math mark

math activities that reach kids

ALGEBRA 1:

Focus on Quadratic Functions

WRITING AND SOLVING QUADRATIC EQUATIONS

lead4ward®

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ALGEBRA 1:
Focus on Quadratic Functions

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TABLE OF STANDARDS

OVERVIEW

Algebra I: Focus on Quadratic Functions provides a variety of activites that address select standards bundled in the lead4ward Quadratic Functions TEKS Cluster. See below for descriptions of the three types of activities.

Testing Success Guides

Testing Success Guides address one Readiness Standard with 3-8 problems that represent a variety of ways that STAAR as assessed (or may assess) the SE. Students learn to read a problem, recognize what the problem is asking them to do, and answer the right question.

Students work through a Guided Analysis of the problems, seeing a variety of ways the content has been tested, examining both right and wrong answer choices. Testing Success Guides are designed to be done in small groups leaving the teacher time for small group support.

Note: The problem is the Testing Success Guides represent a mix of multiple- choice items and interactive item types included on STAAR assessments. While not identical to interacting with these items electronically, the goal in this resource is to build on the thinking and reasoning skills necessary to be successful on STAAR assessments.

Skill Builders

Skill Builders address one Readiness or Supporting standards with an activity that builds understanding and fluency of the concept. Students learn a skill or underlying skill in bitesize pieces making these activities perfect for reteaching, tutoring, or intervention. Activities include guided learning and/or steps that lead students to successfully solving problems. Skill Builders are designed to be done with teacher-facilitated support or in small groups.

Concept Connectors

Concept Connectors address the concepts in 2-3 student expectations. Activities help students understand how concepts are related, reducing the cognitive load when concepts are mixed as on STAAR. Concept connectors are designed to be done in small groups with a facilitated discussion after the activity.

Each activity includes:

- Focus of the activity
- Setting Up for Instruction – What needs to be copied and any simple supplies needed for the activity
- How-To Guide – How to run the activity in your classroom, including, in some cases, suggestions for classroom conversations about the concepts
- Answer Key
- Students pages or recording sheets

Focus Using technology and the quadratic formula to solve equations.

Setting Up For Instruction

- ☐ Make 1 single-sided copy of **A.8(A) Skill Builder 1** (PG. 11–13) for each student.
- ☐ Materials:
  - ☐ **Highlighter**: 1 per person
  - ☐ **Desmos Texas Grade 8, EOC (Math) Version**

Note: Be sure your students are using the *Texas Grade 8, EOC (Math) Version Desmos graphing calculator*, not the standard Desmos graphing calculator as certain features of the standard Desmos have been restricted from use on STAAR exam.

How-To Guide

1. Place students in pairs and hand out materials.
2. Work with students to adapt the quadratic formula for use with technology, identify *a*, *b*, and *c* from the equation, and solve each equation.

Solving Equations Using the Quadratic Formula

Ask an adult what they remember about Algebra 1 and many of them will remember the quadratic formula. The quadratic formula is a super useful tool to solve quadratic equations, especially when combined with technology. However, because the equations include negative numbers and the technology automatically uses order of operations, you must adjust the way you input the numbers from the equations into the technology.

Understanding How the Quadratic Formula is Used with Technology

1. Adapt the quadratic formula for use with technology using these steps:
    1. Put parentheses around each term.
    2. Put a larger set of parentheses about $b^2 - 4ac$.

$$\frac{-(b) \pm \sqrt{((b)^2 - (4)(a)(c))}}{(2)(a)}$$

2. How is the quadratic formula above different from the traditional one?

    All of the numbers and variables are written using parentheses.

3. Highlight the ± symbol in the formula. This symbol isn't on a graphing calculator or in Desmos. You will have to simplify using the + first and then the –.

Understanding How the Identify *a*, *b* and *c* in an Equation

4. Identify *a*, *b*, and *c* in the equations using these steps:
    1. Examine the equation. If the equation has parentheses, simplify the parentheses.
    2. All three terms must be one side of the =. Move terms as needed.
    3. Write the "invisible 1" in front of variables as needed.
    4. (Optional but makes solving easier…) Examine the equation again. If all signs are negative, multiply each term by –1. If there are fractions, multiply each term by the reciprocal to remove them.
    5. Write in any missing terms as needed using $0x$ or 0 as a placeholder.
    6. Highlight *a*, *b*, and *c* in the equations, including the sign in front of the number.
    7. Then write *a*, *b*, and *c* in the boxes.

$1x^2 + 3x - 5 = 0$			$2x^2 - 4x = 6$ $2x^2 - 4x - 6 = 0$			$-5x^2 + 4 = 0$ $-5x^2 + 0x + 4 = 0$		
$a=$ 1	$b=$ 3	$c=$ –5	$a=$ 2	$b=$ –4	$c=$ –6	$a=$ –5	$b=$ 0	$c=$ 4

$-4x^2 - 5 = 3x$ $-4x^2 - 3x - 5 = 0$ $4x^2 + 3x + 5 = 0$			$2(x - 4)^2 = 32$ $2(x^2 - 8x + 16) = 32$ $2x^2 - 16x + 32 = 32$ $2x^2 - 16x + 0 = 0$			$\frac{1}{2}(x - 1)^2 = 6$ $\frac{1}{2}(x^2 - 2x + 1) = 6$ $x^2 - 2x + 1 = 12$ $x^2 - 2x - 11 = 0$		
$a=$ –4	$b=$ –3	$c=$ –5	$a=$ 2	$b=$ –16	$c=$ 0	$a=$ 1	$b=$ –2	$c=$ –11

