

Claim 1: Concepts and Procedures Students can explain and apply mathematical concepts and interpret and carry out mathematical procedures with precision and fluency.	
Content Domain: Algebra	
Target E [m]: Write expressions in equivalent forms to solve problems. (DOK 1,2) Tasks for this target will require students to choose or produce an equivalent form of an expression, including factoring a quadratic expression, completing the square, and using properties of exponents. Some of these tasks will connect the form of the expression to a property of the quantity represented by the expression.	
Standards: A-SSE.B, A-SSE.B.3 A-SSE.B.3a, A-SSE.B.3b, A-SSE.B.3c	A-SSE.B Write expressions in equivalent forms to solve problems. A-SSE.B.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. <ol style="list-style-type: none"> Factor a quadratic expression to reveal the zeros of the function it defines. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. Use the properties of exponents to transform expressions for exponential functions. For example, the expression 1.15^t can be rewritten as $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.
Related Below-Grade Standards for Purposes of Planning for Vertical Scaling: 8.EE.A, 8.EE.A.1	Related Grade 8 Standards 8.EE.A Work with radicals and integer exponents. 8.EE.A.1 Know and apply the properties of integer exponents to generate equivalent numerical expressions.
DOK Levels	1, 2
Achievement Level Descriptors:	
RANGE Achievement Level Descriptors (Range ALD) Target E: Write expressions in equivalent forms to solve problems.	Level 1 Students should be able to write a quadratic expression with integer coefficients and a leading coefficient of 1 in an equivalent form by factoring. They should be able to use properties of exponents to expand a single variable (coefficient of 1) with a positive integer exponent into an equivalent form and vice versa, e.g., $x^3 = xxx$.
	Level 2 Students should be able to write a quadratic expression with integer coefficients in an equivalent form by factoring or by completing the square. They should be able to use properties of exponents to expand a repeated single variable (coefficient of 1) with a nonnegative integer exponent into an equivalent form and vice versa, e.g., $x^0x^2x^3 = xxxxx = x^{2+3}$.

	<p>Level 3 Students should be able to write a quadratic expression with rational coefficients in an equivalent form by factoring and by completing the square. They should be able to identify and use the zeros to solve or explain familiar problems, and they should be able to use properties of exponents to write equivalent forms of exponential functions with one or more variables, integer coefficients, and nonnegative rational exponents involving operations of addition, subtraction, and multiplication, including distributing an exponent across terms within parentheses.</p> <p>Level 4 Students should be able to find the maximum or minimum values of a quadratic function. They should be able to choose an appropriate equivalent form of an expression in order to reveal a property of interest when solving problems.</p>
Evidence Required:	<ol style="list-style-type: none"> 1. The student understands that the factored form of a quadratic expression reveals the zeros of the function it defines. 2. The student understands that completing the square for a quadratic expression reveals the maximum or minimum value of the function it defines. 3. The student uses the properties of exponents to transform exponential expressions.
Allowable Response Types:	Equation/Numeric; Multiple Choice, single correct response; Hot Spot
Allowable Stimulus Materials:	quadratic expressions (in expanded form), exponential expressions
Construct-Relevant Vocabulary:	monomial, binomial, trinomial, polynomial, maximum value, minimum value, zero (of a function)
Allowable Tools:	calculator (varies by task model)
Target-Specific Attributes:	
Non-Targeted Constructs:	
Accessibility Guidance:	<p>Item writers should consider the following Language and Visual Element/Design guidelines¹ when developing items.</p> <p>Language Key Considerations:</p> <ul style="list-style-type: none"> • Use simple, clear, and easy-to-understand language needed to assess the construct or aid in the understanding of the context • Avoid sentences with multiple clauses • Use vocabulary that is at or below grade level • Avoid ambiguous or obscure words, idioms, jargon, unusual names and references

¹ For more information, refer to the General Accessibility Guidelines at: <http://www.smarterbalanced.org/wordpress/wp-content/uploads/2012/05/TaskItemSpecifications/Guidelines/AccessibilityandAccommodations/GeneralAccessibilityGuidelines.pdf>

	<p>Visual Elements/Design Key Considerations:</p> <ul style="list-style-type: none"> • Include visual elements only if the graphic is needed to assess the construct or it aids in the understanding of the context • Use the simplest graphic possible with the greatest degree of contrast, and include clear, concise labels where necessary • Avoid crowding of details and graphics <p>Items are selected for a student’s test according to the blueprint, which selects items based on Claims and targets, not task models. As such, careful consideration is given to making sure fully accessible items are available to cover the content of every Claim and target, even if some item formats are not fully accessible using current technology.²</p>
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² For more information about student accessibility resources and policies, refer to http://www.smarterbalanced.org/wordpress/wp-content/uploads/2014/08/SmarterBalanced_Guidelines.pdf

