The Study/Resource Guides are intended to serve as a resource for parents and students. They contain practice questions and learning activities for each content area. The standards identified in the Study/Resource Guides address a sampling of the state-mandated content standards.

For the purposes of day-to-day classroom instruction, teachers should consult the wide array of resources that can be found at www.georgiastandards.org.
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Dear Student,

This Georgia Milestones Grade 8 Study/Resource Guide for Students and Parents is intended as a resource for parents and students. It contains sample questions and helpful activities to give you an idea of what test questions look like on Georgia Milestones and what the Grade 8 End-of-Grade (EOG) assessment covers.

These sample questions are fully explained and will tell you why each answer is either correct or incorrect.

Get ready—open this guide—and get started!
HOW TO USE THIS GUIDE

Let’s get started!

✽ Get it together!
  • This guide
  • Pen or pencil
  • Highlighter
  • Paper

✽ Gather materials
  • Classroom notebooks
  • Textbooks

✽ Study space
  • Find a comfortable place to sit.
  • Use good lighting.
  • Time to focus—no TV, games, or phones!

✽ Study time
  • Set aside some time after school.
  • Set a goal—how long are you going to study?
  • Remember—you cannot do this all at one time.
  • Study a little at a time, every day.

✽ Study buddy
  • Work with a friend, sister, brother, parent—anyone who can help!
  • Ask questions—it is better to ask now and get answers.
  • Make sure you know what you need to do—read the directions before you start.
  • Ask your teacher if you need help.

✽ Test-taking help
  • Read each question and all of the answer choices carefully.
  • Be neat—use scratch paper.
  • Check your work!
Getting ready!

Here are some ideas to think about before you take a test.

- Get plenty of rest and eat right. Take care of your body and your mind will do the rest.

- If you are worried about a test, don’t be. Talk with a teacher, parent, or friend about what is expected of you.

- Review the things you have learned all year long. Feel good about it.

- Remember that a test is just one look at what you know. Your class work, projects, and other tests will also show your teachers how much you have learned throughout the year.

Try your best!
OVERVIEW OF THE END-OF-GRADE ASSESSMENT

What is on the End-of-Grade Assessment?

✽ English Language Arts (ELA)
✽ Mathematics
✽ Science
✽ Social Studies

TYPES OF ITEMS

✽ Selected-response items—also called multiple-choice
  • English Language Arts (ELA), Mathematics, Science, and Social Studies
  • There is a question, problem, or statement that is followed by four answer choices.
  • There is only ONE right answer, so read EACH answer choice carefully.
  • Start by eliminating the answers that you know are wrong.
  • Then look for the answer that is the BEST choice.

✽ Constructed-response items
  • English Language Arts (ELA) and Mathematics only
  • There is a question, problem, or statement but no answer choices.
  • You have to write your answer or work out a problem.
  • Read the question carefully and think about what you are asked to do.
  • In English Language Arts (ELA), go back to the passage to look for details and information.
  • You will be scored on accuracy and how well you support your answer with evidence.

✽ Extended constructed-response items
  • English Language Arts (ELA) and Mathematics only
  • These are similar to the constructed-response items.
  • Sometimes they have more than one part, or they require a longer answer.
  • Check that you have answered all parts of the question.

✽ Extended writing prompt
  • English Language Arts (ELA) only
  • There is a question, problem, or statement.
  • You may be asked to do more than one thing.
  • In English Language Arts (ELA), you will be asked to read two passages and then write an essay.
  • You will be scored on how well you answer the question and the quality of your writing.
  • Organize your ideas clearly.
  • Use correct grammar, punctuation, and spelling.
  • Support your answer with evidence from the text.
DEPTH OF KNOWLEDGE

Test questions are designed with a Depth of Knowledge (DOK) level in mind. As you go from Level 1 to Level 4, the questions get more and more challenging. They take more thinking and reasoning to answer. You may have experienced these types of questions in your classroom as your teachers find ways to challenge you each day.

A Level 1 item may not require as much thinking as a Level 4 item—but that does not mean it’s easy.

A Level 4 item may have more than one part or ask you to write something.

Here is some information to help you understand just what a DOK level really is.

**Level 1 (Recall of Information)**

- Identify, list, or define something.
- Questions may start with **who, what, when, and where**.
- Recall facts, terms, or identify information.

**Level 2 (Basic Reasoning)**

- Think about things—it is more than just remembering something.
- Describe or explain something.
- Answer the questions “how” or “why.”

**Level 3 (Complex Reasoning)**

- Go beyond explaining or describing “how and why.”
- Explain or justify your answers.
- Give reasons and evidence for your response.
- Make connections and explain a concept or a “big idea.”

**Level 4 (Extended Reasoning)**

- Complex thinking required!
- Plan, investigate, or apply a deeper understanding.
- These items will take more time to write.
- Connect and relate ideas.
- Show evidence by doing a task, creating a product, or writing a response.
## Depth of Knowledge

### Level 1—Recall of Information
Level 1 asks you to identify, list, or define. You may be asked to recall who, what, when, and where. You may also be asked to recall facts and terms or identify information in documents, quotations, maps, charts, tables, graphs, or illustrations. Items that ask you to “describe” and/or “explain” could be Level 1 or Level 2. A Level 1 item requires that you just recall, recite, or repeat information.

**Skills Demonstrated**
- Make observations
- Recall information
- Recognize formulas, properties, patterns, processes
- Know vocabulary, definitions
- Know basic concepts
- Perform one-step processes
- Translate from one representation to another
- Identify relationships

**Question Cues**
- Tell who, what, when, or where
- Find
- List
- Define
- Identify; label; name
- Choose; select
- Compute; estimate
- Express as
- Read from data displays
- Order

### Level 2—Basic Reasoning
Level 2 includes some thinking that goes beyond recalling or repeating a response. A Level 2 “describe” and/or “explain” item would require that you go beyond a description or explanation of information to describe and/or explain a result or “how” or “why.”

**Skills Demonstrated**
- Apply learned information to abstract and real-life situations
- Use methods, concepts, and theories in abstract and real-life situations
- Perform multi-step processes
- Solve problems using required skills or knowledge (requires more than habitual response)
- Make a decision about how to proceed
- Identify and organize components of a whole
- Extend patterns
- Identify/describe cause and effect
- Recognize unstated assumptions; make inferences
- Interpret facts
- Compare or contrast simple concepts/ideas

**Question Cues**
- Apply
- Calculate; solve
- Complete
- Describe
- Explain how; demonstrate
- Construct data displays
- Construct; draw
- Analyze
- Extend
- Connect
- Classify
- Arrange
- Compare; contrast
### Level 3—Complex Reasoning

Level 3 requires reasoning, using evidence, and thinking on a higher level than Level 1 and Level 2. You will go beyond explaining or describing “how and why” to justifying the “how and why” through reasons and evidence. Level 3 items often involve making connections across time and place to explain a concept or a “big idea.”

<table>
<thead>
<tr>
<th>Skills Demonstrated</th>
<th>Question Cues</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Solve an open-ended problem with more than one correct answer</td>
<td>• Plan; prepare</td>
</tr>
<tr>
<td>• Create a pattern</td>
<td>• Predict</td>
</tr>
<tr>
<td>• Generalize from given facts</td>
<td>• Create; design</td>
</tr>
<tr>
<td>• Relate knowledge from several sources</td>
<td>• Ask “what if?” questions</td>
</tr>
<tr>
<td>• Draw conclusions</td>
<td>• Generalize</td>
</tr>
<tr>
<td>• Make predictions</td>
<td>• Justify; explain why; support; convince</td>
</tr>
<tr>
<td>• Translate knowledge into new contexts</td>
<td>• Assess</td>
</tr>
<tr>
<td>• Compare and discriminate between ideas</td>
<td>• Rank; grade</td>
</tr>
<tr>
<td>• Assess value of methods, concepts, theories, processes, and formulas</td>
<td>• Test; judge</td>
</tr>
<tr>
<td>• Make choices based on a reasoned argument</td>
<td>• Recommend</td>
</tr>
<tr>
<td>• Verify the value of evidence, information, numbers, and data</td>
<td>• Select</td>
</tr>
</tbody>
</table>

### Level 4—Extended Reasoning

Level 4 requires the complex reasoning of Level 3 with the addition of planning, investigating, applying deeper understanding, and/or developing that will require a longer period of time. You may be asked to connect and relate ideas and concepts within the content area or among content areas in order to be at this highest level. The Level 4 items would be a show of evidence—through a task, a product, or an extended response—that the higher-level demands have been met.

<table>
<thead>
<tr>
<th>Skills Demonstrated</th>
<th>Question Cues</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Analyze and synthesize information from multiple sources</td>
<td>• Design</td>
</tr>
<tr>
<td>• Examine and explain alternative perspectives across a variety of sources</td>
<td>• Connect</td>
</tr>
<tr>
<td>• Describe and illustrate how common themes are found across texts from different cultures</td>
<td>• Synthesize</td>
</tr>
<tr>
<td>• Apply mathematical models to illuminate a problem or situation</td>
<td>• Apply concepts</td>
</tr>
<tr>
<td>• Design a mathematical model to inform and solve a practical or abstract situation</td>
<td>• Critique</td>
</tr>
<tr>
<td>• Combine and synthesize ideas into new concepts</td>
<td>• Analyze</td>
</tr>
<tr>
<td></td>
<td>• Create</td>
</tr>
<tr>
<td></td>
<td>• Prove</td>
</tr>
</tbody>
</table>
DESCRIPTION OF TEST FORMAT AND ORGANIZATION

The Grade 8 Mathematics EOG assessment consists of a total of 73 items.

