Algebra 1 Unit 4 Overview: Expressions and Equations

In this unit, students build on their knowledge from unit 2, where they extended the laws of exponents to rational exponents. Students apply this new understanding of number and strengthen their ability to see structure in and create quadratic and exponential expressions. They create and solve equations, inequalities, and systems of equations involving quadratic expressions.

Note:
It is important to note that the units (or critical areas) are intended to convey coherent groupings of content. The clusters and standards within units are ordered as they are in the Common Core State Standards, and are not intended to convey an instructional order. Considerations regarding constraints, extensions, and connections are found in the instructional notes. The instructional notes are a critical attribute of the courses and should not be overlooked. For example, one will see that standards such as A.CED.1 and A.CED.2 are repeated in multiple courses, yet their emphases change from one course to the next. These changes are seen only in the instructional notes, making the notes an indispensable component of the pathways. (All instructional notes/suggestions will be found in italics throughout this document)

Modeling is best interpreted not as a collection of isolated topics but rather in relation to other standards. Making mathematical models is a Standard for Mathematical Practice, and specific modeling standards appear throughout the high school standards indicated by a star symbol ★
## Unit 4: Expressions and Equations - A.SSE.1, A.SSE.1a, A.SSE.1b

### Cluster: Interpret the structure of expressions.

### Standard

**Instructional Notes:** Focus on quadratic and exponential expressions. For A.SSE.1b, exponents are extended from the integer exponents found in Unit 1 to rational exponents focusing on those that represent square or cube roots.

**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.*

### Suggested Learning Targets

- I can define expression, term, factor, and coefficient.
- I can interpret the real-world meaning of the terms, factors, and coefficients of an expression in terms of their units.
- I can group the parts of an expression differently in order to better interpret their meaning.

### Standards of Mathematical Practice (SMP’s)

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

### Essential Questions/Enduring Understandings

- Why structure expressions in different ways?
  Expressions can be written in multiple ways using the rules of algebra; each version of the expression tells something about the problem it represents.

### Assessment

- Assessments align to suggested learning targets.

  - Directly Aligned
  - Somewhat Aligned
  - Not Aligned

  - Check all assessment types that address this standard
    - Drill and practice
    - Multiple choice
    - Short answer (written)
    - Performance (verbal explanation)
    - Product / Project

### Vocabulary

- Expression, term, factor, coefficient, equivalent
### Unit 4: Expressions and Equations - A.SSE.2

#### Cluster: Interpret the structure of expressions.

**Instructional Notes:** Focus on quadratic and exponential expressions. For A.SSE.1b, exponents are extended from the integer exponents found in Unit 1 to rational exponents focusing on those that represent square or cube roots.

**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 \((x^2 - y^2)(x^2 + y^2)\).

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<thead>
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<tbody>
<tr>
<td><strong>Instructional Notes:</strong> Focus on quadratic and exponential expressions. For A.SSE.1b, exponents are extended from the integer exponents found in Unit 1 to rational exponents focusing on those that represent square or cube roots.</td>
<td>• I can look for and identify clues in the structure of expressions (e.g., like terms, common factors, difference of squares, perfect squares) in order to rewrite it another way.</td>
<td>Content/Skills Included in Textbook (Include page numbers and comments)</td>
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</tbody>
</table>
| **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 \((x^2 - y^2)(x^2 + y^2)\). | • I can explain why equivalent expressions are equivalent.  
  • I can apply models for factoring and multiplying polynomials to rewrite expressions. | | | |

#### Standards of Mathematical Practice (SMP’s)

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

#### Essential Questions/Enduring Understandings

- Why structure expressions in different ways? Expressions can be written in multiple ways using the rules of algebra; each version of the expression tells something about the problem it represents.

#### Assessment

- Assessments align to suggested learning targets.

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<tr>
<td>Product / Project</td>
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</table>

#### Vocabulary

- Equivalent expressions, polynomials
## Unit 4: Expressions and Equations - A.SSE.3, A.SSE.3a, A.SSE.3b