<p>Task Model 1</p> <p>Response Type: Hot Spot</p> <p>DOK Level 2</p> <p>A-SSE.B.3a Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.</p> <p>a. Factor a quadratic expression to reveal the zeros of the function it defines.</p> <p>Evidence Required: 1. The student understands that the factored form of a quadratic expression reveals the zeros of the function it defines.</p> <p>Tools: None</p> <p>Accessibility Note: Hot Spot items are not currently able to be Brailled. Minimize the number of items developed to this TM.</p>	<p>Prompt Features: The student identifies the factored form of a quadratic expression that represents $f(x)$ as best for revealing zeros and chooses the zeros.</p> <p>Stimulus Guidelines:</p> <ul style="list-style-type: none"> Equivalent forms of quadratic equations are given in different forms. Difficulty level can be altered by varying the type of expression, and by using different variables and coefficients. <p>TM1a Stimulus: The student is presented with equivalent quadratic equations for $f(x)$.</p> <p>Example Stem:</p> <p>Part A: Three equations that all represent the same function f are shown. Select the equation that includes the zeros of $f(x)$ as numbers that appear in the equation.</p> <p>Part B: Select all values of x for which $f(x) = 0$.</p> <div style="border: 1px solid black; padding: 10px; margin: 10px 0;"> <p>Part A:</p> $f(x) = -2x^2 + 24x - 54$ $f(x) = -2(x - 3)(x - 9)$ $f(x) = -2(x - 6)^2 + 18$ <p>Part B:</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>-54</td> <td>-18</td> <td>-9</td> <td>-6</td> <td>-3</td> </tr> <tr> <td>0</td> <td>3</td> <td>6</td> <td>9</td> <td>18</td> <td>54</td> </tr> </table> </div> <p>Rubric: (1 point) The student selects the correct equation for $f(x)$ and selects the correct zeros.</p>	-54	-18	-9	-6	-3	0	3	6	9	18	54
-54	-18	-9	-6	-3								
0	3	6	9	18	54							

Part A:

$$f(x) = -2x^2 + 24x - 54$$

$$f(x) = -2(x - 3)(x - 9)$$

$$f(x) = -2(x - 6)^2 + 18$$

Part B:

-54	-18	-9	-6	-3	
0	3	6	9	18	54

Response Type: Hot spot

<p>Task Model 1</p> <p>Response Type: Hot Spot</p> <p>DOK Level 2</p> <p>A-SSE.B.3a Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.</p> <p>a. Factor a quadratic expression to reveal the zeros of the function it defines.</p> <p>Evidence Required: 1. The student understands that the factored form of a quadratic expression reveals the zeros of the function it defines.</p> <p>Tools: None</p> <p>Accessibility Note: Hot Spot items are not currently able to be Brailled. Minimize the number of items developed to this TM.</p>	<p>Prompt Features: The student identifies the standard form of a quadratic expression that represents $f(x)$ as best for finding the value of $f(0)$.</p> <p>Stimulus Guidelines:</p> <ul style="list-style-type: none"> Equivalent forms of quadratic equations are given in different forms. Difficulty level can be altered by using different variables and coefficients. <p>TM1b Stimulus: The student is presented with equivalent quadratic expressions for $f(x)$.</p> <p>Example Stem: Part A: Three equations that all represent the same function f are shown. Select the equation that includes the value of $f(0)$ as a number that appears in the equation.</p> <p>Part B: Identify $f(0)$.</p> <div style="border: 1px solid black; padding: 10px; margin: 10px 0;"> <p>Part A:</p> $f(x) = -2x^2 + 24x - 54$ $f(x) = -2(x - 3)(x - 9)$ $f(x) = -2(x - 6)^2 + 18$ <p>Part B:</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>-54</td> <td>-18</td> <td>-9</td> <td>-6</td> <td>-3</td> </tr> <tr> <td>0</td> <td>3</td> <td>6</td> <td>9</td> <td>18</td> <td>54</td> </tr> </table> </div> <p>Rubric: (1 point) The student selects the correct equation for $f(x)$ and selects the correct value for $f(0)$.</p>	-54	-18	-9	-6	-3	0	3	6	9	18	54
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	<p>Response Type: Hot Spot</p>											