You will answer a variety of item types on the test. Some of the items are selected response (multiple-choice), which means you choose the correct answer from four choices. Some items will ask you to write your response.

The test will be given in two sections.

- You may have up to 85 minutes per section to complete Sections 1 and 2.
- The test will take about 120 to 170 minutes.

CONTENT

The Grade 8 Mathematics EOG assessment will measure the Grade 8 standards that are described at [www.georgiastandards.org](http://www.georgiastandards.org).

The content of the assessment covers standards that are reported under these domains:

- Numbers, Expressions, and Equations
- Algebra and Functions
- Geometry
- Statistics and Probability

ITEM TYPES

The Mathematics portion of the Grade 8 EOG assessment consists of selected-response (multiple-choice) items, constructed-response items, and extended constructed-response items.
Example Item 1

DOK Level 1: This is a DOK level 1 item because it requires students to recall a square root.

Mathematics Grade 8 Content Domain II: Numbers, Expressions, and Equations

Standard: MGSE8.NS.2. Use rational approximation of irrational numbers to compare the size of irrational numbers, locate them approximately on a number line, and estimate the value of expressions (e.g., estimate \( \pi^2 \) to the nearest tenth). For example, by truncating the decimal expansion of \( \sqrt{2} \) (square root of 2), show that \( \sqrt{2} \) is between 1 and 2, then between 1.4 and 1.5, and explain how to continue on to get better approximations.

Which of these is the closest approximation to the value of \( \sqrt{97} \)?

A. 9 
B. 10 
C. 48 
D. 49 

Correct Answer: B

Explanation of Correct Answer: The correct answer is choice (B) 10. The square root of 97 is between the perfect squares 81 and 100, but it is closer to the square root of 100. Choice (A) is incorrect because the square root of 81 is 9, but the square root of 100 is 10, which the square root of 97 is closer to. Choice (C) is incorrect because it is a result of dividing 97 by 2 and incorrectly rounding down. Choice (D) is incorrect because it is a result of dividing 97 by 2 and rounding up.
Example Item 2

DOK Level 2: This is a DOK level 2 item because it requires students to find the rate of change and then apply reasoning to determine whether an equation represents the function.

Mathematics Grade 8 Content Domain VI: Algebra and Functions

Standard: MGSE8.F.4. Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two \((x, y)\) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models and in terms of its graph or a table of values.

When a linear function is graphed, it passes through the points \((-1, 1), (1, 5),\) and \((3, 9)\).

Part A: What is the rate of change for the function?

Part B: Does the equation \(y = 2x + 3\) represent the function? Explain your reasoning.
### Scoring Rubric

<table>
<thead>
<tr>
<th>Points</th>
<th>Description</th>
</tr>
</thead>
</table>
| 2      | The response achieves the following:  
• The response demonstrates a complete understanding of constructing functions to model a linear relationship between quantities.  
• Give 2 points for the correct rate of change and identifying the correct equation and rationale.  
• Response is correct and complete.  
• Response shows application of a reasonable and relevant strategy.  
• Mathematical ideas are expressed coherently through a clear, complete, logical, and fully developed response using words, calculations, and/or symbols, as appropriate. |
| 1      | The response achieves the following:  
• The response demonstrates a partial understanding of constructing functions to model a linear relationship between quantities.  
• Give 1 point if Part A OR Part B is correct.  
• Response is mostly correct, but contains either a computational error or an unclear or incomplete explanation.  
• Response shows application of a relevant strategy, though it may be only partially applied or remain unexplained.  
• Mathematical ideas are expressed only partially using words, calculations, and/or symbols, as appropriate. |
| 0      | The response achieves the following:  
• Response demonstrates limited to no understanding of constructing functions to model a linear relationship between quantities.  
• Response is incorrect.  
• Response shows no application of a strategy.  
• Mathematical ideas cannot be interpreted or lack sufficient evidence to support even a limited understanding. |

### Exemplar Response

<table>
<thead>
<tr>
<th>Points Awarded</th>
<th>Sample Response</th>
</tr>
</thead>
</table>
| 2              | Part A: 2  
Part B: Yes. The equation represents the function because it is a linear function with a slope of 2 and an initial value of 3.  
OR other valid explanation |
| 1              | Part A: 2  
Part B: No. The equation does not represent the function because its initial value should be negative. |
| 0              | Response is irrelevant, inappropriate, or not provided. |
Example Item 3

DOK Level 3: This is a DOK level 3 item that assesses complex reasoning. Students have to apply their knowledge of decimals and explain their reasoning. It is also an example of an extended constructed-response item.

Mathematics Grade 8 Content Domain II: Numbers, Expressions, and Equations

Standard: MGSE8.NS.1. Know that numbers that are not rational are called irrational. Understand informally that every number has a decimal expansion; for rational numbers, show that the decimal expansion repeats eventually, and convert a decimal expansion, which repeats eventually into a rational number.
Part A: Is $0.571428$ the decimal equivalent of $\frac{4}{7}$? Explain your reasoning.

Part B: Is the number in Part A rational or irrational? Explain your reasoning.

Part C: What is $0.1\overline{6}$ written as a fraction?

Part D: Is the number in Part C rational or irrational? Explain your reasoning.
### Scoring Rubric

<table>
<thead>
<tr>
<th>Points</th>
<th>Description</th>
</tr>
</thead>
</table>
| 4      | The response achieves the following:  
|        | • The response demonstrates a complete understanding of calculating decimal equivalents of fractions and recognizing repeating decimals as rational numbers.  
|        | • Give 4 points for four parts answered correctly.  
|        | • Response is correct and complete.  
|        | • Response shows application of a reasonable and relevant strategy.  
|        | • Mathematical ideas are expressed coherently through a clear, complete, logical, and fully developed response using words, calculations and/or symbols, as appropriate. |
| 3      | The response achieves the following:  
|        | • The response demonstrates a nearly complete understanding of calculating decimal equivalents of fractions and recognizing repeating decimals as rational numbers.  
|        | • Give 3 points for three parts answered correctly or for two parts correct and two parts partially correct.  
|        | • Response is mostly correct, but contains either a computational error or an unclear or incomplete explanation.  
|        | • Response shows application of a relevant strategy, though it may be only partially applied or remain unexplained.  
|        | • Mathematical ideas are expressed only partially using words, calculations, and/or symbols, as appropriate. |
| 2      | The response achieves the following:  
|        | • The response demonstrates a partial understanding of calculating decimal equivalents of fractions and recognizing repeating decimals as rational numbers.  
|        | • Give 2 points for two parts answered correctly or for three parts partially correct.  
|        | • Response is only partially correct.  
|        | • Response shows application of a relevant strategy, though it may be only partially applied or remain unexplained.  
|        | • Mathematical ideas are expressed only partially using words, calculations, and/or symbols, as appropriate. |
### Points | Description
--- | ---
1 | The response achieves the following:
   - The response demonstrates a minimal understanding of calculating decimal equivalents of fractions and recognizing repeating decimals as rational numbers.
   - Give 1 point for one part answered correctly or for two parts partially correct.
   - Response is only partially correct.
   - Response shows incomplete or inaccurate application of a relevant strategy.
   - Mathematical ideas are expressed only partially using words, calculations, and/or symbols, as appropriate.
0 | The response achieves the following:
   - The response demonstrates limited to no understanding of calculating decimal equivalents of fractions and recognizing repeating decimals as rational numbers.
   - Response is incorrect.
   - Response shows no application of a strategy.
   - Mathematical ideas cannot be interpreted or lack sufficient evidence to support even a limited understanding.

### Points Awarded | Sample Response
--- | ---
4 | Part A: Yes, it is the correct decimal equivalent of the fraction. I know because I divided the numerator, 4, by the denominator, 7. The quotient was the given repeating decimal.  
   AND  
   Part B: The number is rational because by dividing 7 into 4, you eventually start repeating a pattern that leads to a repeating decimal. Repeating decimals are rational numbers.  
   AND  
   Part C: 166/999  
   Part D: The number is rational because any number that can be written as a fraction with nonzero integers in the numerator and denominator is a rational number.
3 | The student correctly answers three out of the four parts.
2 | The student correctly answers two out of the four parts.
1 | The student correctly answers one of the four parts.
0 | Response is irrelevant, inappropriate, or not provided.
MATHEMATICS CONTENT DESCRIPTION AND ADDITIONAL SAMPLE ITEMS

In this section, you will find information about what to study in order to prepare for the Grade 8 Mathematics EOG assessment. This includes key terms and important vocabulary words. This section also contains practice questions, with an explanation of the correct answers, and activities that you can do on your own or with your classmates or family to prepare for the assessment.

All example and sample items contained in this guide are the property of the Georgia Department of Education.

CONTENT DESCRIPTION

- Apply and extend understanding of rational numbers
- Work with radicals and integer exponents
- Understand congruence and similarity using physical models or software
- Apply the Pythagorean theorem
- Solve real-world and mathematical problems involving volume of cylinders, cones, and spheres
- Understand the connections between proportional relationships, lines, and linear equations
- Analyze and solve linear equations
- Define, evaluate, and compare functions, and use functions to model relationships between quantities
- Investigate patterns of association in bivariate data
You can find mathematics formula sheets on the Georgia Milestones webpage at http://www.gadoe.org/Curriculum-Instruction-and-Assessment/Assessment/Pages/Georgia-Milestones-Assessment-System.aspx.

Look under “EOG Resources.”
Unit 1: Transformations, Congruence, and Similarity

In this unit, you will work with transformations and identify and compare similar and congruent figures. You will identify and measure angles and study line segments.

KEY TERMS

Transformation: The movement of a figure by performing the same operation or movement on each point of the figure.

