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## Algebra I
### Spring 2019 Item Release
#### Content Summary and Answer Key

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<th>Answer Key</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</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>
<tr>
<td>2</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>3</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>
<tr>
<td>6</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>
<tr>
<td>7</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>
</tbody>
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<tbody>
<tr>
<td>11</td>
<td>Equation Item</td>
<td>Solve equations and inequalities in one variable.</td>
<td>Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. <em>(A.REI.3)</em></td>
<td>Level 1</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>12</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 ). <em>(F.IF.3)</em></td>
<td>Level 3</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>14</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. <em>(A1, M1) (A.REI.6)</em></td>
<td>Level 2</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>15</td>
<td>Grid Item</td>
<td>Analyze functions using different representations.</td>
<td>Graph functions expressed symbolically and indicate key features of the graph, by hand in simple cases and using technology for more complicated cases. Include applications and how key features relate to characteristics of a situation, making selection of a particular type of function model appropriate. <em>(F.IF.7)</em> b. Graph quadratic functions and indicate intercepts, maxima, and minima. <em>(A2, M2)</em></td>
<td>Level 2</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>20</td>
<td>Multi Select Item</td>
<td>Interpret linear models.</td>
<td>Compute (using technology) and interpret the correlation coefficient of a linear fit. <em>(S.ID.8)</em></td>
<td>Level 1</td>
<td>C, D</td>
<td>1 point</td>
</tr>
</tbody>
</table>

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<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>21</td>
<td>Multiple Choice Item</td>
<td>Construct and compare linear, quadratic, and exponential models and solve problems.</td>
<td>Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly or quadratically. (A1, M2) (F.LE.3)</td>
<td>Level 2</td>
<td>C</td>
<td>1 point</td>
</tr>
<tr>
<td>26</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>27</td>
<td>Multiple Choice Item</td>
<td>Interpret expressions for functions in terms of the situation they model.</td>
<td>Interpret the parameters in a linear or exponential function in terms of a context. (F.LE.5)</td>
<td>Level 2</td>
<td>B</td>
<td>1 point</td>
</tr>
<tr>
<td>30</td>
<td>Multiple Choice Item</td>
<td>Perform arithmetic operations on polynomials.</td>
<td>Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials. a. Focus on polynomial expressions that simplify to forms that are linear or quadratic. (A1, M2) (A.APR.1)</td>
<td>Level 1</td>
<td>C</td>
<td>1 point</td>
</tr>
<tr>
<td>31</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>
</tbody>
</table>

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</thead>
<tbody>
<tr>
<td>33</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>34</td>
<td>Multi Select 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>A, B, C</td>
<td>1 point</td>
</tr>
<tr>
<td>35</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>
<tr>
<td>36</td>
<td>Inline Choice 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>
</tbody>
</table>

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<th>Answer Key</th>
<th>Points</th>
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</thead>
<tbody>
<tr>
<td>38</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. a. Focus on formulas in which the variable of interest is linear or square. For example, rearrange Ohm's law $V=IR$ to highlight resistance $R$, or rearrange the formula for the area of a circle $A=(\pi)r^2$ to highlight radius $r$. (A1) (A.CED.4)</td>
<td>Level 2</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>43</td>
<td>Matching 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, use statistics appropriate to the shape of the data distribution to compare center (median and mean) and spread (mean absolute deviation, interquartile range, and standard deviation) of two or more different data sets. (S.ID.2)</td>
<td>Level 2</td>
<td>---</td>
<td>1 point</td>
</tr>
</tbody>
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**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 Recall</th>
<th>Level 2 Skills/Concepts</th>
<th>Level 3 Strategic Thinking</th>
<th>Level 4 Extended Thinking</th>
</tr>
</thead>
<tbody>
<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. <strong>Solve a routine problem</strong> 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 procedures 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>j. Provide mathematical justifications</td>
<td></td>
</tr>
</tbody>
</table>

