Ohio’s State Tests

ITEM RELEASE

SPRING 2019

INTEGRATED MATHEMATICS I
# Table of Contents

Content Summary and Answer Key ........................................................................................................ iii

Depth of Knowledge (DOK) .................................................................................................................... viii

Question 1: Question and Scoring Guidelines .................................................................................. 1
Question 1: Sample Responses ............................................................................................................ 4

Question 3: Question and Scoring Guidelines .................................................................................. 11
Question 3: Sample Responses .......................................................................................................... 14

Question 5: Question and Scoring Guidelines ................................................................................ 19
Question 5: Sample Responses .......................................................................................................... 22

Question 9: Question and Scoring Guidelines ................................................................................ 29
Question 9: Sample Responses .......................................................................................................... 32

Question 10: Question and Scoring Guidelines .............................................................................. 37
Question 10: Sample Responses ........................................................................................................ 40

Question 15: Question and Scoring Guidelines ............................................................................. 47
Question 15: Sample Responses ........................................................................................................ 50

Question 17: Question and Scoring Guidelines .............................................................................. 56
Question 17: Sample Responses ........................................................................................................ 59

Question 20: Question and Scoring Guidelines .............................................................................. 65
Question 20: Sample Responses ........................................................................................................ 68

Question 21: Question and Scoring Guidelines .............................................................................. 75
Question 21: Sample Response ........................................................................................................... 78

Question 24: Question and Scoring Guidelines .............................................................................. 79
Question 24: Sample Response ........................................................................................................... 81

Question 25: Question and Scoring Guidelines .............................................................................. 82
Question 25: Sample Response ........................................................................................................... 84

Question 31: Question and Scoring Guidelines .............................................................................. 85
Question 31: Sample Response ........................................................................................................... 87

Question 32: Question and Scoring Guidelines .............................................................................. 88
Question 32: Sample Responses ......................................................................................................... 91
<table>
<thead>
<tr>
<th>Question</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question 33: Question and Scoring Guidelines</td>
<td>100</td>
</tr>
<tr>
<td>Question 33: Sample Responses</td>
<td>103</td>
</tr>
<tr>
<td>Question 34: Question and Scoring Guidelines</td>
<td>108</td>
</tr>
<tr>
<td>Question 34: Sample Response</td>
<td>110</td>
</tr>
<tr>
<td>Question 36: Question and Scoring Guidelines</td>
<td>111</td>
</tr>
<tr>
<td>Question 36: Sample Response</td>
<td>114</td>
</tr>
<tr>
<td>Question 42: Question and Scoring Guidelines</td>
<td>115</td>
</tr>
<tr>
<td>Question 42: Sample Responses</td>
<td>118</td>
</tr>
<tr>
<td>Question 43: Question and Scoring Guidelines</td>
<td>122</td>
</tr>
<tr>
<td>Question 43: Sample Responses</td>
<td>125</td>
</tr>
<tr>
<td>Question 51: Question and Scoring Guidelines</td>
<td>131</td>
</tr>
<tr>
<td>Question 51: Sample Responses</td>
<td>134</td>
</tr>
<tr>
<td>Question 53: Question and Scoring Guidelines</td>
<td>141</td>
</tr>
<tr>
<td>Question 53: Sample Responses</td>
<td>144</td>
</tr>
<tr>
<td>Question 54: Question and Scoring Guidelines</td>
<td>150</td>
</tr>
<tr>
<td>Question 54: Sample Response</td>
<td>152</td>
</tr>
</tbody>
</table>
## Integrated Math I
### Spring 2019 Item Release
#### Content Summary and Answer Key

<table>
<thead>
<tr>
<th>Question No.*</th>
<th>Item Type</th>
<th>Content Cluster</th>
<th>Content Standard</th>
<th>Depth of Knowledge</th>
<th>Answer Key</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Equation Item</td>
<td>Prove geometric theorems both formally and informally using a variety of methods.</td>
<td>Prove and apply theorems about parallelograms. Theorems include but are not restricted to the following: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals. (G.CO.11)</td>
<td>Level 1</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>3</td>
<td>Equation Item</td>
<td>Interpret the structure of expressions.</td>
<td>Interpret expressions that represent a quantity in terms of its context. (A.SSE.1) b. Interpret complicated expressions by viewing one or more of their parts as a single entity.</td>
<td>Level 2</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>5</td>
<td>Equation Item</td>
<td>Create equations that describe numbers or relationships.</td>
<td>Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. b. Focus on formulas in which the variable of interest is linear. For example, rearrange Ohm’s law $V = IR$ to highlight resistance $R$. (M1) (A.CED.4)</td>
<td>Level 2</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>9</td>
<td>Table Item</td>
<td>Construct and compare linear, quadratic, and exponential models and solve problems.</td>
<td>Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). (F.LE.2)</td>
<td>Level 3</td>
<td>---</td>
<td>1 point</td>
</tr>
</tbody>
</table>

* The question number matches the item number in the Item Level Report in the Online Reporting System. The items are numbered sequentially in the practice site.
<table>
<thead>
<tr>
<th>Question No.*</th>
<th>Item Type</th>
<th>Content Cluster</th>
<th>Content Standard</th>
<th>Depth of Knowledge</th>
<th>Answer Key</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Equation Item</td>
<td>Solve systems of equations.</td>
<td>Solve systems of linear equations algebraically and graphically. (a). Limit to pairs of linear equations in two variables. (A1, M1) (A.REI.6)</td>
<td>Level 2</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>15</td>
<td>Equation Item</td>
<td>Understand the concept of a function and use function notation.</td>
<td>Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by (f(0) = f(1) = 1, f(n + 1) = f(n) + f(n - 1)) for (n \geq 1). (F.IF.3)</td>
<td>Level 3</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>17</td>
<td>Equation Item</td>
<td>Represent and solve equations and inequalities graphically.</td>
<td>Explain why the (x)-coordinates of the points where the graphs of the equation (y=f(x)) and (y=g(x)) intersect are the solutions of the equation (f(x)=g(x)); find the solutions approximately, e.g., using technology to graph the functions, making tables of values, or finding successive approximations. (A.REI.11)</td>
<td>Level 3</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>20</td>
<td>Equation Item</td>
<td>Create equations that describe numbers or relationships.</td>
<td>Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods. (A1, M1) (A.CED.3)</td>
<td>Level 2</td>
<td>---</td>
<td>1 point</td>
</tr>
</tbody>
</table>

*The question number matches the item number in the Item Level Report in the Online Reporting System. The items are numbered sequentially in the practice site.*
<table>
<thead>
<tr>
<th>Question No.*</th>
<th>Item Type</th>
<th>Content Cluster</th>
<th>Content Standard</th>
<th>Depth of Knowledge</th>
<th>Answer Key</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>Multiple Choice Item</td>
<td>Summarize, represent, and interpret data on a single count or measurement variable.</td>
<td>In the context of real-world applications by using the GAISE model, interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). (S.ID.3)</td>
<td>Level 2</td>
<td>A</td>
<td>1 point</td>
</tr>
<tr>
<td>24</td>
<td>Multiple Choice Item</td>
<td>Construct and compare linear, quadratic, and exponential models and solve problems.</td>
<td>Distinguish between situations that can be modeled with linear functions and with exponential functions. (F.LE.1)</td>
<td>Level 2</td>
<td>D</td>
<td>1 point</td>
</tr>
<tr>
<td>25</td>
<td>Multiple Choice Item</td>
<td>Reason quantitatively and use units to solve problems.</td>
<td>Define appropriate quantities for the purpose of descriptive modeling. (N.Q.2)</td>
<td>Level 2</td>
<td>B</td>
<td>1 point</td>
</tr>
<tr>
<td>31</td>
<td>Multiple Choice Item</td>
<td>Interpret linear models.</td>
<td>Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. (S.ID.7)</td>
<td>Level 2</td>
<td>B</td>
<td>1 point</td>
</tr>
<tr>
<td>32</td>
<td>Gap Match Item</td>
<td>Classify and analyze geometric figures.</td>
<td>Classify two-dimensional figures in a hierarchy based on properties. (G.CO.14)</td>
<td>Level 2</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>33</td>
<td>Equation Item</td>
<td>Represent and solve equations and inequalities graphically.</td>
<td>Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). (A.REI.10)</td>
<td>Level 1</td>
<td>---</td>
<td>1 point</td>
</tr>
</tbody>
</table>

* The question number matches the item number in the Item Level Report in the Online Reporting System. The items are numbered sequentially in the practice site.
<table>
<thead>
<tr>
<th>Question No.*</th>
<th>Item Type</th>
<th>Content Cluster</th>
<th>Content Standard</th>
<th>Depth of Knowledge</th>
<th>Answer Key</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>34</td>
<td>Multiple Choice Item</td>
<td>Interpret functions that arise in applications in terms of the context.</td>
<td>Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function $h(n)$ gives the number of person-hours it takes to assemble $n$ engines in a factory, then the positive integers would be an appropriate domain for the function. a. Focus on linear and exponential functions. (M1) (F.IF.5)</td>
<td>Level 2</td>
<td>A</td>
<td>1 point</td>
</tr>
<tr>
<td>36</td>
<td>Multi Select Item</td>
<td>Experiment with transformations in the plane.</td>
<td>Identify the symmetries of a figure, which are the rotations and reflections that carry it onto itself. (G.CO.3) a. Identify figures that have line symmetry; draw and use lines of symmetry to analyze properties of shapes.</td>
<td>Level 1</td>
<td>B, E</td>
<td>1 point</td>
</tr>
<tr>
<td>42</td>
<td>Matching Item</td>
<td>Understand and apply theorems about circles.</td>
<td>Identify and describe relationships among angles, radii, chords, tangents, and arcs and use them to solve problems. Include the relationship between central, inscribed, and circumscribed angles and their intercepted arcs; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle. (G.C.2)</td>
<td>Level 1</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>43</td>
<td>Equation Item</td>
<td>Build a function that models a relationship between two quantities.</td>
<td>Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms. (F.BF.2)</td>
<td>Level 2</td>
<td>---</td>
<td>1 point</td>
</tr>
</tbody>
</table>

* The question number matches the item number in the Item Level Report in the Online Reporting System. The items are numbered sequentially in the practice site.
<table>
<thead>
<tr>
<th>Question No.*</th>
<th>Item Type</th>
<th>Content Cluster</th>
<th>Content Standard</th>
<th>Depth of Knowledge</th>
<th>Answer Key</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>51</td>
<td>Table Item</td>
<td>Summarize, represent, and interpret data on two categorical and quantitative variables.</td>
<td>Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data. (S.ID.5)</td>
<td>Level 3</td>
<td>---</td>
<td>2 points</td>
</tr>
<tr>
<td>53</td>
<td>Equation Item</td>
<td>Use coordinates to prove simple geometric theorems algebraically and to verify specific geometric statements.</td>
<td>Justify the slope criteria for parallel and perpendicular lines, and use them to solve geometric problems, e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point. (G.GPE.5)</td>
<td>Level 2</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>54</td>
<td>Multiple Choice Item</td>
<td>Reason quantitatively and use units to solve problems.</td>
<td>Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (N.Q.1)</td>
<td>Level 1</td>
<td>D</td>
<td>1 point</td>
</tr>
</tbody>
</table>

* The question number matches the item number in the Item Level Report in the Online Reporting System. The items are numbered sequentially in the practice site.
Depth of Knowledge (DOK)

DOK refers to the complexity of thinking required to complete a task in a given item. Items with a DOK 1 designation focus on the recall of information, such as definitions and terms, and simple procedures. Items with a DOK 2 designation require students to make decisions, solve routine problems, perform calculations, or recognize patterns. Items with a DOK 3 designation feature higher-order cognitive tasks. These DOK 3 tasks include but are not limited to: critiquing a statement and forming a conclusion; explaining, justifying, or proving a statement; or approaching abstract, complex, open-ended, and non-routine problems. Each grade’s blueprint contains information about the number of points of opportunity students will encounter at each DOK level.