- Rotation: Turns a figure around a fixed point. Movement is described by an angle of rotation and a direction the figure is turned.
- Reflection: Flips a figure over a line of reflection.
- Translation: Sliding or moving all points of a figure a specific distance in a given direction.
- Dilation: Changing the size of a figure based on a scale factor. The scale factor is applied to the distance from a fixed center to each point of the figure. (G.1)

Transformations do not change the shape or relationship between attributes of a figure. A line segment will remain a line segment and will not change size unless the figure is dilated. Angles will remain the same degree of measure in all figures. Also, parallel lines will remain parallel. (G.1)

Congruent figures: Shapes that have the same size and shape, the result of any combination of rotations, reflections, or translations. (G.2)

An effect of a transformation can be described using the coordinates on the coordinate plane of the original figure and the transformed figure. (G.3)

Similar figures: Shapes that have the same shape but different sizes, the result of any combination of rotations, reflections, translations, and dilations. (G.4)

Describe the sequence of transformations that a two-dimensional shape undergoes to result in a congruent or similar figure. This includes the type of transformation, angle of rotation, reflection line, distance and direction translated, and the factor of dilation. (G.2, G.4)

The measure of an exterior angle of a triangle is equal to the sum of the two opposite interior angles. The two opposite angles do not share a side or vertex with the exterior angle. (G.5)

A set of parallel lines that is cut by a transversal results in alternate angles that are congruent and same-side angles that are supplementary. (G.5)

Transversal: A line crossing two or more lines. (G.5)

Alternate angles: A pair of angles formed when a transversal crosses two parallel lines. The angles are on the opposite sides of the transversal and on either the interior or the exterior of the parallel lines. The angles are equal or congruent. (G.5)

Same-side angles: A pair of angles formed when a transversal crosses two parallel lines. The angles are on the same side of the transversal and on either the interior or the exterior of the parallel lines. The angles are supplementary, or have a sum of 180°. (G.5)
To determine whether two triangles are similar, compare **corresponding sides** or **corresponding angles**. The length of all three pairs of corresponding sides will be proportional. Or, the measures of the angles can be compared and each pair of corresponding angles will be equal.

**Important Tips**

- Two congruent figures have the same size and shape. Two similar figures have the same shape and angle measures. The length of each corresponding side is proportional to the original figure using a scale factor.
- A scale factor or factor of dilation that is greater than 1 will increase the size of the shape. A factor of dilation that is less than 1 will decrease the size of the shape.

**Sample Items 1–3**

**Item 1**

Look at the graph of a line segment before and after a transformation occurred.

![Graph of a line segment before and after transformation](image)

Which statement describes the transformation that could have been made on the line segment?

A. The line segment was dilated by a factor of $\frac{1}{2}$.
B. The line segment was rotated 180° counterclockwise about the origin.
C. The line segment was reflected over the x-axis.
D. The line segment was translated 6 units down and 1 unit left.
Item 2

Quadrilaterals $ABCD$, $A'B'C'D'$, and $A''B''C''D''$ are shown on the graph.

Part A: Describe a transformation or sequence of transformations to quadrilateral $ABCD$ that would result in an image quadrilateral with the coordinates $A'(0, 0)$, $B'(2, 0)$, $C'(2, -3)$, and $D'(0, -3)$.
Part B: A sequence of transformations to quadrilateral $A'B'C'D'$ that would result in an image quadrilateral $A'B'C'D'$, as shown in the graph, starts with a dilation about the origin. This is followed by a horizontal and a vertical translation. Name the horizontal and vertical translation.

Part C: What is the scale factor of the dilation described in Part B?

Part D: Is there another sequence of transformations that could result in the same coordinates? Explain your reasoning.
**Item 3**

A line segment on a graph has endpoints of \((-3, 1)\) and \((3, 1)\). It is translated 5 units down and reflected across the \(x\)-axis.

What are the endpoints after the series of transformations?

A. \((-3, -4)\) and \((3, 4)\)
B. \((-3, -1)\) and \((3, -1)\)
C. \((-3, 4)\) and \((3, 4)\)
D. \((-3, -6)\) and \((3, -6)\)
Unit 2: Exponents

In this unit, you will work with exponents, square roots, rational and irrational numbers, and scientific notation.

**KEY TERMS**

**Exponent:** Represents repeated multiplication and is one strategy for representing very large or very small numbers. For example, \(10 \cdot 10 \cdot 10 = 10^3\), so 10 is multiplied by itself 3 times, and the base of 10 is written with an exponent of 3. The same strategy for writing exponents can be used with any number or variable. (EE.1)

**Square root:** One of two equal factors that equals a nonnegative number. For example, \(\sqrt{9} = 3\) because \(3^2 = 3 \cdot 3 = 9\). (EE.2)

**Perfect square:** A number with a square root that is a rational number. (EE.2)

**Cube root:** One of three equal factors that equals a nonnegative number. For example, \(\sqrt[3]{27} = 3\) because \(3^3 = 3 \cdot 3 \cdot 3 = 27\). (EE.2)

**Scientific notation:** A product of a number (between 1 and 10) and a power of 10. (EE.3)

Perform operations (add, subtract, multiply, and divide) with numbers containing exponents, including scientific notation. Scientific notation represents one value that can be added, subtracted, multiplied, and divided using the strategies for operations on multi-digit whole numbers and decimals. (EE.4)

Solve linear equations that include one variable. The linear equations can include coefficients or use the variable on both sides of the equation. Use the properties of operations including the distributive property, addition property of equality, and the multiplication property of equality to find the solution to the equation. (EE.7)

**Distributive property:** Multiplies a factor that is outside of a set of parentheses with each addend within the parentheses to solve. (EE.7)

**Addition property of equality:** Adding the same number or value to both sides of an equation results in equivalent equations. (EE.7)

**Multiplication property of equality:** Multiplying the same number or value to both sides of an equation results in equivalent equations. (EE.7)

**Rational number:** A ratio of two integers written as a repeating or terminating decimal. (NS.1)

**Irrational number:** A number that cannot be written as the ratio of two integers and is a nonrepeating and nonterminating decimal. (NS.1)

To compare irrational numbers, approximate the value of the irrational numbers and place on the number line between the nearest rational numbers. An approximation of an irrational number can also be used to estimate the value of an expression containing an irrational number. For example, \(5 \cdot \sqrt{2}\) can be estimated using \(5 \cdot 1.4 = 7\). (NS.2)
Important Tip

Scientific notation is used to represent numbers that are very large or very small. The power of 10 can have a positive exponent to represent larger numbers. For example, $3 \times 10^3 = 3,000$. The power of 10 can also have a negative exponent to represent smaller numbers. For example, $3 \times 10^{-3} = 3 \cdot \frac{1}{10^3} = 0.003$.

Sample Items 4–6

Item 4

Between which two integers is the value of $\sqrt{21}$?

A. 0 to 1
B. 4 to 5
C. 6 to 7
D. 10 to 11

Item 5

A grain of sand has a mass of approximately $6 \times 10^{-2}$ grams. Earth has a mass of approximately $6 \times 10^{28}$ grams.

How many times smaller is the mass of the grain of sand than the mass of Earth?

A. $1 \times 10^{-54}$
B. $1 \times 10^{-14}$
C. $1 \times 10^{26}$
D. $1 \times 10^{30}$
Item 6

Part A: Write the expression $7^{-3} \cdot 7^6$ as a fraction or integer.

_______________________________________________________________________________

Part B: Explain how you found your answer.
Unit 3: Geometric Applications of Exponents

In this unit, you will work with the Pythagorean theorem and determine the lengths of sides of triangles. You will determine the distance between two points on a grid and find the volume of three-dimensional figures. You will learn to simplify expressions that include exponents, squares, cubes, square roots, and cubed roots using the properties of operations.

KEY TERMS

Pythagorean theorem: States that the squared length of the hypotenuse in a right triangle equals the sum of the squared lengths of the other two sides. This is often written as \( a^2 + b^2 = c^2 \). (G.6)

The converse of the Pythagorean theorem states that if the squared length of the longest side is equal to the sum of the squared length of the two shorter sides, then the triangle is a right triangle. (G.6)

The formula for the Pythagorean theorem can be used to determine unknown side lengths in a right triangle by inserting both known lengths into the formula and solving for the variable. (G.7)

The formula for the Pythagorean theorem can be used to determine the distance between two points by creating a right triangle along the coordinate grid. The distance between the two points is the length of the hypotenuse. (G.8)

Volume: The amount of space that an object or a three-dimensional figure occupies.

- **Cone**: A figure with one vertex and a circular or elliptical base. Find the volume using \( V = \frac{1}{3} \pi r^2 h \).
- **Sphere**: A figure that has all points equidistant from the center. Find the volume using \( V = \frac{4}{3} \pi r^3 \).
- **Cylinder**: A figure that has two congruent circular bases that are parallel. Find the volume using \( V = \pi r^2 h \). (G.9)

Simplify expressions that include exponents, squares, cubes, square roots, and cubed roots using the properties of operations.

- **Distributive property** multiplies a factor that is outside of a set of parentheses with each addend within the parentheses to solve.
- **Commutative property** allows for addends in an addition equation or factors in a multiplication equation to be moved or placed in a different order while solving.
- **Associative property** allows for addends in addition equations or factors in multiplication equations to be grouped together into different pairs while solving.
- **Identity property** allows for 0 to be added or 1 to be multiplied by any number and the number remains the same.
- **Inverse property** allows a number to be added to the opposite number for a sum of 0. Also, a number multiplied by the reciprocal fraction has a product of 1. (EE.2)
The square or cubed root of a number can be a rational or an irrational number. In the case of irrational numbers, use the radical or cubed root symbol in the solution to the equation. For example, $x = \sqrt[3]{2}$. The value of the square or cubed root can also be approximated to the nearest rational number. (EE.2)

**Rational number:** A ratio of two integers that can be written as a repeating or terminating decimal. (EE.2)

**Irrational number:** A number that cannot be written as the ratio of two integers and is a nonrepeating and nonterminating decimal. (EE.2)

**Important Tip**

> The value cubed is the inverse operation of the cubed root, and a value squared is the inverse operation of a square root.