Using the Quadratic Formula to Solve Equations

5. Write *a*, *b*, and *c* from the problems on the previous page in the quadratic formula. Then use it to solve the problems.

$$\frac{-(\boxed{3}) \pm \sqrt{((\boxed{3})^2 - (4)(\boxed{1})(\boxed{-5}))}}{2(\boxed{1})}$$

$$\frac{-3 \pm \sqrt{9 + 20}}{2}$$

$$\frac{-3 + \sqrt{29}}{2} \qquad \frac{-3 - \sqrt{29}}{2}$$

$$\frac{-(\boxed{-4}) \pm \sqrt{((\boxed{-4})^2 - (4)(\boxed{2})(\boxed{-6}))}}{2(\boxed{2})}$$

$$\frac{4 \pm \sqrt{16 + 48}}{2}$$

$$\frac{4 \pm \sqrt{64}}{2}$$

$$\frac{4 + 8}{2} \qquad \frac{4 - 8}{2}$$

$$6 \qquad -2$$

$$\frac{-(\boxed{0}) \pm \sqrt{((\boxed{0})^2 - (4)(\boxed{-5})(\boxed{4}))}}{2(\boxed{-5})}$$

$$\frac{0 \pm \sqrt{0 + 80}}{2}$$

$$\frac{-4\sqrt{5}}{2} \qquad \frac{-4\sqrt{5}}{2}$$

$$2\sqrt{5} \qquad -2\sqrt{5}$$

$$\frac{-(\boxed{3}) \pm \sqrt{((\boxed{3})^2 - (4)(\boxed{1})(\boxed{-5}))}}{2(\boxed{1})}$$

$$\frac{-3 \pm \sqrt{9 + 20}}{2}$$

$$\frac{-3 + \sqrt{29}}{2} \qquad \frac{-3 - \sqrt{29}}{2}$$

$$\frac{-(\boxed{-16}) \pm \sqrt{((\boxed{-16})^2 - (4)(\boxed{2})(\boxed{0}))}}{2(\boxed{2})}$$

$$\frac{-16 \pm \sqrt{256}}{2}$$

$$\frac{16 + 16}{2} \qquad \frac{16 - 16}{2}$$

$$16 \qquad 0$$

$$\frac{-(\boxed{-2}) \pm \sqrt{((\boxed{-2})^2 - (4)(\boxed{1})(\boxed{-11}))}}{2(\boxed{1})}$$

$$\frac{2 \pm \sqrt{4 + 44}}{2}$$

$$\frac{2 + \sqrt{48}}{2}$$

$$\frac{2 + 4\sqrt{3}}{2}$$

$$1 + 2\sqrt{3} \qquad 1 - 2\sqrt{3}$$

Name: _____

Solving Equations Using the Quadratic Formula

Ask an adult what they remember about Algebra 1 and many of them will remember the quadratic formula. The quadratic formula is a super useful tool to solve quadratic equations, especially when combined with technology. However, because the equations include negative numbers and the technology automatically uses order of operations, you must adjust the way you input the numbers from the equations into the technology.

Understanding How the Quadratic Formula is Used with Technology

1. Adapt the quadratic formula for use with technology using these steps:
    1. Put a larger set of parentheses about $b^2 - 4ac$.
    2. Put a larger set of parentheses about $b^2 - 4ac$.

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

2. How is the quadratic formula above different from the traditional one?

3. Highlight the ± symbol in the formula. This symbol isn't on a graphing calculator or in Desmos. You will have to simplify using the + first and then the −.

Name: _____

Understanding How the Identify *a*, *b* and *c* in an Equation

4. Identify a, b, and c in the equations using these steps:
    1. Examine the equation. If the equation has parentheses, simplify the parentheses.
    2. All three terms must be one side of the =. Move terms as needed.
    3. Write the "invisible 1" in front of variables as needed.
    4. (Optional but makes solving easier…) Examine the equation again. If all signs are negative, multiply each term by –1. If there are fractions, multiply each term by the reciprocal to remove them.
    5. Write in any missing terms as needed using $0x$ or 0 as a placeholder.
    6. Highlight *a*, *b*, and *c* in the equations, including the sign in front of the number.
    7. Then write *a*, *b*, and *c* in the boxes.

$x^2 + 3x - 5 = 0$			$2x^2 - 4x = 6$			$-5x^2 + 4 = 0$		
a=____	*b*=____	*c*=____	*a*=___	*b*=___	*c*=____	*a*=____	*b*=____	*c*=____

$-4x^2 - 5 = 3x$			$2(x - 4)^2 = 32$			$\frac{1}{2}(x - 1)^2 = 6$		
a=____	*b*=___	*c*=__	*a*=____	*b*=____	*c*=____	*a*=____	*b*=____	*c*=____

Name: ____________________

SKILL BUILDER 1 (PG. 3 OF 3)

Using the Quadratic Formula to Solve Equations

5. Write *a*, *b*, and *c* from the problems on the previous page in the quadratic formula. Then use it to solve the problems.

$\dfrac{-(\square) \pm \sqrt{((\square)^2 - (4)(\square)(\square))}}{2(\square)}$	$\dfrac{-(\square) \pm \sqrt{((\square)^2 - (4)(\square)(\square))}}{2(\square)}$
$\dfrac{-(\square) \pm \sqrt{((\square)^2 - (4)(\square)(\square))}}{2(\square)}$	$\dfrac{-(\square) \pm \sqrt{((\square)^2 - (4)(\square)(\square))}}{2(\square)}$
$\dfrac{-(\square) \pm \sqrt{((\square)^2 - (4)(\square)(\square))}}{2(\square)}$	$\dfrac{-(\square) \pm \sqrt{((\square)^2 - (4)(\square)(\square))}}{2(\square)}$

Focus Identify the equality in a word problem in order to set up an equation.