Table 1: Math Descriptors – Applying Depth of Knowledge Levels for Mathematics (Webb, 2002) & NAEP 2002 Mathematics Levels of Complexity
(M. Petit, Center for Assessment 2003, K. Hess, Center for Assessment, updated 2006)

<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recall</td>
<td>Skills/Concepts</td>
<td>Strategic Thinking</td>
<td>Extended Thinking</td>
</tr>
<tr>
<td>a. Recall, observe, or recognize a fact, definition, term, or property</td>
<td>a. Classify plane and three-dimensional figures</td>
<td>a. Interpret information from a complex graph</td>
<td>a. Relate mathematical concepts to other content areas</td>
</tr>
<tr>
<td>b. Apply/compute a well-known algorithm (e.g., sum, quotient)</td>
<td>b. Interpret information from a simple graph</td>
<td>b. Explain thinking when more than one response is possible</td>
<td>b. Relate mathematical concepts to real-world applications in new situations</td>
</tr>
<tr>
<td>c. Apply a formula</td>
<td>c. Use models to represent mathematical concepts</td>
<td>c. Make and/or justify conjectures</td>
<td>c. Apply a mathematical model to illuminate a problem, situation</td>
</tr>
<tr>
<td>d. Determine the area or perimeter of rectangles or triangles given a drawing and labels</td>
<td>d. Solve a routine problem requiring multiple steps/decision points, or the application of multiple concepts</td>
<td>d. Use evidence to develop logical arguments for a concept</td>
<td>d. Conduct a project that specifies a problem, identifies solution paths, solves the problem, and reports results</td>
</tr>
<tr>
<td>e. Identify a plane or three-dimensional figure</td>
<td>e. Compare and/or contrast figures or statements</td>
<td>e. Use concepts to solve non-routine problems</td>
<td>e. Design a mathematical model to inform and solve a practical or abstract situation</td>
</tr>
<tr>
<td>f. Measure</td>
<td>f. Construct 2-dimensional patterns for 3-dimensional models, such as cylinders and cones</td>
<td>f. Perform procedure with multiple steps and multiple decision points</td>
<td>f. Develop generalizations of the results obtained and the strategies used and apply them to new problem situations</td>
</tr>
<tr>
<td>g. Perform a specified or routine procedure (e.g., apply rules for rounding)</td>
<td>g. Provide justifications for steps in a solution process</td>
<td>g. Generalize a pattern</td>
<td></td>
</tr>
<tr>
<td>h. Evaluate an expression</td>
<td>h. Extend a pattern</td>
<td>h. Describe, compare, and contrast solution methods</td>
<td></td>
</tr>
<tr>
<td>i. Solve a one-step word problem</td>
<td>i. Formulate a mathematical model for a complex situation</td>
<td>i. Formulate a mathematical model for a complex situation</td>
<td></td>
</tr>
<tr>
<td>j. Retrieve information from a table or graph</td>
<td>j. Provide mathematical justifications</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1 continued on next page.
<table>
<thead>
<tr>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recall</strong></td>
<td><strong>Skills/Concepts</strong></td>
<td><strong>Strategic Thinking</strong></td>
<td><strong>Extended Thinking</strong></td>
</tr>
<tr>
<td>k. Recall, identify, or make conversions between and among representations or numbers (fractions, decimals, and percents), or within and between customary and metric measures</td>
<td>i. Retrieve information from a table, graph, or figure and use it to solve a problem requiring multiple steps</td>
<td>k. Solve a multiple-step problem and provide support with a mathematical explanation that justifies the answer</td>
<td>g. Apply one approach among many to solve problems</td>
</tr>
<tr>
<td>l. Locate numbers on a number line, or points on a coordinate grid</td>
<td>j. Translate between tables, graphs, words and symbolic notation</td>
<td>l. Solve 2-step linear equations/inequalities in one variable over the rational numbers, interpret solution(s) in the original context, and verify reasonableness of results</td>
<td>h. Apply understanding in a novel way, providing an argument/justification for the application</td>
</tr>
<tr>
<td>m. Solve linear equations</td>
<td>k. Make direct translations between problem situations and symbolic notation</td>
<td>m. Translate between a problem situation and symbolic notation that is not a direct translation</td>
<td>i. Formulate an original problem, given a situation</td>
</tr>
<tr>
<td>n. Represent math relationships in words, pictures, or symbols</td>
<td>l. Select a procedure according to criteria and perform it</td>
<td>n. Compare, classify, organize, estimate, or order data</td>
<td>o. Analyze the similarities and differences between procedures</td>
</tr>
<tr>
<td>o. Read, write, and compare decimals in scientific notation</td>
<td>m. Specify and explain relationships between facts, terms, properties, or operations</td>
<td>p. Draw conclusion from observations or data, citing evidence</td>
<td>p. Draw conclusion from observations or data, citing evidence</td>
</tr>
</tbody>
</table>

**NOTE:** Level 4 involves such things as complex restructuring of data or establishing and evaluating criteria to solve problems.
Parallelogram EFGH is shown. The perimeter of EFGH is 32 centimeters (cm).

What is the length of GH, in centimeters?

\[
\text{cm}
\]

\[
\begin{array}{ccc}
1 & 2 & 3 \\
4 & 5 & 6 \\
7 & 8 & 9 \\
0 & & \\
& & \\
\end{array}
\]
Points Possible: 1

Content Cluster: Prove geometric theorems both formally and informally using a variety of methods.

Content Standard: Prove and apply theorems about parallelograms. Theorems include but are not restricted to the following: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals. (G.CO.11)

Depth of Knowledge: Level 1
  c. Apply a formula
  m. Solve linear equations
  n. Represent math relationships in words, pictures, or symbols

Scoring Guidelines

Exemplar Response
  • 6 cm

Other Correct Responses
  • any equivalent value

For this item, a full-credit response includes:
  • a correct value (1 point).
Integrated Math I
Spring 2019 Item Release

Question 1

Sample Responses
Parallelogram EFGH is shown. The perimeter of EFGH is 32 centimeters (cm).

What is the length of GH, in centimeters?

6.0 cm

Sample Response: 1 point
Notes on Scoring

This response earns full credit (1 point) because it shows a correct side length of the parallelogram.

To find the length of the unknown side GH, use the definition of a perimeter and a theorem about parallelograms. The perimeter of a parallelogram is the sum of all lengths of its sides or

\[ P = EF + FG + GH + HE. \]

Given that the perimeter of the parallelogram is 32, \( EF + FG + GH + HE = 32 \).

One of the theorems about parallelograms states that the opposite sides of a parallelogram have equal lengths. Hence, if \( FG = 10 \text{ cm} \), then \( HE = 10 \text{ cm}, \) too. Since \( EF = GH \), then \( EF \) can be substituted by \( GH \) into the right side of the equation and the equation becomes \( GH + 10 + GH + 10 = 32 \). After combining like terms the equation simplifies to \( 2GH + 20 = 32 \). Next, subtract 20 from both sides to get \( 2GH = 12 \) and then divide both sides by 2 to get \( GH = 6.0 \).
Parallelogram EFGH is shown. The perimeter of EFGH is 32 centimeters (cm).

What is the length of GH, in centimeters?

\[
\frac{32 - 20}{2} \text{ cm}
\]

Sample Response: 1 point
Notes on Scoring

This response earns full credit (1 point) because it shows a correct equivalent side length of the parallelogram.

To find the length of the unknown side GH, the student uses the definition of a perimeter and a theorem about parallelograms. Since the perimeter of a parallelogram is the sum of all lengths of its sides and the lengths of opposite sides are equal, the student finds the sum of FG and EH as 10 + 10 = 20, subtracts the sum from the perimeter, or (32 – 20), and divides the result by 2, or \( \frac{32-20}{2} \). This numerical expression represents the length of one of the two remaining equal sides, FE or GH. The response is stated in a correct equivalent form.
Sample Response: 0 points

Parallelogram EFGH is shown. The perimeter of EFGH is 32 centimeters (cm).

What is the length of GH, in centimeters?

12 cm

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect side length of the parallelogram.

The student may realize that EH = 10 and create a correct equation representing the perimeter but does not divide by 2 in the last step.
Sample Response: 0 points

Parallelogram EFGH is shown. The perimeter of EFGH is 32 centimeters (cm).

What is the length of GH, in centimeters?

\[
\text{3.2 cm}
\]

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect side length of the parallelogram.

The student may confuse the perimeter with the area. He or she may incorrectly think that the area is a product of two adjacent sides of the parallelogram, create the equation \(10 \cdot GH = 32\), and divide both sides by 10 to get 3.2 cm.
Integrated Math I
Spring 2019 Item Release

Question 3

Question and Scoring Guidelines
Question 3

Hector earns $16 per hour at his job. The amount of money, in dollars, that he earns after taxes for working \( h \) hours can be modeled by the given expression.

\[ 0.75(16h) \]

How much money per hour does Hector earn after taxes?

Points Possible: 1

Content Cluster: Interpret the structure of expressions.

Content Standard: Interpret expressions that represent a quantity in terms of its context. (A.SSE.1)

b. Interpret complicated expressions by viewing one or more of their parts as a single entity.

Depth of Knowledge: Level 2

c. Use models to represent mathematical concepts

j. Translate between tables, graphs, words and symbolic notation
Scoring Guidelines

Exemplar Response

- $12

Other Correct Responses

- any equivalent value

For this item, a full-credit response includes:

- a correct value (1 point).
Sample Response: 1 point

Hector earns $16 per hour at his job. The amount of money, in dollars, that he earns after taxes for working $h$ hours can be modeled by the given expression.

$$0.75(16h)$$

How much money per hour does Hector earn after taxes?

$\$12$

Notes on Scoring

This response earns full credit (1 point) because it correctly interprets the structure of the expression by viewing its two parts as a single entity.

There are three factors in the given expression. Two of them, 16 and $h$, are defined in the problem. The contextual meaning of the third factor, 0.75, is the percentage of money Hector earns after the deduction of taxes. So, if Hector earns $16 per hour before taxes, then after taxes, he earns $(0.75 \cdot 16)$, or $12 per hour.
Sample Response: 1 point

Hector earns $16 per hour at his job. The amount of money, in dollars, that he earns after taxes for working \( h \) hours can be modeled by the given expression.

\[ 0.75(16h) \]

How much money per hour does Hector earn after taxes?

$ \boxed{12.00} $

Notes on Scoring

This response earns full credit (1 point) because it correctly interprets the structure of the expression.

If Hector earns $16 per hour before taxes, then after taxes, he earns \( 0.75 \cdot 16 = 12 \), or $12.00 per hour.
Sample Response: 0 points

Hector earns $16 per hour at his job. The amount of money, in dollars, that he earns after taxes for working $h$ hours can be modeled by the given expression.