**Sample Items 7–9**

**Item 7**

Jenna wants to hang outdoor stringed lights on her house along the roof line and horizontally across, connecting the ends of the roof line to create a triangle.

![Diagram of a house with lights and measurements of 18 ft and 32 ft]

What is the approximate total length, in feet, of lights that she needs to create one triangle?

A. 48 feet  
B. 64 feet  
C. 80 feet  
D. 98 feet
Item 8

For a classroom party, there are 12 bottles of fruit punch. Each bottle is filled with 850 cubic centimeters of punch. The fruit punch will be served in cone-shaped paper cups that are 7 centimeters across and 12 centimeters tall.

How many completely full cone-shaped cups of the punch can be poured?

A. 16  
B. 66  
C. 232  
D. 265

Item 9

Look at the right triangle on the coordinate grid.

What is the length of the hypotenuse?

A. $\sqrt{11}$ units  
B. $\sqrt{24}$ units  
C. $\sqrt{55}$ units  
D. $\sqrt{73}$ units
Unit 4: Functions

In this unit, you will work with functions. Functions produce input and output values. You can also graph functions. Functions can be represented numerically, graphically, verbally, and algebraically.

KEY TERMS

Function: A relationship between two sets of numbers, where one input value has only one output value. (F.1)

A function can be graphed using the input values as the x-coordinates and the output values as the y-coordinates. The graph of the function includes all points on the coordinate plane that make the function true. (F.1)

A function produces one output value for one input value. A counterexample can show an equation where one value can be input and produce two values as output. These counterexamples are not functions. (F.1)

Domain: The set of all x-coordinates in the ordered pairs that represent a relationship between numbers. This represents the input or independent value. (F.1)

Range: The set of all y-coordinates in the ordered pairs that represent a relationship between numbers. This represents the output or dependent value. (F.1)

Functions can be represented in four ways:

- Numerically: A function can be represented as numbers in an input/output table.
- Graphically: A function can be graphed on the coordinate plane using ordered pairs: (input, output).
- Verbally: The relationship between numbers in a function can be written in words.
- Algebraically: A function can be written as an equation involving variables. (F.2)

Compare the properties of two different functions written in any form to find which function has a greater rate of change. (F.2)

Important Tip

When listing the domain and range of a relation, list each x-coordinate value for the domain without duplicating numbers. List each y-coordinate value for the range without duplicating numbers. In a list that contains a repeated domain value that is paired with more than one range value, the relation is not a function. This is true because the input, or x-coordinate value, has produced more than one output, or y-coordinate value.
Sample Items 10–12

Item 10

Which of these functions has a greater rate of change than the function \( y = 5.6x + 7 \)?

A. \[
\begin{array}{|c|c|}
\hline
x & y \\
\hline
-1 & -10 \\
0 & -4 \\
1 & 2 \\
2 & 8 \\
\hline
\end{array}
\]

B. \( y = \frac{7}{3} x - 2 \)

C. \[
\begin{array}{|c|c|}
\hline
x & y \\
\hline
-1 & -10 \\
0 & -4 \\
1 & 0 \\
2 & 2 \\
\hline
\end{array}
\]

D. \( y = -6x + 10 \)
**Item 11**

Consider the four tables of values.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>y</td>
<td>x</td>
<td>y</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>14</td>
<td>11</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>3</td>
<td>-4</td>
<td>16</td>
</tr>
</tbody>
</table>

**Part A:** Which table models a relationship that is NOT a function?

- Table A

**Part B:** Why is the relationship in the answer to Part A NOT a function? Explain your reasoning.
**Item 12**

Consider the table of values and the equation, which both represent a function.

![Table and equation](image)

Part A: Which function has the greater rate of change?

Part B: Explain how you found your answer.
Unit 5: Linear Functions

In this unit, you will work with ratios, slope, graphs, and linear functions. You will compare two proportional relationships using the unit rate as the slope. You will compare proportional relationships and determine the rate of change.

KEY TERMS

Proportional relationship: A relationship between two ratios that are equivalent. (EE.5)

Slope: The steepness of a line, also the unit rate in proportional relationships. (EE.5)

Graph proportional relationships on the coordinate plane using the unit rate as the slope. (EE.5)

Compare two proportional relationships that are written in different forms, including graphed on the coordinate plane or written as an equation. Determine the proportional relationship that has the greater rate of change. (EE.5)

Slope can be determined using any two points on a straight line by finding the ratio between the vertical rise of the line and the horizontal run of the line. For example, a line that passes through (0, 0) and (4, 1) has a vertical rise of 1 and a horizontal run of 4, so the slope of the line is $\frac{1}{4}$. (EE.6)

A straight line continues at the same steepness, or slope, through its entire length. The measure of the slope is the same between any two points on the line. (EE.6)

The slope of the side lengths will remain the same between similar triangles. This can be proven using the endpoints of corresponding sides to determine and compare the slopes. (EE.6)

Linear function: A function that produces a straight line when graphed on the coordinate plane. The linear function can be written as an equation in slope-intercept form.

- $y = mx$: the slope-intercept form of a line going through the origin, where $m$ represents the slope.
- $y = mx + b$: the slope-intercept form of a line that crosses the y-axis at $b$, where $m$ represents the slope. (F.3)

Important Tips

- A straight line on a coordinate plane can be vertical, horizontal, or diagonal.
- The slope of a line can be determined using any two points on the line by writing the ratio of the vertical rise to the horizontal run. The ratio written as a fraction can then be reduced to represent the slope if necessary. For example, a line going through the points (1, 2) and (9, 6) has a slope of $\frac{4}{8}$, which can be reduced to $\frac{1}{2}$. 

Sample Items 13–15

Item 13

Which equation represents a nonlinear function?

A.  \( y = 3x^3 \)
B.  \( 3x + 2y = 10 \)
C.  \( y = 15.3 \)
D.  \( y = \frac{1}{4} x - 2 \)

Item 14

Look at \( \triangle ABC \) with coordinates \( A(-1, -1), B(2, 3), \) and \( C(2, -1) \).

Part A: The ordered pair \((5, y)\) defines the location of point \(F\), which is on line \(AB\). What is the value of \(y\) for this ordered pair?

Part B: If you move 3 units to the right from point \(F\), how many units up or down do you need to move in order to stay on line \(AB\)?
Item 15

Consider this graph that passes through points (0, 0) and (5, 30).

Which equation represents the cost of a phone call \( c \) after \( m \) minutes, according to the payment plan?

A. \( c = \frac{1}{6}m \)
B. \( c = 6m \)
C. \( c = \frac{1}{30}m \)
D. \( c = 30m \)
Unit 6: Linear Models and Tables

In this unit, you will work with models that are linear functions, the slope, qualitative and quantitative variables, data, and scatter plots. You will also identify the rate of change from tables, graphs, equations, or verbal description. You will describe patterns using bivariate data using different methods, including clustering, associations, and outliers. You will draw a line of best fit and use tables.

KEY TERMS

Rate of change: The ratio used to describe the change in the input and output values within a function. (F.4)

Model a linear relationship between values as a linear function. Determine the rate of change, or slope, based on a description of the linear relationship and a starting point \((x, y)\). Use this information to graph the linear function on the coordinate plane. (F.4)

Qualitative variable: A variable with a value that is not numerical—for instance, color, type of animal, or other variable in data collection that is described verbally. (F.5)

Quantitative variable: A variable with a value that is numerical—for instance, length, temperature, or other variable in data collection that is described numerically. (SP.2)

Bivariate data: Two response variables from data collection within the same population. For example, height and weight of dogs, with the height being an independent variable and the weight being a dependent variable related to the height. (SP.1)

Scatter plot: A graph placing a point for each ordered pair representing the bivariate data. Conclusions about a data set can be drawn using the visual representation of the scatter plot to look for relationships between values. (SP.1)

Describe patterns in bivariate data using:

- Clustering: breaking a data set into smaller groups that share a common trait or similarity.
- Outliers: pieces of data that stand out from the rest of the data set.
- Positive association: data that increase together; the data points rise from the lower left side to the upper right side of the graph.
- Negative association: data with one variable that increases while the other variable decreases; the data points fall from the upper left side to the lower right side of the graph.
- Linear association: a relationship that is represented using a straight line, such as a linear function.
- Nonlinear association: a relationship that is not represented by a straight line. (SP.1)

Line of best fit: A straight line drawn on a scatter plot that passes through the center of the group of data points. (SP.2)

Bivariate data can be used to create graphs and linear equations based on the slope and intercept of the line. (SP.3)
A two-way table can be used to represent bivariate data, including the frequencies of data occurring. Use the two-way table to identify positive or negative association between variables. (SP.4)

**Important Tips**

- A pattern in the data set can be used to predict the outcomes of other variables.
- The relationship between values can be represented using tables, graphs, and equations using the slope and y-intercept.

**Sample Items 16–18**

**Item 16**

This table of values represents a linear function.