*Table 1 continued on next page.*
<table>
<thead>
<tr>
<th>Level 1 Recall</th>
<th>Level 2 Skills/Concepts</th>
<th>Level 3 Strategic Thinking</th>
<th>Level 4 Extended Thinking</th>
</tr>
</thead>
<tbody>
<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></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. Formulate an original problem, given a situation</td>
<td></td>
</tr>
<tr>
<td>o. Read, write, and compare decimals in scientific notation</td>
<td>i. Specify and explain relationships between facts, terms, properties, or operations</td>
<td>o. Analyze the similarities and differences between procedures</td>
<td></td>
</tr>
<tr>
<td></td>
<td>n. Compare, classify, organize, estimate, or order data</td>
<td>p. Draw conclusion from observations or data, citing evidence</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE:** Level 4 involves such things as complex restructuring of data or establishing and evaluating criteria to solve problems.
Algebra I
Spring 2019 Item Release

Question 1

Question and Scoring Guidelines
Question 1

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
Algebra I
Spring 2019 Item Release

Question 2

Question and Scoring Guidelines
Question 2

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.
Question 3

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).
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Question 3

Sample Responses
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 
\[5(23) - 2(55) = 5.\]
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.

\((3, \underline{5})\)

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.
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Question 6

Question and Scoring Guidelines
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></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).
Algebra I
Spring 2019 Item Release
Question 6
Sample Responses
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 $y = a \cdot b^x$ shows one solution of $x = 0$ and $y = 96$. Substituting these values in the equation of the function leads to the equation $96 = a \cdot b^0$, 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 $96(0.25)^3 = 1.5$. 
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 $96(2)^3 = 768$. 

20 (2019)
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>97</td>
<td>98</td>
<td>99</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 $y = x + 96$. 

21 (2019)
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 with the values for the exponential function.

The table shows values for the linear function $y = 96$. 
Algebra I
Spring 2019 Item Release

Question 7

Question and Scoring Guidelines
Question 7

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  
ed. 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 mass 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 \( \frac{\text{lb}}{\text{mm}^3} \)
- C \( \frac{\text{g}}{\text{cm}^3} \)
- D \( \frac{\text{kg}}{\text{m}^3} \)
- B \( \frac{\text{ton}}{\text{m}^3} \)
Algebra I
Spring 2019 Item Release

Question 11

Question and Scoring Guidelines
Question 11

What is the solution to the equation $12(x + 5) = 4x$?

$x = \phantom{0}$

Points Possible: 1

Content Cluster: Solve equations and inequalities in one variable.

Content Standard: Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. (A.REI.3)

Depth of Knowledge: Level 1
m. Solve linear equations
Scoring Guidelines

Exemplar Response

- – 7.5

Other Correct Responses

- any equivalent value

For this item, a full-credit response includes:

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

What is the solution to the equation $12(x + 5) = 4x$?

$x = -7.5$

Notes on Scoring

This response earns full credit (1 point) because it shows a correct solution to the linear equation in one variable.

To find a solution, the linear equation must be rearranged to isolate the variable $x$. This can be done in several ways. One way is to apply the Distributive Property on the left side of the equation to get $12x + 60 = 4x$. Then, add $-4x$ and $-60$ to both sides of the equation to get $12x + 60 + (-60) + (-4x) = 4x + (-60) + (-4x)$, which simplifies to $8x = -60$. The next step is to use the Multiplication Property of Equality to multiply both sides by $\frac{1}{8}$ (or divide both sides by 8), to get $\frac{1}{8}(8x) = \frac{1}{8}(-60)$, which simplifies to $x = -7.5$. 
Sample Response: 1 point

What is the solution to the equation $12(x + 5) = 4x$?

$x = \frac{15}{2}$

Notes on Scoring

This response earns full credit (1 point) because it shows a correct solution to the linear equation in one variable.

To find a solution, the linear equation must be rearranged to isolate the variable $x$. This can be done in several ways. One way is to apply the Distributive Property on the left side of the equation to get $12x + 60 = 4x$. Then, add $(-4x)$ and $(-60)$ to both sides of the equation to get $12x + 60 + (-60) + (-4x) = 4x + (-60) + (-4x)$, which simplifies to $8x = -60$. The next step is to use the Multiplication Property of Equality to multiply both sides by $\frac{1}{8}$ (or divide both sides by 8), to get $\left(\frac{1}{8}\right)(8x) = \left(\frac{1}{8}\right)(-60)$, which simplifies to $-\frac{15}{2}$, which is equivalent to $x = -7.5$. 
Sample Response: 0 points

What is the solution to the equation $12(x + 5) = 4x$?