Setting Up For Instruction

- ☐ Make 1 copy of **A.8(A) Skill Builder 2** (PG. 16) for each student.
- ☐ Materials:
  - ☐ **Highlighters**: 2 different colors per pair

How-To Guide

1. Place students in pairs and hand out materials.
2. Work with students to identify the equality in the word problem, set up the equation, solve it, and answer the questions.
3. Have students work together to solve Problems #2–3.

Writing Equations from Word Problems

The key to setting up equations from word problems is finding the equality in the words and then identifying the two quantities that are equal. Read the word problem.

The sum of the first *n* consecutive even numbers can be found using $S = n^2 + n$, where $n \geq 2$. What is the value of *n* when the sum is 110?

1. Follow the steps to set up an equation to represent the problem:
    1. Find the part of the problem that means "equal" and highlight it.
    2. Find the two things that are equal and highlight them.
    3. Write the equation and solve it here using your favorite method. Choose the solution that best fits the problem.

$$n^2 + n = 110$$
$$n^2 + n - 110 = 0$$
$$(n + 11)(n - 10) = 0$$
$n + 11 = 0$ ~~$n = -11$~~ $\quad n - 10 = 0$, $n = 10$

Why is the negative solution incorrect?

n must be greater than 2.

Use the steps to write equations and solve the problems.

2. A rectangular backyard swimming pool has an area of 150 sq. ft. The width of the pool is 5 feet less than its length. This situation can be presented by $w^2 - 5w - 150 = 0$. What is the width of the pool?

$$w^2 + 5w - 150 = 0$$
$$(w + 15)(w - 10) = 0$$
$w + 15 = 0$ ~~$w = -15$~~ $\quad w - 10 = 0$, $w = 10$

The width of the pool is 10 feet.

The length of the pool is 15 feet.

3. The seats in a movie theater are rectangular. The total number of seats is modeled by $m(x) = x^2 + 4x$, where x stands for the number of seats in each row. The theater has 96 seats. How many rows are there in the theater?

$$x^2 + 4x = 96$$
$$x^2 + 4x - 96 = 0$$
$$(x + 8)(x - 12) = 0$$
$x + 8 = 0$ ~~$x = -8$~~ $\quad x - 12 = 0$, $x = 12$

The theater has 12 seats in each row.

The theater has 8 rows of seats.

Name: _____

Writing Equations from Word Problems

The key to setting up equations from word problems is finding the equality in the words and then identifying the two quantities that are equal. Read the word problem.

The sum of the first *n* consecutive even numbers can be found using $S = n^2 + n$, where $n \geq 2$. What is the value of *n* when the sum *is 110*?

1. Follow the steps to set up an equation to represent the problem:
    1. Find the part of the problem that means "equal" and highlight it.
    2. Find the two things that are equal and highlight them.
    3. Write the equation and solve it here using your favorite method. Choose the solution that best fits the problem.

Why is the negative solution incorrect?

Use the steps to write equations and solve the problems.

2. A rectangular backyard swimming pool has an area of 150 sq. ft. The width of the pool is 5 feet less than its length. This situation can be presented by $w^2 - 5w - 150 = 0$. What is the width of the pool?

The width of the pool is ____ feet.
The length of the pool is ____ feet.

3. The seats in a movie theater are rectangular. The total number of seats is modeled by $m(x) = x^2 + 4x$, where x stands for the number of seats in each row. The theater has 96 seats. How many rows are there in the theater?

The theater has ____ seats in each row.
The theater has ____ rows of seats.

Focus Use any method to solve quadratic equations.

Setting Up For Instruction

- ☐ Make 1 copy of **A.8(A) Testing Success Guide Problems** (PG. 20) for each student.
- ☐ Make 1 copy of **A.8(A) Testing Success Guide Analysis** (PG. 21) for each student.

How-To Guide

1. Place students in pairs and hand out materials.
2. Have students place the Problems side by side with their Analysis.
3. Students work together to use the Analysis to understand and solve the Problems.

1

Which values of x are solutions to this equation?

$$2x^2 - 6x - 20 = 0$$

Choose TWO solutions.

- ☐ $x = 2$
- ■ $x = -2$
- ■ $x = 5$
- ☐ $x = -5$

2

Which values of x are solutions to this equation?

$$3(x + 4)^2 = 12$$

Choose TWO solutions.

- ■ $x = -2$
- ☐ $x = 2$
- ☐ $x = 6$
- ■ $x = -6$

3

The area of a rectangular garden is 375 ft². The length of the garden is 10 ft greater than the width. This situation can be represented by the equation $x^2 + 10x - 375 = 0$.

What is the width of the trampoline in feet?

A 15 feet

B 75 feet

C 25 feet

D 125 feet

There are two common methods used to solve quadratic equations – factoring and the quadratic formula. You can also complete the square. If a quadratic equation is easy to factor, factoring the equation is often easier than using the quadratic formula. If an equation can't be factored, use the quadratic formula.

PROBLEM #1

Solve by factoring.

Each of the terms in this equation has a common factor. Divide each term in the equation by the common factor. Then factor the equation.	$2x^2 - 6x - 20 = 0$ $x^2 - 3x - 10 = 0$ $(x - 5)(x + 2) = 0$
Set each factor equal to 0 and solve.	$x - 5 = 0$ $\quad$ $x + 2 = 0$ $x = 5$ $\quad$ $x = -2$
To be sure you got the right answer, substitute each solution into either the original equation or the equation after the constant has been factored out. Fill in the correct answers on the problem.	$x^2 - 3x - 10 = 0$ $\quad$ $x^2 - 3x - 10 = 0$ $5^2 - 3(5) - 10 = 0$ $\quad$ $(-2)^2 - 3(-2) - 10 = 0$ $25 - 15 - 10 = 0$ $\quad$ $4 + 6 - 10 = 0$

PROBLEM #2

Solve using the quadratic formula.