<table>
<thead>
<tr>
<th>x</th>
<th>y</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>80</td>
</tr>
<tr>
<td>4</td>
<td>60</td>
</tr>
<tr>
<td>8</td>
<td>40</td>
</tr>
<tr>
<td>12</td>
<td>20</td>
</tr>
</tbody>
</table>

**Part A:** Is the rate of change of this function −5? Explain how you know.

__________________________________________________________

__________________________________________________________

__________________________________________________________

**Part B:** What is the initial value of this function?

__________________________________________________________

__________________________________________________________
Item 17

Look at the scatter plot showing the relationship between the average daily temperature and the number of visitors at a beach.

What is the pattern of association shown by the data?

A. no association
B. positive association
C. negative association
D. nonlinear association
Item 18

Which straight line BEST fits the data for the scatter plot?

A. 

B. 

C. 

D.
Unit 7: Solving Systems of Equations

In this unit, you will work with systems of equations to define relationships between variables. You will find the solutions to systems of equations. You will learn about parallel, co-linear, and intersecting lines and about how to solve systems of equations algebraically.

KEY TERMS

System of equations: Multiple equations that work together to define the relationship between variables. (EE.8a)

The solution to a system of equations can be represented by graphing the line of solutions for each equation. The point or points where the lines intersect on the coordinate plane show the valid solutions to all of the equations in the system. (EE.8a)

Parallel lines: Two lines that have the same slope and do not intersect. A system of equations that produces two parallel lines has no solution. (EE.8b)

Collinear lines: Two lines that share all of the same points. A system of equations that produces two co-linear lines has an infinite number of solutions. (EE.8b)

Systems of equations can also be solved algebraically by completing the operations on each side of the equation using the addition property of equality and multiplication property of equality. (EE.8b)

Addition property of equality: Adding the same number or value to both sides of an equation results in equivalent equations. (EE.8b)

Multiplication property of equality: Multiplying the same number or value to both sides of an equation results in equivalent equations. (EE.8b)

Use systems of equations in real-world situations by determining the solution or set of solutions that will satisfy a set of equations. A solution can also be determined based on sets of points. Given two sets of points, draw the corresponding line for each set and identify any locations where the lines intersect. (EE.8c)

Important Tip

☞ The number of solutions to a system of equations can be no solution, one solution, or multiple solutions, including an infinite number of solutions.
Sample Items 19–21

Item 19

Consider this system of equations.

\[-7x + 8y = 1\]
\[4x - 8y = 20\]

What is the \(y\)-coordinate of the solution for this system?

A. \(-1\)
B. \(-6\)
C. 1
D. 6
Item 20

Consider this system of equations.

\[ y = -2x - 1 \]
\[ y = \frac{1}{2}x + 4 \]

Which graph represents the solution of the system?
Item 21

Which system of equations has exactly one solution?

A. \(5x - y = -3\)
   \(5x - y = -2\)

B. \(8x - 3y = -12\)
   \(x - 3y = 9\)

C. \(3x - y = 4\)
   \(9x - 3y = 12\)

D. \(2x - y = 3\)
   \(2x - y = -4\)
### MATHEMATICS ADDITIONAL SAMPLE ITEM KEYS

<table>
<thead>
<tr>
<th>Item</th>
<th>Standard/Element</th>
<th>DOK Level</th>
<th>Correct Answer</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>MGSE8.G.1</td>
<td>2</td>
<td>C</td>
<td>The correct answer is choice (C) because the before and after segments have the same x-coordinates and opposite y-coordinates. Choice (A) is incorrect because the before and after segments are congruent, while a dilation by a factor of ( \frac{1}{2} ) would make the after segment half the length of the before segment. Choice (B) is incorrect because rotation would not result in the vertices having the same x-coordinates. Choice (D) is incorrect because the line segment was translated 6 units down, but it was not translated 1 unit to the left.</td>
</tr>
<tr>
<td>2</td>
<td>MGSE8.G.3</td>
<td>3</td>
<td>N/A</td>
<td>See scoring rubric beginning on page 112 and sample response on page 114.</td>
</tr>
<tr>
<td>3</td>
<td>MGSE8.G3</td>
<td>2</td>
<td>C</td>
<td>The correct answer is choice (C) because it follows the correct sequence of transformations. Choice (A) is incorrect because it is translated and only the right endpoint is reflected. Choice (B) is incorrect because it is reflected without the translation. Choice (D) is incorrect because it is reflected first and then translated.</td>
</tr>
<tr>
<td>4</td>
<td>MGSE8.N.S.2</td>
<td>2</td>
<td>B</td>
<td>The correct answer is choice (B) because 21 falls between 16 and 25, the perfect squares of 4 and 5. Choice (A) is incorrect because it does not show understanding that the number is not a fractional value. Choice (C) is incorrect because the square of all the values in this range is greater than 21. Choice (D) is incorrect because it is the result of dividing 21 by 2.</td>
</tr>
<tr>
<td>5</td>
<td>MGSE8.EE.3</td>
<td>1</td>
<td>D</td>
<td>The correct answer is choice (D). The exponents are subtracted because these two numbers are being divided. Choice (A) is incorrect because the exponents are multiplied together. Choice (B) is incorrect because the exponents are divided. Choice (C) is incorrect because the exponents are added together.</td>
</tr>
<tr>
<td>6</td>
<td>MGSE8.EE.1</td>
<td>2</td>
<td>N/A</td>
<td>See scoring rubric on page 115 and sample response on page 116.</td>
</tr>
<tr>
<td>7</td>
<td>MGSE8.G.8</td>
<td>2</td>
<td>C</td>
<td>The correct answer is choice (C) because each slanted side length ( \sqrt{18^2 + 16^2} \approx 24 ). So the perimeter of the triangle ( \approx 24 + 24 + 32 = 80 ) ft. Choice (A) is incorrect because only the slants of the roof are calculated, without including the horizontal distance. Choice (B) is incorrect because the slants of the roof are calculated without doubling the horizontal distance to cover both right triangles. Choice (D) is incorrect because the height of the triangle is included in the total length.</td>
</tr>
<tr>
<td>Item</td>
<td>Standard/Element</td>
<td>DOK Level</td>
<td>Correct Answer</td>
<td>Explanation</td>
</tr>
<tr>
<td>------</td>
<td>------------------</td>
<td>-----------</td>
<td>----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>8</td>
<td>MGSE8.G.9</td>
<td>2</td>
<td>B</td>
<td>The correct answer is choice (B) because the volume of each cup is ( \frac{1}{3} \pi (3.5)^2(12) \approx 154 \text{ cm}^3 ): There is a total of ( 12.850 = 10,200 \text{ cm}^3 ) of punch. So ( 10,200 \div 154 \approx 66 ) cups can be filled. Choice (A) is incorrect because the diameter was mistakenly used. Choice (C) is incorrect because the radius was not squared in the calculations. Choice (D) is incorrect because half the radius was mistakenly used in the formula.</td>
</tr>
<tr>
<td>9</td>
<td>MGSE8.G.8</td>
<td>2</td>
<td>D</td>
<td>The correct answer is choice (D) because the length of the hypotenuse ( = \sqrt{8^2 + 3^2} = \sqrt{73} ). Choice (A) is incorrect because the legs were not squared before finding the hypotenuse value. Choice (B) is incorrect because it is the square root of the product of two legs. Choice (C) is incorrect because the squares of the leg values are subtracted instead of added.</td>
</tr>
<tr>
<td>10</td>
<td>MGSE8.F.2</td>
<td>2</td>
<td>A</td>
<td>The correct answer is choice (A) because it has the greatest rate of change, which is 6. Choice (B) is incorrect because the rate of change is 2.3. Choice (C) is incorrect because the rate of change is 5. Choice (D) is incorrect because it has the rate of change as (-6).</td>
</tr>
<tr>
<td>11</td>
<td>MGSE8.F.1</td>
<td>2</td>
<td>N/A</td>
<td>See scoring rubric on page 117 and sample response on page 118.</td>
</tr>
<tr>
<td>12</td>
<td>MGSE8.F.2</td>
<td>2</td>
<td>N/A</td>
<td>See scoring rubric on page 119 and sample response on page 120.</td>
</tr>
<tr>
<td>13</td>
<td>MGSE8.F.3</td>
<td>1</td>
<td>A</td>
<td>The correct answer is choice (A) because the exponent of 3 causes the graph to be a curve. Choice (B) is a straight line when graphed. Choice (C) is a straight line when graphed. Choice (D) is a straight line when graphed.</td>
</tr>
<tr>
<td>14</td>
<td>MGSE8.EE.6</td>
<td>2</td>
<td>N/A</td>
<td>See scoring rubric on page 121 and sample response on page 122.</td>
</tr>
<tr>
<td>15</td>
<td>MGSE8.EE.6</td>
<td>2</td>
<td>B</td>
<td>The correct answer choice is (B) because every minute costs 6 cents. Choice (A) is incorrect because the line was interpreted with the ( x )-value read before the ( y )-value. Choice (C) is incorrect because the slope was misinterpreted to have a rise of 1 and a run of 30. Choice (D) is incorrect because, though there is a point with the rise of 30, the run was not interpreted.</td>
</tr>
<tr>
<td>Item</td>
<td>Standard/Element</td>
<td>DOK Level</td>
<td>Correct Answer</td>
<td>Explanation</td>
</tr>
<tr>
<td>------</td>
<td>------------------</td>
<td>-----------</td>
<td>----------------</td>
<td>-------------</td>
</tr>
<tr>
<td>16</td>
<td>MGSE8.F.4</td>
<td>2</td>
<td>N/A</td>
<td>See scoring rubric on page 123 and sample response on page 124.</td>
</tr>
<tr>
<td>17</td>
<td>MGSE8.SP.1</td>
<td>1</td>
<td>B</td>
<td>The correct answer choice is (B) because the scatter plot shows the warmer the temperatures the more visitors there are. Choice (A) is incorrect because there is an association because the dots are clustered together near a line of best fit. Choice (C) is incorrect because a negative association would mean that as the temperature gets warmer, the number of visitors goes down. Choice (D) is incorrect because the points seem to follow a linear pattern.</td>
</tr>
<tr>
<td>18</td>
<td>MGSE8.SP.2</td>
<td>2</td>
<td>C</td>
<td>The correct answer is choice (C) because the points are distributed evenly above and below the line. Choice (A) and choice (B) are not correct because, though they show a negative slope with a line of best fit, the points are not distributed equally above and below the line of best fit. Choice (D) is incorrect because the line of best fit shows a positive slope that does not match the pattern of the data points.</td>
</tr>
<tr>
<td>19</td>
<td>MGSE8.EE.8b</td>
<td>2</td>
<td>B</td>
<td>The correct answer is choice (B) because –6 is the y-coordinate of the point that makes both equations true. Choice (A) is incorrect because the rules for integer operations were not followed, though the steps were performed correctly. Choice (C) is incorrect because the integer sign rules were not followed initially, but the steps thereafter are correct. Choice (D) is incorrect because the integer rules were not followed.</td>
</tr>
<tr>
<td>20</td>
<td>MGSE8.EE.8a</td>
<td>2</td>
<td>D</td>
<td>The correct answer is choice (D) because the solution to both the system of equations and the graph is (−2, 3). Choice (A) is incorrect because the graph has correct y-intercepts but incorrect slopes. Choice (B) is incorrect because the graph has incorrect slopes but correct y-intercepts. Choice (C) is incorrect because the y-intercepts are incorrect, though the graph has the correct slopes.</td>
</tr>
<tr>
<td>21</td>
<td>MGSE8.EE.8b</td>
<td>2</td>
<td>B</td>
<td>The correct answer is choice (B) because the solution is (−3, −4). Choice (A), choice (C), and choice (D) are all systems with no solution or infinitely many solutions.</td>
</tr>
</tbody>
</table>
### MATHEMATICS SAMPLE SCORING RUBRICS AND EXEMPLAR RESPONSES

