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# Algebra I

## Spring 2018 Item Release

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<tr>
<td>5</td>
<td>Multiple Choice</td>
<td>Summarize, represent, and interpret data on a single count or measurement variable.</td>
<td>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>A</td>
<td>1 point</td>
</tr>
<tr>
<td>7</td>
<td>Multiple Choice</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>B</td>
<td>1 point</td>
</tr>
<tr>
<td>10</td>
<td>Equation Item</td>
<td>Solve systems of equations.</td>
<td>Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. (A.REI.6)</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>15</td>
<td>Equation Item</td>
<td>Interpret functions that arise in applications in terms of the context.</td>
<td>For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. (F.IF.4)</td>
<td>---</td>
<td>2 points</td>
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<tr>
<td>17</td>
<td>Multiple Choice</td>
<td>Summarize, represent, and interpret data on two categorical and quantitative variables.</td>
<td>Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. (S.ID.6)</td>
<td>C</td>
<td>1 point</td>
</tr>
<tr>
<td>19</td>
<td>Equation Item</td>
<td>Understand solving equations as a process of reasoning and explain the reasoning.</td>
<td>Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method. (A.REI.1)</td>
<td>---</td>
<td>2 points</td>
</tr>
<tr>
<td>21</td>
<td>Graphic Response</td>
<td>Summarize, represent, and interpret data on a single count or measurement variable.</td>
<td>Represent data with plots on the real number line (dot plots, histograms, and box plots). (S.ID.1)</td>
<td>---</td>
<td>1 point</td>
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<tr>
<td>22</td>
<td>Multiple Choice</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. (F.IF.5)</td>
<td>A</td>
<td>1 point</td>
</tr>
<tr>
<td>23</td>
<td>Multiple Choice</td>
<td>Interpret the structure of expressions.</td>
<td>Interpret expressions that represent a quantity in terms of its context. ( a. ) Interpret parts of an expression, such as terms, factors, and coefficients. (A.SSE.1a)</td>
<td>B</td>
<td>1 point</td>
</tr>
<tr>
<td>25</td>
<td>Equation Item</td>
<td>Analyze functions using different representations.</td>
<td>Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. ( a. ) Graph linear and quadratic functions and show intercepts, maxima, and minima. (F.IF.7a)</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>29</td>
<td>Equation Item</td>
<td>Represent and solve equations and inequalities graphically.</td>
<td>Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes. (A.REI.12)</td>
<td>---</td>
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<td>30</td>
<td>Equation Item</td>
<td>Understand the concept of a function and use function notation.</td>
<td>Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. (F.IF.2)</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>33</td>
<td>Equation Item</td>
<td>Create equations that describe numbers or relationships.</td>
<td>Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions. (A.CED.1)</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>36</td>
<td>Matching 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>---</td>
<td>1 point</td>
</tr>
<tr>
<td>37</td>
<td>Equation 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>---</td>
<td>1 point</td>
</tr>
<tr>
<td>38</td>
<td>Table Input</td>
<td>Solve systems of equations.</td>
<td>Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. For example, find the points of intersection between the line y = -3x and the circle x² + y² = 3. (A.REI.7)</td>
<td>---</td>
<td>1 point</td>
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<tr>
<td>41</td>
<td>Multiple Choice</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. For example, rearrange Ohm’s law ( V = IR ) to highlight resistance ( R ). (A.CED.4)</td>
<td>B</td>
<td>1 point</td>
</tr>
<tr>
<td>42</td>
<td>Equation Item</td>
<td>Solve equations and inequalities in one variable.</td>
<td>Solve quadratic equations in one variable. b. Solve quadratic equations by inspection (e.g., for ( x^2 = 49 )), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as ( a \pm bi ) for real numbers ( a ) and ( b ). (A.REI.4b)</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>43</td>
<td>Equation 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>---</td>
<td>1 point</td>
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Question 5

Question and Scoring Guidelines
Question 5

The histograms shown display the number of cans of food donated by students in the freshman class and the sophomore class at a school.

Which statement is true?

A. The freshman class has a lesser mean number of cans donated than the sophomore class.
B. The freshman class has the same median number of cans donated as the sophomore class.
C. The freshman class has a greater mean number of cans donated than the sophomore class.
D. The freshman class has a greater median number of cans donated than the sophomore class.

Points Possible: 1

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

Content Standard: 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)
Scoring Guidelines

Rationale for Option A: **Key** – The student correctly compares the means of the classes based on the skew of the histograms. For the freshman class, the mean can be approximated using the middle values of each histogram’s group. For example, the middle value of the first group is 57.5 and the corresponding frequency is 22. The number of cans represented by the first histogram’s bar is $57.5 \cdot 22 = 1265$. Repeating the same procedure for each group, the mean of cans donated by the freshman class is

\[
\frac{57.5 \cdot 22 + 62.5 \cdot 22 + 67.5 \cdot 25 + 72.5 \cdot 27 + 77.5 \cdot 24 + 82.5 \cdot 22 + 87.5 \cdot 21}{22 + 22 + 25 + 27 + 24 + 22 + 21} \approx 72.38
\]

Similarly, the mean of cans donated by the sophomore class is

\[
\frac{62.5 \cdot 21 + 67.5 \cdot 22 + 72.5 \cdot 23 + 77.5 \cdot 26 + 82.5 \cdot 26 + 87.5 \cdot 22 + 92.5 \cdot 21 + 97.5 \cdot 21}{21 + 22 + 23 + 26 + 26 + 22 + 21 + 21} \approx 79.89
\]

The freshman class has a lesser mean number of cans than the sophomore class.

Rationale for Option B: The student may incorrectly compare the median numbers of students who donated cans by either incorrectly calculating the medians or confusing the data sets. The median can be calculated by finding the total number of students in each class and then determining the number of cans donated by the middle student. In the freshman class, the number of students is $22 + 22 + 25 + 27 + 24 + 22 + 21 = 163$. The middle student is then between the 81st and 82nd data points, which is in the highest bar of histogram which corresponds to a median between 70 and 75 cans.

In the sophomore class, the number of students is $21 + 22 + 23 + 26 + 26 + 22 + 21 + 21 = 182$. The middle student is the 91st data point, which is in the histogram bar for 75-80 cans. Thus, the median for the sophomore class is higher than the median for the freshman class.