$0.75(16h)$

How much money per hour does Hector earn after taxes?

$\$ \boxed{15.25}$

Notes on Scoring

This response earns no credit (0 points) because it incorrectly interprets the structure of the expression.

The student does not understand the meaning of 0.75 and subtracts it from $16$ to get $15.25$ per hour after taxes.
Sample Response: 0 points

Hector earns $16 per hour at his job. The amount of money, in dollars, that he earns after taxes for working $h$ hours can be modeled by the given expression.

$$0.75(16h)$$

How much money per hour does Hector earn after taxes?

$\$\ 16.75$

Notes on Scoring

This response earns no credit (0 points) because it incorrectly interprets the structure of the expression.

The student does not understand the meaning of 0.75 and adds it to $16$ to get $16.75$ per hour after taxes.
Integrated Math I
Spring 2019 Item Release

Question 5

Question and Scoring Guidelines
Question 5

An equation is given.

\[ y = 3x + c \]

Create an equivalent equation by solving for \( x \) in terms of \( y \) and \( c \).

\[ x = \]

Points Possible: 1

Content Cluster: Create equations that describe numbers or relationships.

Content Standard: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. b. Focus on formulas in which the variable of interest is linear. For example, rearrange Ohm’s law \( V = IR \) to highlight resistance \( R \). (M1) (A.CED.4)

Depth of Knowledge: Level 2

l. Select a procedure according to criteria and perform it
d. Solve a routine problem requiring multiple steps/decision points, or the application of multiple concepts
Scoring Guidelines

Exemplar Response

- $x = \frac{y-c}{3}$

Other Correct Responses

- any equivalent equation

For this item, a full-credit response includes

- a correct equation (1 point).
Integrated Math I
Spring 2019 Item Release

Question 5

Sample Responses
An equation is given.

\[ y = 3x + c \]

Create an equivalent equation by solving for \( x \) in terms of \( y \) and \( c \).

\[ x = \frac{1}{3}y - \frac{c}{3} \]
Notes on Scoring

This response earns full credit (1 point) because it shows a correct equation expressing $x$ in terms of $y$ and $c$.

To solve the equation for $x$, rearrange the given equation $y = 3x + c$ to isolate the variable $x$ by applying the same reasoning as used in solving a linear equation. First, use the Addition Property of Equality to add $-c$ to both sides:

$$y - c = 3x + c - c$$
$$y - c = 3x$$

Then, use the Multiplication Property of Equality (or Division Property of Equality) to isolate $x$ by multiplying both sides of the equation by $\frac{1}{3}$ to get $\frac{1}{3}(y - c) = \frac{1}{3}3x$.

Last, use the Distributive Property to multiply $\frac{1}{3}$ and $(y - c)$ and the Reflexive Property of Equality to switch the sides of the equation and get $x = \frac{1}{3}y - \frac{c}{3}$. 
Sample Response: 1 point

An equation is given.

\[ y = 3x + c \]

Create an equivalent equation by solving for \( x \) in terms of \( y \) and \( c \).

\[ x = -\left( \frac{3}{c-y} \right)^{-1} \]

Notes on Scoring

This response earns full credit (1 point) because it shows a correct equation expressing \( x \) in terms of \( y \) and \( c \) that is equivalent to \( x = \frac{y-c}{3} \).

Using the properties of exponents, the expression \( -\left( \frac{3}{c-y} \right)^{-1} \) can be restated as \( -\left( \frac{c-y}{3} \right) \), then using the properties of operations can be changed to \( \frac{-c+y}{3} \) and finally to \( \frac{y-c}{3} \).
Sample Response: 0 points

An equation is given.

\[ y = 3x + c \]

Create an equivalent equation by solving for \( x \) in terms of \( y \) and \( c \).

\[ x = \frac{3(y-c)}{\square} \]
Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect equation expressing x in terms of y and c.

To solve the equation for x, the student may rearrange the given equation $y = 3x + c$ to isolate the variable x by applying the same reasoning as used in solving a linear equation. First, the student may use the Addition Property of Equality to add $-c$ to both sides:

\[ y - c = 3x + c - c \]
\[ y - c = 3x \]

Then, the student may use the Multiplication Property of Equality to isolate x and incorrectly multiply both sides of the equation by 3, instead of $\frac{1}{3}$ to get $3(y - c) = x$ and then interchange the sides of the equation to get $x = 3(y - c)$. 
Sample Response: 0 points

An equation is given.

\[ y = 3x + c \]

Create an equivalent equation by solving for \( x \) in terms of \( y \) and \( c \).

\[ x = \frac{3y + c}{3} \]

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect equation expressing \( x \) in terms of \( y \) and \( c \). The student may think that switching the variables creates an equivalent expression.
Integrated Math I
Spring 2019 Item Release

Question 9

Question and Scoring Guidelines
Question 9

An incomplete table of values for an exponential function is shown. The exponential function is of the form $y = a \cdot b^x$, where $a$ is a real number such that $a \neq 0$ and $b$ is a positive real number not equal to 1.

Complete the table with possible values for the exponential function.

<table>
<thead>
<tr>
<th>$x$</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>96</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Points Possible: 1

Content Cluster: Construct and compare linear, quadratic, and exponential models and solve problems.

Content Standard: Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). (F.LE.2)

Depth of Knowledge: Level 3
  e. Use concepts to solve non-routine problems
  f. Perform procedure with multiple steps and multiple decision points
  m. Translate between a problem situation and symbolic notation that is not a direct translation
Scoring Guidelines

Exemplar Response

<table>
<thead>
<tr>
<th>x</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>96</td>
<td>48</td>
<td>24</td>
<td>12</td>
</tr>
</tbody>
</table>

Other Correct Responses

- any values that could represent an exponential relationship between $x$ and $y$ according to the form $y = a \cdot b^x$ and the values do not equal 96

For this item, a full-credit response includes:

- the correct values (1 point).
Sample Response: 1 point

An incomplete table of values for an exponential function is shown. The exponential function is of the form $y = a \cdot b^x$, where $a$ is a real number such that $a \neq 0$ and $b$ is a positive real number not equal to 1.

Complete the table with possible values for the exponential function.

<table>
<thead>
<tr>
<th>$x$</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>96</td>
<td>24</td>
<td>6</td>
<td>1.5</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns full credit (1 point) because it shows a correctly completed table with three possible values for the exponential function.

The table representing the exponential function in the form $y = ab^x$ shows one solution of $x = 0$ and $y = 96$. Substituting these values in the equation of the function leads to the equation $96 = ab^0$, which can be restated to $96 = a \cdot 1$ or $a = 96$.

Since no other solutions of the function are given, there are infinitely many correct possibilities for the value of $b$. The only other restriction is that $b$ must be a positive real number not equal to one.

This student chooses $b = 0.25$. Since $a = 96$, the function is represented by the equation $y = 96(0.25)^x$. Then for $x = 1$, the corresponding value of $y$ is 24 because $96(0.25)^1 = 24$. For $x = 2$, the corresponding value of $y$ is 6 because $96(0.25)^2 = 6$. For $x = 3$, the corresponding value of $y$ is 1.5 because $96(0.25)^3 = 1.5$. 

33 (2019)
Sample Response: 1 point

An incomplete table of values for an exponential function is shown. The exponential function is of the form \( y = a \cdot b^x \), where \( a \) is a real number such that \( a \neq 0 \) and \( b \) is a positive real number not equal to 1.

Complete the table with possible values for the exponential function.

<table>
<thead>
<tr>
<th>( x )</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y )</td>
<td>96</td>
<td>192</td>
<td>384</td>
<td>768</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns full credit (1 point) because it shows a correctly completed table with three possible values for the exponential function.

The table representing the exponential function in the form \( y = ab^x \) shows one solution of \( x = 0 \) and \( y = 96 \). Substituting these values in the equation of the function leads to the equation \( 96 = ab^0 \), which can be restated as \( 96 = a \cdot 1 \) or \( a = 96 \).

Since no other solutions of the function are given, there are infinitely many correct possibilities for the value of \( b \). The only other restriction is that \( b \) must be a positive real number not equal to one.

This student chooses \( b = 2 \). Since \( a = 96 \), the function is represented by the equation \( y = 96(2)^x \). Then for \( x = 1 \), the corresponding value of \( y \) is 192 because \( 96(2)^1 = 192 \). For \( x = 2 \), the corresponding value of \( y \) is 384 because \( 96(2)^2 = 384 \). For \( x = 3 \), the corresponding value of \( y \) is 768 because \( 96(2)^3 = 768 \).
Sample Response: 0 points

An incomplete table of values for an exponential function is shown. The exponential function is of the form \( y = a \cdot b^x \), where \( a \) is a real number such that \( a \neq 0 \) and \( b \) is a positive real number not equal to 1.

Complete the table with possible values for the exponential function.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>( x )</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>( y )</td>
<td>96</td>
<td>97</td>
<td>98</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrectly completed table of values for the exponential function.

The table shows values for the linear function \( y = x + 96 \).
Sample Response: 0 points

An incomplete table of values for an exponential function is shown. The exponential function is of the form $y = a \cdot b^x$, where $a$ is a real number such that $a \neq 0$ and $b$ is a positive real number not equal to 1.

Complete the table with possible values for the exponential function.

<table>
<thead>
<tr>
<th>$x$</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>$y$</td>
<td>96</td>
<td>96</td>
<td>96</td>
<td>96</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrectly completed table of values for the exponential function.

The table shows values for the linear function $y = 96$. 
Question 10

A system of equations is given.

\[
\begin{align*}
   y + 2 &= 3(x - 1) \\
   y &= -2x + 10
\end{align*}
\]

What is the solution to the system?

(______, ______)

Points Possible: 1

Content Cluster: Solve systems of equations.

Content Standard: Solve systems of linear equations algebraically and graphically. a. Limit to pairs of linear equations in two variables. (A1, M1) (A.REI.6)

Depth of Knowledge: Level 2
d. Solve a routine problem requiring multiple steps/decision points, or the application of multiple concepts

1. Select a procedure according to criteria and perform it
Scoring Guidelines

Exemplar Response

• (3, 4)

Other Correct Responses

• any equivalent decimal values

For this item, a full-credit response includes:

• a correct ordered pair (1 point).
Integrated Math I
Spring 2019 Item Release

Question 10

Sample Responses
Sample Response: 1 point

A system of equations is given.

\[
\begin{align*}
  y + 2 &= 3(x - 1) \\
  y &= -2x + 10
\end{align*}
\]

What is the solution to the system?

(3 , 4 )

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Notes on Scoring

This response earns full credit (1 point) because it shows two correct numbers representing a solution of a system of two linear equations in two variables.

The second equation is given in the slope-intercept form with $y$ by itself on the left side. The first equation can be transformed into the same form by applying the Distributive Property to the right side, and then subtracting 2 from both sides to get $y = 3x - 5$. When both equations of the system are in slope-intercept form, $y = 3x - 5$ and $y = -2x + 10$, it is reasonable to use substitution to solve the system.