**Item 2**

**Scoring Rubric**

<table>
<thead>
<tr>
<th>Points</th>
<th>Description</th>
</tr>
</thead>
</table>
| 4      | The response achieves the following:  
|        | • The response demonstrates a complete understanding of applying a sequence of transformations to obtain a similar figure.  
|        | • Give 4 points for four parts answered correctly.  
|        | • Response is correct and complete.  
|        | • Response shows application of a reasonable and relevant strategy.  
|        | • Mathematical ideas are expressed coherently through a clear, complete, logical, and fully developed response using words, calculations, and/or symbols, as appropriate. |
| 3      | The response achieves the following:  
|        | • The response demonstrates a nearly complete understanding of applying a sequence of transformations to obtain a similar figure.  
|        | • Give 3 points for three parts answered correctly OR for correct answers for four parts but no explanation given for either Part C or Part D.  
|        | • Response is mostly correct but contains either a computational error or an unclear or incomplete explanation.  
|        | • Response shows application of a relevant strategy, though it may be only partially applied or remain unexplained.  
|        | • Mathematical ideas are expressed only partially using words, calculations, and/or symbols, as appropriate. |
| 2      | The response achieves the following:  
|        | • The response demonstrates a partial understanding of applying a sequence of transformations to obtain a similar figure.  
|        | • Give 2 points for two parts answered correctly OR for correct answers for four parts but no explanations given for both Part C and Part D.  
|        | • Response is only partially correct.  
|        | • Response shows application of a relevant strategy, though it may be only partially applied or remain unexplained.  
|        | • Mathematical ideas are expressed only partially using words, calculations, and/or symbols, as appropriate. |
## Points | Description
--- | ---
1 | The response achieves the following:
- The response demonstrates a minimal understanding of applying a sequence of transformations to obtain a similar figure.
- Give 1 point for one part answered correctly.
- Response is only partially correct.
- Response shows incomplete or inaccurate application of a relevant strategy.
- Mathematical ideas are expressed only partially using words, calculations, and/or symbols, as appropriate.
0 | The response achieves the following:
- The response demonstrates limited to no understanding of applying a sequence of transformations to obtain a similar figure.
- Response is incorrect.
- Response shows no application of a strategy.
- Mathematical ideas cannot be interpreted or lack sufficient evidence to support even a limited understanding.

### Exemplar Response

<table>
<thead>
<tr>
<th>Points Awarded</th>
<th>Sample Response</th>
</tr>
</thead>
</table>
| 4 | Part A: Figure is translated 1 unit up and 4 units to the right.  
Part B: Figure is translated 4 units to the right and 2 units down.  
Part C: Figure is dilated by a scale factor of 2.  
Part D: Yes. You could translate the quadrilateral $A'B'C'D'$ first (by different amounts) and then dilate it by 2.  
*Or other valid explanation* |
| 3 | The student correctly answers three out of the four parts. |
| 2 | The student correctly answers two out of the four parts. |
| 1 | The student correctly answers one of the four parts. |
| 0 | Response is irrelevant, inappropriate, or not provided. |
### Item 6 Scoring Rubric

<table>
<thead>
<tr>
<th>Points</th>
<th>Description</th>
</tr>
</thead>
</table>
| **2**  | The response achieves the following:  
  • Response demonstrates a complete understanding of applying properties of integer exponents to perform operations.  
  • Give 2 points for Part A correct AND Part B correct.  
  • Response is correct and complete.  
  • Response shows application of a reasonable and relevant strategy.  
  • Mathematical ideas are expressed coherently through a clear, complete, logical, and fully developed response using words, calculations, and/or symbols, as appropriate. |
| **1**  | The response achieves the following:  
  • Response demonstrates a partial understanding of applying properties of integer exponents to perform operations.  
  • Give 1 point for Part A OR Part B correct.  
  • Response is mostly correct but contains either a computational error or an unclear or incomplete explanation.  
  • Response shows application of a relevant strategy, though it may be only partially applied or remain unexplained.  
  • Mathematical ideas are expressed only partially using words, calculations, and/or symbols, as appropriate. |
| **0**  | The response achieves the following:  
  • The response demonstrates limited to no understanding of applying properties of integer exponents to perform operations.  
  • Response is incorrect.  
  • Response shows no application of a strategy.  
  • Mathematical ideas cannot be interpreted or lack sufficient evidence to support even a limited understanding. |

### Exemplar Response

<table>
<thead>
<tr>
<th>Points Awarded</th>
<th>Sample Response</th>
</tr>
</thead>
</table>
| **2**          | Part A: 343 or $7^3$ or equivalent  
  Part B: I found the answer by adding the exponents because the two factors have the same base. The result is $7$ to the third power, which equals 343. |
| **1**          | Part A: 6  
  Part B: By adding them together |
| **0**          | Response is irrelevant, inappropriate, or not provided. |
## Item 11 Scoring Rubric

<table>
<thead>
<tr>
<th>Points</th>
<th>Description</th>
</tr>
</thead>
</table>
| 2      | The response achieves the following:  
• Response demonstrates a complete understanding of functions as the set of ordered pairs consisting of an input and the corresponding output.  
• Give 2 points for Part A correct AND Part B correct.  
• Response is correct and complete.  
• Response shows application of a reasonable and relevant strategy.  
• Mathematical ideas are expressed coherently through a clear, complete, logical, and fully developed response using words, calculations, and/or symbols, as appropriate. |
| 1      | The response achieves the following:  
• Response demonstrates a partial understanding of functions as the set of ordered pairs consisting of an input and the corresponding output.  
• Give 1 point for Part A OR Part B correct.  
• Response is mostly correct but contains either a computational error or an unclear or incomplete explanation.  
• Response shows application of a relevant strategy, though it may be only partially applied or remain unexplained.  
• Mathematical ideas are expressed only partially using words, calculations, and/or symbols, as appropriate. |
| 0      | The response achieves the following:  
• The response demonstrates limited to no understanding of functions as a set of ordered pairs consisting of an input and corresponding output.  
• Response is incorrect.  
• Response shows no application of a strategy.  
• Mathematical ideas cannot be interpreted or lack sufficient evidence to support even a limited understanding. |

### Exemplar Response

<table>
<thead>
<tr>
<th>Points Awarded</th>
<th>Sample Response</th>
</tr>
</thead>
</table>
| 2              | Part A: Table D  
Part B: It is not a function because the same value of x has two different output values and a function can have only one unique output for every input. |
| 1              | Part A: Table D  
Part B: It is not a function. |
| 0              | Response is irrelevant, inappropriate, or not provided. |
### Item 12 Scoring Rubric

<table>
<thead>
<tr>
<th>Points</th>
<th>Description</th>
</tr>
</thead>
</table>
| 2      | The response achieves the following:  
- Response demonstrates a complete understanding of comparing properties of two functions represented in different ways.  
- Give 2 points for Part A correct AND Part B correct.  
- Response is correct and complete.  
- Response shows application of a reasonable and relevant strategy.  
- Mathematical ideas are expressed coherently through a clear, complete, logical, and fully developed response using words, calculations, and/or symbols, as appropriate. |
| 1      | The response achieves the following:  
- Response demonstrates a partial understanding of comparing properties of two functions represented in different ways.  
- Give 1 point for Part A OR Part B correct.  
- Response is mostly correct but contains either a computational error or an unclear or incomplete explanation.  
- Response shows application of a relevant strategy, though it may be only partially applied or remain unexplained.  
- Mathematical ideas are expressed only partially using words, calculations, and/or symbols, as appropriate. |
| 0      | The response achieves the following:  
- The response demonstrates limited to no understanding of comparing properties of two functions represented in different ways.  
- Response is incorrect.  
- Response shows no application of a strategy.  
- Mathematical ideas cannot be interpreted or lack sufficient evidence to support even a limited understanding. |

