Algebra II Curriculum Guide
Tier 1 & 2

Unit 2: Polynomial Function and Equations
September 10 – November 28

ORANGE PUBLIC SCHOOLS 2018 - 2019

OFFICE OF CURRICULUM AND INSTRUCTION

OFFICE OF MATHEMATICS

Algebra II Unit 1

Contents

Unit Overview

Unit 2: Polynomial Function and Equations
Overview
This course uses Agile Mind as its primary resource, which can be accessed at the following URL: ➢ www.orange.agilemind.com Each unit consists of 1-3 topics. Within each topic, there are "Exploring" lessons with accompanying activity sheets, practice, and assessments. The curriculum guide provides an analysis of teach topic, detailing the standards, objectives, skills, and concepts to be covered. In addition, it will provide suggestions for pacing, sequence, and emphasis of the content provided.
Essential Questions
➢ What is polynomial function? ➢ How do you perform arithmetic operation on polynomials? ➢ How do you interpret key features of graphs and tables in terms of the quantities? ➢ How do you identify odd and even function based on the symmetry? ➢ What is a rational expression? ➢ How do you simplify rational expressions? ➢ How do you re-write rational expressions? ➢ How are the degrees of polynomials related to its' zeroes? ➢ How can you analyze functions using different representation? ➢ How do you sketch graphs showing key features given a verbal description of the relationship? ➢ What is the difference between absolute values and relative values? ➢ What is a short-term behavior? ➢ What is a long-term behavior? ➢ How can you analyze functions using different representation? ➢ What is polynomial equation? ➢ What is a complex number? ➢ How do you solve polynomial equation? ➢ How does discriminant help you make prediction about roots of quadratic equations? ➢ What is the fundamental theorem of Algebra? ➢ What is remainder theorem?
Enduring Understandings
➢ Polynomial functions take the form $f(x) = a_n x^n + a_{n-1}x^{n-1} + \ldots + a_1 x + a_0$, where n is a nonnegative integer and $a_n \neq 0$. ➢ 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. ➢ Understand the Key features of graphs such as; intercepts, intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries and point of inflections. ➢ Understand that a function that has line symmetry with respect to y axis is called even function ➢ Understand that function that has point symmetry with respect to the origin is called odd function ➢ A rational expression is the quotient of two polynomial expressions, expressed as a ratio. ➢ Rational expression can be simplified through factoring ➢ Understand how to use long division to 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).

- Identify zeros of polynomials when suitable factorizations are available.
- Use the zeros of a function, critical points (relative max, min) and intervals for increasing and decreasing function, end behavior, and symmetries to construct a rough graph of the function defined by the polynomial.
- Understand that for any absolute values graph reaches the highest or lowest point then decreases or increases over an interval
- Understand that for any local values graph reaches a high point then a low point and then it keep increasing or decreasing and there is not absolute values
- The behavior of a function over small intervals is called the short-term behavior**,** or local behavior**,** of a function
- Long-term behavior is the same as end behavior, of the polynomial. End behavior of the function is defined as the behavior of the values of f(x) as x approaches negative infinity and as x approaches positive infinity.
- Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).
- A polynomial equation is any equation that can be written in the form ($a_nx^n + a_{n-1}x^{n-1}+...+a_1x+a_0= 0$.
- 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.
- When you know one of the roots you can find other factor by dividing the polynomial by linear expression.
- You can solve polynomial through factoring. If it is quadratic equation then you can also solve by completing the square or by using the quadratic equation
- If the discriminant is positive, there are two distinct real roots. If the discriminant is zero, there is one distinct real root. If the discriminant is negative, there are two distinct non-real complex roots.
- According to the Fundamental Theorem of Algebra, any polynomial with real coefficients of degree n has at least one complex root.
- For a polynomial p(x) and a number a, the remainder on division by x –a is p(a)

NJSLS/CCSS

1) 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.

2) A.SSE.2: Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that can be factored as $(x^2 - y^2)(x^2 + y^2)$

3) A.SSE.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.
 a. Factor a quadratic expression to reveal the zeros of the function it defines.

4) 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.

5) 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).

6) 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.

7) A-APR.4: Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 – y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples.

8) 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.

9) A-REI.4: Solve quadratic equations in one variable.
   b. Solve quadratic equations by inspection (e.g., for x 2 = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real Numbers a and b
   d. Represent and solve equations and inequalities graphically

10) 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.

11) 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.~~

12) 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

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

14) 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~~

15) 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

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

17) 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

18) N-CN-2: Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

19) N-CN.7: Solve quadratic equations with real coefficients that have complex solutions

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

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

Major Content
Supporting Content
Additional Content
~~Parts of standard not contained in this unit~~
Algebra I Content

21st Century Career Ready Practice

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.

<table>
<tr><th colspan="4">Essential Learning Goals for Algebra 2 Unit 1</th></tr>
<tr><th>CCSS</th><th>Related Topic</th><th>Lesson Objective</th><th>Notes</th></tr>
<tr>
<td rowspan="6">F.IF.8a:
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.
A-REI.4: Solve quadratic equations in one variable.
A. Use the method of completing the square to transform any quadratic equation in xinto an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form.
B. Solve quadratic equations by inspection (e.g., for x 2 = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real numbers a and b
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.
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.</td>
<td rowspan="6">Quadratic Equations and complex numbers</td>
<td>1.1a F.IF.7
Give a quadratic graph and its function in standard form, students will
• identify key features of graph, and justify zeros algebraically.
Give a quadratic function in standard from, students will
• sketch the graph showing y-intercept & end behavior.</td>
<td>(Transition lesson if needed) –</td>
</tr>
<tr>
<td>1.1 b F.IF.7 , F.IF.4
Students will:
• Identify key features of quadratic functions in factored form and standard form and sketch showing key features
• Using a graphing calculator to graph a quadratic function, and use the graph to re-write the standard form into factored form</td>
<td>(Transition lesson if needed) –</td>
</tr>
<tr>
<td>1.2a F.IF.8a, ASSE.3b
Students will:
• Re-write standard form in to factored form using area model, or any factored strategies</td>
<td>(Transition lesson if needed) –</td>
</tr>
<tr>
<td>1.2b - A.REI.4, F.IF.7, A.REI.11
Students will
• Solve quadratic equations in standard form by factoring or graphing and sketch the graph to show key features.</td>
<td>(Transition lesson if needed) –</td>
</tr>
<tr>
<td>1.2 c - F.IF.4 F.IF.7
Given a vertex form of the quadratic function students will
• Identify key features of the vertex
• Sketch the graph of the quadratic equation in vertex form without the calculator</td>
<td>(Transition lesson if needed) –</td>
</tr>
<tr>
<td>1.2d: – A.RE.I4, F.IF.7
Given a vertex form of the quadratic function students will
• Solve simple quadratic equations (eg. $X^2 = 49$, $(x+2)^2 = 49$, $x^2 - 2 = 2$) and sketch the graph to show key features.
• Solve quadratic equations in vertex form by taking square roots</td>
<td></td>
</tr>
</table>

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. 7b: Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. A.SSE.3 Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. 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 multiply complex numbers. N-CN.7: Solve quadratic equations with real coefficients that have complex solutions 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.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).		1.3a A.SSE.3, A.REI.4 After a mini lesson on expanding sum of squares students will • Solve quadratic equations by completing squares	
		1.3b - A.REI.4a By completing squares students will • Derive the quadratic formula • Apply the quadratic formula to find real solution • identify the nature of the roots and number of real roots from graphs And the discriminate	
		1.4 N.CN.7, N.CN.1 By using the quadratic formula and the definition of imaginary numbers students will • Solve and graph Quadratic equations with non-real solutions • Derive the definition of complex number	
		1.5 N.CN.2, By using the definition of complex number students will • Simply complex numbers • Perform operation with complex numbers	
	Key features of polynomial and sketching polynomial	2.1a – F.IF.7 Objective: Given a polynomial functions in factored form students will • Identify zeroes and y intercept • Plot them on the coordinate plane • Develop strategies to find the end behavior • Create a sketch of the cubic function • Identify the end behavior of functions with positive and negative leading coefficients	

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 A.SSE.2: Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 – y^4$ as $(x^2)^2 – (y^2)^{2,}$ thus recognizing it as a difference of squares that can be factored as $(x^2-y^2)(x^2+y^2)$		2.1b -F.IF.4, F.IF.6 A.CED.1 Objective: Given a real life situation Students will • Create a mathematical model (polynomial function) to represent the situation • Sketch the graph • Identify key features from graphs and equations; and interpret the key features in terms of context	
	Remainder Theorem and Long Division	3.1a – A.APR.6, Using Area model students will • Understand the concept of long division • Perform long division on polynomial • Rewrite simple rational expression in different form	
		3.1b – A.APR.2 Through long division and by evaluating the polynomial for a given root students will • Understand the remainder theorem • Apply the remainder theorem to find the remainder of a polynomial and see the connection between factor and the remainder.	
		3.2 – A.SSE.2 students will • Re-write the sum and difference of cube as factored form	
		3.3a - A. APR.3 Using Area model and or GCF students will • Factor cubic polynomials	
	Solving Cubic Equation	3.3b - A. APR.3 By performing factoring by grouping or long division and quadratic formula students will • Solve cubic equation • Identify key features • Create a rough sketch and show key features of the polynomial functon	

Calendar

September 2018						
Sun	Mon	Tue	Wed	Thu	Fri	Sat
2	3	4	5	6	7	8
9	10 First Day for Students	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

Algebra II Unit 1

October 2018						
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
30	**1**	**2**	**3**	**4**	**5**	**6**
7	**8** **Columbus Day – No School**	**9**	**10**	**11**	**12**	**13**
14	**15**	**16**	**17**	**18**	**19**	**20**
21	**22**	**23** **PD Half Day**	**24**	**25**	**26** **MP1 Benchmark Window opens**	**27**
28	**29**	**30**	**31**			

November 2018						
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
5	**6**	**7** **MP1 Benchmark Window closes**	***8***	**9** **NJEA Conv No School**	**10** **NJEA Conv No School**	
11	**12**	**13**	**14**	**15**	**16**	**17**
18	**19**	**20**	**21** **Half Day**	**22** **Thanks Giving**	**23** **Thanks giving**	**24**
25	**26**	**27**	**28**	**29**	**30**	

Algebra II Unit 1

Assessment Framework

Assessment	Estimated Time	Date	Format	Grading Weight
Unit 1 ***Readiness Assessment***	40 miutes	Before Start the Unit 1	Individual	Graded (weight : 0)
Diagnostic Assessment *NWEA*	1 – 1 ½ Block	Week 2	Individual	Software graded (baseline of student growth)
Performance Task	50 minutes	After Lesson 2.4	Individual	Yes
Performance Task	40 minute	After Lesson 3.1	Individual,	Yes
Benchmark 1 Assessment	1 Block	District test window	Individual	Yes
Assessment check points (exit tickets)	5-10 minutes	Everyday	Individual	Varies
Quiz -- Teacher generated (6 per marking Period)	15-20 minutes		Individual	Yes
Test – Teacher generated (at least 2 per marking period)	30-40 minutes		Individual	Yes

Algebra II Unit 1

Scope and Sequence

Overview			
Topic	Name	Agile Mind "Topics"*	Suggesting Pacing
0	Transition lessons	**n/a**	**Upto 10 days**
1	Quadratic function and complex numbers	**Topic 4 and 6**	**10 days without transition lesson**
2	Key features of cubic and quartic Polynomial function	**Topic 5**	**10 days**
3	Long division of polynomials/Remainder theorem and solving cubic polynomials	**Topic 4 and topic 6**	**10 days**

Diagnostic Assessment	**½ day**
Transition lesson	**½ - 1 day**
Mid Unit Assessment	**1 day**
End of Unit Assessment	**2 days**
Performance Task 1	**½ day**
Performance Task 2	**½ day**
Review	**2 days**
Total	**21 ½ days**

*1 Agile Mind Block = 45 minutes

Lesson 1.1 a – F.IF.4, F.IF.7 Transition Lesson – If Needed

Students will:

Identify zeroes of the quadratic equations in standard form graphs, justify their solution algebraically and sketch using key features.