Rationale for Option C: The student may incorrectly compare the means of students who donated cans by either incorrectly calculating the means or confusing the data sets.

Rationale for Option D: The student may confuse the median of the sophomore class with the median of the freshman class. The median for the freshman class is between 70 and 75 cans while the median for the sophomore class is between 75 and 80 cans.
The histograms shown display the number of cans of food donated by students in the freshman class and the sophomore class at a school.

Which statement is true?

- The freshman class has a lesser mean number of cans donated than the sophomore class.
- The freshman class has the same median number of cans donated as the sophomore class.
- The freshman class has a greater mean number of cans donated than the sophomore class.
- The freshman class has a greater median number of cans donated than the sophomore class.
Question 7

A sequence is shown.

3, 6, 12, 24, 48, ...

Which function, \( f(n) \), represents the \( n \)th term of the sequence, where \( f(1) = 3 \)?

A \( f(n) = 2 \cdot 3^{n-1} \)

B \( f(n) = 3 \cdot 2^{n-1} \)

C \( f(n) = 3 \cdot 2^n \)

D \( f(n) = 6^n \)

**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)
Scoring Guidelines

Rationale for Option A: The student may correctly notice that the first term of the sequence is 3 and each term after the first is 2 times the previous term but incorrectly switches the base of the exponential expression with the y-intercept when writing the function. Then, the student may verify this answer choice by incorrectly calculating $f(1) = 2^{1-1} \cdot 3 = 2^0 \cdot 3 = 1 \cdot 3 = 3$ and comparing this with the first term of the sequence, 3.

Rationale for Option B: Key - The student correctly realizes that the value of $f(1)$ for this answer choice would be $f(1) = 3 \cdot 2^{1-1} = 3 \cdot 2^0 = 3 \cdot 1 = 3$, which matches the given sequence. Additionally, the value of $f(2)$ is 6 because $f(2) = 3 \cdot 2^{2-1} = 3 \cdot 2^1 = 3 \cdot 2 = 6$, which matches the second term, 6, and so on.

Rationale for Option C: The student may notice the first term of the sequence is 3 and each term after the first is 2 times the previous term but does not realize that if $f(n) = 3 \cdot 2^n$, then $f(1) = 3 \cdot 2^1 = 3 \cdot 2 = 6$, which does not match the given value of $f(1)$.

Rationale for Option D: The student may notice that 6 is a common factor for a few terms of the sequence and select a function with base 6.

Sample Response: 1 point

A sequence is shown.

3, 6, 12, 24, 48, ...

Which function, $f(n)$, represents the $n$th term of the sequence, where $f(1) = 3$?

A $f(n) = 2 \cdot 3^{n-1}$

B $f(n) = 3 \cdot 2^{n-1}$

C $f(n) = 3 \cdot 2^n$

D $f(n) = 6^n$
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Question 10

Question and Scoring Guidelines
Question 10

A total of 330 children and adults attended a school play. There were 21 times as many children in attendance as there were adults.

This situation is modeled by the given system of equations, where $a$ represents the number of adults and $c$ represents the number of children.

\[
c = 21a \\
a + c = 330
\]

How many children attended the play?

Points Possible: 1

Content Cluster: Solve systems of equations.

Content Standard: Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. (A.REI.6)
Scoring Guidelines

Exemplar Response

• 315

Other Correct Responses

• Any equivalent value

For this item, a full-credit response includes:

• A correct value (1 point).
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Question 10

Sample Responses
Sample Response: 1 point

A total of 330 children and adults attended a school play. There were 21 times as many children in attendance as there were adults.

This situation is modeled by the given system of equations, where $a$ represents the number of adults and $c$ represents the number of children.

\[
c = 21a \\
a + c = 330
\]

How many children attended the play?

315
Notes on Scoring

This response earns full credit (1 point) because it shows a correct number of children who attended the play. This item requires the student to find a solution of a system with two linear equations in two variables.

There are many methods to solve a system of linear equations, including substitution. To solve by substitution, first substitute 21$a$ for $c$ in the equation $a + c = 330$. The equation becomes $a + 21a = 330$. Then, combine like terms to get $22a = 330$. Next, apply the Multiplication Property of Equality to multiply both sides of the equation by $\frac{1}{22}$, or divide both sides by 22, to find $a = 15$. Since the variable $a$ represents the number of adults who attended the play, 15 needs to be substituted into one of the original equations for $a$ to find the number of children, $c$, or $15 + c = 330$. Then using the Addition Property of Equality, add $(-15)$ to both sides of the equation to get $c = 315$. So, there are 315 children who attended the play.
Sample Response: 1 point

A total of 330 children and adults attended a school play. There were 21 times as many children in attendance as there were adults.

This situation is modeled by the given system of equations, where $a$ represents the number of adults and $c$ represents the number of children.

$c = 21a$
$a + c = 330$

How many children attended the play?

315.00

Notes on Scoring

This response earns full credit (1 point) because it shows an equivalent correct number of children ($315.00 = 315$) who attended the play.
Sample Response: 0 points

A total of 330 children and adults attended a school play. There were 21 times as many children in attendance as there were adults.

This situation is modeled by the given system of equations, where \( a \) represents the number of adults and \( c \) represents the number of children.

\[
c = 21a \\
a + c = 330
\]

How many children attended the play?

15

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect number of children attended the play. The student may provide the number of adults, 15, instead of the number of children, 315.
Sample Response: 0 points

A total of 330 children and adults attended a school play. There were 21 times as many children in attendance as there were adults.

This situation is modeled by the given system of equations, where \( a \) represents the number of adults and \( c \) represents the number of children.

\[
\begin{align*}
c &= 21a \\
a + c &= 330
\end{align*}
\]

How many children attended the play?

\[
\begin{array}{c}
\frac{330}{22}
\end{array}
\]

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect number of children attended the play. The student may solve the first equation for \( a \) \( a = \frac{c}{21} \) to substitute it into the second equation, resulting in \( \frac{c}{21} + c = 330 \). Next, to solve for \( c \), instead of multiplying both sides of the equation by 21, the student may incorrectly multiply only the left side by 21 to get \( c + 21c = 330 \). Then the student may combine like terms to get \( 22c = 330 \) and solve to get \( c = \frac{330}{22} \).
Question 15

The manager of a company uses the function shown to model its daily profit based on the price of a product in dollars, \( x \).

\[ f(x) = (x - 22)(53 - x) \]

A. What is the minimum price, in dollars, to avoid a loss?

B. What is the maximum price, in dollars, to avoid a loss?

C. What is the price, in dollars, that results in the greatest profit?

A. $ [ ]  
B. $ [ ]  
C. $ [ ]

Points Possible: 2

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

Content Standard: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. (F.IF.4)
**Scoring Guidelines**

**Exemplar Response**

- A. 22
- B. 53
- c. 37.50

**Other Correct Responses**

- Any equivalent value for each part

For this item, a full-credit response includes:

- The correct minimum and maximum prices (1 point)
   - AND
- The correct profit maximizing price (1 point).