**Exemplar Response**

<table>
<thead>
<tr>
<th>Points Awarded</th>
<th>Sample Response</th>
</tr>
</thead>
</table>
| 2              | Part A: The equation represents the function with the greater rate of change.  
Part B: The rate of change for the table is 3. I know because as the value of x increases by 1, the value of y increases by 3. The rate of change for the equation is 5. I know because the equation is in slope-intercept form and the slope, m, is 5. Since 5 is greater than 3, the equation has the greater rate of change. |
| 1              | Part A: The equation represents the function with the greater rate of change.  
Part B: I know because the initial value of the equation is greater than the initial value for the table. |
| 0              | Response is irrelevant, inappropriate, or not provided. |
### Item 14

**Scoring Rubric**

<table>
<thead>
<tr>
<th>Points</th>
<th>Description</th>
</tr>
</thead>
</table>
| 2      | The response achieves the following:  
- Response demonstrates a complete understanding of using similar triangles to define the slope between any two points and writing an equation of the line using the slope.  
- Give 2 points for Part A correct AND Part B correct.  
- Response is correct and complete.  
- Response shows application of a reasonable and relevant strategy.  
- Mathematical ideas are expressed coherently through a clear, complete, logical, and fully developed response using words, calculations, and/or symbols, as appropriate. |
| 1      | The response achieves the following:  
- Response demonstrates a partial understanding of using similar triangles to define slope between any two points and writing an equation of the line using the slope.  
- Give 1 point for Part A OR Part B correct.  
- Response is mostly correct but contains either a computational error or an unclear or incomplete explanation.  
- Response shows application of a relevant strategy, though it may be only partially applied or remain unexplained.  
- Mathematical ideas are expressed only partially using words, calculations, and/or symbols, as appropriate. |
| 0      | The response achieves the following:  
- The response demonstrates limited to no understanding of using similar triangles to define slope between any two points and writing an equation of the line using the slope.  
- Response is incorrect.  
- Response shows no application of a strategy.  
- Mathematical ideas cannot be interpreted or lack sufficient evidence to support even a limited understanding. |

**Exemplar Response**

<table>
<thead>
<tr>
<th>Points Awarded</th>
<th>Sample Response</th>
</tr>
</thead>
</table>
| 2              | Part A: 7  
Part B: You must move 4 units up. |
| 1              | Part A: 7  
Part B: You must move 1 unit up. |
| 0              | Response is irrelevant, inappropriate, or not provided. |
### Item 16

**Scoring Rubric**

<table>
<thead>
<tr>
<th>Points</th>
<th>Description</th>
</tr>
</thead>
</table>
| 2      | The response achieves the following:  
• Response demonstrates a complete understanding of determining the rate of change and initial value of a function.  
• Give 2 points for Part A correct AND Part B correct.  
• Response is correct and complete.  
• Response shows application of a reasonable and relevant strategy.  
• Mathematical ideas are expressed coherently through a clear, complete, logical, and fully developed response using words, calculations, and/or symbols, as appropriate. |
| 1      | The response achieves the following:  
• Response demonstrates a partial understanding of determining rate of change and initial value of a function.  
• Give 1 point for Part A OR Part B correct.  
• Response is mostly correct but contains either a computational error or an unclear or incomplete explanation.  
• Response shows application of a relevant strategy, though it may be only partially applied or remain unexplained.  
• Mathematical ideas are expressed only partially using words, calculations, and/or symbols, as appropriate. |
| 0      | The response achieves the following:  
• The response demonstrates limited to no understanding of determining rate of change and initial value of a function.  
• Response is incorrect.  
• Response shows no application of a strategy.  
• Mathematical ideas cannot be interpreted or lack sufficient evidence to support even a limited understanding. |

**Exemplar Response**

<table>
<thead>
<tr>
<th>Points Awarded</th>
<th>Sample Response</th>
</tr>
</thead>
</table>
| 2              | Part A: Yes, that is the correct rate of change. I know because as x increases by 1, y decreases by 5.  
Part B: 80 |
| 1              | Part A: Yes, that is the correct rate of change. I know because as x increases by 1, y decreases by 5.  
Part B: 0 |
<p>| 0              | Response is irrelevant, inappropriate, or not provided. |</p>
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<th>Section</th>
<th>Page</th>
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<td>Types of Items Included in the Sampler and Uses of the Sampler</td>
<td>1</td>
</tr>
<tr>
<td>ELA Constructed-Response Item Types</td>
<td>1</td>
</tr>
<tr>
<td>Mathematics Constructed-Response Item Types</td>
<td>2</td>
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<tr>
<td>Item Alignment</td>
<td>2</td>
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<td>Item and Scoring Sampler Format</td>
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<td>Passage 1</td>
<td>5</td>
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<tr>
<td>Constructed-Response Item</td>
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<td><strong>#1 Item Information</strong></td>
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<td>Item-Specific Scoring Guideline</td>
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<td>Student Responses</td>
<td>8</td>
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<tr>
<td>Constructed-Response Item</td>
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<tr>
<td><strong>#2 Item Information</strong></td>
<td>13</td>
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<tr>
<td>Scoring Guideline for Narrative Item</td>
<td>14</td>
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<tr>
<td>Student Responses</td>
<td>16</td>
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<tr>
<td>Passage 2</td>
<td>25</td>
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<tr>
<td>Passage 3</td>
<td>26</td>
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<tr>
<td>Constructed-Response Item</td>
<td>27</td>
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<tr>
<td><strong>#3 Item Information</strong></td>
<td>27</td>
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<tr>
<td>Item-Specific Scoring Guideline</td>
<td>28</td>
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<td>Student Responses</td>
<td>29</td>
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<td><strong>Writing Task</strong></td>
<td>34</td>
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<tr>
<td>Constructed-Response Item</td>
<td>35</td>
</tr>
<tr>
<td><strong>#4 Item Information</strong></td>
<td>35</td>
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<td>Seven-Point, Two-Trait Rubric</td>
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<td>Student Responses</td>
<td>39</td>
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<tr>
<td>Mathematics</td>
<td>52</td>
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<tr>
<td>Constructed-Response Item</td>
<td>53</td>
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<td><strong>#5 Item Information</strong></td>
<td>54</td>
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<tr>
<td>Item-Specific Scoring Guideline</td>
<td>54</td>
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<tr>
<td>Student Responses</td>
<td>55</td>
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<tr>
<td>Constructed-Response Item</td>
<td>59</td>
</tr>
<tr>
<td><strong>#6 Item Information</strong></td>
<td>59</td>
</tr>
<tr>
<td>Item-Specific Scoring Guideline</td>
<td>60</td>
</tr>
<tr>
<td>Student Responses</td>
<td>61</td>
</tr>
</tbody>
</table>
CONSTRUCTED-RESPONSE ITEM

MGSE8.G.2

5. Look at ΔABC and ΔEFG on the coordinate grid.

Part A: Explain why ΔABC cannot be mapped onto ΔEFG by a reflection of ΔABC over the x-axis followed by a slide of 8 units to the left. Write your answer in the space provided on your answer document.

Part B: Describe a rigid transformation or series of transformations that maps ΔABC onto ΔEFG. Write your answer in the space provided on your answer document.
#5 Item Information

**Standard:** MGSE8.G.2
Understand that a two-dimensional figure is congruent to another if the second can be obtained from the first by a sequence of rotations, reflections, and translations; given two congruent figures, describe a sequence that exhibits the congruence between them.

**Item Depth of Knowledge:** 2
Basic Application of Skill/Concept
Student uses information, conceptual knowledge, and procedures.

## ITEM-SPECIFIC SCORING GUIDELINE

<table>
<thead>
<tr>
<th>Score Point</th>
<th>Description</th>
</tr>
</thead>
</table>
| 2 | Response demonstrates a complete understanding of the standard.  
Give 2 points for student explaining why the given series of transformations will not map ΔABC onto ΔEFG and providing a series of transformations that will map ΔABC onto ΔEFG.  
**Exemplar Response:**  
With the transformation described, angle A would align with angle G, which is not true. *(1 point)*  
**AND**  
Reflection over the x-axis followed by a reflection over the y-axis. *(1 point)*  
**OR**  
Other valid response |
| 1 | Response demonstrates partial understanding of the standard.  
Student earns 1 point for answering 1 key element. |
| 0 | Response demonstrates limited to no understanding of the standard.  
Student earns 0 points because the student does not show understanding of transformations of two-dimensional figures. |
Part A: Explain why $\triangle ABC$ cannot be mapped onto $\triangle EFG$ by a reflection of $\triangle ABC$ over the $x$-axis followed by a slide of 8 units to the left. Write your answer in the space provided on your answer document.

Part B: Describe a rigid transformation or series of transformations that maps $\triangle ABC$ onto $\triangle EFG$. Write your answer in the space provided on your answer document.

Part A: That would not work because $A$ should be where $E$ is but those steps will put $A$ where $G$ is.

Part B: Rotate 180 degrees about the origin.
The response demonstrates a complete understanding by providing an explanation of why the transformations will not map the first triangle onto the second triangle in Part A and a description of a correct transformation in Part B. The student shows that a reflection over the x-axis followed by a slide of 8 units to the right maps point A to point G, but the corresponding point on triangle EFG should be point E. The student provides a correct description of the rotation of 180 degrees about the origin.
MGSE8.G.2

Response Score: 1

5. Look at ΔABC and ΔEFG on the coordinate grid.

Part A: Explain why ΔABC cannot be mapped onto ΔEFG by a reflection of ΔABC over the x-axis followed by a slide of 8 units to the left. Type your answer in the space provided.