Pre-requisite: Graphing calculator to find zeros and concept of x intercepts from any function.

Opener: (5 minutes) – Can be used as do now. The purpose of the do now is to see the x intercept of the linear function. x intercept is same as zero. Another purpose is to see how you can verify zero of the function algebraically by substituting the x intercept into the equation to check if the equation becomes zero.

- Teacher will circulate and monitor student work. Select students to de-brief.
- The look for is the x intercepts or zeroes and the verification of the zero algebraically

Summary (2 minutes) have students show the zero and verification of the zero. Explain to students that x intercept is the same as zero, in other words x intercept is the value that will make the equation or the output y equal to zero when substituted in the equation.

Task (15 minutes): Purpose of the task is to see the zero as x intercept of the function from the graphs and also to be able to verify the zero algebraically. Goal is to help students understand that find zeros of the function means solving the function when it is equal to zero.

- The task can be tried independently first then teacher can pair students into 2 to 3 per group.
- As the students are working teacher will monitor and select students to call on during the summary of the task.
- The look for's are zeroes of the function and verification algebraically
- Teachers can call on certain students (pre-selected during monitoring) to go over the look for's.

Guided Practice (15 minutes)

Note: justifying algebraically does not mean factoring; it means to substitute your answer in the original equation to see if both sides are equal.

Summary: 10 minutes

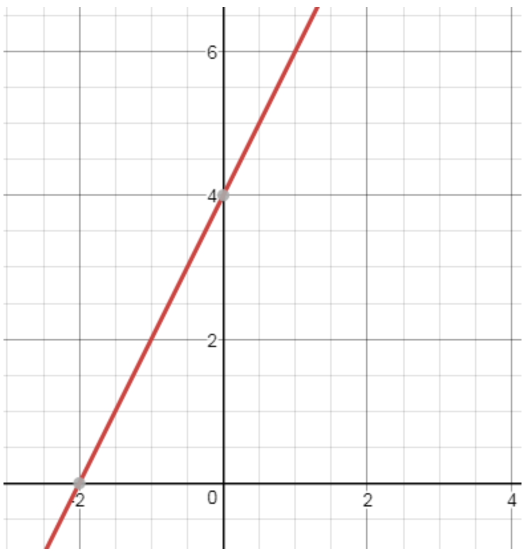
Independent Practice (15 minutes)

Closure: (4 minutes)

Exit Ticket (5 minutes)

Opener (Do Now):

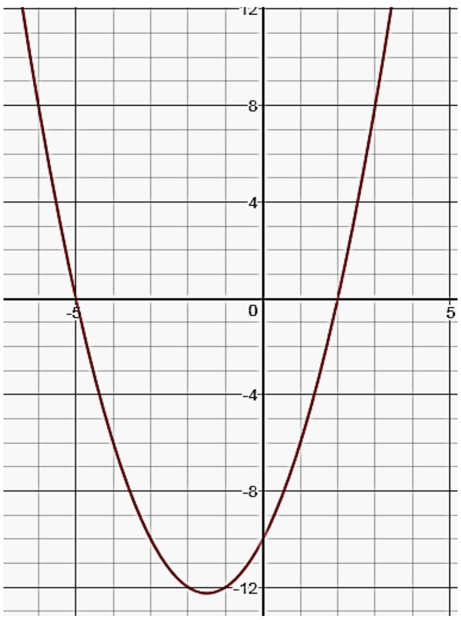
Find the zeros of the function f(x) = 2x + 4 from the graph below (5 minutes) Justify your answer algebraically:



Algebra II Unit 1

Task

Part A. Find the zeros of the function f(x) = $x^2 + 3x - 10$



- Justify your answer algebraically.

Part B: Sketch f(x) = (x – 8)(x+2)

Find the zeroes of the function and justify your answer algebraically

Part C:

Sketch f(x) = (x + 4)(x+ 1)

Find the zeroes of the function and justify your answer algebraically

Algebra II Unit 1

Guided Practice: (15 minutes)--- no calculators

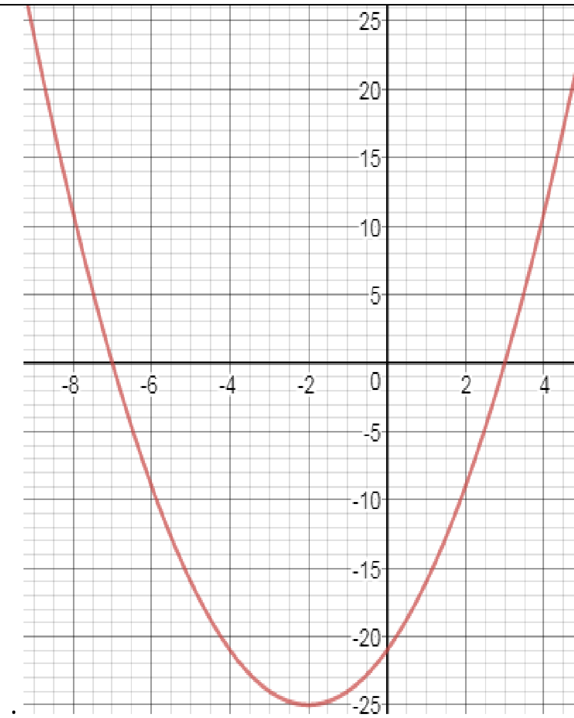
Match the following equations with the graphs

1. $f(x) = 3x^2 – 9x + 6$ 2. $g(x) = (x+7)(x – 3)$ 3. $u(x) = (2x – 1)(x+4)$ 4. $k(x) = x^2 + 6x + 8$

<table>
<tr><th>Equation</th><th>Graph</th></tr>
<tr><td>

- Zeroes:_________________
- Equation :_____________________
- Justify Algebraically:

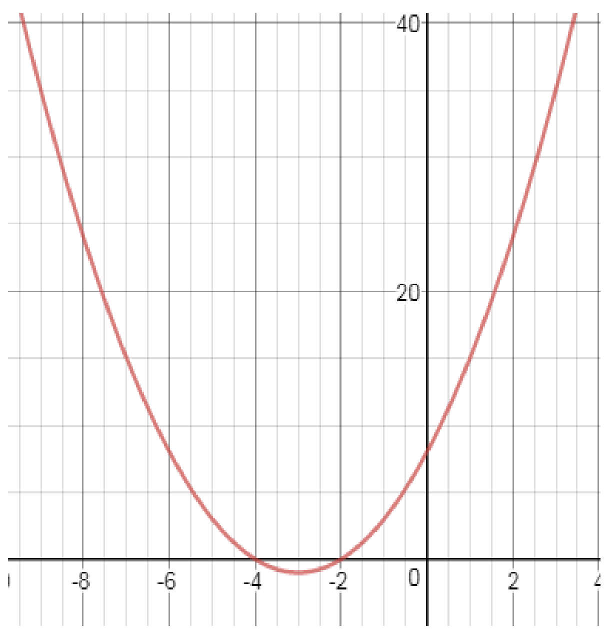
</td><td>



</td></tr>
<tr><td>

- Zeroes:_________________
- Equation :_____________________
- Justify Algebraically:

</td><td>



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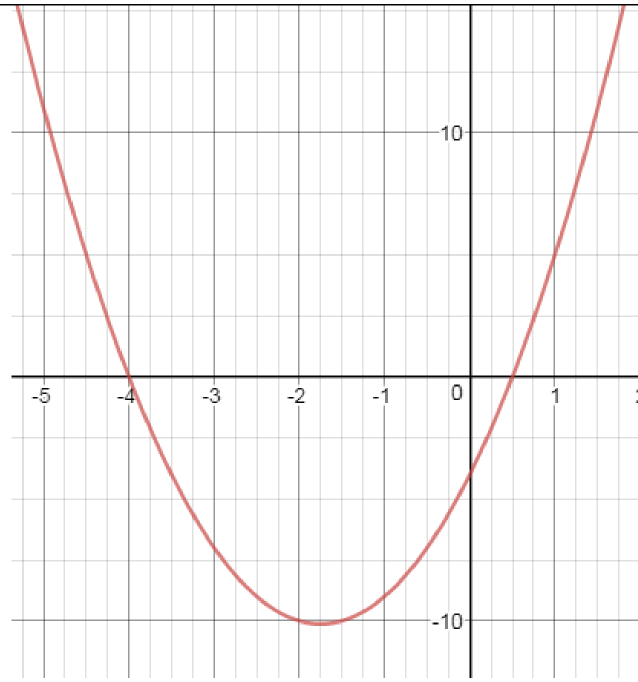
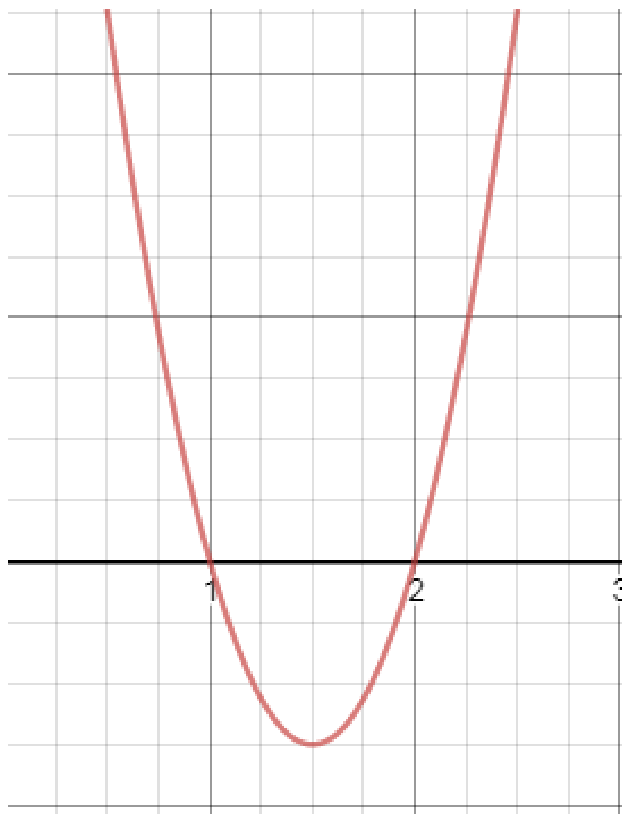
</table>

- Zeroes:___________________
- Equation :_______________________
- Justify Algebraically:



- Zeroes:___________________
- Equation :_______________________
- Justify Algebraically:



Algebra II Unit 1

Independent Practice: (No Calculator)

Which of the following functions have the zeros of x = 4 and x = -2? Justify algebraically.

1. $f(x) = x^2 + 7x - 8$
2. $f(x) = x^2 - 7x - 8$

2. Find the zeroes of the function $f(x) = (x - 2)(x - 7)$. Justify your answer algebraically, and Sketch the function.

Lesson 1.1.b: CCSS: F.IF.4 and F.IF.7 Transition lesson: if needed

Objective: Students will:

- Identify key features of quadratic functions in factored form and standard form and sketch showing key features.
- Using a graphing calculator re-write the standard form into factored form

Pre-requisite: Student must know how to use the graphing calculator to find max and min and y intercept.

Opener: (5 minutes) – Can be used as do now. Take two minutes to review. The purpose of the opener is diagnosis/review in nature. This will help identify how much students remember about the key features of the quadratic functions from Algebra 1.

- Teacher will circulate and monitor student work. Select students to de-brief.
- The look for is that the given function representation is a parabola, quadratic function, the zeroes, y-intercept, vertex, axis of symmetry, and where the function increases and where it decreases.

Student may also arrive to factored form of the quadratic function from the zeroes on the graph with a positive leading coefficient.