$x = \boxed{7.5}$

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect solution to the linear equation in one variable. The student may ignore the negative sign when solving for $x$. 
**Sample Response: 0 points**

What is the solution to the equation $12(x + 5) = 4x$?

$x = 3$

---

**Notes on Scoring**

This response earns no credit (0 points) because it shows an incorrect solution to the linear equation in one variable. The student may incorrectly think that 12 should be equal to $4x$ and then use the Multiplication Property of Equality to divide both sides of the equation $12 = 4x$ by 4 and get $x = 3$. 
Algebra I
Spring 2019 Item Release

Question 12

Question and Scoring Guidelines
Question 12

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).
Algebra I
Spring 2019 Item Release

Question 12

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></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.
Algebra I
Spring 2019 Item Release

Question 14

Question and Scoring Guidelines
Question 14

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
l. 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).
Algebra I
Spring 2019 Item Release

Question 14

Sample Responses
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)

Sample Response: 1 point
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 $x$:

$$3x – 5 = –2x + 10$$

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

add (2$x$) and 5 to both sides of the equation

$$5x = 15$$  

collect like terms

$$x = 3$$  

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.

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

What is the solution to the system?

\[
(3.0, \quad \frac{-4}{-1})
\]
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 \( \frac{-4}{1} \). Therefore, the solution to the system can be shown as \((3.0, \frac{-4}{1})\).

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.

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

What is the solution to the system?

\[(4 \text{ }, 3)\]

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 \( y \).
Algebra I
Spring 2019 Item Release

Question 15

Question and Scoring Guidelines
Question 15

A function is given.

\[ f(x) = (2x - 2)(x - 3) \]

Use the Add Point tool to plot the zeros and the maximum or minimum value of the function.

Points Possible: 1

Content Cluster: Analyze functions using different representations.

Content Standard: Graph functions expressed symbolically and indicate key features of the graph, by hand in simple cases and using technology for more complicated cases. Include applications and how key features relate to characteristics of a situation, making selection of a particular type of function model appropriate. (F.IF.7)

b. Graph quadratic functions and indicate intercepts, maxima, and minima. (A1, M2)

Depth of Knowledge: Level 2

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

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

Exemplar Response

For this item, a full-credit response includes:

• three correct points (1 point).

Other Correct Responses

• N/A
Sample Response: 1 point

A function is given.

\[ f(x) = (2x - 2) (x - 3) \]

Use the Add Point tool to plot the zeros and the maximum or minimum value of the function.
This response earns full credit (1 point) because it shows three correctly plotted points – two zeros of the function and a minimum of the function.

There are several ways to approach this question. All three points can be determined either by using a graphing utility or algebraically. Since the graph of \( f(x) = (2x - 2)(x - 3) \) opens upwards, the vertex, \((2, -2)\), is the lowest point of the graph, or the minimum of the function. The zeros of the function are the \( x \)-intercepts of the graph, or \((1, 0)\) and \((3, 0)\).

Algebraically, to determine zeros, set the function \( f(x) \) equal to zero as \((2x - 2)(x - 3) = 0\), and solve it for \( x \) using the Zero Product Property, as \( 2x - 2 = 0 \) or \( x - 3 = 0 \) to get \( x = 1 \) or \( x = 3 \). These two values represent the zeros of the function. The minimum point of the function (or vertex) has the \( x \)-coordinate that is the average of the zeros or \( \frac{1+3}{2} = 2 \). The \( y \)-coordinate of the vertex can then be found by substituting the value of \( x \) into the equation for the function to get 

\[
 f(2) = (2 \cdot 2 - 2)(2 - 3) = 2(-1) = -2,
\]

indicating the minimum of the function is represented by the point \((2, -2)\).
Sample Response: 0 points

A function is given.

\[ f(x) = (2x - 2)(x - 3) \]

Use the Add Point tool to plot the zeros and the maximum or minimum value of the function.

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect extreme value of the function. The student may think that the graph is open downward with the maximum value of 2 instead of open upward with a minimum value of (–2).
Sample Response: 0 points

A function is given.

\[ f(x) = (2x - 2)(x - 3) \]

Use the Add Point tool to plot the zeros and the maximum or minimum value of the function.