Set the two right sides of the equations equal to each other and solve for $x$:

$$3x - 5 = -2x + 10$$

$$3x + 2x = 5 + 10$$  \hspace{1cm} \text{add (2x) and 5 to both sides of the equation}$$

$$5x = 15$$  \hspace{1cm} \text{collect like terms}$$

$$x = 3$$  \hspace{1cm} \text{divide both sides of the equation by 5}$$

To find the second variable, $y$, substitute $x = 3$ into one of the two given equations. For example, $y = -2(3) + 10$ to get $y = 4$. Therefore, the solution to the system is $(3, 4)$. If $x = 3$ is substituted into the other equation, or $y + 2 = 3(3 - 1)$, the value of $y$ is the same. The value of $y$ is correct regardless of which equation the value of $x$ is substituted into.
Sample Response: 1 point

A system of equations is given.

\[
\begin{align*}
\{ & y + 2 = 3(x - 1) \\
& y = -2x + 10 \\
\end{align*}
\]

What is the solution to the system?

\[(3.0, -\frac{4}{1})\]
Notes on Scoring

This response earns full credit (1 point) because it shows two correct numbers representing a solution of a system of two linear equations in two variables.

The second equation is given in the slope-intercept form with \( y \) by itself on the left side. The first equation can be transformed into the same form by applying the Distributive Property to the right side, and then subtracting 2 from both sides to get \( y = 3x - 5 \). When both equations of the system are in slope-intercept form, \( y = 3x - 5 \) and \( y = -2x + 10 \), it is reasonable to use substitution to solve the system.

Set the two right sides of the equations equal to each other and solve for \( x \):

\[
3x - 5 = -2x + 10
\]

\[
3x + 2x = 5 + 10 \quad \text{add (2x) and 5 to both sides of the equation}
\]

\[
5x = 15 \quad \text{collect like terms}
\]

\[
x = 3 \quad \text{divide both sides of the equation by 5}
\]

To find the second variable, \( y \), substitute \( x = 3 \) into one of the two given equations. For example, \( y = -2(3) + 10 \) to get \( y = 4 \) which is equivalent to \( \frac{4}{-4} \). Therefore, the solution to the system can be shown as \( (3, \frac{4}{-4}) \).

If \( x = 3 \) is substituted into the other equation, or \( y + 2 = 3(3 - 1) \), the value of \( y \) is the same. The value of \( y \) is correct regardless of which equation the value of \( x \) is substituted into.


Sample Response: 0 points

A system of equations is given.

\[
\begin{align*}
\begin{cases}
y + 2 &= 3(x - 1) \\
y &= -2x + 10
\end{cases}
\end{align*}
\]

What is the solution to the system?

\((4 \ \ , \ 3 \ )\)

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect ordered pair of numbers representing a solution of a system of two linear equations in two variables.

The student may correctly find the values of \(x\) and \(y\) but then change their order in the ordered pair, which makes the response incorrect.
Sample Response: 0 points

A system of equations is given.

\[
\begin{align*}
    y + 2 &= 3 (x - 1) \\
    y &= -2x + 10
\end{align*}
\]

What is the solution to the system?

\[
\left( \frac{13}{5}, \frac{24}{5} \right)
\]

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect ordered pair of numbers representing a solution of a system of two linear equations in two variables.

The student may ignore 2 in the first equation when solving the system by a substitution method, set two right sides of the equations equal, solve the equation for \(x\) and then use an incorrect value to find the \(y\).
Integrated Math I
Spring 2019 Item Release

Question 15

Question and Scoring Guidelines
Question 15

The values of several terms in a sequence are shown in the table.

<table>
<thead>
<tr>
<th>Term</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second</td>
<td>5</td>
</tr>
<tr>
<td>Fourth</td>
<td>12</td>
</tr>
<tr>
<td>Seventh</td>
<td>22.5</td>
</tr>
</tbody>
</table>

Find the first term, \( f(1) \).

\[ f(1) = \]

Points Possible: 1

Content Cluster: Understand the concept of a function and use function notation.

Content Standard: Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. For example, the Fibonacci sequence is defined recursively by \( f(0) = f(1) = 1, f(n + 1) = f(n) + f(n - 1) \) for \( n \geq 1 \). (F.IF.3)

Depth of Knowledge: Level 3
d. Use evidence to develop logical arguments for a concept
   g. Generalize a pattern
Scoring Guidelines

Exemplar Response

- \( f(1) = 1.5 \)

Other Correct Responses

- any equivalent value

For this item, a full-credit response includes:

- a correct initial value (1 point).
Sample Responses
Sample Response: 1 point

The values of several terms in a sequence are shown in the table.

<table>
<thead>
<tr>
<th>Term</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second</td>
<td>5</td>
</tr>
<tr>
<td>Fourth</td>
<td>12</td>
</tr>
<tr>
<td>Seventh</td>
<td>22.5</td>
</tr>
</tbody>
</table>

Find the first term, \( f(1) \).

\[
f(1) = 1.5
\]
Notes on Scoring

This response earns full credit (1 point) because in an arithmetic sequence, each term is generated by adding a constant value (a common difference) to the previous term. If the table shows terms of an arithmetic sequence, then the third term would be exactly halfway between the second term and fourth term, $\frac{5+12}{2} = 8.5$. The common difference would be 3.5 and would be added to each term to generate the next consecutive term.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>Second</td>
</tr>
<tr>
<td>Second</td>
<td>5</td>
</tr>
<tr>
<td>Third</td>
<td>$5 + 3.5 = 8.5$</td>
</tr>
<tr>
<td>Fourth</td>
<td>$8.5 + 3.5 = 12$</td>
</tr>
<tr>
<td>Fifth</td>
<td>$12 + 3.5 = 15.5$</td>
</tr>
<tr>
<td>Sixth</td>
<td>$15.5 + 3.5 = 19$</td>
</tr>
<tr>
<td>Seventh</td>
<td>$19 + 3.5 = 22.5$</td>
</tr>
</tbody>
</table>

This calculation confirms that the sequence is arithmetic. Finally, by subtracting 3.5 from the second term, the first term can be found, $5 - 3.5 = 1.5$.

*There is no reason to justify against the geometric sequence because a given list of more than 2 terms cannot be terms of both an arithmetic and a geometric sequence.*
Sample Response: 1 point

The values of several terms in a sequence are shown in the table.

<table>
<thead>
<tr>
<th>Term</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second</td>
<td>5</td>
</tr>
<tr>
<td>Fourth</td>
<td>12</td>
</tr>
<tr>
<td>Seventh</td>
<td>22.5</td>
</tr>
</tbody>
</table>

Find the first term, \( f(1) \).

\[ f(1) = 1.50 \]

Notes on Scoring

This response earns full credit (1 point) because it shows a correct first term of the sequence in the equivalent form.
Sample Response: 0 points

The values of several terms in a sequence are shown in the table.

<table>
<thead>
<tr>
<th>Term</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second</td>
<td>5</td>
</tr>
<tr>
<td>Fourth</td>
<td>12</td>
</tr>
<tr>
<td>Seventh</td>
<td>22.5</td>
</tr>
</tbody>
</table>

Find the first term, \( f(1) \).

\[
f(1) = 5
\]

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect first term of the sequence. The student may think that the term in the first row of the table is the first term in the sequence, but instead, this is the second term of the sequence.
Sample Response: 0 points

The values of several terms in a sequence are shown in the table.

<table>
<thead>
<tr>
<th>Term</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second</td>
<td>5</td>
</tr>
<tr>
<td>Fourth</td>
<td>12</td>
</tr>
<tr>
<td>Seventh</td>
<td>22.5</td>
</tr>
</tbody>
</table>

Find the first term, \( f(1) \).

\[
f(1) = -2
\]

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect first term of the sequence. The student may identify the term in the second row of the table as the third term of the sequence. The student may then subtract 12 and 5 and conclude that 7 is the common difference. Finally, the student may subtract 7 from 5 to get \(-2\) for the first term.
Integrated Math I
Spring 2019 Item Release

Question 17

Question and Scoring Guidelines
A linear function is given.

\[ a(x) = 26 - 12.4x \]

The function \( b(x) \) is also linear. The equation \( a(x) = b(x) \) has exactly one solution at \( x = 5 \).

Create a possible equation for function \( b(x) \).

\[ b(x) = \]
Scoring Guidelines

Exemplar Response

- \( b(x) = -\frac{36}{5}x \)

Other Correct Responses

- any linear equation that:
  - is not equivalent to \( a(x) \)
  - has an x-coefficient other than -12.4
  - has (5, -36) as a solution

For this item, a full-credit response includes

- a correct function (1 point).
Sample Response: 1 point

A linear function is given.

\[ a(x) = 26 - 12.4x \]

The function \( b \) is also linear. The equation \( a(x) = b(x) \) has exactly one solution at \( x = 5 \).

Create a possible equation for function \( b \).

\[ b(x) = -36 \]
Notes on Scoring

This response earns full credit (1 point) because it shows a correct equation of the linear function \( b(x) \).

Given that \( b(x) \) is a linear function, and the equation \( a(x) = b(x) \) is only true when \( x = 5 \), then the corresponding function values, \( a(5) \) and \( b(5) \), are equal, and the graphs of the functions \( a(x) \) and \( b(x) \) intersect at the point that has the \( x \)-coordinate 5.

Therefore, since \( b(x) \) is linear, it is represented by an equation such as \( b(x) = mx + p \). Substituting 5 into the equations for \( b(x) \) and \( a(x) \) leads to the equations \( b(5) = 5m + p \) and \( a(5) = 26 - 12.4 \cdot 5 = -36 \). Then since \( a(5) \) and \( b(5) \) are equal, \( 5m + p = -36 \).

The linear equation \( 5m + p = -36 \) has infinitely many solutions or values for \( m \) and \( p \) that satisfy this equation. Since the graphs of two functions intersect, the graphs are not parallel or coinciding, and their equations must not have equal slopes. Therefore, except for \( m = -12.4 \), any value for \( m \) can be selected to calculate a corresponding value of \( p \).

This student substitutes \( m = 0 \) into the equation \( 5m + p = -36 \) so that \( 5(0) + p = -36 \) and \( p = -36 \). Therefore, \( b(x) = -36 \).
Sample Response: 1 point

A linear function is given.

\[ a(x) = 26 - 12.4x \]

The function \( b \) is also linear. The equation \( a(x) = b(x) \) has exactly one solution at \( x = 5 \).

Create a possible equation for function \( b \).

\[ b(x) = -6(x+1) \]

Notes on Scoring

This response earns full credit (1 point) because it shows a correct equation of the linear function \( b(x) \).

This student substitutes \( m = -6 \) into the equation \( 5m + p = -36 \) so that \( 5(-6) + p = -36 \) and \( p = -6 \). Therefore, \( b(x) = -6x - 6 \) or \( b(x) = -6(x + 1) \).
Sample Response: 0 points

A linear function is given.

\[ a(x) = 26 - 12.4x \]

The function \( b \) is also linear. The equation \( a(x) = b(x) \) has exactly one solution at \( x = 5 \).

Create a possible equation for function \( b \).

\[ b(x) = (x - 5) \]

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect equation of the linear function \( b(x) \).

The student creates a function that intercepts the \( x \)-axis at \( x = 5 \) instead of the function that has only one common solution with \( a(x) \) at \( x = 5 \). The equation \( 26 - 12.4x = x - 5 \) has a solution \( x = \frac{155}{67} \).
Sample Response: 0 points

A linear function is given.

\[ a(x) = 26 - 12.4x \]

The function \( b \) is also linear. The equation \( a(x) = b(x) \) has exactly one solution at \( x = 5 \).

Create a possible equation for function \( b(x) \).

\[ b(x) = 5 \]

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect equation of the linear function \( b(x) \).