Before task: 5 minutes

Students might need a mini lesson on how to use a graphing calculator

Task (15 minutes)

The purpose of the task is to see which form will show the some of the key features directly and how one can write the factored form of the quadratic from the standard from using the graph and zeroes.

- The task can be tried independently first then teacher can pair students into 2 to 3 per group.
- As the students are working teacher will monitor and select students to call on during the summary of the task.
- The look for are as follows: standard form is good for identifying the concavity and the y-intercept directly. Factored form is also good for identifying the concavity but also the zeroes(x-intercepts) directly. Students will also use the graph to write the standard from into the factored form.
- Students should also see that the leading coefficient plays a key role in the concavity. Teacher will need to mention it in the summary if none of students see it.
- Another look for is that zeros of the factored forms are opposite in the equation and graph.

Guided Practice (15 minutes) First two question no calculator. During the summary, for the second question, use the vertex to find the value of “a”. 3rd question calculator is allowed.

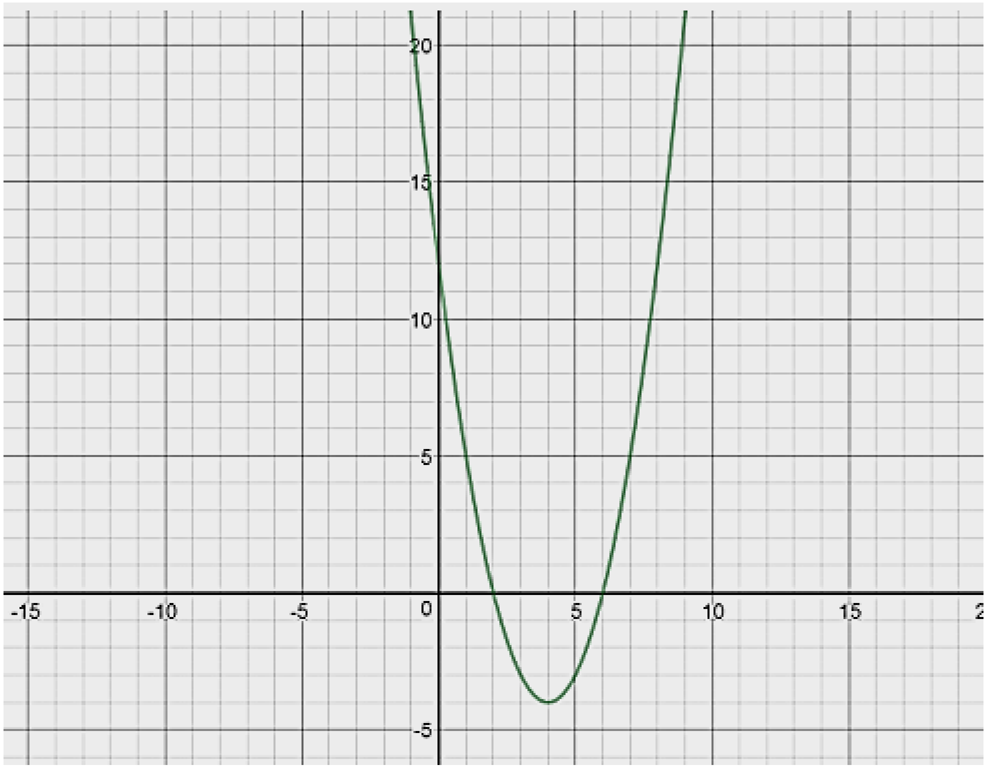
Summary: 10 minutes

Independent Practice (15 minutes) First two question no calculator. 3rd question calculator is allowed

Closure: (4 minutes)

Exit Ticket (5 minutes)

Opener



What do you know about the graph above? (i.e. type of function, key features….etc. Write down the information that you know about the graph as much as you can)

Algebra II Unit 1
Task 1.1b:

Part I: Consider the following equations:

A. $f(x) = x^2 - 8x + 10$ B. $g(x) = (x + 4)(x - 3)$ C. $h(x) = -2x^2 - 6x + 8$ D. $k(x) = (x - 2)(x - 6)$

1. Using the graphic calculator, sketch the graph of each function.
   Label the key features: vertex, axis of symmetry, y-intercept, x-intercepts.

$f(x) = f(x) = x^2 - 8x + 10$ Sketch: Zeroes__________ vertex:___________ y-intercepts:_________ A.O.S	$g(x) = g(x) = (x + 4)(x - 3)$ Sketch: Zeroes__________ vertex:___________ y-intercepts:_________ A.O.S
$h(x) = -2x^2 - 6x + 8$ Sketch: Zeroes__________ vertex:___________ y-intercepts:_________ A.O.S	. $k(x) = (x - 2)(x - 6)$ Sketch: Zeroes__________ vertex:___________ y-intercepts:_________ A.O.S

2. What key features you can notice directly from equations A, B, C and D.

3. Equations ABOVE that are in standard forms: $ax^2 + bx + c$, re-write them in factored form: $a(x - r_1)(x - r_1)$

Guided Practice:

1. Without using the graphing calculator identify key features of the following functions directly from the function

i. $f(x) = 2x^2 - 5x - 6$

ii. $f(x) = -x^2 - 6x + 7$

iii. $f(x) = (x + 5)(x - 3)$

iv. $f(x) = -(x + 2)(x + 4)$

v. $f(x) = -2(x - 1)(x - 3)$

2. Use the given information to write a quadratic function in factored form, f(x) = a(x - r_1)(x - r_2). And then sketch it.

- The parabola opens upward and the Zeroes are (2,0) and (4, 0).
- The vertex is (3, -10)

Quadratic function in factored form:_f(x) = ____

Sketch:

3. Use graphing calculator to determine the zeroes of each functions. Sketch each graph using zeroes, y-intercept, vertex, and then write each equation of the function in factored form.

a. $f(x) = x^2 - 8x + 12$

Zeroes:_______________________________________

Factored Form:______________________________________

Sketch:

b. $f(x) = -x^2 - 4x$

Zeroes:_______________________________________

Factored Form:______________________________________

Sketch:

Algebra II Unit 1

Independent Practice

1: Without using the calculator. Find the key features from the given functions below:

i. $f(x) = -x^2 + 6x + 8$

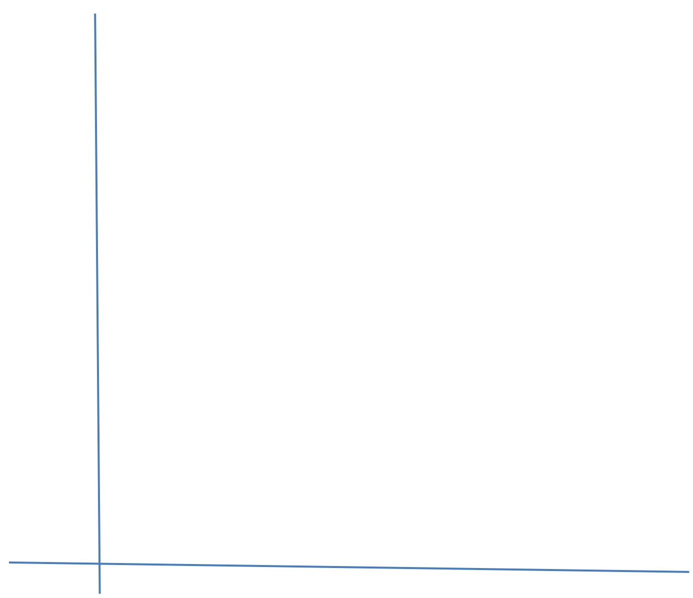
ii. $f(x) = (x + 6)(x - 3)$

2: Use the given information to write a quadratic function in factored form, $f(x) = a(x - r_1)(x - r_2)$. And then sketch it.

- The parabola opens Downward and the Zeroes are (-2,0) and (6, 0).
- The vertex is (2, 10)

Quadratic function in factored form:_f(x) = ______________________________________

Sketch:



3. Use graphing calculator to determine the zeroes of each functions. Sketch each graph using zeroes, y-intercept, vertex, and then write each equation of the function in factored form.

a. $f(x) = x^2 - 5x - 14$

Zeroes:______________________________________

Factored Form:_____________________________________

Sketch:

b. $f(x) = -2x^2 + 6x + 20$

Zeroes:______________________________________

Factored Form:_____________________________________

Sketch:

Algebra II Unit 1

Lesson 1.2a (Transition lesson if needed) – F.IF.8a

Students will:

- Connect area model with distributive property and use the concept to rewrite a quadratic expression in factored form given in standard form
- Connect concept of area model with other methods of factoring quadratic expression to rewrite a quadratic expression in factored form

Pre-requisite: Student must know how to multiply binomial by a binomial using area model and or distributive property

Opener: (5 minutes) – Can be used as do now. The purpose of the opener is review the pre-req for this lesson. This will help students review multiplying binomial with binomial and understand the concept to product as the area or standard form and the factors as length and width of the area. Teacher can make it more concreate using numbers if needed.

- Teacher will circulate and monitor student work. Select students to de-brief.
- The look for is area model and distributive property

Summary (2 minutes) have students show the distributive property and area model. Define product and factors

Task (15 minutes): Purpose of the task is to draw area model to write standard form into factored form and factored form into standard form.

Note: Tiles are not needed since it is covered in Algebra I. However if needed, teachers can use the tiles to draw a rectangle to make the model more concrete.

- The task can be tried independently first then teacher can pair students into 2 to 3 per group.
- As the students are working teacher will monitor and select students to call on during the summary of the task.
- The look for's are the area model to write standard forms and then using the same model to write the factored form.
- Teachers can call on certain students (pre-selected during monitoring) to go over the look for's.

Mini Lesson: **Use the concept of area model** to introduce other methods for factoring a quadratic expression (i.e. FIOL,…)

Guided Practice (15 minutes)

Summary: 10 minutes

Independent Practice (15 minutes) First two question no calculator. 3rd question calculator is allowed

Closure: (4 minutes)

Exit Ticket (5 minutes)

Opener/Do Now

Write the factored form $(x-\ 6)(x+2)$ into standard form ax^2+bx+c

Identify the following two terms from the above question:

Product **Factor**

Task : **Re-write the functions in standard form or factored form. Also show the area model for each function (No Calculator)**

Standard form	Area Model	Factored Form
		1. $(x+3)(x+2)$
		1. $(x+1)(x+2)$
		2. $(x-3)(x+4)$
		3. $(x-4)(x+2)$
		4. $(x-3)(x-5)$

5. $x^2 + 10x + 24$		
6. $x^2 + 10x + 24$		
7. $x^2 + 5x - 6$		
8. $x^2 - 5x + 6$		

Guided Practice:

Write the factored form of the following standard form of quadratics using the area model for #1 - #5, choose any methods to rewrite the quadratic function in factored form for #6 - #12

Standard form: f(x) =	Area Model	Factored Form
1. $x^2 + 9x + 18$		
2. $x^2 + 7x + 12$		
3. $x^2 + 11x + 18$		
4. $x^2 + 14x + 24$		
5. $x^2 - 2x - 15$		
6. $x^2 + 3x - 18$		

7. $x^2 - 7x + 12$		
8. $x^2 - 17 + 72$		
9. $x^2 + 8x - 24$		
10. $3x^2 + 9x + 6$		
11. $4x^2 - 8x - 60$		
12. $x^2 + 0x - 16$		

Independent Practice: Write the factored form of the following standard form of quadratics using the area model for #1 - #5, choose any methods to rewrite the quadratic function in factored form for #6 - #10

Standard form g(x) =	Area Model	Factored Form
1. $x^2 + 17x + 30$		
2. $x^2 - 12x + 32$		
3. $x^2 - 13x - 48$		
4. $5x^2 + 50x + 80$		
5. $x^2 + 0x - 25$		
6. $2x^2 - 20x - 48$		

7. $3x^2 - 21x + 48$		
8. $4x^2 + 0x - 100$		
9. $-2x^2 + 4x + 15$		
10. $-x^2 + 7x - 6$		

Algebra II Unit 1

Lesson 1.2b:

- Students will solve quadratic equations in standard form by factoring or graphing and sketch the graph to show key features. A.REI.4, F.IF.7, A.RE.11

Pre-requisite: Student must know how to factor, use zero product property to find zero, and use graphing calculator to find point of intersection.