Simplify the equation to find a, b, and c.	$3(x + 4)^2 = 12$ $3(x^2 + 8x + 16) = 12$ $3x^2 + 24x + 48 = 12$ $3x^2 + 24x + 36 = 0$ $x^2 + 8x + 12 = 0$
Substitute a, b, and c into the quadratic formula and simplify. Fill in the correct answers on the problem.	$\frac{-8 \pm \sqrt{82 - 4(1)(12)}}{2(1)}$ $\frac{-8 \pm \sqrt{64 - 48}}{2}$ $\frac{-8 \pm \sqrt{16}}{2}$ $\frac{-8 \pm 4}{2}$ -2 $\quad$ -6

PROBLEM #3

Solve using your favorite method.

Solve.	$x^2 + 10x - 375 = 0$ $(x - 15)(x + 25) = 0$ $x - 15 = 0$ $\quad$ $x + 25 = 0$ $x = 15$ $\quad$ $x = -25$
Which answer is correct? What is the length of the garden?	15 feet is the width. 25 feet is the length.

1

Which values of x are solutions to this equation?

$$2x^2 - 6x - 20 = 0$$

Choose TWO solutions.

- ☐ $x = 2$
- ☐ $x = -2$
- ☐ $x = 5$
- ☐ $x = -5$

2

Which values of x are solutions to this equation?

$$3(x + 4)^2 = 12$$

Choose TWO solutions.

- ☐ $x = -2$
- ☐ $x = 2$
- ☐ $x = 6$
- ☐ $x = -6$

3

The area of a rectangular garden is 375 ft². The length of the garden is 10 ft greater than the width. This situation can be represented by the equation $x^2 + 10x - 375 = 0$.

What is the width of the trampoline in feet?

A 15 feet

B 75 feet

C 25 feet

D 125 feet

There are two common methods used to solve quadratic equations – factoring and the quadratic formula. You can also complete the square. If a quadratic equation is easy to factor, factoring the equation is often easier than using the quadratic formula. If an equation can't be factored, use the quadratic formula.

PROBLEM #1

Solve by factoring.

Each of the terms in this equation has a common factor. Divide each term in the equation by the common factor. Then factor the equation.	
Set each factor equal to 0 and solve.	
To be sure you got the right answer, substitute each solution into either the original equation or the equation after the constant has been factored out. Fill in the correct answers on the problem.	

PROBLEM #2

Solve using the quadratic formula.

Simplify the equation to find a, b, and c.	
Substitute a, b, and c into the quadratic formula and simplify. Fill in the correct answers on the problem.	

PROBLEM #3

Solve using your favorite method.

Solve.	
Which answer is correct? What is the length of the garden?	

Focus Use equivalent equations to change a quadratic equation from vertex to standard form.

Setting Up For Instruction

☐ Make 1 copy of **A.6(B) Skill Builder** (PG. 20) for each pair of students.

How-To Guide

1. Place students in pairs and hand out materials.
2. Work with students to solve Problem #1. Then have students work together to solve Problem #2.

Change Vertex Form to Standard Form

The equation for a parabola can be written in either vertex form or standard form.

Vertex Form	$y = a(x - h)^2 + k$ The vertex is (h, k).

Standard Form	$y = ax^2 + bx + c$

Use the steps below to change the vertex form of the equation of a parabola to standard form.

PROBLEM #1

$$y = \frac{1}{2}(x - 3)^2 + 6$$

1. Square the quantity in parentheses $(x - h)$.	$y = \frac{1}{2}(x - 3)^2 + 6$ $y = \frac{1}{2}(x^2 - 6x + 9) + 6$
2. Multiply by a (the constant in front of the parentheses).	$y = \frac{1}{2}x^2 - 3x + \frac{9}{2} + 6$
3. Add k. This is the standard form of the equation of a parabola.	$y = \frac{1}{2}x^2 - 3x + 2\frac{1}{2}$

What is the vertex of the parabola? (3, 6) What is a? $\frac{1}{2}$

What is A? $\frac{1}{2}$ What is B? -3 What is C? $2\frac{1}{2}$

PROBLEM #2

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

4. Square the quantity in parentheses $(x - h)$.	$y = 2(x + 6)^2 - 3$ $y = 2(x^2 + 12x + 36) - 3$
5. Multiply by a (the constant in front of the parentheses).	$y = 2x^2 + 24x + 72 - 3$
6. Add k. This is the standard form of the equation of a parabola.	$y = 2x^2 + 24x + 69$

What is the vertex of the parabola? (–5, –3) What is a? 2

What is A? 2 What is B? 24 What is C? 69

Name: _____

Change Vertex Form to Standard Form

The equation for a parabola can be written in either vertex form or standard form.

Vertex Form	$y = a(x - h)^2 + k$ The vertex is (h, k).

Standard Form	$y = ax^2 + bx + c$

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PROBLEM #1

$$y = \frac{1}{2}(x - 3)^2 + 6$$

1. Square the quantity in parentheses $(x - h)$.	
2. Multiply by a (the constant in front of the parentheses).	
3. Add k. This is the standard form of the equation of a parabola.	