For this item, a partial-credit response includes:

- The correct minimum and maximum prices (1 point)
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Question 15

Sample Responses
Sample Response: 2 points

The manager of a company uses the function shown to model its daily profit based on the price of a product in dollars, \( x \).

\[ f(x) = (x - 22)(53 - x) \]

A. What is the minimum price, in dollars, to avoid a loss?

B. What is the maximum price, in dollars, to avoid a loss?

C. What is the price, in dollars, that results in the greatest profit?

\[ A. \$ \quad 22.00 \]
\[ B. \$ \quad 53.00 \]
\[ C. \$ \quad 37.50 \]

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<td>( \frac{b}{a} )</td>
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</table>
Notes on Scoring

This response earns full credit (2 points) because it shows all three correct values that could be determined by graphing a function and then correctly interpreting its key features. The graph of the function \( f(x) = (x - 22)(53 - x) \) is a parabola that opens downwards as shown.

Since the variable \( x \) represents the price, in dollars, of the company’s product, and \( y \) represents the profit, in dollars, the part of the parabola that is above the \( x \)-axis represents a positive profit and the part of the parabola that is below the \( x \)-axis represents a loss. The left \( x \)-intercept, or \( x = 22 \), is the minimum price to break even and avoid a loss. The right \( x \)-intercept, or \( x = 53 \), is the maximum price to break even and avoid a loss. The price that results in the greatest profit is the \( x \)-coordinate of maximum point of the parabola or the \( x \)-coordinate of the vertex that is \( x = 37.50 \).
The manager of a company uses the function shown to model its daily profit based on the price of a product in dollars, $x$.

$f(x) = (x - 22)(53 - x)$

A. What is the minimum price, in dollars, to avoid a loss?

B. What is the maximum price, in dollars, to avoid a loss?

C. What is the price, in dollars, that results in the greatest profit?

A. $\$ 22$

B. $\$ 53$

C. $\$ 37.5$

Notes on Scoring

This response earns full credit (2 points) because it shows all three correct values.
Sample Response: 1 point

The manager of a company uses the function shown to model its daily profit based on the price of a product in dollars, $x$.

$f(x) = (x - 22)(53 - x)$

A. What is the minimum price, in dollars, to avoid a loss?

B. What is the maximum price, in dollars, to avoid a loss?

C. What is the price, in dollars, that results in the greatest profit?

A. $\$ 22$

B. $\$ 53$

C. $\$ 38$

Notes on Scoring

This response earns partial credit (1 point) because it shows the correct minimum and maximum prices only. This student incorrectly rounds the answer for the greatest profit to the nearest whole number.
Sample Response: 1 point

The manager of a company uses the function shown to model its daily profit based on the price of a product in dollars, $x$.

$$f(x) = (x - 22)(53 - x)$$

A. What is the minimum price, in dollars, to avoid a loss?

B. What is the maximum price, in dollars, to avoid a loss?

C. What is the price, in dollars, that results in the greatest profit?

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</table>

A. $ \ 22$

B. $ \ 53$

C. $ \ 31$

Notes on Scoring

This response earns partial credit (1 point) because it shows the correct minimum and maximum prices only. To find the price resulting in the greatest profit, the student may subtract the minimum price from the maximum price instead of finding the average of those prices.
Sample Response: 0 points

The manager of a company uses the function shown to model its daily profit based on the price of a product in dollars, $x$.

$$f(x) = (x - 22)(53 - x)$$

A. What is the minimum price, in dollars, to avoid a loss?

B. What is the maximum price, in dollars, to avoid a loss?

C. What is the price, in dollars, that results in the greatest profit?

A. $0$

B. $0$

C. $240.25$

Notes on Scoring

This response earns no credit (0 points) because it shows all three incorrect values. The student may provide the $y$-coordinates instead of $x$-coordinates for the three points.
Sample Response: 0 points

The manager of a company uses the function shown to model its daily profit based on the price of a product in dollars, x.

\[ f(x) = (x - 22)(53 - x) \]

A. What is the minimum price, in dollars, to avoid a loss?

B. What is the maximum price, in dollars, to avoid a loss?

C. What is the price, in dollars, that results in the greatest profit?

A. $23
B. $52
C. $36.5

Notes on Scoring

This response earns no credit (0 points) because it shows all three incorrect values. The student may misinterpret the wording of “to avoid loss” to mean that the price needs to be greater than 0 and provide integer values, 23 and 52, consecutive to the two correct values 22 and 53. Then the student may find the mean of the incorrect values in part A and B to determine the price that results in the greatest profit.
Question 17

A new car wash business records the number of cars it washes each day for the first 7 days the business is open. The data are shown in the table.

<table>
<thead>
<tr>
<th>Day</th>
<th>Number of Cars Washed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>41</td>
</tr>
<tr>
<td>2</td>
<td>44</td>
</tr>
<tr>
<td>3</td>
<td>48</td>
</tr>
<tr>
<td>4</td>
<td>52</td>
</tr>
<tr>
<td>5</td>
<td>57</td>
</tr>
<tr>
<td>6</td>
<td>56</td>
</tr>
<tr>
<td>7</td>
<td>57</td>
</tr>
</tbody>
</table>

The car wash owner uses the equation \( y = x + 44 \) to model the data, where \( x \) represents the number of days the business has been open and \( y \) represents the number of cars washed.

Which explanation best describes whether the equation is a good fit for the data?

A. The equation is a good fit because the residual points are approximately linear.
B. The equation is a good fit because the residual points have a positive association.
C. The equation is not a good fit because a residual plot with the pattern from this data set indicates a bad fit.
D. The equation is not a good fit because there should be an equal number of points below and above the \( x \)-axis in the residual plot.