Notes on Scoring

This response earns no credit (0 points) because it shows one correct and one incorrect zero and an incorrect extreme of the function. The student may think that the graph is open downward with one zero at (–3) instead of 1 and the maximum value at 6 instead of (–2).
Algebra I
Spring 2019 Item Release
Question 20
Question and Scoring Guidelines
Question 20

Select all of the correlation coefficients that represent a linear model with a weak correlation.

☐ –0.982
☐ –0.618
☐ –0.103
☐ 0.204
☐ 0.907
☐ 1

Points Possible: 1

Content Cluster: Interpret linear models.

Content Standard: Compute (using technology) and interpret the correlation coefficient of a linear fit. (S.ID.8)

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 confuse a weak negative correlation with a negative number and think that the further away the negative number is from zero, the weaker the correlation.

Rationale for Second Option: This is incorrect. The student may mistakenly think that a weak correlation coefficient should be about halfway between 0 and -1.

Rationale for Third Option: Key – The student correctly identifies that a weak correlation can be either negative or positive but must be closer to 0 than 1.

Rationale for Fourth Option: Key – The student correctly identifies that a weak correlation can be either negative or positive but must be closer to 0 than 1.

Rationale for Fifth Option: This is incorrect. The student may mistakenly think that to represent a weak correlation the correlation coefficient has to be closer to 1 than 0.

Rationale for Sixth Option: This is incorrect. The student may mistakenly think that to represent a weak correlation the correlation coefficient has to be a 1 or a number that is very close to 1.

Sample Response: 1 point

Select all of the correlation coefficients that represent a linear model with a weak correlation.

-0.982
-0.618
-0.103
0.204
0.907
1
Algebra I
Spring 2019 Item Release

Question 21

Question and Scoring Guidelines
Question 21

Functions \( f(x) \) and \( g(x) \) are given.

\[
f(x) = 2^x \\
g(x) = 2x
\]

Which statement about \( f(x) \) and \( g(x) \) is true?

A. \( f(x) > g(x) \) for all values of \( x \).
B. \( g(x) > f(x) \) for all values of \( x \).
C. \( f(x) > g(x) \) for all values of \( x \) where \( x > 2 \).
D. \( g(x) > f(x) \) for all values of \( x \) where \( x > 2 \).

Points Possible: 1

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

Content Standard: Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly or quadratically. (A1, M2) (F.LE.3)

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 incorrectly think that since $f(x)$ is exponential, the output of $f(x)$ is always greater than the output of the linear function $g(x)$, for all values of $x$.

Rationale for Option B: This is incorrect. The student may graph both functions and notice that between two points of intersection $(1, 2)$ and $(2, 4)$ the graph of $g(x)$ is above the graph of $f(x)$ and incorrectly conclude that $g(x) > f(x)$ for all values of $x$.

Rationale for Option C: Key – The student identifies that the graphs of $f(x)$ and $g(x)$ intersect at the point $(2, 4)$, where values of the functions are equal, and that for values of $x$ greater than 2, the exponential function $f(x)$ exceeds the linear function $g(x)$.

Rationale for Option D: This is incorrect. The student may confuse the linear function $g(x)$ with the exponential function $f(x)$ and think that the exponential function exceeds the linear function on the given interval.

Sample Response: 1 point

Functions $f(x)$ and $g(x)$ are given.

\[
f(x) = 2^x
\]

\[
g(x) = 2x
\]

Which statement about $f(x)$ and $g(x)$ is true?

- A $f(x) > g(x)$ for all values of $x$.
- B $g(x) > f(x)$ for all values of $x$.
- C $f(x) > g(x)$ for all values of $x$ where $x > 2$.
- D $g(x) > f(x)$ for all values of $x$ where $x > 2$.
Algebra I
Spring 2019 Item Release

Question 26

Question and Scoring Guidelines
Question 26

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 2,000 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, \( m = -2,000 \).

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?

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

Question 27

Question and Scoring Guidelines
Question 27

A fitness club charges members an initial fee and a separate monthly membership fee. The equation of the function given models the total fee, \( f(x) \), in dollars, that a person pays for \( x \) months of membership.

\[ f(x) = 30x + 25 \]

What does the number 30 represent in this situation?