<p>Task Model 2</p> <p>Response Type: Hot Spot</p> <p>DOK Level 2</p> <p>A-SSE.B.3b Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.</p> <p style="padding-left: 20px;">b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.</p> <p>Evidence Required: 2. The student understands that completing the square for a quadratic expression reveals the maximum or minimum value of the function it defines.</p> <p>Tools: None</p> <p>Accessibility Note: Hot Spot items are not currently able to be Brailled. Minimize the number of items developed to this TM.</p>	<p>Prompt Features: The student identifies the form of a quadratic expression that represents $f(x)$ that reveals the maximum or minimum value of the function and chooses the maximum or minimum value of the function.</p> <p>Stimulus Guidelines:</p> <ul style="list-style-type: none"> The completed square form is $a(x - h)^2 + k$, knowing that $h = -b/2a$ and $k = c - b^2/4a$ Difficulty level can be altered by using different variables and coefficients <p>TM2a Stimulus: The student is presented with equivalent quadratic expressions for $f(x)$.</p> <p>Example Stem: Part A: Three equations that all represent the same function f are shown. Select the equation that includes the maximum value of f as a number that appears in the equation.</p> <p>Part B: Select the maximum value of $f(x)$.</p> <div style="border: 1px solid black; padding: 10px; margin: 10px 0;"> <p>Part A:</p> $f(x) = -2x^2 + 24x - 54$ $f(x) = -2(x - 3)(x - 9)$ $f(x) = -2(x - 6)^2 + 18$ <p>Part B:</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td>-54</td> <td>-18</td> <td>-9</td> <td>-6</td> <td>-3</td> </tr> <tr> <td>0</td> <td>3</td> <td>6</td> <td>9</td> <td>18</td> <td>54</td> </tr> </table> </div> <p>Rubric: (1 point) The student selects the correct equation for $f(x)$ and selects the maximum value.</p>	-54	-18	-9	-6	-3	0	3	6	9	18	54
-54	-18	-9	-6	-3								
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Part A:

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Part B:

-54	-18	-9	-6	-3	
0	3	6	9	18	54

Response Type: Hot Spot

<p>Task Model 2</p> <p>Response Type: Multiple Choice, single correct response</p> <p>DOK Level 1</p> <p>A-SSE.B.3b Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.</p> <p style="padding-left: 20px;">b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.</p> <p>Evidence Required: 2. The student understands that completing the square for a quadratic expression reveals the maximum or minimum value of the function it defines.</p> <p>Tools: None</p>	<p>Prompt Features: The student identifies the form of a given quadratic expression that reveals the maximum or minimum of the expression.</p> <p>Stimulus Guidelines:</p> <ul style="list-style-type: none"> • The completed square form is $a(x - h)^2 + k$, knowing that $h = -b/2a$ and $k = c - b^2/4a$. • Difficulty level can be altered by using different variables and coefficients. <p>TM2b</p> <p>Stimulus: The student is presented with four quadratic equations.</p> <p>Example Stem: Which equation includes the minimum or maximum value of f as a number that appears in the equation?</p> <p>A. $f(x) = (x - 1)^2 - 4$ B. $f(x) = x^2 - 2x - 3$ C. $f(x) = x^2 - 3x + x - 3$ D. $f(x) = (x + 1)(x - 3)$</p> <p>Rubric: (1 point) The student correctly chooses the equation that reveals the maximum or minimum of the quadratic function (e.g., A).</p> <p>Response Type: Multiple Choice, single correct response</p>
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<p>Task Model 2</p> <p>Response Type: Equation/Numeric</p> <p>DOK Level 2</p> <p>A-SSE.B.3b Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.</p> <p style="padding-left: 20px;">b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.</p> <p>Evidence Required: 2. The student understands that completing the square for a quadratic expression reveals the maximum or minimum value of the function it defines.</p> <p>Tools: None</p>	<p>Prompt Features: The student completes the square for a quadratic expression to reveal the maximum or minimum of the expression.</p> <p>Stimulus Guidelines:</p> <ul style="list-style-type: none"> • The completed square form which is $a(x - h)^2 + k$, knowing that $h = -b/2a$ and $k = c - b^2/4a$ • Difficulty level can be altered by using different variables and coefficients. <p>TM2c</p> <p>Stimulus: The student is presented with a quadratic function in standard form.</p> <p>Example Stem 1: Enter the function $f(x) = x^2 - 7x - 18$, in the form $f(x) = a(x - h)^2 + k$, where a, h, and k are constants.</p> <p>Enter your answer in the first response box.</p> <p>Enter the x-coordinate of the vertex of the graph of f in the second response box.</p> <p>Example Stem 2: Enter the function $f(x) = 28x^2 + 16x - 80$, in the form $f(x) = a(x - h)^2 + k$, where a, h, and k are constants.</p> <p>Enter your answer in the first response box.</p> <p>Enter the x-coordinate of the vertex of the graph of f in the second response box.</p> <p>Rubric: (2 points) The student correctly enters the function in the appropriate form and enters the x-coordinate of the vertex of the graph [e.g., $f(x) = (x - \frac{7}{2})^2 - \frac{121}{4}$ and $\frac{7}{2}$; $28(x + \frac{2}{7})^2 - \frac{576}{7}$ and $-\frac{2}{7}$]. (1 point) The student correctly enters the function in the equivalent form or enters the x-coordinate of the vertex of the graph [e.g., $f(x) = (x - \frac{7}{2})^2 - \frac{121}{4}$ or $\frac{7}{2}$; $28(x + \frac{2}{7})^2 - \frac{576}{7}$ or $-\frac{2}{7}$].</p> <p>Response Type: Equation/Numeric (two response boxes)</p>
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<p>Task Model 3</p> <p>Response Type: Equation/Numeric;</p> <p>DOK Level 2</p> <p>A-SSE.B.3c Use the properties of exponents to transform expressions for exponential functions. For example, the expression 1.15^t can be rewritten as $\approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.</p> <p>Evidence Required: 3. The student uses the properties of exponents to transform exponential expressions.</p> <p>Tools: None</p>	<p>Prompt Features: The student uses the properties of exponents to produce an equivalent expression for an exponential expression (transforming expressions into both simpler and expanded forms, as specified in the stem).</p> <p>Stimulus Guidelines:</p> <ul style="list-style-type: none"> Exponential algebraic expressions with one or more variables, integer and rational coefficients, and rational exponents involving operations of addition, subtraction, multiplication, and division Difficulty level can be altered by using different variables and exponents. <p>TM3a Stimulus: The student is presented with an exponential expression and the form in which it is to be transformed.</p> <p>Example Stem 1: Enter an expression equivalent to $\left(\frac{a^9}{a^3}\right)$ in the form a^m.</p> <p>Example Stem 2: Enter an expression equivalent to a^{20} in the form $(a^n)^m$.</p> <p>Example Stem 3: Enter an expression equivalent to a^{-12} in the form $(a^n)^m$.</p> <p>Example Stem 4: Enter an expression equivalent to $(a^2a^4b)^5$ in the form a^mb^n.</p> <p>Rubric: (1 point) The student correctly enters an equivalent expression in the given form [e.g., a^6; $(a^4)^5$; $(a^{-3})^4$; $a^{30}b^5$].</p> <p>Multiple correct answers may be possible for some items.</p> <p>Response Type: Equation/Numeric</p>
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<p>Task Model 3</p> <p>Response Type: Multiple Choice, single correct response</p> <p>DOK Level 2</p> <p>A-SSE.B.3c Use the properties of exponents to transform expressions for exponential functions. For example, the expression 1.15^t can be rewritten as $\approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.</p> <p>Evidence Required: 3. The student uses the properties of exponents to transform exponential expressions.</p> <p>Tools: Calculator</p>	<p>Prompt Features: The student is prompted to use the properties of exponents to transform exponential expressions.</p> <p>Stimulus Guidelines:</p> <ul style="list-style-type: none"> All numbers, variables, and operations should be changed to create an item. Difficulty level can be altered by using different variables and coefficients. <p>TM3b Stimulus: The student is presented with a contextual situation and an exponential expression representing an exponentially increasing or decreasing quantity within the given situation.</p> <p>Example Stem: This expression defines a function that models the future population of wolves in a park after t years.</p> $3280(1.15)^t$ <p>Which expression best defines the function that represents the wolf population after x months?</p> <p>A. $3280(1.0125)^x$ B. $3280(1.0117)^x$ C. $3280(1.12)^x$ D. $3280(1.2)^x$</p> <p>Rubric: (1 point) Student selects the correct expression (e.g., B).</p> <p>Response Type: Multiple Choice, single correct response</p>
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<p>Task Model 3</p> <p>Response Type: Equation/Numeric</p> <p>DOK Level 2</p> <p>A-SSE.B.3c Use the properties of exponents to transform expressions for exponential functions. For example, the expression 1.15^t can be rewritten as $\approx 1.012^{12t}$ to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.</p> <p>Evidence Required: 3. The student uses the properties of exponents to transform exponential expressions.</p> <p>Tools: Calculator</p>	<p>Prompt Features: The student is prompted to use the properties of exponents to transform exponential expressions to find the growth or decay rate for different units of time.</p> <p>Stimulus Guidelines:</p> <ul style="list-style-type: none"> All numbers, variables, and operations should be changed to create an item. Difficulty level can be altered by using different variables and coefficients. <p>TM3c Stimulus: The student is presented with a contextual situation and an exponential expression representing an exponentially increasing or decreasing quantity within the given situation.</p> <p>Example Stem: This expression defines a function that models the future population of wolves in a park after x months.</p> $3280(1.0117)^x$ <p>Enter the yearly growth rate for the wolf population as a percent. Round to the nearest hundredth.</p> <p>Rubric: (1 point) Student produces the correct growth or decay rate (e.g., 14.98%).</p> <p>Response Type: Equation/Numeric</p>
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