Points Possible: 1

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

Content Standard: Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. (S.ID.6)
Scoring Guidelines

Rationale for Option A: The student may correctly note that the residual plot for this data set is approximately linear but may not realize that a presence of a linear pattern in the residual plot is an indication of bad fit of the equation for the data set.

Rationale for Option B: The student may correctly note that the residual plot for this data set has a positive association but may not realize that a positive pattern of the residual plot indicates a bad fit of the equation for the data set.

Rationale for Option C: Key - The student correctly determines that the equation is not a good fit for the data set because a residual plot that either has an approximate linear pattern or does not have an approximately symmetric distribution of points above and below the x-axis indicates a bad fit.

Rationale for Option D: The student may correctly note only one criteria for why the equation is not a good fit for the data set and may miss that the unequal number of points above and below the x-axis is not the only indication of a bad fit of the equation for the data set.
Sample Response: 1 point

A new car wash business records the number of cars it washes each day for the first 7 days the business is open. The data are shown in the table.

<table>
<thead>
<tr>
<th>Day</th>
<th>Number of Cars Washed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>4</td>
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<tr>
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<td>57</td>
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<tr>
<td>6</td>
<td>56</td>
</tr>
<tr>
<td>7</td>
<td>57</td>
</tr>
</tbody>
</table>

The car wash owner uses the equation $y = x + 44$ to model the data, where $x$ represents the number of days the business has been open and $y$ represents the number of cars washed.

Which explanation best describes whether the equation is a good fit for the data?

A. The equation is a good fit because the residual points are approximately linear.

B. The equation is a good fit because the residual points have a positive association.

C. The equation is not a good fit because a residual plot with the pattern from this data set indicates a bad fit.

D. The equation is not a good fit because there should be an equal number of points below and above the x-axis in the residual plot.
Algebra I
Spring 2018 Item Release

Question 19

Question and Scoring Guidelines
Question 19

This item has three parts.

Eleanor incorrectly solves the equation \( \frac{1}{2}(x + 18) = 4(2x - 6) - 9x \).

Part A. Select the first equation in which Eleanor makes an error.

<table>
<thead>
<tr>
<th>Step</th>
<th>Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Given</td>
<td>( \frac{1}{2}(x+18)=4(2x-6)-9x )</td>
</tr>
<tr>
<td>1.</td>
<td>( x + 18 = 8(2x - 6) - 9x )</td>
</tr>
<tr>
<td>2.</td>
<td>( x + 18 = 16x - 48 - 9x )</td>
</tr>
<tr>
<td>3.</td>
<td>( x + 18 = 7x - 48 )</td>
</tr>
<tr>
<td>4.</td>
<td>( 66 = 6x )</td>
</tr>
<tr>
<td>5.</td>
<td>( x = 11 )</td>
</tr>
</tbody>
</table>

Part B. Create an equation to correct Eleanor’s error identified in Part A.
Points Possible: 2

Content Cluster: Understand solving equations as a process of reasoning and explain the reasoning.

Content Standard: Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method. (A.REI.1)
## Scoring Guidelines

<table>
<thead>
<tr>
<th>Score Point</th>
<th>Description</th>
</tr>
</thead>
</table>
| 2 points    | **Both** bullets are necessary for full credit of 2 points:  
- The student identified the error in the work, providing evidence of the ability to identify a flaw related to the equality of numbers in a solution process AND the student created a correct equation, providing evidence of the ability to correct a flaw related to the equality of numbers in a solution process.  
- The student calculated the correct solution, providing evidence of the ability to complete each step in a solution process.  
**Exemplar:**  
For example, the response may include:  
Part 1: Step 1  
Part 2: $x + 18 = 8(2x - 6) - 18x$  
Part 3: $-22$ |

| 1 point     | **One** of the following bullets is necessary for partial credit of 1 point:  
- The student identified the error in the work, providing evidence of the ability to identify a flaw related to the equality of numbers in a solution process AND the student created a correct equation, providing evidence of the ability to correct a flaw related to the equality of numbers in a solution process.  
- The student calculated the correct solution, providing evidence of the ability to complete each step in a solution process.  
**Exemplar:**  
For example, the response may include:  
Part 1: Step 1  
Part 2: $x + 18 = 8(2x - 6) - 18x$  
Part 3: $22$ |
Sample Response: 2 points

This item has three parts.

Eleanor incorrectly solves the equation $\frac{1}{2}(x + 18) = 4(2x - 6) - 9x$.

**Part A.** Select the first equation in which Eleanor makes an error.

<table>
<thead>
<tr>
<th>Step</th>
<th>Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Given</td>
<td>$\frac{1}{2}(x + 18) = 4(2x - 6) - 9x$</td>
</tr>
<tr>
<td>1.</td>
<td>$x + 18 = 8(2x - 6) - 9x$</td>
</tr>
<tr>
<td>2.</td>
<td>$x + 18 = 16x - 48 - 9x$</td>
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<td>$x + 18 = 7x - 48$</td>
</tr>
<tr>
<td>4.</td>
<td>$66 = 6x$</td>
</tr>
<tr>
<td>5.</td>
<td>$x = 11$</td>
</tr>
</tbody>
</table>

**Part B.** Create an equation to correct Eleanor’s error identified in Part A.

$x + 18 = 8(2x - 6) - 18x$
Part C. What is the correct solution to $\frac{1}{2}(x + 18) = 4(2x - 6) - 9x$?

$x = -22$
Notes on Scoring

This response earns full credit (2 points). For the first point, it correctly selects the first equation with an error (part A) and creates an equation to correct the error identified (part B). For the second point (part C), it finds a correct solution for the equation in part B.

Eleanor’s solution attempts to clear a fraction $\frac{1}{2}$ using the Multiplication Property of Equality to multiply both sides of the equation by 2. She does it correctly on the left side of the equation, $[2 \cdot \left[ \frac{1}{2} (x + 18) \right]]$, to get $x + 18$ but makes an error on the right side of the equation. Eleanor multiplies only one term on the right side of the equation instead of both terms, $[2 \cdot [4(2x - 6) - 9x]]$. Based on the Distributive Property, the correct expression on the right side should be $8(2x - 6) - 18x$ instead of $8(2x - 6) - 9x$. Therefore, the correct response for part A is Step 1.