A. the initial membership fee
B. the monthly membership fee
C. the number of months that a person is a member
D. the total amount that a member pays in monthly fees

Points Possible: 1

Content Cluster: Interpret expressions for functions in terms of the situation they model.

Content Standard: Interpret the parameters in a linear or exponential function in terms of a context. \((F.LE.5)\)

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 realize that the initial fee should be part of the function but miss that since 30 is multiplied by \(x\), which is the number of months, this fee will be charged monthly rather than just one time.

Rationale for Option B: **Key** – The student correctly identifies that since 30 is multiplied by \(x\), the number of months, 30 represents the fee that a member pays each month.

Rationale for Option C: This is incorrect. The student may realize that since 30 is multiplied by \(x\) and is a factor of the variable term of the function, it has something to do with the monthly fees, but miss that \(x\) is defined as the number of months.

Rationale for Option D: This is incorrect. The student may realize that since 30 is multiplied by \(x\), it has something to do with the monthly fee but miss that the amount of $30.00 that the person pays monthly is not the same as the total amount that a member pays in \(x\) months or $30\(x\).

Sample Response: 1 point

A fitness club charges members an initial fee and a separate monthly membership fee. The equation of the function given models the total fee, \(f(x)\), in dollars, that a person pays for \(x\) months of membership.

\[
f(x) = 30x + 25
\]

What does the number 30 represent in this situation?

A. the initial membership fee

B. the monthly membership fee

C. the number of months that a person is a member

D. the total amount that a member pays in monthly fees
Algebra I
Spring 2019 Item Release

Question 30

Question and Scoring Guidelines
Question 30

An expression is given.

\[(2x + 8) (5x - 7)\]

Which expression is equivalent to the given expression?

A. 36x - 56
B. 10x^2 - 56
C. 10x^2 + 26x - 56
D. 10x^2 + 54x + 56

Points Possible: 1

Content Cluster: Perform arithmetic operations on polynomials.

Content Standard: Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials. a. Focus on polynomial expressions that simplify to forms that are linear or quadratic. (A1, M2) (A.APR.1)

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

Rationale for Option A: This is incorrect. The student may attempt to multiply each term of the first binomial by each term of the second binomial but make a mistake when multiplying $2x \cdot 5x$ to get $10x$ and then correctly combine $10x$ with the rest of the like terms, $10x - 14x + 40x - 56 = 36x - 56$.

Rationale for Option B: This is incorrect. The student may attempt to multiply only the first terms ($2x$ and $5x$) and the last terms ($8$ and $-7$) of the two binomials to get $2x \cdot 5x + 8 \cdot (-7) = 10x^2 - 56$ instead of multiplying each term of the first binomial by each term of the second binomial.

Rationale for Option C: Key – The student correctly multiplies each term of the first binomial by each term of the second binomial, and then combines like terms $(2x + 8)(5x - 7) = 2x \cdot 5x + 8 \cdot 5x + 2x \cdot (-7) + 8 \cdot (-7) = 10x^2 + 40x - 14x - 56 = 10x^2 + 26x - 56$.

Rationale for Option D: This is incorrect. The student may attempt to multiply the two binomials but may neglect to include the negative sign when multiplying $(2x + 8)$ by $(-7)$, finding the products of $2x \cdot (+7)$ and $8 \cdot (+7)$ instead of $2x \cdot (-7)$ and $8 \cdot (-7)$ to get $2x \cdot 5x + 8 \cdot 5x + 2x \cdot 7 + 8 \cdot 7 = 10x^2 + 40x + 14x + 56 = 10x^2 + 54x + 56$.

Sample Response: 1 point

An expression is given.

$(2x + 8)(5x - 7)$

Which expression is equivalent to the given expression?