Opener: Purposed of the opener is to review the zero product property (which is covered in algebra 1)

Task (15 minutes):

Purpose of the task (Q1 –Q 4)

- Is to show that zeros can be found without using the calculators. Knowing how to factor will help solving quadratic equations when it is factorable. The task also emphasizes on the key features and multiple representation of the quadratic function through a rough sketch.

Purpose of the task (Q5)

- Is to help students understand that finding zero or roots is not the only way to solve a quadratic equation. It all depends on what the question is asking. Finding the point where to sides of the equation equal to each other is also solving the equation. Finding zero is also finding point of intersection, because the equation g(x) is intersecting at f(x) = 0.

During the task

- The task can be tried independently first then teacher can pair students into 2 to 3 per group.
- As the students are working teacher will monitor and select students to call on during the summary of the task.
- The look for's are correct factored form and zeros of the function, y intercept from the standard form and a rough sketch of the quadratic function. Students will need to turn their graph at the midpoint of the x intercepts to make the graph symmetrical. A common misconception during sketching is that students turn their graph at the y intercept, when they are supposed to cross the y-intercept and turn at the axis of symmetry. .
- Teachers can call on certain students (pre-selected during monitoring) to go over the look for's

Guided Practice (15 minutes)

Summary: 10 minutes

Independent Practice (15 minutes) First two question no calculator. 3rd question calculator is allowed

Closure: (4 minutes)

Exit Ticket (5 minutes)

Opener/Do Now:

Without using the calculator find the zeros of the following factored forms:

$(x - 3)(x - 1) = f(x)$ $(2x - 4)(x + 5) = f(x)$

Algebra II Unit 1

Task

Without using the calculator find the zero of the following quadratic functions and create a rough sketch showing the key features such as zeroes, concavity, y intercept and axis of symmetry

Functions	Sketch
1. $x^2 + 5x - 6 = f(x)$	
2. $x^2 - x - 6 = f(x)$	
3. $x^2 + 3x - 18 = f(x)$	
4. $x^2 + 10x + 16 = f(x)$	

5. Mike and Julie are solving the following equations

$x^2 - 5x - 6 = 2x + 12$

Below are the methods Julie and Tom used to solve this equation

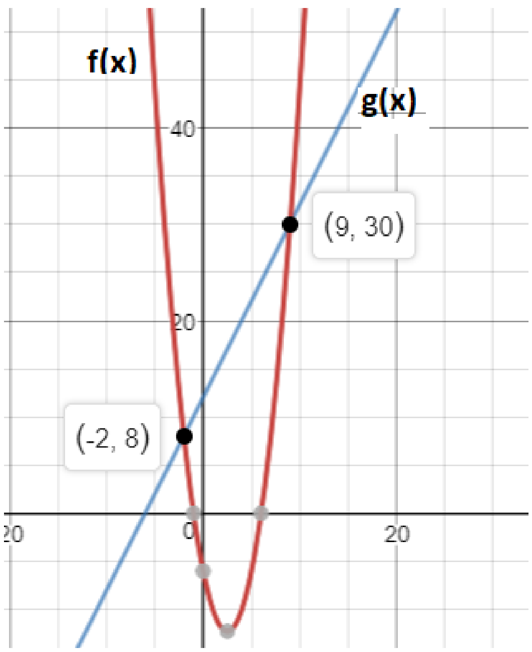
<table>
<tr><th>Julie's Method</th><th>Mike Method</th></tr>
<tr><td>

$x^2 - 5x - 6 = 2x + 12$

f(x) = $x^2 - 5x - 6$

g(x) = $2x + 12$

Then she graphed these two functions by using a graphing calculator.



x = -2
x = 9

</td><td>

$x^2 - 5x - 6 = 2x + 12$

$x^2 - 5x - 6 - 2x - 12 = 0$ subtract 2x and 12 from Both sides

$x^2 - 7x - 18 = 0$ combine like terms on the left hand Side

$(x - 9)(x + 2) = 0$ Write the factored form to reveal zeroes

$x - 9 = 0$ $x + 2 = 0$
$+9 \quad +9$ $-2 \quad -2$
$x = 9$ $x = -2$

</td></tr>
</table>

Is solving a quadratic equation is the same as finding zero or finding the point of intersection? Explain your reasoning.

Guided Practice:

Solve for the value of x that will make the following equations true using Either Julie's method and Mike's method

Mike's Method	Julie's Method
1. $x^2 - 9x + 20 = 6$	Graph
2. $x^2 + 2x = 6x + 12$	Graph

3. $x^2 - 30 = 6 - 0x$	Graph
4. $x^2 + 8 = 11 - 2x$	Graph

Independent Practice:

Solve for the value of x by using both algebraically and graphically

1. $2x^2 - 12x = x^2 + 32$	Graph
1. $x^2 + 3 = x + 9$	Graph

Lesson 1.2 c– A.RE.I4, F.IF.4 F.IF.7 Transition lesson – If needed

Given a vertex form of the quadratic function Students will

- Identify key features of the vertex and sketch the function using vertex
- Using the vertex form the graph, re-write the standard form into the vertex form

Pre-requisite: Student must know to use graphing calculator to identify the vertex.

Opener/Do Now:

Use a graphing calculator to find the coordinate pairs of the zeros and vertex for the function below

$f(x) = \frac{1}{2}(x + 6)(x - 2)$

Purpose of the Opener: Review the graphing calculator skills for finding zeros and vertex

Task (20 minutes):

Purpose of the task:

- See that the standard form can be written as vertex form.
- Vertex form is good for identifying A.O.S. and vertex.

During the task

- The task can be tried independently first then teacher can pair students into 2 to 3 per group.
- As the students are working teacher will monitor and select students to call on during the summary of the task.
- The look for's correct key features, correct sketch, and that student notices the standard form and vertex form is the same equation, however the vertex form reveals the vertex and standard form reveals the y-intercept. Students may also notice that the axis of symmetry is opposite in the equation. For example: $y = (x - 3)^2$ has a A.O.S of $x = 3$

During the summary

- Teachers can call on certain students (pre-selected during monitoring) to go over the look for's
- Teacher needs to introduce the vertex form of the equation $a(x - h)^2 + k = y$

Guided Practice (15 minutes)

Summary: 10 minutes

Independent Practice (15 minutes) First two question no calculator. 3rd question calculator is allowed

Closure: (4 minutes)

Exit Ticket (5 minutes)

Task
Part I: Consider the following equations:

B. $f(x) = -2x^2 + 12x - 13$ B. $g(x) = -2(x - 3)^2 + 5$ c. $h(x) = x^2 – 8x + 10$ d. $k(x) = (x - 4)^2 - 6$

2. Using the graphing calculator, sketch the graph of each function.
   Label the key features: vertex, axis of symmetry, y-intercept, x-intercepts.

$f(x) = -2x^2 + 12x - 13$ Sketch: Zeroes__________ vertex:___________ y-intercepts:_________ A.O.S	$g(x) = -2(x - 3)^2 + 5$ Sketch: Zeroes__________ vertex:___________ y-intercepts:_________ A.O.S
$h(x) = x^2 – 8x + 10$ Sketch: Zeroes__________ vertex:___________ y-intercepts:_________ A.O.S	$k(x) = (x - 4)^2 – 6$ Sketch: Zeroes__________ vertex:___________ y-intercepts:_________ A.O.S

2. What key features you can notice directly from equations A, B, C and D.

Guided Practice

Without a calculator Sketch the graphs for the following equations and showing the key features and label them on your graph.

$y = (x + 1)^2 - 3$

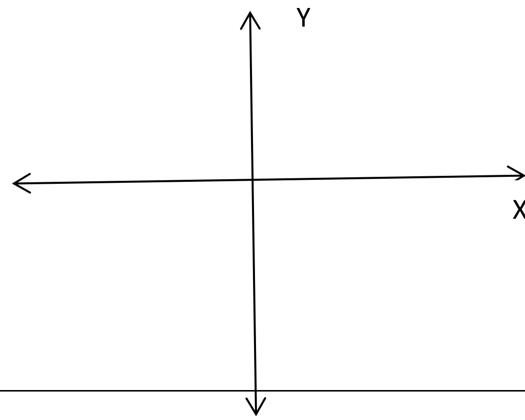
Graph:

Vertex: (,   )

Axis of Symmetry: x = __________

Concave up or down?

y-intercept: (,   )



$y = -(x + 3)^2 + 5$

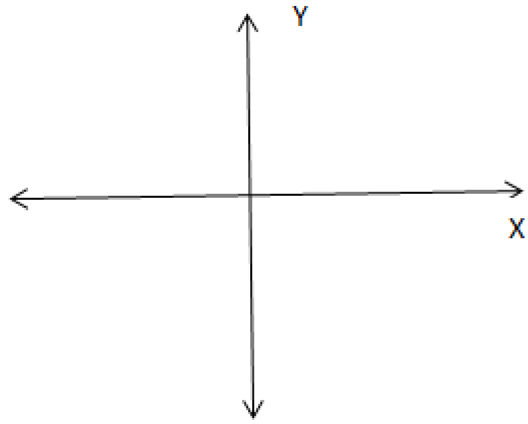
Graph

Vertex: (,   )

Axis of Symmetry: x = __________

Concave up or down?

y-intercept: (,   )



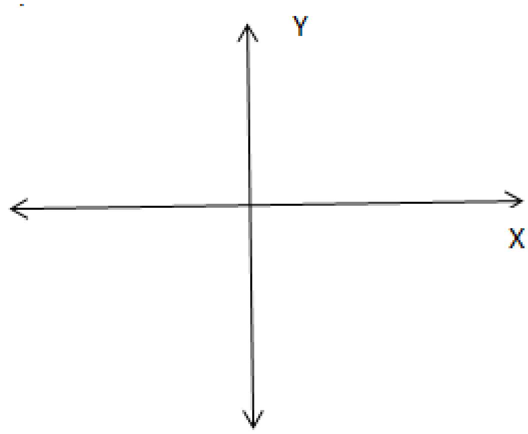
$y = (x - 3)^2$

Vertex: (,   )

Axis of Symmetry: x = __________

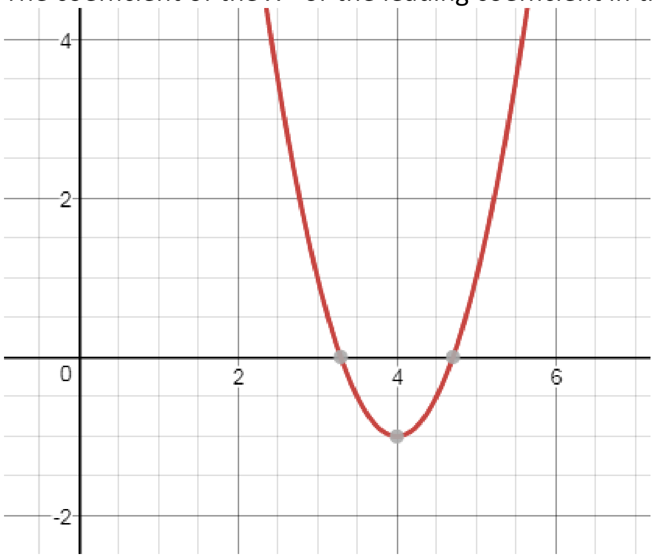
Concave up or down?

y-intercept: (,   )



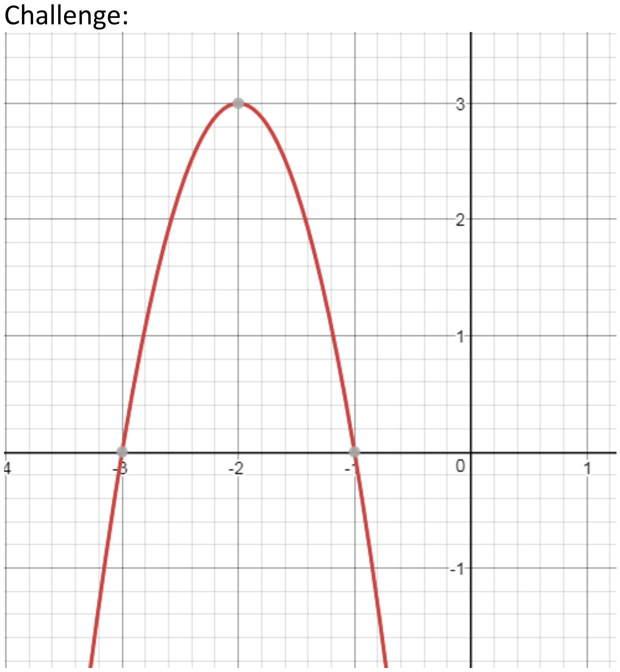
2. Write equations in vertex form for the graphs given.