What is the vertex of the parabola? _____ What is a? _____

What is A?_____ What is B?_____ What is C? _____

PROBLEM #2

$$y = 2(x + 5)^2 - 6$$

4. Square the quantity in parentheses $(x - h)$.	
5. Multiply by a (the constant in front of the parentheses).	
6. Add k. This is the standard form of the equation of a parabola.	

What is the vertex of the parabola? _____ What is a? _____

What is A?_____ What is B?_____ What is C? _____

WRITING AND SOLVING QUADRATIC EQUATIONS

A.7(B) Find Zeros

SKILL BUILDER TEACHER PAGE

Focus Find the zeros of a quadratic function by factoring

Setting Up For Instruction

- ☐ Make 1 single-sided copy of **A.7(B) Equations and Factors** (PG. 26) for each student.
- ☐ Make 1 copy of **A.7(B) Equations and Factors Recording Sheet** (PG. 28) for each student.
- ☐ Materials:
  - ☐ **Scissors**: 1 per person
  - ☐ **Glue sticks**: 1 per person

How-To Guide

1. Place students in pairs and hand out materials.
2. Have students cut out the equations and factors. Then match the factors to the equations.
3. Once pairs have determined that they have the correct factorization, have them use the factorizations to create linear equations and find the zeros.

Finding Zeros of Quadratic Functions

$y = x^2 - 64$	A factor is $(x - 32)$.	A factor is $(x + 2)$.
$y = x^2 - 20x + 64$	A factor is $(x + 8)$.	A factor is $(x + 32)$.
$y = x^2 + 12x - 64$	A factor is $(x - 8)$.	A factor is $(x + 2)$.
$y = x^2 + 20x + 64$	A factor is $(x - 2)$.	A factor is $(x + 16)$.
$y = x^2 - 12x - 64$	A factor is $(x - 4)$.	A factor is $(x + 8)$.
$y = x^2 + 34x + 64$	A factor is $(x - 2)$.	A factor is $(x + 4)$.
$y = x^2 - 34x + 64$	A factor is $(x + 32)$.	A factor is $(x + 16)$.
$y = x^2 - 30x - 64$	A factor is $(x - 16)$.	A factor is $(x - 32)$.
$y = x^2 + 30x - 64$	A factor is $(x - 16)$.	A factor is $(x + 4)$.
$y = -x^2 - 34x - 64$	A factor is $(x - 4)$.	A factor is $(x - 4)$.
$y = -x^2 - 12x + 64$	A factor is $(x + 16)$.	A factor is $(x + 32)$.
$y = 2x^2 - 60x - 128$	A factor is $(x - 32)$.	A factor is $(x + 2)$.
$y = -2x^2 + 128$	A factor is $(x - 8)$.	A factor is $(x + 2)$.

Finding Zeros of Quadratic Functions
Equations and Factors Recording Sheet

$y = x^2 - 64$ $y = (x + 8)(x - 8)$ $x + 8 = 0$ $\quad$ $x - 8 = 0$ $x = -8$ $\quad$ $x = 8$	$y = x^2 - 30x - 64$ $y = (x + 2)(x - 32)$ $x + 2 = 0$ $\quad$ $x - 32 = 0$ $x = -2$ $\quad$ $x = 32$
$y = x^2 - 20x + 64$ $y = (x - 4)(x - 16)$ $x - 4 = 0$ $\quad$ $x - 16 = 0$ $x = 4$ $\quad$ $x = 16$	$y = x^2 + 30x - 64$ $y = (x + 32)(x - 2)$ $x + 32 = 0$ $\quad$ $x - 2 = 0$ $x = -32$ $\quad$ $x = 2$
$y = x^2 + 12x - 64$ $y = (x + 16)(x - 4)$ $x + 16 = 0$ $\quad$ $x - 4 = 0$ $x = -16$ $\quad$ $x = 4$	$y = -x^2 - 34x - 64$ $y = -(x^2 + 34x + 32)$ $y = -(x + 32)(x + 2)$ $x + 32 = 0$ $\quad$ $x + 2 = 0$ $x = -32$ $\quad$ $x = -2$
$y = x^2 + 20x + 64$ $y = (x + 16)(x + 4)$ $x + 16 = 0$ $\quad$ $x + 4 = 0$ $x = -16$ $\quad$ $x = -4$	$y = -x^2 - 12x + 64$ $y = -(x^2 + 12x - 32)$ $y = -(x + 16)(x - 4)$ $x + 16 = 0$ $\quad$ $x - 4 = 0$ $x = -16$ $\quad$ $x = 4$
$y = x^2 - 12x - 64$ $y = (x + 4)(x - 16)$ $x + 4 = 0$ $\quad$ $x - 16 = 0$ $x = -4$ $\quad$ $x = 16$	$y = 2x^2 - 60x - 128$ $y = 2(x^2 - 30x - 64)$ $y = 2(x - 32)(x + 2)$ $x - 32 = 0$ $\quad$ $x + 2 = 0$ $x = 32$ $\quad$ $x = -2$
$y = x^2 + 34x + 64$ $y = (x + 32)(x + 2)$ $x + 32 = 0$ $\quad$ $x + 2 = 0$ $x = -32$ $\quad$ $x = -2$	$y = -2x^2 + 128$ $y = -2(x^2 - 64)$ $y = -2(x + 8)(x - 8)$ $x + 8 = 0$ $\quad$ $x - 8 = 0$ $x = -8$ $\quad$ $x = 8$
$y = x^2 - 34x + 64$ $y = (x + 8)(x - 8)$ $x + 8 = 0$ $\quad$ $x - 8 = 0$ $x = -8$ $\quad$ $x = 8$	

Name: _____

Finding Zeros of Quadratic Functions
Equations and Factors Recording Sheet

$y = x^2 - 64$	$y = x^2 - 30x - 64$
$y = x^2 - 20x + 64$	$y = x^2 + 30x - 64$
$y = x^2 + 12x - 64$	$y = -x^2 - 34x - 64$
$y = x^2 + 20x + 64$	$y = -x^2 - 12x + 64$
$y = x^2 - 12x - 64$	$y = 2x^2 - 60x - 128$
$y = x^2 + 34x + 64$	$y = -2x^2 + 128$

WRITING AND SOLVING QUADRATIC EQUATIONS

A.8(B) Parabola of Best Fit

SKILL BUILDER TEACHER PAGE

Focus Use Desmos to find the parabola of best fit and make predictions.