The correct equation for part B would be $x + 18 = 8(2x - 6) - 18x$ or an equivalent equation such as $\frac{1}{2}x + 9 = 4(2x - 6) - 9x$.

Part C shows a correct solution, $x = -22$, for the equation in part A.

\[
\begin{align*}
x + 18 &= 8(2x - 6) - 18x \\
x + 18 &= 16x - 48 - 18x & \text{Distributive Property} \\
x + 18 &= -2x - 48 & \text{Combining like terms} \\
x + 2x &= -18 - 48 & \text{Addition Property of Equality} \\
3x &= -66 & \text{Combining like terms} \\
x &= -22 & \text{Multiplication Property of Equality}
\end{align*}
\]
Sample Response: 2 points

This item has three parts.

Eleanor incorrectly solves the equation \( \frac{1}{2}(x + 18) = 4(2x - 6) - 9x \).

Part A. Select the first equation in which Eleanor makes an error.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>Given</td>
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</tr>
<tr>
<td>1.</td>
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<td>( 66 = 6x )</td>
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<td>5.</td>
<td>( x = 11 )</td>
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</table>

Part B. Create an equation to correct Eleanor’s error identified in Part A.

\( \frac{1}{2}x + 9 = 4(2x - 6) - 9x \)
Part C. What is the correct solution to \( \frac{1}{2} (x + 18) = 4(2x - 6) - 9x \)?

\[ x = -22 \]

Notes on Scoring

This response earns full credit (2 points). For the first point, it correctly selects the first equation with an error (part A) and creates an equivalent equation to correct the error identified (part B). For the second point (part C), it finds a correct solution for the equation in part A.
Sample Response: 1 point

This item has three parts.

Eleanor incorrectly solves the equation $\frac{1}{2}(x + 18) = 4(2x - 6) - 9x$.

Part A. Select the first equation in which Eleanor makes an error.

<table>
<thead>
<tr>
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<tr>
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<td>$66 = 6x$</td>
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<td>5.</td>
<td>$x = 11$</td>
</tr>
</tbody>
</table>

Part B. Create an equation to correct Eleanor’s error identified in Part A.

$$\frac{1}{2}x + 9 = 4(2x - 6) - 9x$$
Notes on Scoring

This response earns partial credit (1 point). The student correctly selects the equation with an error (part A) and creates an equivalent equation to correct the error identified (part B). In part C, the student leaves off the negative sign to give an incorrect answer, 22, instead of (-22) for the equation in part A.
Sample Response: 1 point

This item has three parts.

Eleanor incorrectly solves the equation \( \frac{1}{2}(x + 18) = 4(2x - 6) - 9x \).

**Part A.** Select the first equation in which Eleanor makes an error.

<table>
<thead>
<tr>
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<tbody>
<tr>
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<tr>
<td>5.</td>
<td>x = 11</td>
</tr>
</tbody>
</table>

**Part B.** Create an equation to correct Eleanor’s error identified in Part A.

\[ x = -22 \]
Notes on Scoring

This response earns partial credit (1 point). The student correctly selects the first equation with an error (part A) and states the correct solution in part C but provides an incorrect equation to correct the error in part A.
Sample Response: 0 points

This item has three parts.

Eleanor incorrectly solves the equation \( \frac{1}{2} (x + 18) = 4(2x - 6) - 9x \).

**Part A.** Select the first equation in which Eleanor makes an error.

<table>
<thead>
<tr>
<th>Step</th>
<th>Equation</th>
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<tbody>
<tr>
<td>Given</td>
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<td>( 66 = 6x )</td>
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<td>5.</td>
<td>( x = 11 )</td>
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</table>

**Part B.** Create an equation to correct Eleanor's error identified in Part A.

\[ \frac{1}{2}x + 9 = 8(2x - 6) - 9x \]
Notes on Scoring

This response earns no credit (0 points). The student correctly selects the first equation with an error (part A) but fails to provide the correct equation in part B by misapplying the Multiplication Property of Equality. The student multiplies only $4(2x - 6)$ by 2 instead of the entire equation. In part C, the student provides an incorrect solution to the incorrect equation from part A. On the right side of the equation, the student may only multiply the first term inside the parentheses by 8 to get \( \frac{1}{2}x + 9 = 16x - 6 - 9x \). Then the student may solve this equation as shown.

\[
\begin{align*}
\frac{1}{2}x + 9 &= 16x - 6 - 9x \\
\frac{1}{2}x + 9 &= 7x - 6 \\
-6.5x &= -15 \\
x &\approx 2.3
\end{align*}
\]
Sample Response: 0 points

This item has three parts.

Eleanor incorrectly solves the equation \( \frac{1}{2}(x + 18) = 4(2x - 6) - 9x \).

**Part A.** Select the first equation in which Eleanor makes an error.

<table>
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<td>66 = 6x</td>
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<tr>
<td>5.</td>
<td>( x = 11 )</td>
</tr>
</tbody>
</table>

**Part B.** Create an equation to correct Eleanor’s error identified in Part A.

\[ x + 18 = 25x - 48 \]
Notes on Scoring

This response earns no credit (0 points). In part A, the student does not select the first equation with an error. In part A, the student selects the wrong equation, which is not the first error Eleanor made. In part C, the student provides an incorrect answer for the equation in part A.
Algebra I
Spring 2018 Item Release
Question 21
Question and Scoring Guidelines
Question 21

A landscaper records the heights, in feet, of 15 newly planted trees in a community garden, as shown.

3.2, 4.3, 3.5, 5.4, 3.7, 5.5, 6.2, 3.1, 6.8, 7.1, 4.8, 6.5, 4.9, 5.3, 5.9

Complete the histogram by selecting frequencies for the heights of the newly planted trees in the community garden.

Points Possible: 1

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

Content Standard: Represent data with plots on the real number line (dot plots, histograms, and box plots). (S.ID.1)
Scoring Guidelines

Exemplar Response

Other Correct Responses

- N/A

For this item, a full-credit response includes:

- The correct histogram (1 point).
A landscaper records the heights, in feet, of 15 newly planted trees in a community garden, as shown.

3.2, 4.3, 3.5, 5.4, 3.7, 5.5, 6.2, 3.1, 6.8, 7.1, 4.8, 6.5, 4.9, 5.3, 5.9

Complete the histogram by selecting frequencies for the heights of the newly planted trees in the community garden.
Notes on Scoring

This response earns full credit (1 point) because it shows a correct histogram representing the heights of the newly planted trees.