The student may assume that if the equation \( a(x) = b(x) \) has exactly one solution at \( x = 5 \), then \( b(x) = 5 \). The equation \( 26 - 12.4x = 5 \) has a solution \( x = \frac{105}{62} \), instead of \( x = 5 \).
Integrated Math I
Spring 2019 Item Release

Question 20

Question and Scoring Guidelines
Question 20

Chad buys pineapples, watermelons, and a bag of grapes for a fruit salad. He spends a total of $29.68 on the fruit salad. Pineapples cost $2.15 each, and watermelons cost $3.75 each. The bag of grapes costs $4.48.

Create an equation to model this situation, where $p$ represents the number of pineapples Chad can purchase and $w$ represents the number of watermelons he can purchase.
Points Possible: 1

Content Cluster: Create equations that describe numbers or relationships.

Content Standard: Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or non-viable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods. (A1, M1) (A.CED.3)

Depth of Knowledge: Level 2
c. Use models to represent mathematical concepts
k. Make direct translations between problem situations and symbolic notation

Scoring Guidelines

Exemplar Response

- $2.15p + 3.75w + 4.48 = 29.68$

Other Correct Responses

- any equivalent equation

For this item, a full-credit response includes

- the correct equation (1 point).
Chad buys pineapples, watermelons, and a bag of grapes for a fruit salad. He spends a total of $29.68 on the fruit salad. Pineapples cost $2.15 each, and watermelons cost $3.75 each. The bag of grapes costs $4.48.

Create an equation to model this situation, where \( p \) represents the number of pineapples Chad can purchase and \( w \) represents the number of watermelons he can purchase.

\[
29.68 = 3.75w + 2.15p + 4.48
\]
Notes on Scoring

This response earns full credit (1 point) because it shows a correct equation.

The cost of the entire purchase consisting of pineapples, watermelons and one bag of grapes is $29.68. This can be modeled by the equation:

cost of pineapples + cost of watermelons + cost of grapes = 29.68.

If each pineapple is $2.15, and Chad purchased \( p \) pineapples, then the cost of \( p \) pineapples is $2.15 \( p \). If each watermelon is $3.75 and Chad purchased \( w \) watermelons, then the cost of \( w \) watermelons is $3.75 \( w \). Chad purchased only one bag of grapes which costs $4.48. By substituting all three costs into the equation, the equation becomes

\[ 2.15p + 3.75w + 4.48 \cdot 1 = 29.68. \]

After applying the Reflexive Property of Equality and Commutative Property of Addition, the equivalent equation is

\[ 29.68 = 3.75w + 2.15p + 4.48. \]
Sample Response: 1 point

Chad buys pineapples, watermelons, and a bag of grapes for a fruit salad. He spends a total of $29.68 on the fruit salad. Pineapples cost $2.15 each, and watermelons cost $3.75 each. The bag of grapes costs $4.48.

Create an equation to model this situation, where \( p \) represents the number of pineapples Chad can purchase and \( w \) represents the number of watermelons he can purchase.

\[ 2.15p + 3.75w = 25.2 \]
Notes on Scoring

This response earns full credit (1 point) because it shows a correct equation modeling a given situation.

The cost of the entire purchase consisting of pineapples, watermelons and one bag of grapes is $29.68. This can be modeled by the equation:

cost of pineapples + cost of watermelons + cost of grapes = 29.68.

If each pineapple is $2.15, and Chad purchased $p$ pineapples, then the cost of $p$ pineapples is $2.15p$. If each watermelon is $3.75 and Chad purchased $w$ watermelons, then the cost of $w$ watermelons is $3.75w$. Chad purchased only one bag of grapes which costs $4.48. By substituting all three costs into the equation, the equation becomes $2.15p + 3.75w + 4.48 \cdot 1 = 29.68$. After subtracting 4.48 from both sides, the equivalent equation is $2.15p + 3.75w = 25.2$. 
Sample Response: 0 points

Chad buys pineapples, watermelons, and a bag of grapes for a fruit salad. He spends a total of $29.68 on the fruit salad. Pineapples cost $2.15 each, and watermelons cost $3.75 each. The bag of grapes costs $4.48.

Create an equation to model this situation, where \( p \) represents the number of pineapples Chad can purchase and \( w \) represents the number of watermelons he can purchase.

\[
2.15 + 3.75 + 4.48 + p + w = 29.68
\]

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect equation.

The student writes an equation using all numbers and variables given in the problem but does not relate them in a way that models the situation.
Sample Response: 0 points

Chad buys pineapples, watermelons, and a bag of grapes for a fruit salad. He spends a total of $29.68 on the fruit salad. Pineapples cost $2.15 each, and watermelons cost $3.75 each. The bag of grapes costs $4.48.

Create an equation to model this situation, where \( p \) represents the number of pineapples Chad can purchase and \( w \) represents the number of watermelons he can purchase.

\[3.75w + 2.15p + 4.48\]

Notes on Scoring

This response earns no credit (0 points) because it shows an expression instead of an equation modeling a given situation.
Integrated Math I
Spring 2019 Item Release

Question 21

Question and Scoring Guidelines
Question 21

Four different companies compile the ages of their employees.

Which company has the greatest range of ages in the middle 50% of the population?

A

Company A

B

Company B

C

Company C

D

Company D
Points Possible: 1

Content Cluster: Summarize, represent, and interpret data on a single count or measurement variable.

Content Standard: In the context of real-world applications by using the GAISE model, interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). (S.ID.3)

Depth of Knowledge: Level 2
i. Retrieve information from a table, graph, or figure and use it to solve a problem requiring multiple steps
n. Compare, classify, organize, estimate, or order data

Scoring Guidelines

Rationale for Option A: Key – The student understands that the middle 50% of a population is between Q1(40) and Q3(52), or the interquartile range, and correctly identifies the box plot with the greatest interquartile range, which is 52 – 40 = 12.

Rationale for Option B: This is incorrect. The student may select the box plot with the greatest area between Q1 and the median instead of selecting the box plot with the greatest interquartile range.

Rationale for Option C: This is incorrect. The student may select the box plot with the largest Q1(46) instead of selecting the box plot with the greatest interquartile range.

Rationale for Option D: This is incorrect. The student may confuse range with interquartile range and select the box plot with the largest range.
Sample Response: 1 point

Four different companies compile the ages of their employees.

Which company has the greatest range of ages in the middle 50% of the population?

- Company A
- Company B
- Company C
- Company D
Question 24

Which situation describes a quantity that increases by a constant percent rate?

(A) The size of one photo is 15% larger than the size of another photo.

(B) The number of plants in a pond is 85% of the number from the previous year.

(C) The population of one city is 85% greater than the population of another city.

(D) The number of magazine subscribers each year is 15% greater than the previous year.

Points Possible: 1

Content Cluster: Construct and compare linear, quadratic, and exponential models and solve problems.

Content Standard: Distinguish between situations that can be modeled with linear functions and with exponential functions. (F.LE.1)

Depth of Knowledge: Level 2
c. Use models to represent mathematical concepts
e. Compare and/or contrast figures or statements
j. Translate between tables, graphs, words and symbolic notation
Scoring Guidelines

Rationale for Option A: This is incorrect. The student may think that if the sizes of the photos are compared by a percentage, then the situation describes a quantity that is growing at a constant percent rate. However, since the sizes of only two photos are compared, the situation does not describe an increasing percent rate.

Rationale for Option B: This is incorrect. The student may realize that if the number of plants is being compared to its previous year using a percentage, then the situation describes exponential growth, without realizing that the number of plants decreases, not increases.

Rationale for Option C: This is incorrect. The student may realize that if the populations of cities are being compared by a percentage, then the situation describes a quantity that grows at a constant percent rate. However, since the populations of only two cities are compared the situation does not describe an increasing percent rate.

Rationale for Option D: Key – The student correctly identifies the situation that describes a quantity that grows by a constant percent rate because the number of subscribers increases by the same percentage from year to year.

Sample Response: 1 point

Which situation describes a quantity that increases by a constant percent rate?

A The size of one photo is 15% larger than the size of another photo.

B The number of plants in a pond is 85% of the number from the previous year.

C The population of one city is 85% greater than the population of another city.

D The number of magazine subscribers each year is 15% greater than the previous year.
Integrated Math I
Spring 2019 Item Release

Question 25

Question and Scoring Guidelines
Question 25

Michelle holds a small rock in her hand.

Density ($D$) can be found using the formula $D = \frac{\text{mass}}{\text{volume}}$

Which unit would be the most appropriate for calculating the density of the rock in Michelle's hand?

A. $\frac{\text{lb}}{\text{mm}^3}$
B. $\frac{\text{g}}{\text{cm}^3}$
C. $\frac{\text{kg}}{\text{m}^3}$
D. $\frac{\text{ton}}{\text{m}^3}$

Points Possible: 1

**Content Cluster:** Reason quantitatively and use units to solve problems.

**Content Standard:** Define appropriate quantities for the purpose of descriptive modeling. (N.Q.2)

**Depth of Knowledge:** Level 2

e. Compare and/or contrast figures or statements
Scoring Guidelines

Rationale for Option A: This is incorrect. The student may focus on millimeters cubed (mm³) being a small unit but ignore the fact that pounds (lb) are not appropriate for an object as small as a rock with dimensions that are measured in mm.

Rationale for Option B: Key – The student identifies two units appropriate for measuring small objects: a gram is about the weight of a paperclip, and a cubic centimeter is less than half the volume of a typical number cube.

Rationale for Option C: This is incorrect. The student may misunderstand that the units kilograms (kg) and meters (m) are large and not appropriate for calculating the density of a small rock.

Rationale for Option D: This is incorrect. The student may misunderstand that the units tons and meters (m) are large and not appropriate for calculating the density of a small rock.

Sample Response: 1 point

Michelle holds a small rock in her hand.

Density \( D \) can be found using the formula \( D = \frac{\text{mass}}{\text{volume}} \)

Which unit would be the most appropriate for calculating the density of the rock in Michelle’s hand?

- A \( \frac{\text{lb}}{\text{mm}^3} \)
- B \( \frac{\text{g}}{\text{cm}^3} \)
- C \( \frac{\text{kg}}{\text{m}^3} \)
- D \( \frac{\text{ton}}{\text{m}^3} \)
Integrated Math I
Spring 2019 Item Release

Question 31

Question and Scoring Guidelines
The population of a town has grown by an average of 2,000 people per year over the last 10 years.

Which equation could represent an appropriate linear model of the population?

(A) $y = 25,000x + 2,000$
(B) $y = 2,000x + 25,000$
(C) $y = -25,000x + 2,000$
(D) $y = -2,000x + 25,000$

Points Possible: 1

Content Cluster: Interpret linear models.

Content Standard: Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data. (S.ID.7)

Depth of Knowledge: Level 2
  c. Use models to represent mathematical concepts
  j. Translate between tables, graphs, words and symbolic notation
Scoring Guidelines

Rationale for Option A: This is incorrect. The student may incorrectly think that the y-intercept of the linear equation represents an average growth of 2000 people per year.

Rationale for Option B: Key – The student correctly chooses the linear model where growth per year is represented by the slope, 2,000 people per year.

Rationale for Option C: This is incorrect. The student may incorrectly think that the y-intercept of the linear equation represents an average change in population per year. He or she may also confuse the growing population model with the decreasing population model and select an equation with a negative slope, \( m = -25,000 \).