Part B: Describe a rigid transformation or series of transformations that maps ΔABC onto ΔEFG. Type your answer in the space provided.

It won’t be the same

Reflect over the y axis and then reflect over the x axis

The response demonstrates partial understanding by providing a correct description of a series of transformations in Part B. The student describes the correct transformations (reflection over the y-axis followed by reflection over the x-axis) that will map triangle ABC onto triangle EFG. Though the student states in Part A that “It won’t be the same,” this is not detailed enough to explain why the series of transformations provided will result in triangle ABC not being mapped onto triangle EFG.
MGSE8.G.2

Response Score: 0

5. Look at ΔABC and ΔEFG on the coordinate grid.

Part A: Explain why ΔABC cannot be mapped onto ΔEFG by a reflection of ΔABC over the x-axis followed by a slide of 8 units to the left. **Type your answer in the space provided.**

Part B: Describe a rigid transformation or series of transformations that maps ΔABC onto ΔEFG. **Type your answer in the space provided.**

That will work
Reflect and translate

The response shows inadequate understanding of the concepts being measured. The student incorrectly asserts that the series of transformations in Part A will result in mapping triangle ABC onto triangle EFG. The series of transformations provided in Part B is not correct and is a general restatement of the transformation provided in Part A.
CONSTRUCTED-RESPONSE ITEM

MCC8.EE.8c

6. Zoe wants to rent a bicycle. Rent-A-Bicycle offers two pricing plans to rent a bicycle.

   Plan 1: $15 an hour

   Plan 2: a flat fee of $9 plus $12 an hour

Part A: Write a system of equations that represents both pricing plans. For each equation, use \( x \) to represent the number of hours a bicycle is rented and \( y \) to represent the total cost. Write your answer in the space provided on your answer document.

Part B: At what number of hours do the two plans cost the same amount? Show work or explain how you found your answer. Write your answer in the space provided on your answer document.

#6 Item Information

<table>
<thead>
<tr>
<th>Standard: MCC8.EE.8c</th>
<th>Item Depth of Knowledge: 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solve real-world and mathematical problems leading to two linear equations in two variables. For example, given coordinates for two pairs of points, determine whether the line through the first pair of points intersects the line through the second pair.</td>
<td>Strategic Thinking</td>
</tr>
<tr>
<td>Student uses reasoning and develops a plan or sequence of steps; process has some complexity.</td>
<td></td>
</tr>
</tbody>
</table>
ITEM-SPECIFIC SCORING GUIDELINE

<table>
<thead>
<tr>
<th>Score Point</th>
<th>Description</th>
</tr>
</thead>
</table>
| 4           | Response demonstrates a complete understanding of the standard.  
            | Give 4 points for correctly providing the two equations that represent the pricing plans, determining that at 3 hours the two plans have the same cost, and explaining how the value of 3 hours was determined. |
|             | **Exemplar Response:**  
            | **Part A:** Plan 1 is $y = 15x$  (1 point)  
            | AND  
            | Plan 2 is $y = 9 + 12x$  (1 point)  
            | **Part B:** 3 hours  (1 point)  
            | AND  
            | I set $15x$ equal to $9 + 12x$ and solved for $x$. The result is $x$ is 3 hours for both plans to be the same.  (1 point)  
            | OR  
            | Other valid response |
| 3           | Response demonstrates nearly complete understanding of the standard.  
            | Student earns 3 points for answering 3 key elements.* |
| 2           | Response demonstrates partial understanding of the standard.  
            | Student earns 2 points for answering 2 key elements.* |
| 1           | Response demonstrates minimal understanding of the standard.  
            | Student earns 1 point for answering 1 key element.* |
| 0           | Response demonstrates limited to no understanding of the standard.  
            | Student earns 0 points because the student does not show understanding of solving real-world problems leading to two linear equations in two variables. |

*If a student makes an error in Part A that is carried through to Part B (or subsequent parts), then the student is not penalized again for the same error.*
STUDENT RESPONSES

MCC8.EE.8c

Response Score: 4

6. Zoe wants to rent a bicycle. Rent-A-Bicycle offers two pricing plans to rent a bicycle.

   **Plan 1:** $15 an hour

   **Plan 2:** a flat fee of $9 plus $12 an hour

Part A: Write a system of equations that represents both pricing plans. For each equation, use \( x \) to represent the number of hours a bicycle is rented and \( y \) to represent the total cost. Write your answer in the space provided on your answer document.

Part B: At what number of hours do the two plans cost the same amount? Show work or explain how you found your answer. Write your answer in the space provided on your answer document.

\[
\begin{align*}
\text{y} &= 15x \quad \text{and} \quad y = 12x + 9 \\
3 \text{ hours} \\
15x &= 12x + 9 \\
15x - 12x &= 12x + 9 - 12x \\
3x &= 9 \\
x &= 9/3 \\
x &= 3
\end{align*}
\]

The response demonstrates complete understanding by providing equations that represent both pricing plans in Part A, providing a correct answer in Part B, and providing a correct explanation of how to determine the number of hours for which the two pricing plans have the same cost. The student correctly shows how to model an hourly rate pricing plan as well as a fixed cost plus hourly rate pricing plan using a system of equations. The student shows that the number of hours for which the plans cost the same requires that the two expressions equal to \( y \) should be set equal to each other. The student correctly solves this equation to get the answer of 3 hours.
MCC8.EE.8c

Response Score: 3

6. Zoe wants to rent a bicycle. Rent-A-Bicycle offers two pricing plans to rent a bicycle.

   Plan 1: $15 an hour
   Plan 2: a flat fee of $9 plus $12 an hour

Part A: Write a system of equations that represents both pricing plans. For each equation, use $x$ to represent the number of hours a bicycle is rented and $y$ to represent the total cost. Type your answer in the space provided.

Part B: At what number of hours do the two plans cost the same amount? Show work or explain how you found your answer. Type your answer in the space provided.

$$y = 15x \text{ and } y = 10x + 9$$

1.8

15x = 10x + 9

5x = 9

x = 1.8

The response demonstrates partial understanding by providing an equation that represents one pricing plan in Part A and a correct answer in Part B based on the two equations from Part A. It includes a correct explanation of how to find the number of hours for which the two pricing plans have the same cost. The student shows how to model an hourly rate pricing plan as well as a fixed cost plus hourly rate pricing plan using a system of equations, but uses an incorrect hourly rate for the fixed cost plus hourly rate plan ($y = 10x + 9$ rather than $y = 12x + 9$). The student shows that to find the number of hours for which the costs are equal, the two expressions that represent $y$ should be set equal to each other. The student solves this equation to get an answer of 1.8 hours, which is correct given the two equations from Part A.
6. Zoe wants to rent a bicycle. Rent-A-Bicycle offers two pricing plans to rent a bicycle.

Plan 1: $15 an hour
Plan 2: a flat fee of $9 plus $12 an hour

Part A: Write a system of equations that represents both pricing plans. For each equation, use $x$ to represent the number of hours a bicycle is rented and $y$ to represent the total cost. **Type your answer in the space provided.**

Part B: At what number of hours do the two plans cost the same amount? Show work or explain how you found your answer. **Type your answer in the space provided.**

$y=15x$ and $y=12x+9$

7.2 hours because it’s the correct answer

The response demonstrates partial understanding by providing equations that represent both pricing plans in Part A and an incorrect answer in Part B. The student shows how to model an hourly rate pricing plan as well as a fixed cost plus hourly rate pricing plan using a system of equations. The student does not show how to find the number of hours for which the plans have the same cost by setting the two expressions that represent $y$ equal to each other. The answer provided for Part B is not correct.
MATHEMATICS

MCC8.EE.8c

Response Score: 1

6. Zoe wants to rent a bicycle. Rent-A-Bicycle offers two pricing plans to rent a bicycle.

   Plan 1: $15 an hour
   Plan 2: a flat fee of $9 plus $12 an hour

Part A: Write a system of equations that represents both pricing plans. For each equation, use $x$ to represent the number of hours a bicycle is rented and $y$ to represent the total cost. Write your answer in the space provided on your answer document.

Part B: At what number of hours do the two plans cost the same amount? Show work or explain how you found your answer. Write your answer in the space provided on your answer document.

\[ y = 15x \]
\[ y = 12x + 9 \]

The response demonstrates minimal understanding by providing an equation that represents the hourly rate pricing plan in Part A. The student shows how to model an hourly rate pricing plan, but does not account for a pricing plan with a fixed cost plus hourly rate. The student does not show how to find the number of hours for which the plans have the same cost.
MCC8.EE.8c

Response Score: 0

6. Zoe wants to rent a bicycle. Rent-A-Bicycle offers two pricing plans to rent a bicycle.

   Plan 1: $15 an hour
   Plan 2: a flat fee of $9 plus $12 an hour

Part A: Write a system of equations that represents both pricing plans. For each equation, use $x$ to represent the number of hours a bicycle is rented and $y$ to represent the total cost. Write your answer in the space provided on your answer document.

Part B: At what number of hours do the two plans cost the same amount? Show work or explain how you found your answer. Write your answer in the space provided on your answer document.

| plan 1 | 15 every hour |
| plan 2 | 12 every hour + $9 |

In 5 hours they are equal

The response demonstrates inadequate understanding of the concepts being measured. The student restates the price plans without a system of equations using the plan information. The response of “5” in Part B is incorrect, with no supporting explanation.