To make a histogram, the first step is to arrange the data set in order from lowest value to greatest value:
3.1, 3.2, 3.5, 3.7, 4.3, 4.8, 4.9, 5.3, 5.4, 5.5, 5.9, 6.2, 6.5, 6.8, 7.1
Students must then find the frequency distribution. The idea behind a frequency distribution is to break the data into groups so that patterns become clearer.

The second step is to figure out the number of groups. The number of data points in each group is the frequency. In this situation, since the given data set contains 15 data points and begins at 3.1, it is reasonable to start the first group at 3 and separate the data into 5 groups.

Group One, with values between 3 and 4 (not inclusive), contains 4 data points 3.1, 3.2, 3.5, and 3.7, so the frequency is 4.

Group Two, with values between 4 and 5 (not inclusive), contains 3 data points 4.3, 4.8, and 4.9, so the frequency is 3.

Group Three, with values between 5 and 6 (not inclusive), contains 4 data points 5.3, 5.4, 5.5, and 5.9, so the frequency is 4.

Group Four, with values between 6 and 7 (not inclusive), contains 3 data points between 6.2, 6.5, and 6.8, so the frequency is 3.

Group Five, with values between 7 and 8 (not inclusive), contains 1 data point, 7.1, so the frequency is 1.

The last step is to show the groups on the horizontal axis, and the frequency on the vertical axis. Then use bars to represent the frequency of each individual group.
A landscaper records the heights, in feet, of 15 newly planted trees in a community garden, as shown:

3.2, 4.3, 3.5, 5.4, 3.7, 5.5, 6.2, 3.1, 6.8, 7.1, 4.8, 6.5, 4.9, 5.3, 5.9

Complete the histogram by selecting frequencies for the heights of the newly planted trees in the community garden.

---

**Notes on Scoring**

This response earns no credit (0 points) because it shows an incorrect histogram representing the heights of the newly planted trees. Even though the student breaks the data into five groups, the frequencies for some classes are incorrect. In Group One, with values between 3 and 4 (not inclusive), the frequency is 2 instead of 4. In Group Five, with values between 7 and 8 (not inclusive), the frequency is 3 instead of 1.
A landscaper records the heights, in feet, of 15 newly planted trees in a community garden, as shown.

3.2, 4.3, 3.5, 5.4, 3.7, 5.5, 6.2, 3.1, 6.8, 7.1, 4.8, 6.5, 4.9, 5.3, 5.9

Complete the histogram by selecting frequencies for the heights of the newly planted trees in the community garden.

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect histogram representing the heights of the newly planted trees. Per the histogram, Group One contains values between 1 and 2 (not inclusive) but the data set does not include any heights within this interval. The student may misread 3.1 as 1.3.
Question 22

The graph of a function is shown.

What is the domain of the function?

A. \( x \geq -4 \)
B. \( x \geq -2 \)
C. \( x \geq 0 \)
D. \( x \geq 1 \)

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. (F.IF.5)
Scoring Guidelines

**Rationale for Option A: Key** - The student correctly determines that the domain of the function is a set containing the $x$-coordinate of the leftmost point, $(-4, -2)$, of the graph and $x$-coordinates of all points of the graph to the right of $-4$ that can be described by the inequality $x \geq -4$.

**Rationale for Option B:** The student may confuse domain, the set of $x$-coordinates of points on the graph starting from the leftmost point, $(-4, -2)$, with range, the set of $y$-coordinates of points of the graph, and then describe the range by the inequality $x \geq -2$.

**Rationale for Option C:** The student may think that the lowest value of the domain must be represented by the $x$-coordinate of the $y$-intercept $(0, 1)$ of the graph. Since the graph is continuous to the right, the student may incorrectly conclude that the domain is $x \geq 0$.

**Rationale for Option D:** The student may think that the lowest value of the domain must be represented by the $y$-coordinate of the $y$-intercept $(0, 1)$ of the graph. Since the graph is continuous to the right, the student may incorrectly conclude that the domain is $x \geq 1$. 
Sample Response: 1 point

The graph of a function is shown.

What is the domain of the function?

- $x \geq -4$
- $x \geq -2$
- $x \geq 0$
- $x \geq 1$
Algebra I
Spring 2018 Item Release

Question 23

Question and Scoring Guidelines
Question 23

Samantha sells two types of wristbands, rope or beaded. She charges more for beaded wristbands than for rope wristbands. The amount of money, in dollars, that she collects from selling $x$ wristbands of one type and $y$ wristbands of the other type can be modeled by the expression $5x + 8y$.

What does the variable $y$ represent in this situation?

A) the number of rope wristbands sold
B) the number of beaded wristbands sold
C) the selling price of one rope wristband
D) the selling price of one beaded wristband

Points Possible: 1

Content Cluster: Interpret the structure of expressions.

Content Standard: Interpret expressions that represent a quantity in terms of its context. a. Interpret parts of an expression, such as terms, factors, and coefficients. (A.SSE.1a)
Scoring Guidelines

Rationale for Option A: The student may correctly determine that $5x$ and $8y$ represent the amount of money earned from selling each type of wristband but misses that Samantha charges more for a beaded wristband than she does for a rope wristband, so the $5x$ represents the amount of money earned from selling $x$ beaded wristbands and $8y$ from selling $y$ rope wristbands.

Rationale for Option B: Key – The student correctly determines that $5x$ and $8y$ represent the amount of money earned from selling each type of wristband, $5$ and $8$ represent the selling price for each type of wristband, and $x$ and $y$ represent the number of wristbands sold of each type. Since Samantha charges more for beaded wristbands, then $8y$ represents the amount of money earned from selling beaded wristbands and $y$ is the number of beaded wristbands sold.

Rationale for Option C: The student may correctly determine that $5x$ and $8y$ represent the amount of money earned from selling each type of wristband but confuses the price and the quantity of wristbands. The student may think that $8$ represents the number of rope wristbands and $y$ represents the selling price of one rope wristband.

Rationale for Option D: The student may correctly determine that $5x$ and $8y$ represent the amount of money earned from selling each type of wristband but confuses the price and the quantity of wristbands. The student may think that $8$ represents the number of beaded wristbands and $y$ represents the selling price of one beaded wristband.