The coefficient of the X^2 or the leading coefficient in the equation is “2”



Equation:

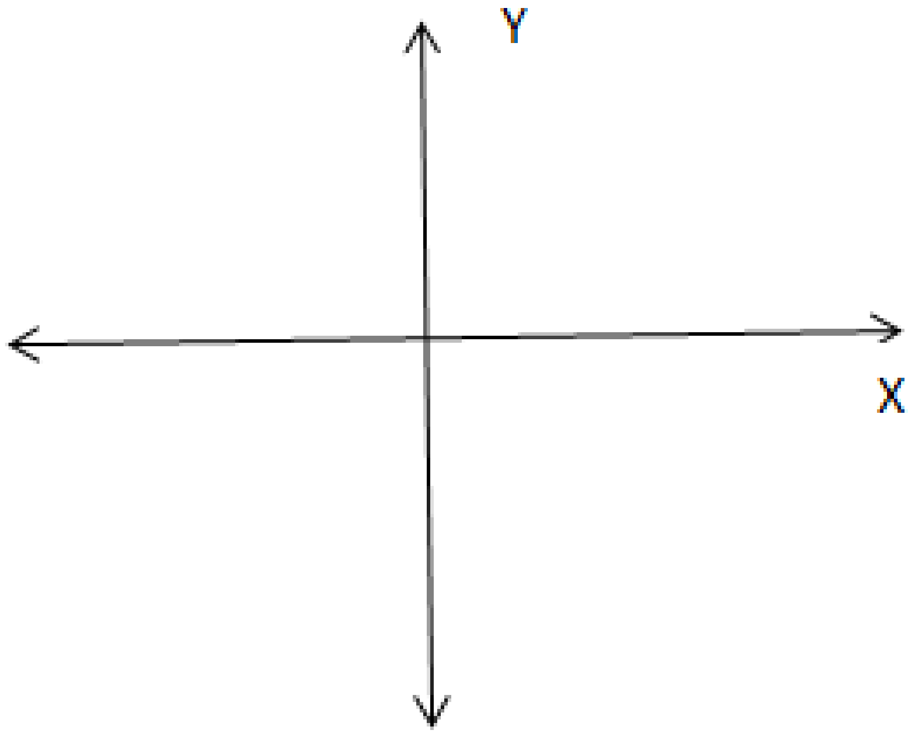
Challenge:



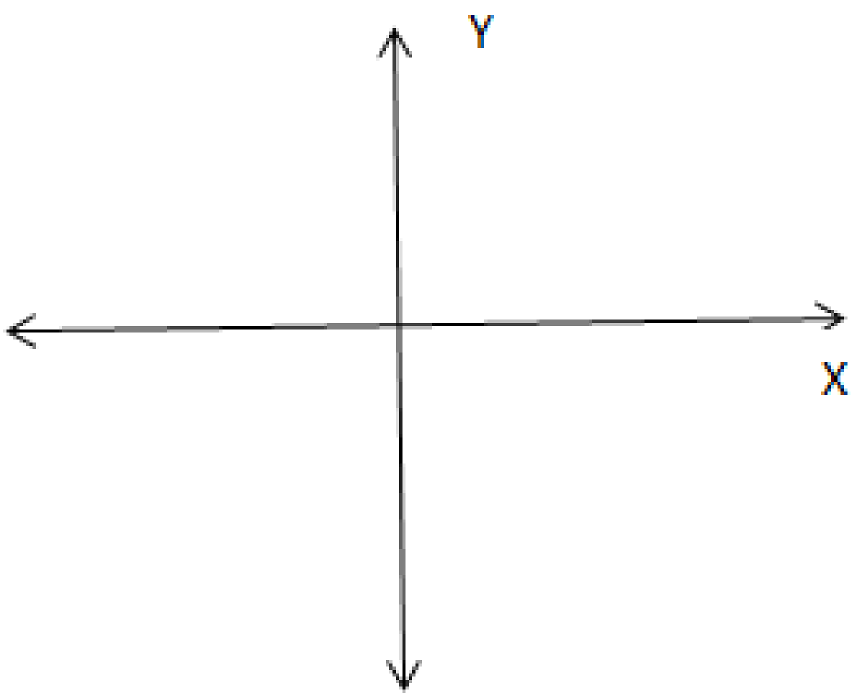
Equation

Independent Practice:

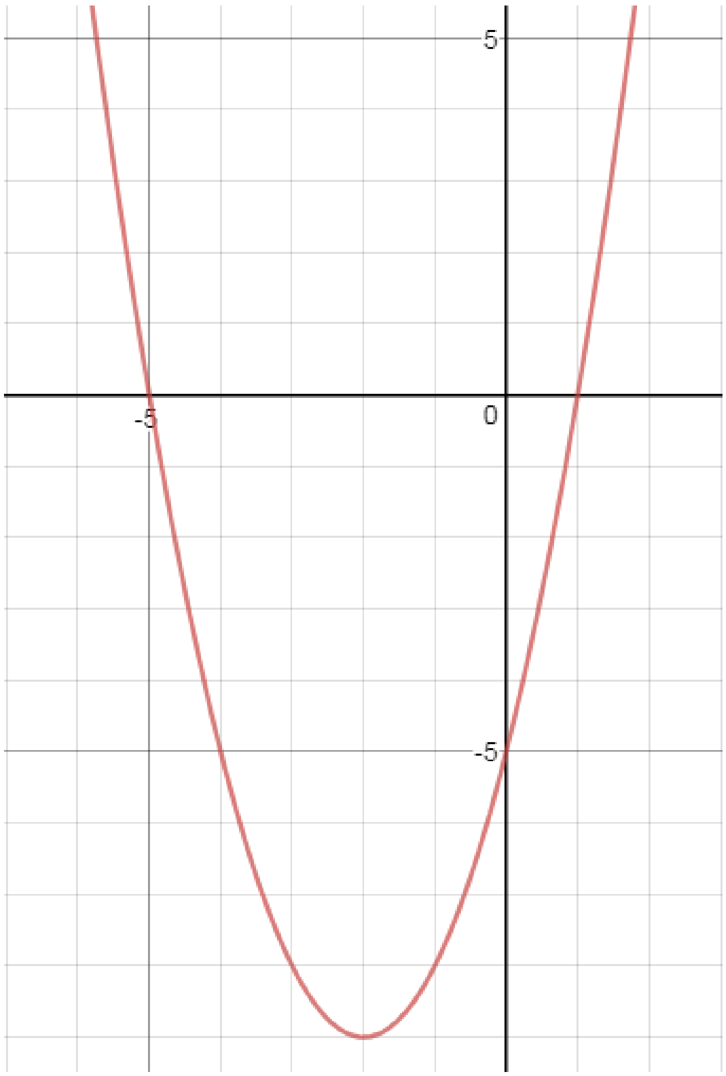
Sketch the graph for the equation given and find the key features $y = 2(x - 4)^2 - 1$



Sketch the graph for the equation given and find the key features $y = (x + 1)(x - 3)$



Find **the key features** and write the **equation in vertex form** for the graph below (the leading coefficient of the equation is 1)



Agile Mind Topics

Topic 4: Building New functions

Topic Objectives (Note: these are not in 3-part or SMART objective format)

1. Identify polynomial functions from linear and quadratic functions
2. Add, subtract, and multiply polynomial expressions
3. Identify the interval or increasing and decreasing functions from a graph
4. Use interval notation to describe a part of a graph
5. Identify odd and even functions from graphs
6. Define rational expression
7. Simplify rational expression

Focused Mathematical Practices

- MP 2: Reason abstractly and quantitatively
- MP4: Model with mathematics
- MP 5: Use appropriate tools strategically
- MP 6: Attend to precision
- MP7: Look for and make sense of structure

Vocabulary

Polynomial expression, polynomial function, rational expression, rational function, leading coefficient, increasing function, decreasing function, concavity, inflection point, interval notation, odd function, and even function

Fluency

- Compare and contrast the parent functions
- Simplify Algebraic expressions
- Multiply binomial and trinomial
- Factor trinomials in standard form

Suggested Topic Structure and Pacing

day	Objective(s) covered	Agile Mind "Blocks" (see Professional Support for further lesson details)	MP	Additional Notes
Day 1	1 & 2	*Block 1* *Block 2*	2,4,5	Overview is optional Explore (Building Polynomial) page 1-6
Day 2	1 & 2	*Block 3*	2, 4, 5,	Explore (Building Polynomial) page 7-11
Day 3	3, 4	*Block 4*	4,5, 6	Explore "Quadratic and cubic" page 1,2, 3, 6, and 7 Skip pages 4,5,8 and 9 Introduce interval notation on slide 3
Day 4	5	*Block 4*	4,5,6	Explore "Quadratic and Cubic" page 10 and 11 Department will provide supplements for identifying even and odd functions algebraically and graphically
Day 5	6, 7	*Block 5*	2, 8	Explore "Building rational from polynomial" page 1 and 2 (Students only need to "simplify") Department will provide supplements or the standard A-APR.6

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/Resource
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.	***Day 1*** ***Review*** • Algebraic Expressions, binomials, parent function ***New*** • Polynomials • Adding subtracting and multiplying polynomials will result in new polynomials • Structure of polynomial (leading coefficient, constant term, degree..etc)	***Day 1*** ***Review*** • Simplify algebraic expressions by distributive property and combing like terms • Multiply binomials • Compare and contrast the parent functions learned in previous unit ***New*** • Create cubic function for the problem given	***Day 1*** Agile Mind Topic 4 *** Overview** *** Exploring** "Building polynomials " **P 1 – 6** Suggested assignment: SAS 1 Q4a – d More practice 1 – 6 *Overview is optional.
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. A-CED.2: Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	***Day 2 (concept)*** ***REVIEW*** • Understand the graph of inequality • Function domain & range ***New*** • Graph of cubic function	***Day 2 (skills)*** ***Review*** • Graphing linear equation or inequality • Solving linear inequality (1 variable) ***New*** • Graph cubic function (graphing calculator) • Find maximum or minimum from a graph given	***Day 2 (Material)*** Agile Mind Topic 4 *** Exploring "Building polynomials"** **P 7– 11** **Suggested assignment** **SAS 2 Q9a – c and Q10 a-d** **More Practice 5-6**

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.~~	**Day 3 (Concept)** ***Review*** • Domain of a function, , linear function, quadratic function ***New*** • Cubic expressions and cubic functions • Increasing and decreasing function • Point of inflection • Interval notation • Rate of change makes a difference in the increasing or decreasing function	***Day 3 (Skills)*** ***Review*** • Multiplying three binomials • Graphing Linear equation ***New*** • Graphing cubic function • Describe behavior of a function for an interval given (in terms of increasing, or decreasing) Use the interval notation to describe for what values of x the graph is increasing or decreasing	**Day 3 (Material)** **Agile Mind** **Topic 4** ***Exploring "quadratic and Cubics"** **P 1,2,3,6, and 7** **Suggested assignment:** **SAS 3 Q14a-c** **GP P1-5** **Moe Practice** **P 7 only** ***skip pages 4,5,8, and 9** **However introduce interval notation on slide 3**