### Cluster: Write expressions in equivalent forms to solve problems.

<table>
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<tr>
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</thead>
<tbody>
<tr>
<td><strong>Instructional Notes:</strong> It is important to balance conceptual understanding and procedural fluency in work with equivalent expressions. For example, development of skill in factoring and completing the square goes hand-in-hand with understanding what different forms of a quadratic expression reveal.</td>
<td>Part A</td>
<td>I can factor a quadratic expression ( ax^2 + bx + c ) to find the zeroes of the function it represents.</td>
<td>Content/Skills Included in Textbook <em>(Include page numbers and comments)</em></td>
<td></td>
</tr>
<tr>
<td><strong>A.SSE.3</strong> Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. ★</td>
<td>Part B</td>
<td>I can identify and factor perfect-square trinomials.</td>
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<tr>
<td><strong>a.</strong> Factor a quadratic expression to reveal the zeros of the function it defines.</td>
<td></td>
<td>I can complete the square to rewrite a quadratic expression ( ax^2 + bx + c ) with the form ( a(x-h)^2 + k ).</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>b.</strong> Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines.</td>
<td></td>
<td>I can predict whether a quadratic will have a minimum or maximum based on the value of ( a ).</td>
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<tr>
<td></td>
<td></td>
<td>I can identify the maximum or minimum of a quadratic written in the form ( a(x-h)^2 + k ).</td>
<td></td>
<td></td>
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### Standards of Mathematical Practice (SMP’s)

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

### Essential Questions/Enduring Understandings

- Why structure expressions in different ways?

Expressions can be written in multiple ways using the rules of algebra; each version of the expression tells something about the problem it represents.

### Assessment

- Assessments align to suggested learning targets.

- **Directly Aligned**
- **Somewhat Aligned**
- **Not Aligned**

Check all assessment types that address this standard

- Drill and practice
- Multiple choice
- Short answer (written)
- Performance (verbal explanation)
- Product / Project

### Vocabulary

- Quadratic expression, quadratic equation, zeros, perfect-square trinomial, complete the square, function, minimum, maximum, exponential function
Unit 4: Expressions and Equations - A.SSE.3c

Cluster: Write expressions in equivalent forms to solve problems.

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<tr>
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</thead>
</table>
| Instructional Notes: It is important to balance conceptual understanding and procedural fluency in work with equivalent expressions. For example, development of skill in factoring and completing the square goes hand-in-hand with understanding what different forms of a quadratic expression reveal. | Part C  
- I can define an exponential function, \( f(x) = ab^x \).  
- I can rewrite exponential functions using the properties of exponents.                                                                 |                  |                  |             |
| A.SSE.3 Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. ★ | Content/Skills Included in Textbook (Include page numbers and comments)                  |                  |                  |             |
| c. Use the properties of exponents to transform expressions for exponential functions. For example the expression 1.15t can be rewritten as \((1.15/12)12t \approx 1.01212t\) to reveal the approximate equivalent monthly interest rate if the annual rate is 15%. | Part C  
- I can define an exponential function, \( f(x) = ab^x \).  
- I can rewrite exponential functions using the properties of exponents.                                                                 |                  |                  |             |

Standards of Mathematical Practice (SMP’s)  
- #1 Make sense of problems and persevere in solving them.  
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- #4 Model with mathematics  
- #5 Use appropriate tools strategically.  
- #6 Attend to precision.  
- #7 Look for and make use of structure  
- #8 Look for and express regularity in repeated reasoning.

Essential Questions/ Enduring Understandings  
- Why structure expressions in different ways? Expressions can be written in multiple ways using the rules of algebra; each version of the expression tells something about the problem it represents.

Assessment  
- Assessments align to suggested learning targets.
- Check all assessment types that address this standard.
  - Drill and practice  
  - Multiple choice  
  - Short answer (written)  
  - Performance (verbal explanation)  
  - Product / Project

Vocabulary  
- Quadratic expression, quadratic equation, zeros, perfect-square trinomial, complete the square, function, minimum, maximum, exponential function
Unit 4: Expressions and Equations - A.APR.1

Cluster: Perform arithmetic operations on polynomials.

### Instructional Notes:
Focus on polynomial expressions that simplify to forms that are linear or quadratic in a positive integer power of x.

#### 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.

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<tbody>
<tr>
<td>A.APR.1</td>
<td>• I can apply the definition of an integer to explain why adding, subtracting, or multiplying two integers always produces an integer.</td>
<td>Content/Skills Included in Textbook (Include page numbers and comments)</td>
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<tr>
<td></td>
<td>• I can apply the definition of polynomial to explain why adding, subtracting, or multiplying two polynomials always produces a polynomial.</td>
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<td>• I can add and subtract polynomials.</td>
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<td>• I can multiply polynomials.</td>
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#### Standards of Mathematical Practice (SMP's)
- #1 Make sense of problems and persevere in solving them.
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- #8 Look for and express regularity in repeated reasoning.