Sample Response: 1 point

Samantha sells two types of wristbands, rope or beaded. She charges more for beaded wristbands than for rope wristbands. The amount of money, in dollars, that she collects from selling $x$ wristbands of one type and $y$ wristbands of the other type can be modeled by the expression $5x + 8y$.

What does the variable $y$ represent in this situation?

A. the number of rope wristbands sold
B. the number of beaded wristbands sold
C. the selling price of one rope wristband
D. the selling price of one beaded wristband
Algebra I
Spring 2018 Item Release

Question 25

Question and Scoring Guidelines
Question 25

The graph of a function is shown.

What is the maximum value of the function?

[Graph of a function is shown]

Points Possible: 1

Content Cluster: Analyze functions using different representations.

Content Standard: Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph linear and quadratic functions and show intercepts, maxima, and minima. (F.IF.7a)
Scoring Guidelines

Exemplar Response

• 3

Other Correct Responses

• Any equivalent value

For this item, a full-credit response includes:

• A correct value (1 point).
Algebra I
Spring 2018 Item Release

Question 25

Sample Responses
**Sample Response: 1 point**

The graph of a function is shown.

![Graph of a function](image)

What is the maximum value of the function?

3

Notes on Scoring

This response earns full credit (1 point) because it shows a correct maximum value of the function.

Since the graph (parabola) opens downwards, the vertex (1, 3) is the highest point of the graph and its y-coordinate is the maximum value. Therefore, the maximum value of the function is 3.
Sample Response: 1 point

The graph of a function is shown.

What is the maximum value of the function?

3.0

Notes on Scoring

This response earns full credit (1 point) because it shows a correct equivalent maximum value of the function.
Sample Response: 0 points

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect maximum value of the function.

The student may recognize that the graph (parabola) opens downwards and the vertex (1, 3) is the highest point of the graph; however, the student may incorrectly conclude that the $x$-coordinate of the vertex represents the maximum value of the function.
Sample Response: 0 points

[Image: Graph of a parabola]

What is the maximum value of the function?

4

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect maximum value of the function.

The student may recognize that the graph (parabola) opens downwards and the vertex is the highest point of the graph but misreads the correct vertex (1, 3) as (1, 4) and uses its y-coordinate, 4, as the maximum value of the function.
Algebra I
Spring 2018 Item Release

Question 29

Question and Scoring Guidelines
Question 29

The graph of a system of inequalities is shown.

Create the system of inequalities that is represented by the graph.
**Scoring Guidelines**

**Exemplar Response**

- \( y < -3 \)
- \( y \geq \frac{2}{3}x - 5 \)

**Other Correct Responses**

- Any equivalent system of inequalities

For this item, a full-credit response includes:

- A correct inequality (1 point)
  AND
- Another correct inequality (1 point).

For this item, a partial-credit response includes:

- One correct inequality (1 point)

**Points Possible:** 2

**Content Cluster:** Represent and solve equations and inequalities graphically.

**Content Standard:** Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes. (A.REI.12)
The graph of a system of inequalities is shown.

Create the system of inequalities that is represented by the graph.

\[ y < -3 \]
\[ y \geq \frac{2}{3}x - 5 \]
Notes on Scoring

This response earns full credit (2 points) because it shows a correct system of two linear inequalities in two variables representing the graph.

In this situation, the shaded region denotes the solution set for the system of the two linear inequalities. The shaded region is the overlap of the two individual solution sets of linear inequalities given in the system.

The solution for the inequality \( y < -3 \) is the region below the horizontal dotted line because any point from this region makes the inequality true. For example, the point (-2, -6) makes \( y < -3 \) true because \(-6 < -3\).

The solution for the inequality \( y \geq \frac{2}{3}x - 5 \) is the region above the solid line because any point from this region makes the inequality true. For example, the point (-4, 0) makes the inequality true because of the following comparison:

\[
0 \geq \frac{2}{3}(-4) - 5 \\
0 \geq \frac{-21}{3} \\
0 > -7
\]
Sample Response: 2 points

The graph of a system of inequalities is shown.

Create the system of inequalities that is represented by the graph.

\[-3 > y\]

\[3y \geq 2x - 15\]
Notes on Scoring

This response earns full credit (2 points) because it shows a correct system of two equivalent linear inequalities in two variables representing the graph. The inequality \(-3 > y\) is equivalent to inequality \(y < -3\) and, using the Multiplication Property of Inequality to multiply both sides by \(\frac{1}{3}\), the inequality \(3y \geq 2x - 15\) becomes \(y \geq \frac{2}{3}x - 5\).
Sample Response: 1 point

The graph of a system of inequalities is shown.

Create the system of inequalities that is represented by the graph.

\[
y \geq \frac{2}{3}x - 5
\]

\[
y \leq -3
\]
Notes on Scoring

This response earns partial credit (1 point) because it shows one correct and one incorrect linear inequality in two variables representing the graph.

The student may not recognize that the region below the horizontal dotted line should be represented by inequality \( y < -3 \) instead of \( y \leq -3 \) because the points on the dotted line should not be included in the solution set.
Sample Response: 1 point

The graph of a system of inequalities is shown.

Create the system of inequalities that is represented by the graph.

\[
\begin{align*}
y &> \frac{2}{3}x - 5 \\
y &< -3
\end{align*}
\]
Notes on Scoring

This response earns partial credit (1 point) because it shows one correct and one incorrect linear inequality in two variables representing the graph.

The student may not recognize that the region above the solid line should be represented by inequality \( y \geq \frac{2}{3}x - 5 \) instead of \( y > \frac{2}{3}x - 5 \) because the points on the solid line should be included in the solution set.
Sample Response: 0 points

The graph of a system of inequalities is shown.

Create the system of inequalities that is represented by the graph.

\[
\begin{align*}
y & > -3 \\
3y & \leq 2x - 15
\end{align*}
\]
Notes on Scoring

This response earns no credit (0 points) because it shows a system of two incorrect linear inequalities in two variables representing the graph.

The student may not realize that the region below the horizontal dotted line should be represented by inequality $y < -3$ instead of $y > -3$ that would represent a region above the dotted line.