F-BF.3. Identify the effect on the graph of replacing ~~f(x) by f(x) + k, k f(x),~~ f(kx), ~~and f(x + k)~~ for specific values of k (both positive and negative); ~~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.	***Day 4 (Concept)*** ***Review*** • Rotation, Reflection ***New*** • Definition of even and odd functions • Definition of Line symmetry Point symmetry	***Day 4 (Skills)*** ***Review*** • Rotating shapes on a coordinate plane • Reflecting lines over line ***New*** • Sketching graphs given intervals where the function is concave up or down and given the point of inflection • Determining whether a function is even or odd graphically • Determining whether a function is odd or even algebraically	**Day 4 (Material)** Agile Mind Topic 4 *** Exploring** "Quadratic and Cubic" **P10 - 11** SAS 3 Q15a – c GP 7 – 10 MP pg. only 11 Department provide supplements for identifying even and odd functions algebraically, graphically
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. -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. F-IF.1: Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then f(x) denotes the output of f corresponding to the input x. The graph of f is the graph of the equation y = f(x)	***Day 5 (Concept)*** ***Review*** Polynomial equation ***New*** • Definition of rational function • Rational expression can be formed by dividing polynomial expressions	***Day 5 (Skills)*** ***Review*** Factor trinomial Factor perfect squares Long division (number_ ***Block 4 : New*** • Use Polynomial division to simplify rational expression (only do long division, NO SYNTHETIC DIVISION) Write rational expressions from the polynomials Factor to simplify rational functions	**Day 5 (Material)** Agile Mind Topic 4 *** Exploring** "Building rational from polynomials" **P 1 – 2 only** **MP 12, 13, 14** * When simplifying rational expressions, the degree in the numerator and denominator is limited to 2

Topic 5: Polynomial function

Topic Objectives (Note: these are not in 3-part or SMART objective format)

1. Understand the relationship between the degree of a polynomial and the number of real zeroes it has, as detailed in the Fundamental Theorem of Algebra and related theorems.
2. Understand the relationship between the degree of a polynomial function and the number of local extreme values of the function.
3. Describe the end behavior of polynomials of odd and even degree
4. Determine the number of zeroes in higher order polynomials
5. Use the quadratic formula to find zeroes of a 2nd degree polynomial
6. Determine the end behavior of the higher order polynomials

Focused Mathematical Practices

- MP 2: Reason abstractly and quantitatively
- MP4: Model with mathematics
- MP 5: Use appropriate tools strategically
- MP 6: Attend to precision
- MP7: Look for and make sense of structure

Vocabulary

- Linear Function, Quadratic Function, Cubic Function, Polynomial, Periodic function, Leading coefficient, Degree of a polynomial, increasing function, decreasing function, absolute or global maximum or minimum, local maximum or minimum, Concavity, interval notation, long term or end behavior, zeros of a function, inflection point

Fluency

- Using Inequality
- Graphing linear and quadratic function
- Concept of x intercepts (zeroes)
- Factoring trinomials to find zeroes
- Using the quadratic formula to solve quadratic equations
- Identifying leading coefficients and leading degree

Suggested Topic Structure and Pacing

Day	Objective(s) covered	Agile Mind "Blocks" (see Professional Support for further lesson details)	MP	Additional Notes
1	1	*Block 1* *Block 5*	2, 3,8	Overview – Pages 1-2 Exploring "Polynomial behavior" Pages 1 – 11
2	2,3	*Block 2* *Block 5*	2, 5,6	Exploring "Long-term behavior and zeros" Pages 1 – 9 Question on page 8 will be changed
3	3, 4	*Block 3*	2, 5, 6, 7	Exploring "Higher degree polynomials" Pages 1 – 7 Page 1 will be exchanged with supplements. Please see the drobox (This day focuses on zeroes of higher order polynomials)
4	5, 6	*Block 4*	2,4,6,7	Exploring "Higher degree polynomials" Pages 8 - 11 Page 1 will be exchanged with supplements. Please see the drobox (This day focuses on end behavior of higher order polynomials)

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/Resource
1)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. 2)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.~~	***Day1 (Concept)*** ***Review:*** • Linear function, and quadratic function Graphing • Domain and Range of functions ***New*** • Understand behavior of the cubic function with different coefficients • Understand Global/Absolute max and min the quadratic • Local/Relative max and min • Define the characteristics of cubic function	***Day 1 (Skills)*** ***Review*** • Graphing linear function and quadratic function • Identifying domain and range ***New*** • Describe behavior of the cubic function. • Identify Global max and min of cubic function from a graphing given • Analyze key features of cubic function	**Day 1 (Material)** Agile Mind Topic 5 *** Overview** *** Exploring** "Polynomial behavior " P 1-11 SAS 1 and 2 Suggested assignment: SAS 2 Q8, 9, 1a-b, 12a-c More Practice 1 For question 10 on SAS 2 use graphing calculator
3)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. a. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. 4)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,	***Day 2 (Concept)*** ***Review*** • X intercept and y intercept ***New:*** • Definition End Behavior • Meaning of Zeroes of a function	***Day 2 (Skills)*** ***Review*** • Determine x intercept and y intercept from a table, graph ***New:*** • Identify end/long term behavior of a function • Determine number of zeroes in a function • Graphing functions with given zeroes ,the interval where function increases and decreases • Comparing max and min from represented with graphs and tables (	**Day 2 (Material)** Agile Mind Topic 5 Exploring " Long – term behavior and zeroes " P 1 – 9 SAS 3 Guided Practice P 1 – 11 More Practice

say which has the larger maximum 5)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.	***Day 3 (Concepts)*** ***Review:*** • Definition of X intercept s • Definition of Polynomials • Definition factors ***New:*** • How the number of zeroes related to the degree of a polynomial	***Day 3 (Skills)*** ***Review:*** • finding X intercept s from graphs and equations • Definition of Polynomials • factors trinomials • use discriminants to see if there is a real solution ***New:*** • Identify zeroes from a graph given or function in factor form	**Day 3 (Material)** Agile Mind Topic 5 Exploring " Higher order polynomials " P 1 – 7 SAS 4 Guided Practice note: skip page 1. additional supplements will be provided for page 1 and 2 (see drobox)
6)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 polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.	***Day 4 (Concept)*** ***Review:*** End behavior of a cubic polynomial ***New:*** • The relationship between end behavior and leading coefficient in high order polynomial • zeroes of the higher order polynomials • how the end behavior related to "odd" or "even" **degree** function	***Day 4 (Skills)*** ***Review:*** • X intercept s • End behavior of a cubic polynomial ***New:*** • Describe End behavior for higher order polynomials given in algebraic rules • Find zeroes of the higher order polynomials for a graph given	**Day 4 (Material)** Agile Mind Topic 6 Exploring " Higher order polynomials " P 8 - 12 SAS 4 More practice Pages 8 - 11 note: skip page 8 additional supplements will be provided for page 8 (see drobox)

Topic 6: Polynomial Equation

Topic Objectives (Note: these are not in 3-part or SMART objective format)

After completing the topic polynomial equations, students will be able to

1. Define and use imaginary and complex numbers in the solution of quadratic equations
2. Use the discriminant of a quadratic equation to determine the number and type of roots of the equation;
3. Use polynomial long division to solve problems;
4. Factor the sum and difference of two cubes;
5. Factor polynomial expressions by grouping;
6. Solve polynomial equations with real coefficients by applying a variety of techniques in mathematical and real-world problems;
7. Understand the implications of the Fundamental Theorem of Algebra and the Remainder Theorem.

Focused Mathematical Practices

- MP 2: Reason abstractly and quantitatively
- MP 4: Model with mathematics
- MP 5: Use appropriate tools strategically
- MP 6: Attend to precision
- MP 7: Look for and make use of structure

Vocabulary

Quadratic formula, Imaginary numbers, complex numbers, discriminant, real roots and complex roots

Fluency

- Factoring Trinomials
- Using the quadratic formula to solve quadratic equations
- Solving simple quadratic equations
- Graphing quadratic function

Suggested Topic Structure and Pacing

Day	**Objective(s) covered**	**Agile Mind "Blocks"** (see Professional Spport for further lesson details)	**MP**	**Additional Notes**
1	1	*Block 1* *Block 2*	2,4,5	Over view Exploring " quadratic equation" page 1-5 Note: Students do not to draw the area
2, 3	2 and 3	*Block 3* *Block 4*	2, 4, 5,7	Exploring "quadratic equation" Pages 6- 12. Exploring " complex number" pages 1 – 5 Note: Avoid Synthetic division
4	3,4	*Block 5*	4, 5 7	"Other polynomial equation" page 1- 10 Note: Avoid Synthetic division
5	5-6	*Block 6*	4, 7	"Other polynomial equation" page 11- 18 Note: Avoid Synthetic division
6	7	*Block 7*		"Theorems of algebra" page 1-7

CCSS	Concepts What students will know	Skills What students will be able to do	Material/Resource
1) A.SSE.3: Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. a. Factor a quadratic expression to reveal the zeros of the function it defines. 2) 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 3) 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.	***Day1 (Concept)*** ***Review*** • Quadratic and cubic function, • Effect on the graph of f(x+k), f(x)+k, kf(x), f(kx) for the parent function f(x) • Definition X intercepts ***New*** • Understanding Real zeros and real roots on the graph • Understanding how transformation can show zeroes of the quadratic function • Definition of point of intersection vs. zero of a function	***Day 1 (Skills)*** ***Review*** • Graphing quadratic and cubic function,(by hand or graphing calculator) • Using quadratic function to model problem situation • Factoring trinomial to solve quadratic equation • Using transformation to find the zeroes of the quadratic equation ***New*** • Identifying Number of real zeroes and number of real roots • Applying transformation to find roots of the polynomials	**Day 1 (Material)** Agile Mind Topic 6 *** Overview** *** Exploring** "Quadratic Equation " P 1-5 SAS 1 and 2 Suggested assignment: SAS 2 Q6 a – d and Q8, 9a-e, 10, and 11 a - b Guided Practice Pg. 1 - 4