Setting Up For Instruction

- ☐ Choose whether students will work on finding the parabola of best fit and/or using line of best fit to make predictions.
- ☐ Make 1 copy of the page(s) you chose of **A.8(B) Skill Builder** (PG. 32–33) for each student.
- ☐ Materials:
  - ☐ **Desmos, Texas Grade 8, EOC (Math) Version**

Note: Be sure your students are using the T*exas Grade 8, EOC (Math) Version Desmos graphing calculator*, not the standard Desmos graphing calculator as certain features of the standard Desmos have been restricted from use on STAAR exam.

How-To Guide

1. Place students in pairs and hand out materials.

Find Line of Best Fit

2. Have students graph the table in Desmos.
   - What do you notice about the points on the graph? *They are parabolic but don't make a parabola.*
   - A parabola of best fit is used when data is parabolic, but the data doesn't form an actual parabola.
   - If you input the data into Desmos, it will give you *A*, *B*, and *C* which can be used to write the equation of a line of best fit and make predictions.
3. Work with students to use Desmos to find the line of best fit.

Use Line of Best Fit to Make Predictions

4. Work through Problem #1 with students.
5. Have students work together to solve the rest of the problems.

Find Parabola of Best Fit

1. Graph the table.

x	–5	–3	–2	0	1
y	2	–6	–7	–3	2

What do you need to know to write the equation of a parabola in standard form?

__*a*__, __*b*__ and __*c*__

2. In Desmos, type $y1 \sim ax_1^2 + bx_1 + c$ in the second row. Fill in the blanks below.

$$y_1 \sim ax_1^2 + bx_1 + c$$

STATISTICS

$R^2 = 1$

RESIDUALS

e_2 plot

PARAMETERS

a =	1
b =	4
c =	–3

3. Fill in the blanks to write a parabola of best fit.

$y =$ __1__ $x^2 +$ __4__ $x +$ __–3__

4. In Desmos, enter the equation in the third row. What do you notice?

The line goes through the "middle" of the points.

5. Find the parabola of best fit.

x	–0.25	0	1	–1.5	1.5
y	–3.125	–3	0	0	3

$y =$ __2__ $x^2 +$ __1__ $x +$ __–3__

6. Find the parabola of best fit.

x	–2	0	4	–4.6	–6
y	3	2	–6	1.31	–1

$y =$ __–0.25__ $x^2 +$ __–1__ $x +$ __2__

Find Parabola of Best Fit to Make Predictions

1. Input the table into Desmos and find the line of best fit.

x	−5	−3	−2	0	1
y	2	−6	−7	−3	2

$y =$ __1__ $x^2 +$ __4__ $x +$ __−3__

This equation can be used to predict the value of y when x is a number that isn't in the table. To find the value of y when x is 5,

1. Type the equation of the line of best fit into Desmos.
2. Replace the x with 5.

What is the value of y when x is 5? __42__

2. Use the table to predict the value of y when x is −3.

x	−0.25	0	1	−1.5	1.5
y	−3.125	−3	0	0	3

$y =$ __2__ $x^2 +$ __1__ $x +$ __−3__

$y =$ __18__

3. Use the table to predict the value of y when x is 6.

x	−2	0	4	−4.6	−6
y	3	2	−6	1.31	−1

$y =$ __−0.25__ $x^2 +$ __−1__ $x +$ __2__

$y =$ __−13__

Name: _____

Find Parabola of Best Fit

1. Graph the table.

x	–5	–3	–2	0	1
y	2	–6	–7	–3	2

What do you need to know to write the equation of a parabola in standard form?

_____, _____ and _____

2. In Desmos, type $y1 \sim ax_1^2 + bx_1 + c$ in the second row. Fill in the blanks below.

$$y_1 \sim ax_1^2 + bx_1 + c$$

STATISTICS

$R^2 = 1$

RESIDUALS

e_2 plot

PARAMETERS

a =	
b =	
c =	

3. Fill in the blanks to write a parabola of best fit.

$y =$ ___x^2 + ___x + ____

4. In Desmos, enter the equation in the third row. What do you notice?

5. Find the parabola of best fit.

x	–0.25	0	1	–1.5	1.5
y	–3.125	–3	0	0	3

$y =$ ___x^2 + ___x + _____

6. Find the parabola of best fit.

x	–2	0	4	–4.6	–6
y	3	2	–6	1.31	–1

$y =$ _____x^2 + ____x + _____

Name: _____

Find Parabola of Best Fit to Make Predictions

1. Input the table into Desmos and find the line of best fit.

x	−5	−3	−2	0	1
y	2	−6	−7	−3	2

$y =$ ___x^2 + ___x + ____

This equation can be used to predict the value of y when x is a number that isn't in the table. To find the value of y when x is 5,