Rationale for Option D: This is incorrect. The student may confuse a decreasing population model with a growing population model and select an equation with a negative slope, \( m = -25,000 \).

Sample Response: 1 point

The population of a town has grown by an average of 2,000 people per year over the last 10 years.

Which equation could represent an appropriate linear model of the population?

A  \( y = 25,000x + 2,000 \)

B  \( y = 2,000x + 25,000 \)

C  \( y = -25,000x + 2,000 \)

D  \( y = -2,000x + 25,000 \)
Integrated Math I
Spring 2019 Item Release

Question 32

Question and Scoring Guidelines
Question 32

A partially completed chart shows the hierarchy of a set of polygons.

Move a term to each blank box to complete the chart.

1. Polygon

2. Quadrilateral

3. [Blank]

4. [Blank]

5. [Blank]

6. [Blank]
Points Possible: 1

Content Cluster: Classify and analyze geometric figures.

Content Standard: Classify two-dimensional figures in a hierarchy based on properties. (G.CO.14)

Depth of Knowledge: Level 2
a. Classify plane and three-dimensional figures
b. Interpret information from a simple graph

Scoring Guidelines

Exemplar Response

1. Polygon
2. Quadrilateral
3. Parallelogram
4. Rectangle
5. Rhombus
6. Square

Other Correct Responses
- Boxes 4 and 5 can be switched.

For this item, a full-credit response includes
- the correctly completed table (1 point).
Integrated Math I
Spring 2019 Item Release

Question 32

Sample Responses
A partially completed chart shows the hierarchy of a set of polygons.

Move a term to each blank box to complete the chart.

1. Polygon
2. Quadrilateral
3. Parallelogram
4. Rectangle
5. Rhombus
6. Square
Notes on Scoring

This response earns full credit (1 point) because it shows the correct classification of two-dimensional figures in the hierarchy based on their definitions and properties.

The item asks students to arrange major types of special polygons in such a way that under their formal definitions and properties, any statement about the type of quadrilateral would also be true for all types of quadrilaterals below it.

A kite can be defined as a quadrilateral with two distinct pairs of consecutive congruent sides. If students choose Kite as a type of quadrilateral to place in slot 3, then, based on congruence of sides, they can only place Rhombus and Square in slot 4 or 6, which leaves one empty slot, 5, for either Parallelogram or Rectangle. However, neither Parallelogram nor Rectangle can be placed in a slot beneath a kite because not every property of a kite will work for a rectangle or a parallelogram. So, Kite cannot be in slot 3. Note: There is more than one definition of a kite, but the hierarchy represented by this diagram would be incorrect using either definition.

A parallelogram is a quadrilateral with two pairs of opposite parallel and congruent sides. It implies that a parallelogram is not a kite (Note: A kite is only a parallelogram in the cases of a rhombus depending on the definition of a kite that is used). Since there is no direct connection between a kite and a parallelogram, Kite cannot be placed above or below Parallelogram in the given diagram and should be excluded from the hierarchy.

(continued on next page)
Notes on Scoring

Therefore, no quadrilateral except for Parallelogram should be placed in slot 3. All properties of a parallelogram are true for all types of quadrilaterals beneath - Rhombus, Rectangle and Square.

The placement of a rectangle, a rhombus and a square is based on their definitions and their unique and common properties.

- A rectangle is a quadrilateral (or/and a parallelogram) with four right angles.
- A rhombus is a quadrilateral (or/and a parallelogram) with four congruent sides.
- A square is a quadrilateral (or/and a parallelogram) with four right angles and four congruent sides.

Since every rhombus and rectangle is a parallelogram, Rectangle can go in slot 4 and Rhombus can go in slot 5 (Rectangle and Rhombus can switch slots). Every square is both a rhombus and a rectangle because every square has four equal sides and has four right angles. Hence, Square goes in slot 6.
A partially completed chart shows the hierarchy of a set of polygons.

Move a term to each blank box to complete the chart.

1. Polygon

2. Quadrilateral

3. Parallelogram

4. Rhombus

5. Rectangle

6. Square
Notes on Scoring

This response earns full credit (1 point) because it shows the correct classification of two-dimensional figures in a hierarchy based on their definitions and properties. Since every rhombus and rectangle is a parallelogram, Rhombus can go in slot 4 and Rectangle can go in slot 5 (Rhombus and Rectangle can switch slots). Every square is both a rhombus and a rectangle because every square has four equal sides and has four right angles. Hence, Square goes in slot 6.
Sample Response: 0 points

A partially completed chart shows the hierarchy of a set of polygons.

Move a term to each blank box to complete the chart.

1. Polygon
2. Quadrilateral
3. Parallelogram
4. Kite
5. Rectangle
6. Square

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect classification of two-dimensional figures in the hierarchy based on their definitions and properties. The student may think that kites are always parallelograms; however, per properties of parallelograms and kites, parallelograms do not always have perpendicular diagonals, but kites always have perpendicular diagonals.
A partially completed chart shows the hierarchy of a set of polygons.

Move a term to each blank box to complete the chart.

1. Polygon
2. Quadrilateral
3. Square
4. Rhombus
5. Rectangle
6. Parallelogram
Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect classification of two-dimensional figures in the hierarchy based on their definitions and properties. The student may reverse the order of special polygons in the hierarchy in such way that under their formal definitions and properties, any statement about the type of quadrilateral would also be true for all types of quadrilaterals above it. Per this hierarchy, since all sides of a square are congruent, then all sides of a rectangle and a parallelogram are always congruent too, which is false.
Integrated Math I
Spring 2019 Item Release

Question 33

Question and Scoring Guidelines
Question 33

An equation is given.

\[ 5y - 2x = 5 \]

Create an ordered pair that represents one point on the graph of the equation.

( , )

Points Possible: 1

Content Cluster: Represent and solve equations and inequalities graphically.

Content Standard: Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line). (A.REI.10)

Depth of Knowledge: Level 1
b. Apply/compute a well-known algorithm (e.g., sum, quotient)
Scoring Guidelines

Exemplar Response

• (5, 3)

Other Correct Responses

• any set of coordinates that satisfies the given equation

For this item, a full-credit response includes:

• a correct ordered pair (1 point).
Sample Response: 1 point

An equation is given.

$5y - 2x = 5$

Create an ordered pair that represents one point on the graph of the equation.

$(0, 1)$

Notes on Scoring

This response earns full credit (1 point) because it shows a correct ordered pair that represents one point on the graph of the equation.

This question requires understanding that the graph of an equation in two variables is the set of ordered pairs (solutions) in the coordinate plane that makes the equation a correct statement.

The ordered pair $(0, 1)$ is on the graph because it makes the equation $5y - 2x = 5$ a correct statement, since $5(1) - 2(0) = 5$. 
Sample Response: 1 point

An equation is given.

$5y - 2x = 5$

Create an ordered pair that represents one point on the graph of the equation.

$(55, 23)$

Notes on Scoring

This response earns full credit (1 point) because it shows a correct ordered pair that represents one point on the graph of the equation.

This question requires understanding that the graph of an equation in two variables is the set of ordered pairs (solutions) in the coordinate plane that makes the equation a correct statement.

The ordered pair, $(55, 23)$, is on the graph because it makes the equation $5y - 2x = 5$ a correct statement, since $5(23) - 2(55) = 5$. 

105 (2019)
Sample Response: 0 points

An equation is given.

$5y - 2x = 5$

Create an ordered pair that represents one point on the graph of the equation.

$(-2, 5)$

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect ordered pair.

The ordered pair $(-2, 5)$ is not on the graph because it does not make the equation $5y - 2x = 5$ a correct statement, or $5(5) - 2(-2) = 25 + 4 = 29$ instead of 5.
Sample Response: 0 points

An equation is given.

\[ 5y - 2x = 5 \]

Create an ordered pair that represents one point on the graph of the equation.

\[(3, 5)\]

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect ordered pair.

The ordered pair \((3, 5)\) is not on the graph because it does not make the equation \(5y - 2x = 5\) a correct statement, or \(5(5) - 2(3) = 25 - 6 = 19\) instead of 5. The student may have noticed that \(5(3) - 2(5) = 5\) and thought that this meant that \((3, 5)\) was on the graph.
Integrated Math I
Spring 2019 Item Release

Question 34

Question and Scoring Guidelines
Question 34

Leza sells cupcakes at her store. The profit, in dollars, that Leza makes selling cupcakes is modeled by the function \( p(x) = 3.75x - 962.50 \).

What is the domain of the function when Leza makes a profit of at least $950?

A. all integers greater than or equal to 510
B. all integers greater than or equal to 257
C. all integers greater than or equal to 0 and less than 510
D. all integers greater than or equal to 0 and less than 2601

Points Possible: 1

Content Cluster: Interpret functions that arise in applications in terms of the context.

Content Standard: Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. For example, if the function \( h(n) \) gives the number of person-hours it takes to assemble \( n \) engines in a factory, then the positive integers would be an appropriate domain for the function. a. Focus on linear and exponential functions. (M1) (F.IF.5)

Depth of Knowledge: Level 2

C. Use models to represent mathematical concepts
E. Compare and/or contrast figures or statements
Scoring Guidelines

Rationale for Option A: Key – The student correctly identifies that the domain, or values of $x$, for which Leza makes a profit of at least $950 are solutions of the inequality $3.75x - 962.50 \geq 950$ or $x \geq 1912.5/3.75$ or $x \geq 510$ and is further restricted to positive integers since only whole cupcakes can be sold.

Rationale for Option B: This is incorrect. The student may think that the profit only needs to be greater than or equal to 0 and then correctly solves $3.75x - 962.50 \geq 0$ to get $x \geq 962.50/3.75$, or approximately 257, but misses that the profit needs to be greater than $950$.

Rationale for Option C: This is incorrect. The student may incorrectly think that the domain (or values of $x$) when Leza makes a profit is the solution of the inequality $3.75x - 962.50 \leq 950$ or $x \leq 1912.5/3.75$, or $x \leq 510$ and is further restricted to positive integers since only whole cupcakes can be sold.

Rationale for Option D: This is incorrect. The student may substitute 950 for $x$ and correctly solve for $p(x) = 3.75(950) - 962.50 = 2600$, but miss that the $950$ should represent the profit, $p(x)$, not the number of cupcakes, $x$.

Sample Response: 1 point

Leza sells cupcakes at her store. The profit, in dollars, that Leza makes selling cupcakes is modeled by the function $p(x) = 3.75x - 962.50$.

What is the domain of the function when Leza makes a profit of at least $950$?

- all integers greater than or equal to 510
- all integers greater than or equal to 257
- all integers greater than or equal to 0 and less than 510
- all integers greater than or equal to 0 and less than 2601
Integrated Math I
Spring 2019 Item Release

Question 36

Question and Scoring Guidelines
Question 36

Select all of the shapes that will carry onto themselves after a reflection along the dashed line.

Points Possible: 1

Content Cluster: Experiment with transformations in the plane.

Content Standard: Identify the symmetries of a figure, which are the rotations and reflections that carry it onto itself. (G.CO.3)
a. Identify figures that have line symmetry; draw and use lines of symmetry to analyze properties of shapes.

Depth of Knowledge: Level 1
a. Recall, observe, or recognize a fact, definition, term, or property
Scoring Guidelines

Rationale for First Option: This is incorrect. The student may think that since the dashed line is parallel to two sides of the trapezoid the shape would carry onto itself after the reflection. However, the student does not realize that although the two left vertices of the trapezoid are equidistant from the dashed line, the right two vertices are not.