4) 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 5) N-CN-2: Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers. 6) N-CN.7: Solve quadratic equations with real coefficients that have complex solutions 7) N-CN.8: +) Extend polynomial identities to the complex numbers. For example, rewrite $x^2 + 4$ as $(x + 2i)(x - 2i)$. 8) A-REI.4: Solve quadratic equations in one variable. b. Solve quadratic equations by inspection (e.g., for x 2 = 49), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a ± bi for real Numbers a and b	***Day 2, 3 (Concept)*** ***Review:*** • Quadratic formula and graph • Definition of Whole numbers, integers, real numbers, rational numbers, • Concept of discriminant ***New:*** • Definition of Non-real complex roots of quadratic equations • Connection of non-real root complex solutions to the graph of the associated quadratic function • Definition of complex number	***Day 2, 3 (Skills)*** ***Review*** • Using quadratic formula to solve quadratic equation • Solving simple quadratic equation • Identifying the number system • Multiplying binomials • Simplifying algebraic expressions • Use discriminant to decide number of real roots for quadratic function ***New*** • Use the quadratic formula to determine roots and connect non-real complex solutions to the graph of the associated quadratic function • Perform arithmetic operation with complex numbers	**Day 2, 3 (Material)** Agile Mind Topic 6 *** Exploring** "Quadratic Equation " P 6 – 12 *** Exploring** "Complex number " SAS 2 and 3 Suggested assignment: SAS 2 Q20a-c *More practice* p1-5 SAS 3 SAS 3 Q7a-b, 8a-b, and 9 *More practice* p6-8
~~9)~~ 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~~ 10) A-APR.4: Prove polynomial identities and use them to describe numerical relationships. For example, the polynomial identity $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ can be used to generate Pythagorean triples. 11) A.SSE.2: Use the structure of an expression to identify ways to rewrite it. For example, see $x^4 - y^4$ as $(x^2)^2 - (y^2)^2$, thus recognizing it as a difference of squares that	***Day 4 (Concepts)*** ***Review:*** • Concept of long division (with whole numbers) • Sum and difference of the squares • Square of the sum and difference • x intercepts from graphs ***New:*** • Definition of polynomial equations • Understand the concept of polynomial division is the same as whole number division	***Day 4 (Skills)*** ***Review:*** • Perform long division with whole numbers • Factor trinomials with a = 1 and a>1 • Expanding sum and difference of the squares • Expanding square of the sum and difference • Determining x intercepts from graphs ***New:*** • Using long division to factor cubic polynomial • Solving cubic polynomials	**Day 4 (Material)** Agile Mind Topic 6 *** Exploring** "Other Polynomial equation " P 1-10 Suggested assignment: SAS 4 Q10 *More practice* p9-13

can be factored as $(x^2 - y^2)(x^2 + y^2)$ ~~12)~~ 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.~~	• New terms: sum/difference of two cubes	• Expanding/factor sum and difference of the cubic polynomials	
	Day 5 (Concept) ***Review:*** • Long division (with whole numbers) • Factoring • GCF ***New:*** • Understand "factor polynomial" by area model • Understanding factoring by grouping	***Day 5 (Skills)*** ***Review*** • Factoring simple quadratic expressions by factoring Greatest common factor. • Factoring Trinomials using greatest common factor ***New:*** • Factoring Cubic polynomial by: Area model, grouping and using GCF	**Day 5 (Material)** Agile Mind Topic 6 *** Exploring** "Other Polynomial equation " P 11-18 Suggested assignment: SAS 4 Q15 and 16 More practice p14-16 Guided practice
13) 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). 14) 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.	***Day 6 (Concept)*** ***Review:*** • Long division with a remainder • Quotient, divisor, remainder ***New:*** • Concept of Fundamental theorem of Algebra • Concept of Remainder theorem • Understand the implications of the Fundamental Theorem of Algebra and the Remainder Theorem	***Day 56(Skills):*** ***Review*** • Rewrite the solution to long division as the quotient, divisor and remainder • Long division of the polynomial ***New:*** • Use remainder theorem to find the zeros for a function given • Use remainder theorem to decide if the function has a zero "a" if the value of f(a) is given	**Day 6 (Material)** Agile Mind Topic 6 *** Exploring** "Theorems of Algebra " SAS 5 Q8 More practice p17-20

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) Task (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 (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) Class Activity (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 slip

MTSS MODEL

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 25 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		

Algebra II Unit 1

Sample Lesson Plan (Agile Mind)

<table>
<tr><td>Lesson</td><td>Topic 4 Building polynomials Exploring “Quadratic and cubic”</td><td>Days</td><td>1</td></tr>
<tr><td>Objective</td><td>By using the concept of breathing and the definition of increasing, and decreasing functions SWBAT
Visualize and identify cubic polynomial
Identify the interval where the cubic function is increasing and decreasing
Use interval notation to describe where the concavity and point of inflection
Sketch a graph using the given interval
And show their mastery completing at least 4-4 independent practice problem and 1/1 problems on the DOL correctly</td><td>CCSS</td><td>A.APR.1</td></tr>
<tr><td>Learning activities/strategies</td><td colspan="3">Materials needed: Computer with projection device, transparency to insert the activity sheets, and activity sheet

Fluency Practice: (5 minutes) Graphing inequality on the number line. Quickly go over the concepts and notations used to include a point on the line or not include a point on the line.

Do Now (5 minutes):
Provide the breathing cycle graph to students from yesterday’s lesson and ask “How is the volume of the air in the lung changes shown by the graph.
During the summary ask guided questions such as “as you breathe in does the volume of air increases or decreases?” “As you breathe out does the volume of air increases or decreases? Discuss the rate of the volume also by asking “when is the rate of air increasing faster” students should see from the graph that it’s increasing aster at the beginning as you breath in the air. And it slows down as your lung is filled with air.
Starter/Launch (2 minutes):
Ask students if they think of any other situation where they might see quadratic or cubic polynomials. Introduce the objective of the day and the importance of polynomial in real life
Mini lesson and practice (20 minutes):
Display page 2 from “explore” to introduce the definition of increasing and decreasing function. Have students write the definition down in question 1 SAS 3.
Ask students to show using arrows on the graph where the function is increasing and where the function is decreasing then ask them to hold up their transparency sheet with the activity sheet in it check their answer.
Ask students to use inequality to write the interval where the function is increasing and where the function is decreasing
Display page 3 and play animation slide 1 and 2 for students to see the rate of change for a simple linear and cubic function . Students will complete question 3 SAS3
Guided question: what is happening to rate of change before zero and after zero?
Play animation slide 3 and 4 for students check their answer</td></tr>
</table>

	• Use the animation on page 4 to introduce students to concavity and inflection point on graph as well as the interval notation. Students will complete question 4 from SAS 3 • Use page 6 to illustrate interval notation for students. Point out that often context is the only thing that distinguishes interval notation from ordered pair notation. (Misconception: Students might see the interval notation as ordered pair, which is not the same) **Group work/ Partner work (15 minutes)** Students will complete the puzzle on page 7 and 8 with a partner or in their respective group (SAS 3 questions 5 and 6) Summarize by asking students to come to the smart board and complete the puzzle on Agile mind. **Independent Practice (10 minutes):** • Re-inforce SAS 3: question 14 More practice page 7-10 • Summarize as a class **Closure (2 minutes):** • Ask what is an increasing function, decreasing function, concave up, concave down and point of inflection. **DOL (5 minutes):**

Supplement Materials

Tasks			
CCSS	SMP	Dropbox location and filename	Link (original task and answer key)
F.IF.4, 5, 7, A.APR,3		9-12 Dropbox> curriculum algebra 2>Tier1/2 > Unit 2 > Performance Assessment> Task1	**https://www.dropbox.com/work/Orange%209-12%20Math%202016-17/Curriculum%20Algebra%202/Tier%201/Unit%202/Performance%20Assessment/Task%201?preview=Algebra+2+Unit+2+Performance+task+1+Box+Volume.docx**
HS.C.18.4		9-12 Dropbox> curriculum algebra 2>Tier1/2 > Unit 2 > Performance Assessment> Task2	https://www.dropbox.com/work/Orange%209-12%20Math%202016-17/Curriculum%20Algebra%202/Tier%201/Unit%202/Performance%20Assessment/Task%202?preview=Unit+2+Performance+Task+2.docx

ELL/SWD supplement link

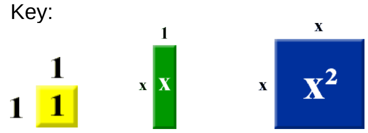
http://nlvm.usu.edu/en/nav/vlibrary.html
http://www.explorelearning.com/index.cfm?method=cResource.dspBrowseCorrelations&v=s&id=USA-000
http://www.thinkingblocks.com/

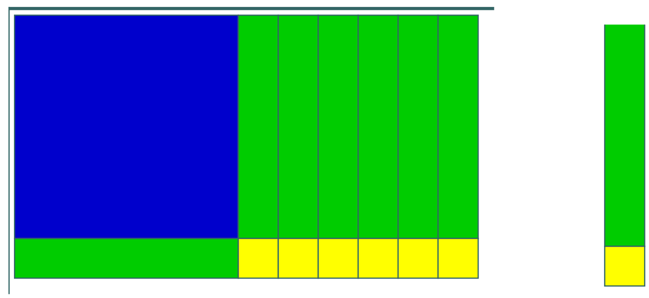
Multiple Representations

Multiple Representation (Dividing Polynomial)

Concreted Model

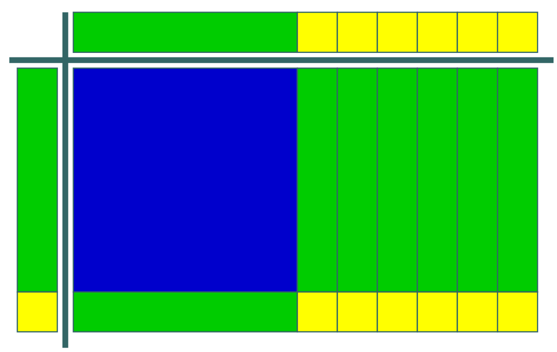
Key:





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

Quotient Q(x)=(x + 6)



Divisor D(x)=(x + 1)

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

Symbolic (Polynomial Long Division)

$$
\begin{array}{r|l}
 & x + 6 \\
\hline
x + 1 & x^2 + 7x + 6 \\
 & x^2 + x \\
\hline
 & 6x + 6 \\
 & 6x + 6 \\
\hline
 & 0
\end{array}
$$

Remainder R(x) = 0

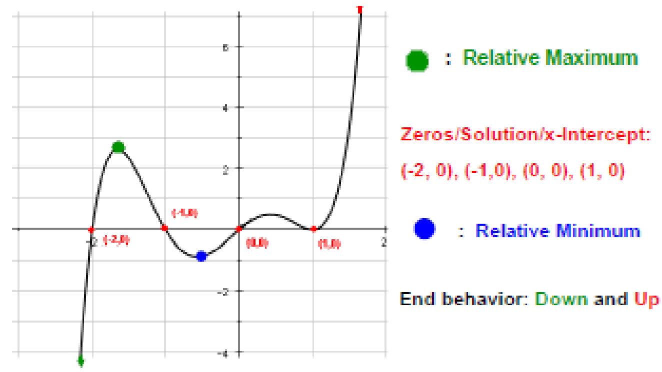
Divident = (Divisor)(quotient) + Remainder

P(x) = D(x)Q(x) + R(x)

Polynomial Graph

Using graph to show vocabulary

Key features of polynomial function graph

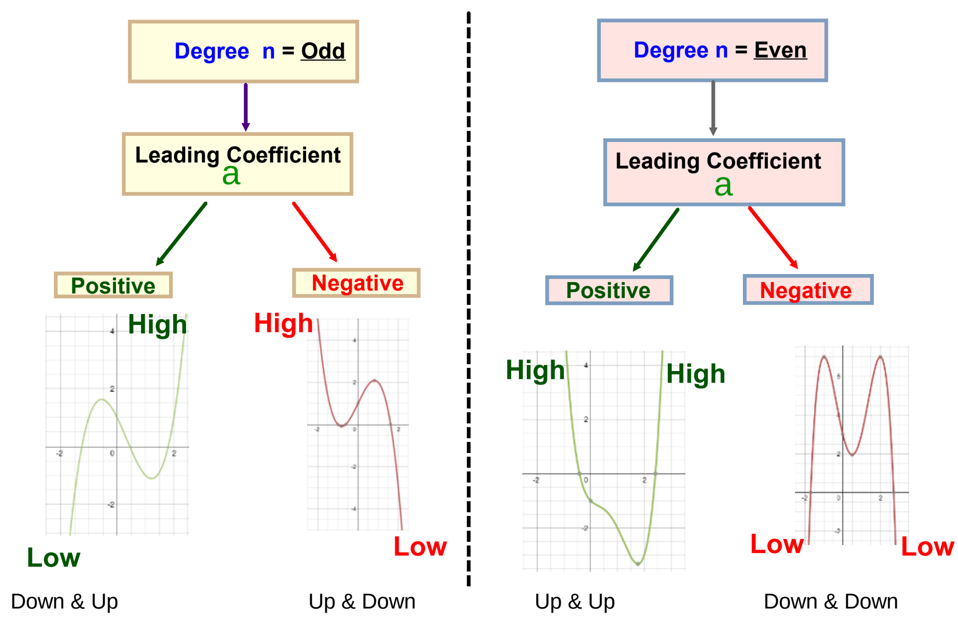


End Behavior of a Polynomial Function With Leading Term ax^n

Using Graphing Organizer

Leading Coefficient Test
(Predicting End Behavior)

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



PARCC Sample Item Unit 1 PARCC Preparation Material

PART I

CCSS: N.CN.A

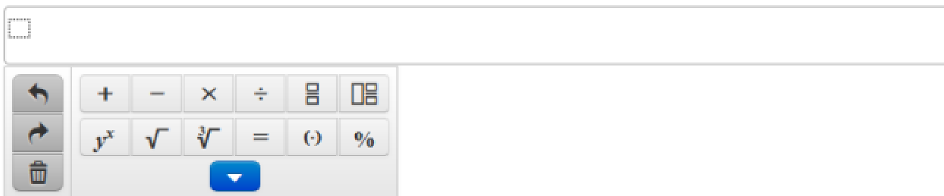
CN.1: **Know there is a complex number** i **such that** i2=−1, **and every complex number has the form** a+bi **with** a**and** b **real**

CN.2: **Use the relation** i2=−1 **and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.**

Task 1

What is $\sqrt{-5}$ in the form $a + bi$?