1. Type the equation of the line of best fit into Desmos.
2. Replace the x with 5.

What is the value of y when x is 5? _____

2. Use the table to predict the value of y when x is −3.

x	−0.25	0	1	−1.5	1.5
y	−3.125	−3	0	0	3

$y =$ ___x^2 + ___x + ____

$y =$ ____

3. Use the table to predict the value of y when x is 6.

x	−2	0	4	−4.6	−6
y	3	2	−6	1.31	−1

$y =$ _____x^2 + ____x + _____

$y =$ _____

Focus Write equations of parabolas in both vertex and standard forms:

- Part 1: Given a vertex and a point
- Part 2: Given solutions or graph

Setting Up For Instruction

- ☐ Decide which activity you want students to do.
- ☐ For Part 1, make 1 single-sided copy of **A.6(B) & A.6(C) Part 1: Given a Vertex and a Point** (PG. 37) for each student.
- ☐ For Part 1, make 1 copy of **A.6(B) & A.6(C) Part 1 Recording Sheet** (PG. 38–39) for each student.
- ☐ For Part 2, make 1 single-sided copy of **A.6(B) & A.6(C) Part 2: Given the Solutions or Graph** (PG. 40) for each student.
- ☐ For Part 2, make 1 copy of **A.6(B) & A.6(C) Part 2 Recording Sheet** (PG. 41–43) for each student.
- ☐ Materials:
  - ☐ **Scissors**: 1 per student
  - ☐ **Glue sticks**: 1 per pair
  - ☐ (Optional) **Desmos, Texas Grade 8, EOC (Math) Version**

Note: Be sure your students are using the *Texas Grade 8, EOC (Math) Version Desmos graphing calculator*, not the standard Desmos graphing calculator as certain features of the standard Desmos have been restricted from use on STAAR exam.

How-To Guide

Part 1: Given a Vertex and a Point

1. Place students in pairs and hand out materials.
2. Students find a and the vertex form and change vertex form to standard form. Students may use Desmos if they wish.
3. Have students cut out the equations and lay them out to be sure that there are no mistakes.
4. Once any mistakes are corrected, glue the equations.

Part 2: Given the Solutions or Graph

1. Place students in pairs and hand out materials.
2. Students find the standard form.
3. Have students cut out the equations and lay them out to be sure that there are no mistakes.
4. Once any mistakes are corrected, glue the equations.

Writing Equations of Parabolas
Part 1: Given a Vertex and a Point

Which quadratic function in vertex form can be represented by the graph that has a vertex as (–4, 5) and passes through the point (0, 37)?	$y = 2(x + 4)^2 + 5$	$y = 2x^2 + 16x + 37$
Which quadratic function in vertex form can be represented by the graph that has a vertex as (4, 5) and passes through the point (0, 37)?	$y = 2(x - 4)^2 + 5$	$y = 2x^2 - 16x + 37$
Which quadratic function in vertex form can be represented by the graph that has a vertex as (–4, –5) and passes through the point (0, 27)?	$y = 2(x + 4)^2 - 5$	$y = 2x^2 + 16x + 27$
Which quadratic function in vertex form can be represented by the graph that has a vertex as (4, –5) and passes through the point (0, 27)?	$y = 2(x - 4)^2 - 5$	$y = 2x^2 - 16x + 27$
Which quadratic function in vertex form can be represented by the graph that has a vertex as (–4, 5) and passes through the point (0, –27)?	$y = -2(x + 4)^2 + 5$	$y = -2x^2 - 16x - 27$
Which quadratic function in vertex form can be represented by the graph that has a vertex as (4, 5) and passes through the point (0, –27)?	$y = -2(x - 4)^2 + 5$	$y = -2x^2 + 16x - 27$
Which quadratic function in vertex form can be represented by the graph that has a vertex as (–4, –5) and passes through the point (0, –37)?	$y = -2(x + 4)^2 - 5$	$y = -2x^2 - 16x - 37$
Which quadratic function in vertex form can be represented by the graph that has a vertex as (4, –5) and passes through the point (0, –37)?	$y = -2(x - 4)^2 - 5$	$y = -2x^2 + 16x - 37$

Writing Equations of Parabolas
Part 2: Given the Solutions

(3, 0) and (–3, 0)	$y = x^2 - 9$
(3, 0) and (2, 0)	$y = x^2 - 5x + 6$
(–3, 0) and (2, 0)	$y = x^2 + x - 6$
(2, 0) and (–2, 0)	$y = x^2 - 4$
(–2, 0) and (4, 0)	$y = x^2 - 2x - 8$
(3, 0) and (–2, 0)	$y = x^2 - x - 6$
(–3, 0) and (–2, 0)	$y = x^2 + 5x + 6$
(2, 0) and (4, 0)	$y = x^2 - 6x + 8$
(3, 0) and (4, 0)	$y = x^2 - 7x + 12$
(–3, 0) and (4, 0)	$y = x^2 - x - 12$

Write Equations of Parabolas
Part 1: Given a Vertex and a Point
Equations

$y = -2(x + 4)^2 - 5$	$y = -2x^2 + 16x - 37$
$y = 2(x + 4)^2 - 5$	$y = -2x^2 - 16x - 37$
$y = 2(x - 4)^2 - 5$	$y = -2x^2 + 16x - 27$
$y = 2(x - 4)^2 + 5$	$y = 2x^2 - 16x + 27$
$y = -2(x + 4)^2 + 5$	$y = 2x^2 -16x + 37$
$y = -2(x - 4)^2 + 5$	$y = 2x^2 + 16x + 37$
$y = -2(x - 4)^2 - 5$	$y = -2x^2 - 16x - 27$
$y = 2(x + 4)^2 + 5$	$y = 2x^2 + 16x + 27$