#### Essential Questions/Enduring Understandings
- How can the properties of the real number system be useful when working with polynomials and rational expressions? Algebraic expressions, such as polynomials and rational expressions, symbolize numerical relationships and can be manipulated in much the same way as numbers.

#### Assessments
- Assessments align to suggested learning targets.

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#### Vocabulary
- Polynomial, closure property, integers
### Unit 4: Expressions and Equations - A.CED.1

#### Cluster: Create equations that describe numbers or relationships.

**Standard**

- Instructional Notes: Extend work on linear and exponential equations in Unit 1 to quadratic equations. Extend A.CED.4 to formulas involving squared variables.

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

**Suggested Learning Targets**

- I can identify the variables and quantities represented in a real-world problem.
- I can determine the best model for the real-world problem (linear equation, linear inequality, quadratic equation, quadratic inequality, rational equation, exponential equation).
- I can write the equation or inequality that best models the problem.
- I can solve the equation or inequality.
- I can interpret the solution in the context of the problem.

*Content/Skills Included in Textbook (Include page numbers and comments)*

#### Standards of Mathematical Practice (SMP’s)

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

#### Essential Questions/ Enduring Understandings

- How can algebra describe the relationship between sets of numbers?
  - Relationships between numbers can be represented by equations, inequalities, and systems.

#### Assessment

- Assessments align to suggested learning targets.
- Check all assessment types that address this standard
  - Drill and practice
  - Multiple choice
  - Short answer (written)
  - Performance (verbal explanation)
  - Product / Project

#### Vocabulary

- Linear, quadratic, rational, exponential
### Unit 4: Expressions and Equations - A.CED.2

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

<table>
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</tr>
</thead>
</table>
| Instructional Notes: Extend work on linear and exponential equations in Unit 1 to quadratic equations. Extend A.CED.4 to formulas involving squared variables. | - I can identify the variables and quantities represented in a real-world problem.  
- I can determine the best model for the real-world problem (e.g., linear, quadratic).  
- I can write the equation that best models the problem.  
- I can set up coordinate axes using an appropriate scale and label the axes.  
- I can graph equations on coordinate axes with appropriate labels and scales. | Content/Skills Included in Textbook (Include page numbers and comments) |

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

**Standards of Mathematical Practice (SMP’s)**

- #1 Make sense of problems and persevere in solving them.
- #2 Reason abstractly and quantitatively.
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- #4 Model with mathematics
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**Essential Questions/ Enduring Understandings**

- How can algebra describe the relationship between sets of numbers?  
  Relationships between numbers can be represented by equations, inequalities, and systems.

**Assessment**

Assessments align to suggested learning targets.

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| Check all assessment types that address this standard  
- Drill and practice  
- Multiple choice  
- Short answer (written)  
- Performance (verbal explanation)  
- Product / Project |

**Vocabulary**

Linear, quadratic, coordinate axes, scale, labels
### Unit 4: Expressions and Equations - A.CED.4

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

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<tbody>
<tr>
<td>Instructional Notes: Extend work on linear and exponential equations in Unit 1 to quadratic equations. Extend CED.4 to formulas involving squared variables. A.CED.4 Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm’s law $V = IR$ to highlight resistance $R$.</td>
<td>• I can solve formulas for a specified variable.</td>
<td>Content/Skills Included in Textbook (Include page numbers and comments)</td>
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#### Standards of Mathematical Practice (SMP’s)
- #1 Make sense of problems and persevere in solving them.
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- #4 Model with mathematics
- #5 Use appropriate tools strategically.
- #6 Attend to precision.
- #7 Look for and make use of structure
- #8 Look for and express regularity in repeated reasoning.

#### Essential Questions/ Enduring Understandings
- • How can algebra describe the relationship between sets of numbers? Relationships between numbers can be represented by equations, inequalities, and systems.

#### Assessment
- Assessments align to suggested learning targets.

#### Vocabulary
- No applicable vocabulary
# Unit 4: Expressions and Equations - A.REI.4, A.REI.4a

**Cluster: Solve equations and inequalities in one variable.**

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</table>
| **A.REI.4 Solve quadratic equations in one variable.**
  **a. Use the method of completing the square to transform any quadratic equation in**
  **x into an equation of the form (x – p)² = q that has the same solutions. Derive**
  **the quadratic formula from this form.**
| Part A:
  - I can identify a quadratic expression, $ax^2 + bx + c$.
  - I can identify a perfect-square trinomial by first noticing if a and c are perfect squares and if $b = 2ac$.
  - I can factor a perfect-square trinomial.
  - I can complete the square of $ax^2 + bx + c$ to write the quadratic in the form $(x - p)^2 = q$.
  - I can derive the quadratic formula by completing the square of $ax^2 + bx + c$.
| Content/Skills Included in Textbook (Include page numbers and comments) |

## Standards of Mathematical Practice (SMP’s)

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

## Essential Questions/Enduring Understandings

- **In what ways can the problem be solved, and why should one method be chosen over the other?**
  There is often an optimal method of manipulating equations and inequalities to solve a mathematical problem; however, other methods, which may not be as efficient, can still provide insight into the problem.