Rationale for Second Option: Key – The student identifies a shape (a pentagon) with a dashed line that is also a line of symmetry. A reflection over the line of symmetry will carry the shape onto itself because corresponding vertices that are not on the line of symmetry are equidistant from the line of symmetry and the endpoints of the line segment that is perpendicular to the line of symmetry.

Rationale for Third Option: This is incorrect. The student may think that the two vertices on opposite sides of the dashed line are equidistant from the dashed line, and therefore the shape will carry onto itself after the reflection. However, the student may not realize that the line segment connecting these two vertices is not perpendicular to the dashed line because the diagonals of the parallelogram are not perpendicular. Since the line segment is not perpendicular to the dashed line, the vertices do not coincide and the shape will not carry onto itself after the reflection.

Rationale for Fourth Option: This is incorrect. The student may confuse reflectional symmetry with rotational symmetry and incorrectly assume that the regular hexagon carries onto itself after a reflection along the dashed line. However, since the pairs of corresponding vertices of the hexagon are not equidistant from the dashed line, the shape will not be carried onto itself after the reflection.

Rationale for Fifth Option: Key – The student identifies a shape (a square) where the dashed line is also a line of symmetry. A reflection over the line of symmetry will carry the shape onto itself because corresponding vertices that are not on the line of symmetry are equidistant from the line of symmetry and the endpoints of the line segment that is perpendicular to the line of symmetry.
Sample Response: 1 point

Select all of the shapes that will carry onto themselves after a reflection along the dashed line.

- [ ] □ □ □ □
- □ □ □ □
Integrated Math I
Spring 2019 Item Release

Question 42

Question and Scoring Guidelines
**Question 42**

Match each diagram to all the terms that describe it.

<table>
<thead>
<tr>
<th>Chord</th>
<th>Diameter</th>
<th>Tangent</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Diagram 1]</td>
<td>[Diagram 2]</td>
<td>[Diagram 3]</td>
</tr>
<tr>
<td>[Diagram 4]</td>
<td>[Diagram 5]</td>
<td>[Diagram 6]</td>
</tr>
<tr>
<td>[Diagram 7]</td>
<td>[Diagram 8]</td>
<td>[Diagram 9]</td>
</tr>
</tbody>
</table>

**Points Possible:** 1

**Content Cluster:** Understand and apply theorems about circles.

**Content Standard:** Identify and describe relationships among angles, radii, chords, tangents, and arcs and use them to solve problems. Include the relationship between central, inscribed, and circumscribed angles and their intercepted arcs; inscribed angles on a diameter are right angles; the radius of a circle is perpendicular to the tangent where the radius intersects the circle. *(G.C.2)*

**Depth of Knowledge:** Level 1
  a. Recall, observe, or recognize a fact, definition, term, or property
**Scoring Guidelines**

**Exemplar Response**

<table>
<thead>
<tr>
<th>Chord</th>
<th>Diameter</th>
<th>Tangent</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram 1" /></td>
<td><img src="image2.png" alt="Diagram 2" /></td>
<td><img src="image3.png" alt="Diagram 3" /></td>
</tr>
</tbody>
</table>

**Other Correct Responses**

- N/A

For this item, a full-credit response includes

- the correct selections (1 point).
Integrated Math I
Spring 2019 Item Release

Question 42

Sample Responses
Sample Response: 1 point

Match each diagram to **all** the terms that describe it.

<table>
<thead>
<tr>
<th>Chord</th>
<th>Diameter</th>
<th>Tangent</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram 1" /></td>
<td><img src="image2" alt="Diagram 2" /></td>
<td><img src="image3" alt="Diagram 3" /></td>
</tr>
<tr>
<td><img src="image4" alt="Diagram 4" /></td>
<td><img src="image5" alt="Diagram 5" /></td>
<td><img src="image6" alt="Diagram 6" /></td>
</tr>
<tr>
<td><img src="image7" alt="Diagram 7" /></td>
<td><img src="image8" alt="Diagram 8" /></td>
<td><img src="image9" alt="Diagram 9" /></td>
</tr>
</tbody>
</table>
**Notes on Scoring**

This response earns full credit (1 point) because it shows a correctly completed chart.

The item asks to match each diagram to all terms that describe it in such a way that the diagram satisfies its precise description or its properties.

The terms in the chart can be described as following:

1. A chord is a line segment connecting any two points of a circle.
2. A diameter is a line segment passing through the center of a circle with both its endpoints lying on the circle. It is also a chord passing through the center of a circle.
3. A tangent is a line that intersects a circle at only one point. It is also a line that touches the circle at just one point.

The top diagram shows the line that touches the circle at only one point. Therefore, per description 3, it is a tangent. Row one has one checkmark in column 3.

The middle diagram shows the line segment passing through the center with endpoints on the circle. Per description 2, it is a diameter and per definition 1, it is also a chord. Row two has two checkmarks in column 1 and column 2.

The bottom diagram shows the line segment that does not pass through the center but has endpoints on a circle. Per description 1, it is a chord. Row three has one checkmark in the first column.
Sample Response: 0 points

Match each diagram to **all** the terms that describe it.

<table>
<thead>
<tr>
<th>Chord</th>
<th>Diameter</th>
<th>Tangent</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Diagram 1" /></td>
<td><img src="image2" alt="Diagram 2" /></td>
<td><img src="image3" alt="Diagram 3" /></td>
</tr>
<tr>
<td><img src="image4" alt="Diagram 4" /></td>
<td><img src="image5" alt="Diagram 5" /></td>
<td><img src="image6" alt="Diagram 6" /></td>
</tr>
<tr>
<td><img src="image7" alt="Diagram 7" /></td>
<td><img src="image8" alt="Diagram 8" /></td>
<td><img src="image9" alt="Diagram 9" /></td>
</tr>
<tr>
<td><img src="image10" alt="Diagram 10" /></td>
<td><img src="image11" alt="Diagram 11" /></td>
<td><img src="image12" alt="Diagram 12" /></td>
</tr>
</tbody>
</table>

**Notes on Scoring**

This response earns no credit (0 points) because it shows an incorrectly completed chart.

The student may think that each diagram should only be described by one term but miss that the diagram in the second row should be paired with two descriptions since all diameters are also chords.
Integrated Math I
Spring 2019 Item Release

Question 43

Question and Scoring Guidelines
Question 43

The first four terms of an arithmetic sequence are given.

27, 32, 37, 42, . . .

What is the 60th term of the sequence?

Points Possible: 1

Content Cluster: Build a function that models a relationship between two quantities.

Content Standard: Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms. (F.BF.2)

Depth of Knowledge: Level 2
  c. Use models to represent mathematical concepts
  d. Solve a routine problem requiring multiple steps/decision points, or the application of multiple concepts
Scoring Guidelines

Exemplar Response

- 322

Other Correct Responses

- any equivalent value

For this item, a full-credit response includes

- a correct value (1 point).
Integrated Math I
Spring 2019 Item Release

Question 43

Sample Responses
The first four terms of an arithmetic sequence are given.
27, 32, 37, 42, ... 

What is the 60th term of the sequence?

322
Notes on Scoring

This response earns full credit (1 point) because it shows a correct 60th term of the arithmetic sequence.

Since the situation shows the first four terms of the arithmetic sequence and asks to find the 60th term, it is helpful to determine the explicit formula for the sequence and then use it to find the 60th term.

The given arithmetic sequence is an ordered list of numbers 27, 32, 37, 42, ... where each successive number is a sum of the previous number and a constant common difference, 5. The sequence can also be presented as a list of ordered pairs such as (1, 27), (2, 32), (3, 37), (4, 42), that shows a relation between the input {1, 2, 3, 4, ...} and the output {27, 32, 37, 42, ...}.

In the ordered pairs, since the increase in y-coordinates (outputs) is constant, or 5, per equal increase, 1, in x-coordinates (inputs), the relation can be described by a linear function f(x) = mx + b. The slope of the function f(x) is equal to the common difference, 5, so m = 5, which can be verified by calculating the slope between any two ordered pairs.

For example, the ordered pairs (1, 27) and (2, 32) give the slope \( m = \frac{32 - 27}{2 - 1} = 5 \). The ordered pairs (1, 27) and (4, 42) give the same slope \( m = \frac{42 - 27}{4 - 1} = 5 \). The y-intercept of f(x) is the point with the x-coordinate of zero and therefore, represents the zeroth term of the sequence that comes right before the first term, 27. The term before 27 is 22, because 27 – 5 = 22.

So, the linear function representing the sequence is \( f(x) = 5x + 22 \), where \( x = \{1, 2, 3, 4, \ldots\} \), and the 60th term of the arithmetic sequence is \( f(60) = 5 \cdot 60 + 22 \) or \( f(60) = 322 \).
Sample Response: 1 point

The first four terms of an arithmetic sequence are given.

27, 32, 37, 42, . . .

What is the 60th term of the sequence?

\[
\frac{966}{3}
\]

Notes on Scoring

This response earns full credit (1 point) because it shows the correct 60th term, 322, of the arithmetic sequence written in the equivalent form \( \frac{966}{3} \).
Sample Response: 0 points

The first four terms of an arithmetic sequence are given.

27, 32, 37, 42, ...

What is the 60th term of the sequence?

300

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect 60th term of the arithmetic sequence. The student may correctly find the common difference of 5 but multiply it by 60 forgetting that the sequence starts at 27, not at 5.
Sample Response: 0 points

The first four terms of an arithmetic sequence are given.

27, 32, 37, 42, ...

What is the 60th term of the sequence?

327

Notes on Scoring

This response earns no credit (0 points) because it incorrectly shows the 61st term instead of 60th term of the arithmetic sequence.
Integrated Math I
Spring 2019 Item Release

Question 51

Question and Scoring Guidelines
Question 51

Alton studies the growth patterns of sassafras trees and yellow birch trees in the 88 counties in Ohio. He finds that:

- approximately 27% of the counties have both species of trees,
- yellow birch only grows in 24 counties, and
- 1 out of 11 counties grows neither species.

Complete the table to show the relationship between the number of counties where sassafras trees and yellow birch trees grow.

<table>
<thead>
<tr>
<th></th>
<th>Sassafras Grow</th>
<th>Sassafras Do Not Grow</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow Birch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Do Not Grow</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>88</td>
</tr>
</tbody>
</table>

Points Possible: 2

Content Cluster: Summarize, represent, and interpret data on two categorical and quantitative variables.

Content Standard: Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data. (S.ID.5)

Depth of Knowledge: Level 3
m. Translate between a problem situation and symbolic notation that is not a direct translation
d. Use evidence to develop logical arguments for a concept
e. Use concepts to solve non-routine problems
Scoring Guidelines

Exemplar Response

<table>
<thead>
<tr>
<th></th>
<th>Sassafras Grow</th>
<th>Sassafras Do Not Grow</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yellow Birch Grow</strong></td>
<td>24</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td><strong>Yellow Birch Do Not Grow</strong></td>
<td>56</td>
<td>8</td>
<td>64</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>80</td>
<td>8</td>
<td>88</td>
</tr>
</tbody>
</table>

Other Correct Responses

- N/A

For this item, a full-credit response includes:

- the student enters correct values for the values determined directly from the given information (Yellow Birch Grow and Sassafras Grow, Yellow Birch Grow Total, and Yellow Birch Do Not Grow and Sassafras Do Not Grow) (1 point)
  AND
- the student correctly completes the rest of the table given the information in the three cells from the above (1 point).
Integrated Math I
Spring 2019 Item Release

Question 51

Sample Responses
Alton studies the growth patterns of sassafras trees and yellow birch trees in the 88 counties in Ohio. He finds that

- approximately 27% of the counties have both species of trees,
- yellow birch only grows in 24 counties, and
- 1 out of 11 counties grows neither species.