Write Equations of Parabolas
Part 1: Given a Vertex and a Point
Recording Sheet

Which quadratic function in vertex form can be represented by the graph that has a vertex as (–4, 5) and passes through the point (0, 37)?	Find *a*.	Change vertex form to standard form.
	Glue the equation in standard form here.	*Glue the equation in standard form here.*
Which quadratic function in vertex form can be represented by the graph that has a vertex as (4, 5) and passes through the point (0, 37)?	Find *a*.	Change vertex form to standard form.
	Glue the equation in standard form here.	*Glue the equation in standard form here.*
Which quadratic function in vertex form can be represented by the graph that has a vertex as (–4, –5) and passes through the point (0, 27)?	Find *a*.	Change vertex form to standard form.
	Glue the equation in standard form here.	*Glue the equation in standard form here.*
Which quadratic function in vertex form can be represented by the graph that has a vertex as (4, –5) and passes through the point (0, 27)?	Find *a*.	Change vertex form to standard form.
	Glue the equation in standard form here.	*Glue the equation in standard form here.*

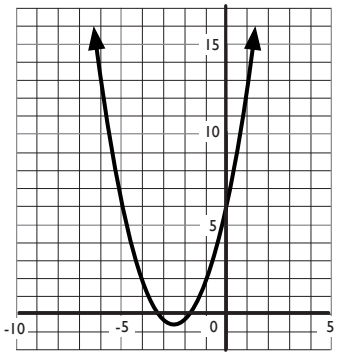
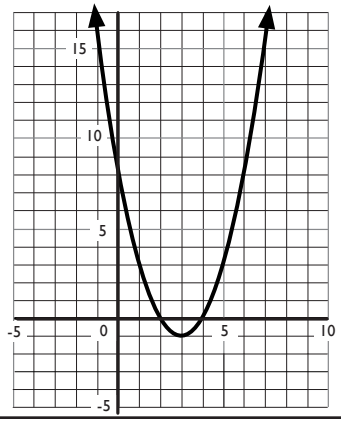
Which quadratic function in vertex form can be represented by the graph that has a vertex as (–4, 5) and passes through the point (0, –27)?	Find *a*.	Change vertex form to standard form.
	Glue the equation in standard form here.	*Glue the equation in standard form here.*
Which quadratic function in vertex form can be represented by the graph that has a vertex as (4, 5) and passes through the point (0, –27)?	Find *a*.	Change vertex form to standard form.
	Glue the equation in standard form here.	*Glue the equation in standard form here.*
Which quadratic function in vertex form can be represented by the graph that has a vertex as (–4, –5) and passes through the point (0, –37)?	Find *a*.	Change vertex form to standard form.
	Glue the equation in standard form here.	*Glue the equation in standard form here.*
Which quadratic function in vertex form can be represented by the graph that has a vertex as (4, –5) and passes through the point (0, –37)?	Find *a*.	Change vertex form to standard form.
	Glue the equation in standard form here.	*Glue the equation in standard form here.*

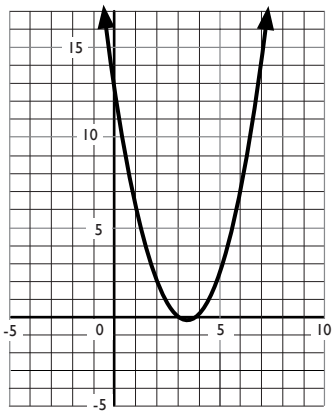
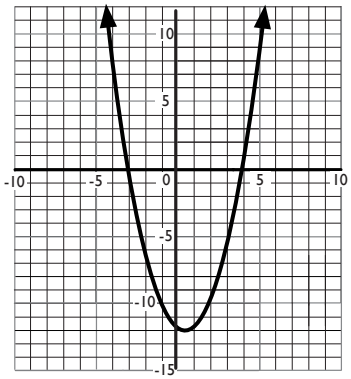
Write Equations of Parabolas
Part 2: Given the Solutions or Graph Equations

$y = x^2 - 9$	$y = x^2 - x - 6$
$y = x^2 - 5x + 6$	$y = x^2 + 5x + 6$
$y = x^2 + x - 6$	$y = x^2 - 6x + 8$
$y = x^2 - 4$	$y = x^2 - 7x + 12$
$y = x^2 - 2x - 8$	$y = x^2 - x - 12$

Write Equations of Parabolas
Part 2: Given the Solutions or Graph Recording Sheet

What quadratic function for $f(x) = 0$ has the solutions $x = 3$ and $x = 2$?	Find the equation in standard form. *Glue the equation in standard form here.*
What quadratic function for $f(x) = 0$ has the solutions $x = -3$ and $x = 2$?	Find the equation in standard form. *Glue the equation in standard form here.*
What quadratic function for $f(x) = 0$ has the solutions $x = 2$ and $x = -2$?	Find the equation in standard form. *Glue the equation in standard form here.*

What quadratic function for $f(x) = 0$ has the solutions $x = -2$ and $x = 4$?	Find the equation in standard form. *Glue the equation in standard form here.*
What quadratic function for $f(x) = 0$ has the solutions $x = 3$ and $x = -2$?	Find the equation in standard form. *Glue the equation in standard form here.*
The graph of a quadratic function is shown on the grid.  	Find the equation in standard form. *Glue the equation in standard form here.*
The graph of a quadratic function is shown on the grid.  	Find the equation in standard form. *Glue the equation in standard form here.*

The graph of a quadratic function is shown on the grid.  	Find the equation in standard form. *Glue the equation in standard form here.*
The graph of a quadratic function is shown on the grid.  	Find the equation in standard form. *Glue the equation in standard form here.*