- A  $36x - 56$
- B  $10x^2 - 56$
- C  $10x^2 + 26x - 56$
- D  $10x^2 + 54x + 56$
Question 31

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></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow Birch 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>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>

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).
Algebra I
Spring 2019 Item Release

Question 31

Sample Responses
Sample Response: 2 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>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 $0.27 \cdot 88 = 24$ (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 $88 \cdot \left(\frac{1}{11}\right) = 8$, 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 Grow</td>
<td>24</td>
<td>0</td>
<td>24</td>
</tr>
<tr>
<td>Yellow Birch 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><strong>Yellow Birch</strong> Grow</td>
<td>24</td>
<td></td>
<td>32</td>
</tr>
<tr>
<td><strong>Yellow Birch Do Not Grow</strong></td>
<td>8</td>
<td></td>
<td>46</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>32</td>
<td></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.
Algebra I
Spring 2019 Item Release

Question 33

Question and Scoring Guidelines
Question 33

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 \( b \).

\[ b(x) = \boxed{} \]
Points Possible: 1

Content Cluster: Represent and solve equations and inequalities graphically.

Content Standard: 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)

Depth of Knowledge: Level 3
c. Make and/or justify conjectures
e. Use concepts to solve non-routine problems
i. Formulate a mathematical model for a complex situation
m. Translate between a problem situation and symbolic notation that is not a direct translation

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).
Algebra I
Spring 2019 Item Release

Question 33

Sample Responses
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 \( b \).

\[ b(x) = -36 \]

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>x</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>5</td>
<td>6</td>
<td>+</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>9</td>
<td>&lt;</td>
</tr>
<tr>
<td>0</td>
<td>.</td>
<td>-</td>
<td>( \sqrt{\text{ }} )</td>
</tr>
</tbody>
</table>

\( \sin \) | \( \cos \) | \( \tan \) | \( \arcsin \) | \( \arccos \) | \( \arctan \)
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, $b(x) = -36$. 

Notes on Scoring
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 \( b \).

\[ b(x) = 5 \]

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 \( x = 5 \).
Question 34

Tim is sorting his book collection into groups. He places each group onto bookshelves that can each hold a maximum of 25 pounds. His collection includes hardcover books that weigh 3 pounds each and softcover books that weigh 2 pounds each.

Select all of the possible numbers of hardcover books that could be on one bookshelf.

☐ 3
☐ 4
☐ 8
☐ 9
☐ 12

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

Rationale for First Option: Key – The student correctly calculates that 3 hardcover books weigh 9 pounds (3 \cdot 3 = 9) and 16 pounds are still available for soft cover books.

Rationale for Second Option: Key – The student correctly calculates that 4 hardcover books weigh 12 pounds (4 \cdot 3 = 12) with 13 pounds left for softcover books.

Rationale for Third Option: Key – The student correctly calculates that the maximum number of hardcover books is 8 because their weight is 24 pounds (8 \cdot 3 = 24) with 1 pound left for another book which is not enough for either a hard or softcover book.

Rationale for Fourth Option: This is incorrect. The student may think that since 1 pound is left over after 8 hardcover books are placed on the shelf, a ninth book could be added, ignoring that the additional book weighs 2 or 3 pounds and the total weight would exceed the allowance of the shelf.

Rationale for Fourth Option: This is incorrect. The student may confuse the hardcover books with softcover books and calculate that 12 softcover books weigh 24 pounds (12 \cdot 2 = 24) and can be placed on the shelf with 1 pound left.
Sample Response: 1 point

Tim is sorting his book collection into groups. He places each group onto bookshelves that can each hold a maximum of 25 pounds. His collection includes hardcover books that weigh 3 pounds each and softcover books that weigh 2 pounds each.

Select all of the possible numbers of hardcover books that could be on one bookshelf.

- ✔ 3
- ✔ 4
- ✔ 8
- □ 9
- □ 12
Algebra I
Spring 2019 Item Release

Question 35

Question and Scoring Guidelines
Question 35

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).
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?

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 \( x = \{1, 2, 3, 4, ...\} \), 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 the 60th term of the arithmetic sequence.
Algebra I
Spring 2019 Item Release
Question 36
Question and Scoring Guidelines
Question 36

Lena sells custom-printed T-shirts at her shop. She can sell 120 T-shirts in a month if she charges $14 for each T-shirt. She plans to change the price per T-shirt by a fixed amount $n$ times. The revenue, in dollars, after $n$ changes in price can be modeled by the expression $(120 + 5n)(14 - 3n)$.

Based on the information, complete the sentence about Lena’s T-shirt sales.

For each ________ in the price per T-shirt by $_______, Lena will sell ________ T-shirts in a month.