## Assessment

Assessments align to suggested learning targets.

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</table>

## Vocabulary

- Quadratic equation, complete the square, inspection, square root method, quadratic formula, complex solution, factoring completely, radicand, imaginary number, perfect square trinomial
### Unit 4: Expressions and Equations - A.REI.4b

**Cluster:** Solve equations and inequalities in one variable.

<table>
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<tr>
<th>Standard</th>
<th>Suggested Learning Targets and Type</th>
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</thead>
<tbody>
<tr>
<td><strong>Instructional Notes:</strong> Students should learn of the existence of the complex number system, but will not solve quadratics with complex solutions until Algebra II.</td>
<td>Part B:</td>
<td>Content/Skills Included in Textbook (Include page numbers and comments)</td>
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</tbody>
</table>

- 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 \( a \pm bi \) for real numbers \( a \) and \( b \).

### Standards of Mathematical Practice (SMP's)

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

### Essential Questions/Enduring Understandings

- In what ways can the problem be solved, and why should one method be chosen over the other?
  - There is often an optimal method of manipulating equations and inequalities to solve a mathematical problem; however, other methods, which may not be as efficient, can still provide insight into the problem.

### Assessment

- Assessments align to suggested learning targets.
  - Directly Aligned
  - Somewhat Aligned
  - Not Aligned

- Check all assessment types that address this standard
  - Drill and practice
  - Multiple choice
  - Short answer (written)
  - Performance (verbal explanation)
  - Product / Project

### Vocabulary

- [Insert relevant vocabulary terms here]
#8 Look for and express regularity in repeated reasoning.

### Quadratic equation, complete the square, inspection, square root method, quadratic formula, complex solution, factoring completely, radicand, imaginary number, perfect square trinomial

### Unit 4: Expressions and Equations - A.REI.7

#### Cluster: Solve systems of equations.

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<tbody>
<tr>
<td>Instructional Notes: Include systems consisting of one linear and one quadratic equation. Include systems that lead to work with fractions. For example, finding the intersections between (x^2+y^2=1) and (y = (x+1)/2) leads to the point ((3/5, 4/5)) on the unit circle, corresponding to the Pythagorean triple (32+42=52).</td>
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</tbody>
</table>

| A.REI.7 Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line \(y = -3x\) and the circle \(x^2 + y^2 = 3\). |

<table>
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<tbody>
<tr>
<td>• I can distinguish between equations that are linear and those that are quadratic.</td>
</tr>
<tr>
<td>• I can use substitution to solve a system of equations in which one equation is linear and one is quadratic.</td>
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<tr>
<td>• I can graph a linear equation on a coordinate plane.</td>
</tr>
<tr>
<td>• I can graph quadratic equations on a coordinate plane.</td>
</tr>
<tr>
<td>• I can determine the approximate solution of a system of equations in which one equation is linear and one equation is quadratic by graphing and estimating the point(s) of intersection.</td>
</tr>
</tbody>
</table>

### Standards of Mathematical Practice (SMP’s)

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

### Essential Questions/ Enduring Understandings

| In what ways can the problem be solved, and why should one method be chosen over the other? |
| There is often an optimal method of manipulating equations and inequalities to solve a mathematical problem; however, other methods, which may not be as efficient, can still provide insight into the problem. |

### Assessment

Assessments align to suggested learning targets.

<table>
<thead>
<tr>
<th>Directly Aligned</th>
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<tr>
<td>Check all assessment types that address this standard</td>
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<tr>
<td>Drill and practice</td>
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<tr>
<td>Multiple choice</td>
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<tr>
<td>Short answer (written)</td>
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<tr>
<td>Performance (verbal explanation)</td>
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<tr>
<td>Product / Project</td>
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</tbody>
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### Vocabulary
| #8   | Look for and express regularity in repeated reasoning. | System of equations, linear equation, quadratic equation, substitution method, solution of system, intersection |