Computation: 1 pt * Correct computation for finding the price of per ticket Sample Student Response The total cost of the prizes is 349 + 42 + 25 + 18 + 16 = 450. For 75 tickets to make $450, they must each cost 450 ÷ 75 = $6. Equation: n= 6x – 450
2	Student response includes 2 of the 3 elements
1	Student response includes 1 of the 3 elements
0	Student response is incorrect or irrelevant.
Part B	
Score	Description
2	Student response includes the following elements: * Logical progression toward problem solving * Correct computation to find the number of tickets and determine the reasonable solution Sample of student work: 6x-450 >= 850 6x >= 1300 x >= 216.6666 Answer: the minimum number of tickets is 217
1	Student response includes 1 of 2 elements
0	Student response is incorrect or irrelevant

Multiple Representation (Dividing Polynomial)

Concreted Model

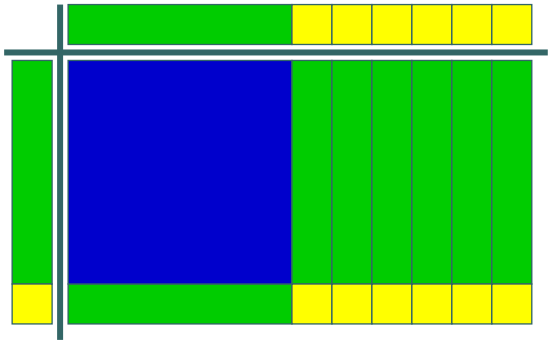
Key:





$(x^2 + 7x + 6) \div (x + 1)$

Quotient Q(x)=(x + 6)



Divisor
D(x)=(x + 1)

Divident P(x)= $(x^2 + 7x + 6)$

Symbolic (Polynomial Long Division)

$$
\begin{array}{r}
x + 6 \\
x + 1 \overline{)\ x^2 + 7x + 6} \\
\underline{x^2 + x} \\
6x + 6 \\
\underline{6x + 6} \\
0
\end{array}
$$

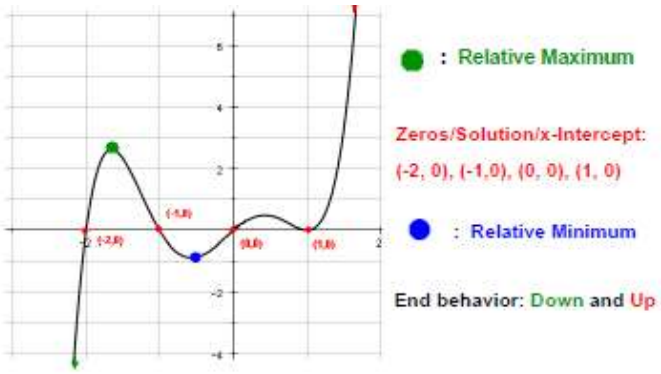
Remainder R(x) = 0

Divident = (Divisor)(quotient) + Remainder
P(x) = D(x)Q(x) + R(x)

Polynomial Graph

Using graph to show vocabulary

Key features of polynomial function graph



End Behavior of a Polynomial Function With Leading Term ax^n

Using Graphing Organizer

Leading Coefficient Test
(Predicting End Behavior)

$ax^n + bx^{n-1} + c\,x^{n-2}\ldots$