**Drop down choices:**

- For each ________ in the price per T-shirt by $_______, Lena
  - increase
  - decrease

- will sell ________ T-shirts in a month.
  - 3 more
  - 5 more
  - 14 more
  - 3 fewer
  - 5 fewer
  - 9 fewer
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
j. Translate between tables, graphs, words and symbolic notation
k. Make direct translations between problem situations and symbolic notation

Scoring Guidelines

Exemplar Response

- For each decrease in the price per T-shirt by $3, Lena will sell 5 more T-shirts in a month.

Other Correct Responses

- N/A

For this item, a full-credit response includes

- the correctly completed statement (1 point).
Algebra I
Spring 2019 Item Release

Question 36

Sample Responses
Sample Response: 1 point

Lena sells custom-printed T-shirts at her shop. She can sell 120 T-shirts in a month if she charges $14 for each T-shirt. She plans to change the price per T-shirt by a fixed amount $n$ times. The revenue, in dollars, after $n$ changes in price can be modeled by the expression $(120 + 5n)(14 - 3n)$.

Based on the information, complete the sentence about Lena’s T-shirt sales.

For each decrease in the price per T-shirt by $3$, Lena will sell 5 more T-shirts in a month.

Notes on Scoring

This response earns full credit (1 point) because it correctly interprets the structure of the expression representing a quantity in terms of its context.

In the context of a situation, the first factor, $(120 + 5n)$, of the given revenue expression represents the number of shirts sold. The second factor, $(14 - 3n)$, represents the price for the shirt, after $n$ equal changes in price have been applied.

Depending on the value of $n$, the value of the expression $(14 - 3n)$ decreases by a constant amount of $3$ per each price change.

Likewise, depending on the value of $n$, the value of the expression $(120 + 5n)$ increases by a constant number of shirts, 5, per each price change.

In one sentence, it can be summarized as:
For each decrease in the price per T-shirt by $3$, Lena will sell 5 more T-shirts in a month.
Sample Response: 0 points

Lena sells custom-printed T-shirts at her shop. She can sell 120 T-shirts in a month if she charges $14 for each T-shirt. She plans to change the price per T-shirt by a fixed amount $n$ times. The revenue, in dollars, after $n$ changes in price can be modeled by the expression $(120 + 5n)(14 – 3n)$.

Based on the information, complete the sentence about Lena’s T-shirt sales.

For each *increase* in the price per T-shirt by $5$, Lena will sell *3 more* T-shirts in a month.

Notes on Scoring

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

The student may switch the meaning of two binomial factors and think that $(120 + 5n)$ represents the increased price for T-shirts and $(14 – 3n)$ represents the decreased number of T-shirts.
Sample Response: 0 points

Lena sells custom-printed T-shirts at her shop. She can sell 120 T-shirts in a month if she charges $14 for each T-shirt. She plans to change the price per T-shirt by a fixed amount \( n \) times. The revenue, in dollars, after \( n \) changes in price can be modeled by the expression \((120 + 5n)(14 - 3n)\).

Based on the information, complete the sentence about Lena’s T-shirt sales.

For each increase \( \downarrow \) in the price per T-shirt by $3 \( \uparrow \), Lena will sell 5 more \( \downarrow \) T-shirts in a month.

Notes on Scoring

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

The student may guess at filling in the blanks by using coefficients from the expression.
Algebra I
Spring 2019 Item Release

Question 38

Question and Scoring Guidelines
Question 38

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. a. Focus on formulas in which the variable of interest is linear or square. For example, rearrange Ohm’s law $V=IR$ to highlight resistance $R$, or rearrange the formula for the area of a circle $A=(\pi)r^2$ to highlight radius $r$. (A1) (A.CED.4)

Depth of Knowledge: Level 2
I. 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).
Sample Response: 1 point

An equation is given.

\[ y = 3x + c \]

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

\[ x = \frac{1}{3}y - \frac{c}{3} \]
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 \( c \).

\[ x = \frac{3(y - c)}{6} \]
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.
Question 43

A gym teacher compares the points scored by three basketball teams in their last 11 games. The points scored by Team A are shown.

Team A

62 72 74 74 76 78 82 85 88 88 92

The scores of Team B and Team C are shown by the following box plots:

Team B

Team C

Scores

Select a box in each row of the table to compare the median scores and the interquartile range of scores for the three teams.