Enter your answer in the space provided. Enter **only** your answer.



Task 2

Which of the following is equivalent to $(i + 3) + i(2i - 4)$?

A. $-5i + 1$

B. $-i + 3$

C. $i - 3$

D. $-3i + 1$

Task 3

For the values listed in the table, i represents the imaginary unit. Select **all** the cells in the table for which the product of the row value and the column value is -1.

Value	i^4	i^5	i^6
i	☐	☐	☐
i^2	☐	☐	☐
i^3	☐	☐	☐

Task 4

For the products listed, i represents the imaginary unit. Which of the products are real numbers?

Select **all** that apply.

Ⓐ $(8 - 2i)(8 + 2i)$

Ⓑ $(8 - 2i)(5i)$

Ⓒ $(3)(5i)$

Ⓓ $(3)(-4)$

Ⓔ $(i)(8 + 2i)$

Ⓕ $(i)(5i)$

Task 5

Which expressions are equal to a real number?

Select **all** that apply.

Ⓐ $(-4i)^{11}$

Ⓑ $(-3i)^{12}$

Ⓒ $(2 + 3i)^2$

Ⓓ $(4 + 5i)(4 - 5i)$

Ⓔ $(6 + 8i)(8 + 6i)$

Task 6

Which statements are true?

Select **all** that apply.

Ⓐ $\sqrt{-4} = 2$

Ⓑ $\sqrt{-4} = 2i$

Ⓒ $\sqrt{4i} = 2i$

Ⓓ $2(i^2)^2 = 2$

Ⓔ $2i^3 = -2i$

<table>
<tr><td>
Task 7
Which of the following is equivalent to i^{49} ?

a. i
b. -1
c. $-i$
d. 1
</td></tr>
<tr><td>
Task 8
What is the sum $(2+3i)+(-4-2i)$?

What is the difference $(5-8i)-(-6-11i)$?

What is the product $(1-6i)(-5+8i)$?
</td></tr>
</table>

Algebra II Unit 1
PART II

CCSS:N.CN.7

Solve quadratic equations with real coefficients that have complex solutions.

PARCC Practice

Task 1

One zero for $x^2 - 10x + 169 = 0$ is $x = 5 + 12i$. Find the second zero for $x^2 - 10x + 169 = 0$.

Task 2

What are the solutions to the equation $2x^2 - x + 1 = 0$?

Ⓐ $\frac{1}{4} - \frac{\sqrt{5}}{4}$ and $\frac{1}{4} + \frac{\sqrt{5}}{4}$

Ⓑ $\frac{1}{4} - \frac{\sqrt{7}}{4}$ and $\frac{1}{4} + \frac{\sqrt{7}}{4}$

Ⓒ $\frac{1}{4} - \left(\frac{\sqrt{7}}{4}\right)i$ and $\frac{1}{4} + \left(\frac{\sqrt{7}}{4}\right)i$

Ⓓ $\frac{1}{4} - \left(\frac{\sqrt{5}}{4}\right)i$ and $\frac{1}{4} + \left(\frac{\sqrt{5}}{4}\right)i$

Task 3

The function f is defined by $f(x) = x^2 - 6x + 21$. What are the solutions of $f(x) = 0$? Show your work.

Task 4

Which of the following are the solutions for the equation $0 = x^2 - x + 1$?

a. $x = \dfrac{-1 + i\sqrt{3}}{2}$ and $x = \dfrac{-1 - i\sqrt{3}}{2}$

b. $x = \dfrac{-1 + i\sqrt{5}}{2}$ and $x = \dfrac{-1 - i\sqrt{5}}{2}$

c. $x = \dfrac{1 + i\sqrt{5}}{2}$ and $x = \dfrac{1 - i\sqrt{5}}{2}$

d. $x = \dfrac{1 + i\sqrt{3}}{2}$ and $x = \dfrac{1 - i\sqrt{3}}{2}$

Task 5

What are the solutions to the equation $x^2 + 9 = 0$?

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.*

PARCC Practice

Task 1

There is a unique quadratic function of the form $f(x) = ax^2 + c$ that satisfies each of these conditions:

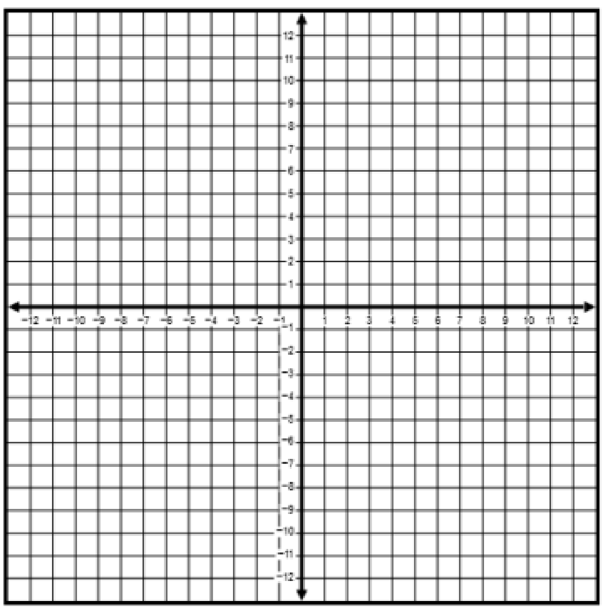
- $f(-2) = f(2) = 0$
- f attains a maximum value of 8

Part A

Create a graph of $f(x)$.

1. Select the quadratic button.
2. Drag the vertex and another point to graph the function.

Quadratic



Part B

Select from the drop-down menus to correctly complete the sentence.

The function f is symmetric about [Choose... ▾] because for all values of x, $f(-x) =$ [Choose... ▾] .

Choose...:
- the x-axis
- the y-axis
- the origin

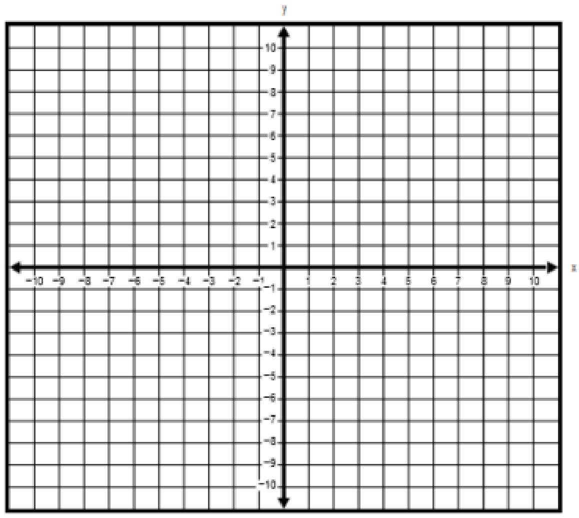
Choose...:
- -f(-x)
- -f(x)
- f(x)

Task 2

Create the approximate graph of the quadratic function with *x*-intercepts at $(-5, 0)$ and $(3, 0)$ and a *y*-intercept at $(0, -7.5)$.

1. Select a button to choose the graph type.
2. Drag the two points to the correct position.

Quadratic



CCSS: A.REI.4

Solve quadratic equations by inspection (e.g., for $x^2=49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as a±bi for real numbers a and b.

Task

Which of the equations have only real solutions?

Select **each** equation with real solutions.

- ☐ A. $(x-7)^2=0$
- ☐ B. $3x^2+7=4x$
- ☐ C. $x=\frac{3\pm\sqrt{-3}}{2}$
- ☐ D. $x=\frac{-18\pm\sqrt{18^2-4(3)(4)}}{2(3)}$
- ☐ E. $(x+2)(x-6)=-18$
- ☐ F. $x^2+8x=-8$

Task

Which quadratic equation has nonreal roots?

- ○ A. $x^2-4x+3=0$
- ○ B. $x^2-4x+4=0$
- ○ C. $x^2-4x+5=0$
- ○ D. $x^2-5x+6=0$

Task

Which equation has non-real solutions?

- Ⓐ $2x^2+4x-12=0$
- Ⓑ $2x^2+3x=4x+12$
- Ⓒ $2x^2+4x+12=0$
- Ⓓ $2x^2+4x=0$

CCSS: A.Int.1

Solve equations that require seeing structure in expressions

Task 1:

Consider the equation $p^2 - 5p - 6 - x(p-6)^2 = 0$, where p is a real constant.

Part A

If $p = 6$, then the equation has

- A. no real solutions.
- B. exactly one real solution.
- C. exactly two real solutions.
- D. infinitely many real solutions.

Part B

If $p \neq 6$, then $x =$

- A. $\frac{p-2}{p-6}$
- B. $\frac{p-1}{p-6}$
- C. $\frac{p+1}{p-6}$
- D. $\frac{p+2}{p-6}$

Task 2

For what value of m is the equation true?

$$x^2 + 10x + 11 = m + (x+5)^2 - 25$$

Enter your answer in the box.

CCSS: HS. C.CCR

Solve multi-step mathematical problems requiring extended chains of reasoning and drawing on a syntheses of the knowledge and skills articulated across.

Task 1

To prepare for a test, three students have been asked to present a review lesson to their class on sketching the graph of a parabola in the *xy*-coordinate plane. They decide to use the quadratic function $f(x) = 4x^2 + 8x - 5$ in their presentation. Each student will use algebra to explain how to find one of three key features of the graph.

- Angella rewrites the equation in factored form.
- Benjamin rewrites the equation by completing the square.
- Carla evaluates $f(0)$.

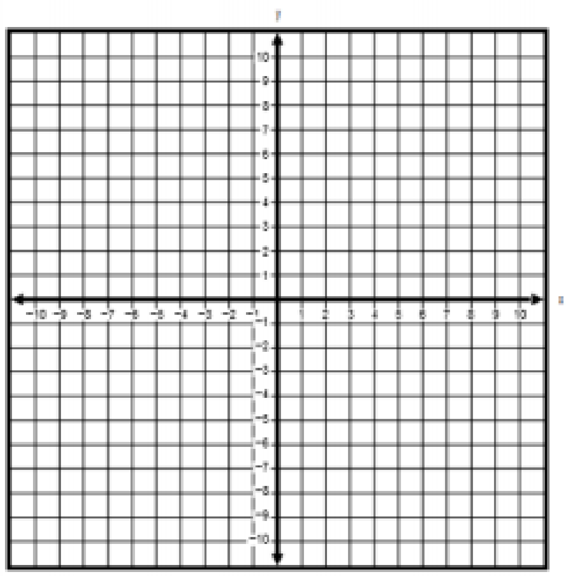
Part A

Sketch the graph of the function on the *xy*-coordinate grid shown.

1. Select the quadratic button.

2. Drag the vertex and another point to graph the function.

Quadratic



Part B

Describe how each student's work contributes to finding the key features of the graph. Complete their work and describe the key feature that is revealed.

Enter your descriptions and your work in the space provided.

[A] [π]

- Math symbols
- Relations
- Geometry
- Groups
- Trigonometry
- Statistics
- Greek