Complete the table to show the relationship between the number of counties where sassafras trees and yellow birch trees grow.

<table>
<thead>
<tr>
<th></th>
<th>Sassafras Grow</th>
<th>Sassafras Do Not Grow</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow Birch Grow</td>
<td>24</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>Yellow Birch Do Not Grow</td>
<td>56</td>
<td>8</td>
<td>64</td>
</tr>
<tr>
<td>Total</td>
<td>80</td>
<td>8</td>
<td>88</td>
</tr>
</tbody>
</table>
**Notes on Scoring**

This response earns full credit (2 points) because it shows a correctly completed two-way frequency table.

The information about yellow birches growing only in 24 counties populates the first subtotal cell (first row, third column). The value that populates the second subtotal cell (second row, third column) is 64 because 88 – 24 = 64.

Since approximately 27% of the counties grow both species of trees, or .27 · 88 = 24 (when rounded to the nearest whole number), the corresponding cell (first row, first column) can be populated.

Given the fact that 1 out of 11 counties grows neither species, or 88 · (1/11) = 8, the corresponding cell (second row, second column) can be populated.

Lastly, using all known frequencies, the remaining parts of the table can be completed as:
24 – 24 = 0 (first row, second column)
64 – 8 = 56 (second row, first column)
24 + 56 = 80 (third row, first column)
88 – 80 = 8 (third row, second column)
Sample Response: 1 point

Alton studies the growth patterns of sassafras trees and yellow birch trees in the 88 counties in Ohio. He finds that

- approximately 27% of the counties have both species of trees,
- yellow birch only grows in 24 counties, and
- 1 out of 11 counties grows neither species.

Complete the table to show the relationship between the number of counties where sassafras trees and yellow birch trees grow.

<table>
<thead>
<tr>
<th></th>
<th>Sassafras Grow</th>
<th>Sassafras Do Not Grow</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow Birch</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grow</td>
<td>24</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>Do Not Grow</td>
<td>66</td>
<td>8</td>
<td>64</td>
</tr>
<tr>
<td>Total</td>
<td>80</td>
<td>8</td>
<td>88</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns partial credit (1 point) because it shows a partially correct two-way frequency table.

The student enters correct rounded values determined directly from the given information, such as 24 (first row, first column), 24 (first row, third column) and 8 (second row, second column), but does not correctly complete the remainder of the two-way frequency table using these values.
Sample Response: 1 point

Alton studies the growth patterns of sassafras trees and yellow birch trees in the 88 counties in Ohio. He finds that

- approximately 27% of the counties have both species of trees,
- yellow birch only grows in 24 counties, and
- 1 out of 11 counties grows neither species.

Complete the table to show the relationship between the number of counties where sassafras trees and yellow birch trees grow.

<table>
<thead>
<tr>
<th></th>
<th>Sassafras Grow</th>
<th>Sassafras Do Not Grow</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow Birch Grow</td>
<td>23.76</td>
<td>0</td>
<td>23.76</td>
</tr>
<tr>
<td>Yellow Birch Do Not Grow</td>
<td>56</td>
<td>8</td>
<td>64</td>
</tr>
<tr>
<td>Total</td>
<td>80</td>
<td>8</td>
<td>88</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns partial credit (1 point) because it shows a partially correct two-way frequency table.

The student enters correct non-rounded values determined directly from the given information, such as 23.76 (first row, first column), 23.76 (first row, third column) and 8 (second row, second column) but does not complete the remainder of the two-way frequency table using these values.
Sample Response: 0 points

Alton studies the growth patterns of sassafras trees and yellow birch trees in the 88 counties in Ohio. He finds that

- approximately 27% of the counties have both species of trees,
- yellow birch only grows in 24 counties, and
- 1 out of 11 counties grows neither species.

Complete the table to show the relationship between the number of counties where sassafras trees and yellow birch trees grow.

<table>
<thead>
<tr>
<th></th>
<th>Sassafras Grow</th>
<th>Sassafras Do Not Grow</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow Birch Grow</td>
<td>24</td>
<td>8</td>
<td>32</td>
</tr>
<tr>
<td>Yellow Birch Do Not Grow</td>
<td>8</td>
<td>46</td>
<td>56</td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
<td>56</td>
<td>88</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrectly completed two-way frequency table.

The student may begin with finding that 8 counties grow neither tree, but incorrectly puts this number in the wrong cell (second row, first column) instead of the correct cell (second row, second column). Then, the student may incorrectly place the given number of yellow birches, 24, in the top left corner instead of the top right subtotal cell. Lastly, using incorrectly placed frequencies, the student incorrectly completes the remaining parts of the table.
Sample Response: 0 points

Alton studies the growth patterns of sassafras trees and yellow birch trees in the 88 counties in Ohio. He finds that

- approximately 27% of the counties have both species of trees,
- yellow birch only grows in 24 counties, and
- 1 out of 11 counties grows neither species.

Complete the table to show the relationship between the number of counties where sassafras trees and yellow birch trees grow.

<table>
<thead>
<tr>
<th></th>
<th>Sassafras Grow</th>
<th>Sassafras Do Not Grow</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow Birch Grow</td>
<td>24</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>Yellow Birch Do Not Grow</td>
<td>63</td>
<td>1</td>
<td>64</td>
</tr>
<tr>
<td>Total</td>
<td>87</td>
<td>1</td>
<td>88</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrectly completed two-way frequency table. The student may begin with the false assumption that only 1 county, instead of 8 counties, grows neither tree (second row, first column). Then, the student may correctly place the number of yellow birches, 24, in the top right subtotal cell. Lastly, using incorrectly placed frequencies, the student completes the remaining parts of the table.
Question 53

Create two different linear functions, \( f(x) \) and \( g(x) \), whose graphs are parallel.

\[
\begin{align*}
  f(x) &= \quad \quad \\
  g(x) &= \quad \quad 
\end{align*}
\]

Points Possible: 1

Content Cluster: Use coordinates to prove simple geometric theorems algebraically and to verify specific geometric statements.

Content Standard: Justify the slope criteria for parallel and perpendicular lines, and use them to solve geometric problems, e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point. (G.GPE.5)

Depth of Knowledge: Level 2
  c. Use models to represent mathematical concepts
  d. Solve a routine problem requiring multiple steps/decision points, or the application of multiple concepts
  j. Translate between tables, graphs, words and symbolic notation
Scoring Guidelines

Exemplar Response

- \( f(x) = 2x + 6 \)
- \( g(x) = 2x + 8 \)

Other Correct Responses

- any two different linear functions with slopes that are equivalent

For this item, a full-credit response includes

- a correct pair of functions (1 point).
Create two different linear functions, \( f(x) \) and \( g(x) \), whose graphs are parallel.

\[
\begin{align*}
  f(x) &= 1 \\
  g(x) &= 2 
\end{align*}
\]
Notes on Scoring

This response earns full credit (1 point) because it shows two different linear functions whose graphs are parallel.

To create two different linear functions whose graphs are parallel, use the slope criteria for parallel lines stating that if two non-vertical lines are parallel they have equal slopes. Note that lines that coincide have equal slopes as well, which means that to create two different functions, the formulas must have not only equal slopes but also different \(y\)-intercepts.

The linear function \(f(x)\) in slope-intercept form is \(f(x) = mx + b_1\) and a linear function \(g(x)\) in slope-intercept form is \(g(x) = mx + b_2\), where \(m\) is the slope of each line and \(b_1\) and \(b_2\) are \(y\)-intercepts of two parallel graphs. There are infinitely many correct answers for this question if they meet these two conditions.

In both equations, substitute the same real number for \(m\) and two different real numbers for \(b_1\) and \(b_2\). This response uses \(m = 0\), \(b_1 = 1\) and \(b_2 = 2\), so that the equations in the slope–intercept form are \(f(x) = 0m + 1\) or \(f(x) = 1\) and \(g(x) = 0m + 2\) or \(g(x) = 2\).
Sample Response: 1 point

Create two different linear functions, \( f(x) \) and \( g(x) \), whose graphs are parallel.

\[
\begin{align*}
f(x) &= -3x \\
g(x) &= -3(x+2)
\end{align*}
\]

Notes on Scoring

This response earns full credit (1 point) because it shows two different linear functions whose graphs are parallel.

The response uses \( m = -3 \), \( b_1 = 0 \) and \( b_2 = -6 \), so that the equations in the slope – intercept form are \( f(x) = -3x + 0 \) or \( f(x) = -3x \) and \( g(x) = -3x - 6 \) or \( g(x) = -3(x + 2) \).
Sample Response: 0 points

Create two different linear functions, $f(x)$ and $g(x)$, whose graphs are parallel.

$$f(x) = 2x$$

$$g(x) = -\frac{1}{2}x$$

Notes on Scoring

This response earns no credit (0 points) because it shows two incorrect linear functions whose graphs are not parallel.

The student may confuse parallel and perpendicular line graphs and use equal values of $y$-intercepts, $b_1 = 0$ and $b_2 = 0$, but different slopes, such as 2 and $-\frac{1}{2}$, that are opposite reciprocals.
Sample Response: 0 points

Create two different linear functions, \( f(x) \) and \( g(x) \), whose graphs are parallel.

\[
\begin{align*}
f(x) &= 2x \\
g(x) &= x^2
\end{align*}
\]

Notes on Scoring

This response earns no credit (0 points) because it shows one linear function and one quadratic function whose graphs are never parallel.
Integrated Math I
Spring 2019 Item Release

Question 54

Question and Scoring Guidelines
Question 54

Francine creates a bar graph showing the distance between her city and each state capital city in the United States.

Which unit of measure would be an appropriate unit for Francine to use to label her graph?

A  centimeters  
B  inches  
C  meters  
D  miles

Points Possible: 1

Content Cluster: Reason quantitatively and use units to solve problems.

Content Standard: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (N.Q.1)

Depth of Knowledge: Level 1  
a. Recall, observe, or recognize a fact, definition, term, or property
**Scoring Guidelines**

**Rationale for Option A:** This is incorrect. The student may think that the unit should be metric, not realizing that a centimeter is a small unit of measure and is not appropriate to measure the distance between cities.

**Rationale for Option B:** This is incorrect. The student may select a unit that is familiar, not realizing that an inch is a small unit of measure and is not appropriate to measure the distance between cities.

**Rationale for Option C:** This is incorrect. The student may think that the unit should be metric, not realizing that a meter is not a large enough unit of measure and is not appropriate to measure the distance between Francine’s city and several state capital cities.

**Rationale for Option D: Key** – The student identifies that a mile is an appropriate unit to measure the distance between cities.

**Sample Response: 1 point**

Francine creates a bar graph showing the distance between her city and each state capital city in the United States.

Which unit of measure would be an appropriate unit for Francine to use to label her graph?

- A centimeters
- B inches
- C meters
- D miles