<table>
<thead>
<tr>
<th>Lowest Median Score</th>
<th>Team A</th>
<th>Team B</th>
<th>Team C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highest Median Score</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Smallest Interquartile Range of Scores</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>Largest Interquartile Range of Scores</td>
<td>□</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>
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, use statistics appropriate to the shape of the data distribution to compare center (median and mean) and spread (mean absolute deviation, interquartile range, and standard deviation) of two or more different data sets. (S.ID.2)

Depth of Knowledge: Level 2
1. Select a procedure according to criteria and perform it
2. Compare, classify, organize, estimate or order data

Scoring Guidelines

Exemplar Response

<table>
<thead>
<tr>
<th></th>
<th>Team A</th>
<th>Team B</th>
<th>Team C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest Median Score</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highest Median Score</td>
<td></td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Smallest Interquartile Range of Scores</td>
<td></td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Largest Interquartile Range of Scores</td>
<td></td>
<td></td>
<td>✔</td>
</tr>
</tbody>
</table>

Other Correct Responses

• N/A

For this item, a full-credit response includes

• the correctly matched table (1 point).
A gym teacher compares the points scored by three basketball teams in their last 11 games. The points scored by Team A are shown.

Team A

62 72 74 74 76 78 82 85 88 88 92

The scores of Team B and Team C are shown by the following box plots:

Select a box in each row of the table to compare the median scores and the interquartile range of scores for the three teams.

<table>
<thead>
<tr>
<th></th>
<th>Team A</th>
<th>Team B</th>
<th>Team C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest Median Score</td>
<td>✔️</td>
<td>❌</td>
<td>❌</td>
</tr>
<tr>
<td>Highest Median Score</td>
<td>❌</td>
<td>✔️</td>
<td>❌</td>
</tr>
<tr>
<td>Smallest Interquartile Range of Scores</td>
<td>❌</td>
<td>✔️</td>
<td>❌</td>
</tr>
<tr>
<td>Largest Interquartile Range of Scores</td>
<td>❌</td>
<td>❌</td>
<td>✔️</td>
</tr>
</tbody>
</table>
Notes on Scoring

This response earns full credit (1 point) because it shows a correct comparison of center (median) and spread (interquartile range) of three data sets.

To complete the chart, determine the median scores of the three teams. For Team A, the median is the midpoint of the data set or the middle score, 78. The scores for Teams B and C are represented by boxplots; the medians can be seen by the vertical line that divides the grey box into two parts. For Team B, the median is 86. For Team C, the median is 82. Among those three median scores, the lowest score is 78 (Team A) and the highest score is 86 (Team B).

The interquartile range (IQR) is the difference between the upper quartile and the lower quartile. Quartiles are the values that divide a list of scores into four quarters.

For Team A, whose scores are shown as the list of scores, the lower and upper quartiles need to be determined. The lower quartile is found by finding the median of the scores below the median: 62, 72, 74, 74, 76, so the lower quartile is 74. The upper quartile is found by finding the median of the scores above the median: 82, 85, 88, 88, 92, so the upper quartile is 88. Therefore, the interquartile range for team A is 88 – 74 = 14.

For Team B and Team C, the left vertical side of the box shows the lower quartile, and the right vertical side of the box shows the upper quartile. The IQR for Team B is 90 – 78 or 12. The IQR for Team C is 86 – 70 or 16. Among those three IQR scores, the smallest score is 12 (Team B) and the largest score is 16 (Team C).
Sample Response: 0 points

A gym teacher compares the points scored by three basketball teams in their last 11 games. The points scored by Team A are shown.

Team A

62 72 74 74 76 78 82 85 88 88 92

The scores of Team B and Team C are shown by the following box plots:

Team B

Team C

Scores

50 54 58 62 66 70 74 78 82 86 90 94 98

Select a box in each row of the table to compare the median scores and the interquartile range of scores for the three teams.

<table>
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<tr>
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<td>Largest Interquartile Range of Scores</td>
<td>✔️</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns no credit (0 points) because it shows a correct comparison of center (median) but an incorrect comparison of spread (interquartile range) of three data sets. The student may incorrectly calculate and compare the interquartile ranges of the three data sets.