Likewise, the region above the solid line would be represented by the inequality $y \geq \frac{2}{3}x - 5$ instead of $y \leq \frac{2}{3}x - 5$ or $3y \leq 2x - 15$. On the graph, the solution to the inequality $3y \leq 2x - 15$ would be the region below the solid line.
Sample Response: 0 points

The graph of a system of inequalities is shown.

Create the system of inequalities that is represented by the graph.

\[ y > \frac{2}{3}x - 5 \]

\[ y \leq -3 \]
Notes on Scoring

This response earns no credit (0 points) because it shows a system of two incorrect linear inequalities in two variables representing the graph.

The student may not recognize that the region below the horizontal dotted line would be represented by inequality $y < -3$ instead of $y \leq -3$ because the points on the dotted line are not included in the solution set. Likewise, the region above the solid line would be represented by inequality $y \geq \frac{2}{3}x - 5$ instead of $y > \frac{2}{3}x - 5$ because the points on the solid line would be included in the solution set.
Algebra I
Spring 2018 Item Release

Question 30

Question and Scoring Guidelines
**Question 30**

A function is given.

\[ f(x) = 2^x + 3 \]

What is the value of \( f(-2) \)?

\[ f(-2) = \]

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<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>0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>-</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Points Possible:** 1

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

**Content Standard:** Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. \((F.IF.2)\)
Scoring Guidelines

Exemplar Response

• 3.25

Other Correct Responses

• Any equivalent value

For this item, a full-credit response includes:

• A correct value (1 point).
Sample Response: 1 point

A function is given.

\[ f(x) = 2^x + 3 \]

What is the value of \( f(-2) \)?

\[ f(-2) = \boxed{3.25} \]

Notes on Scoring

This response earns full credit (1 point) because it shows a correct function value for the input from the function’s domain.

To find the value of \( f(-2) \) means to evaluate the function \( f(x) = 2^x + 3 \) for \( x = -2 \) as \( f(-2) = 2^{-2} + 3 = \frac{1}{4} + 3 = \frac{13}{4} \) or 3.25.
Sample Response: 1 point

A function is given.
\[ f(x) = 2^x + 3 \]

What is the value of \( f(-2) \)?

\[ f(-2) = \frac{13}{4} \]

Notes on Scoring

This response earns full credit (1 point) because it shows a correct function value, \( \frac{13}{4} \), that is equivalent to 3.25.
Sample Response: 0 points

A function is given.

\[ f(x) = 2^x + 3 \]

What is the value of \( f(-2) \)?

\[ f(-2) = -1 \]

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect function value for the input \(-2\). The student may think that

\[ f(-2) = 2^{-2} + 3 = -4 + 3 = -1, \text{ instead of} \]

\[ f(-2) = 2^{-2} + 3 = \frac{1}{4} + 3 = 3.25. \]
Sample Response: 0 points

A function is given.

\[ f(x) = 2^x + 3 \]

What is the value of \( f(-2) \)?

\[ f(-2) = 2.75 \]

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect function value for the input \(-2\). The student may think that \( f(-2) = 2^{-2} + 3 = \frac{1}{4} + 3 = 2.75 \), instead of \( f(-2) = 2^{-2} + 3 = \frac{1}{4} + 3 = 3.25 \).
Question 33

A factory has two assembly lines, M and N, that make the same toy. On Monday, only assembly line M was functioning, and it made 900 toys.

On Tuesday, both assembly lines were functioning for the same amount of time. Line M made 300 toys per hour and line N made 480 toys per hour. Line N made as many toys on Tuesday as line M did over both days.

Write an equation that can be used to find the number of hours, \( t \), that the assembly lines were functioning on Tuesday.

Points Possible: 1

Content Cluster: Create equations that describe numbers or relationships.

Content Standard: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions. (A.CED.1)
Scoring Guidelines

Exemplar Response

• $300t + 900 = 480t$

Other Correct Responses

• Any equivalent equation except $t = 5$

For this item, a full-credit response includes:

• A correct equation (1 point).
Algebra I
Spring 2018 Item Release

Question 33

Sample Responses
Sample Response: 1 point

A factory has two assembly lines, M and N, that make the same toy. On Monday, only assembly line M was functioning, and it made 900 toys.

On Tuesday, both assembly lines were functioning for the same amount of time. Line M made 300 toys per hour and line N made 480 toys per hour. Line N made as many toys on Tuesday as line M did over both days.

Write an equation that can be used to find the number of hours, $t$, that the assembly lines were functioning on Tuesday.

$$300t + 900 = 480t$$

Notes on Scoring

This response earns full credit (1 point) because it shows a correct equation modeling the situation. The equation for finding the number of hours, $t$, should compare production of toys for Line N on Tuesday and the combined production for Line M on Tuesday and Monday.

On Tuesday, by making 480 toys per hour and working for $t$ hours, assembly line N assembled $480t$ toys.

Assembly line M worked on Monday and Tuesday. On Monday, it assembled 900 toys. On Tuesday, by making 300 toys per hour and working for $t$ hours, line M assembled $300t$ toys. A combined two-day production for assembly line M was $300t + 900$.

Since line N assembled as many toys on Tuesday as line M did over two days, the equation modeling the situation is $480t = 300t + 900$. 
A factory has two assembly lines, M and N, that make the same toy. On Monday, only assembly line M was functioning, and it made 900 toys.

On Tuesday, both assembly lines were functioning for the same amount of time. Line M made 300 toys per hour and line N made 480 toys per hour. Line N made as many toys on Tuesday as line M did over both days.

Write an equation that can be used to find the number of hours, $t$, that the assembly lines were functioning on Tuesday.

$900 = 180t$

**Notes on Scoring**

This response earns full credit (1 point) because it shows a correct equation, $900 = 180t$, that is equivalent to the equation $480t = 300t + 900$ after $(-300t)$ has been added to both sides, using the Addition Property of Equality.
A factory has two assembly lines, M and N, that make the same toy. On Monday, only assembly line M was functioning, and it made 900 toys.

On Tuesday, both assembly lines were functioning for the same amount of time. Line M made 300 toys per hour and line N made 480 toys per hour. Line N made as many toys on Tuesday as line M did over both days.

Write an equation that can be used to find the number of hours, $t$, that the assembly lines were functioning on Tuesday.

$t = 5$

Notes on Scoring

This response earns no credit (0 points) because the student solves the equation instead of writing an equation that could be used to model the situation.
Sample Response: 0 points

A factory has two assembly lines, M and N, that make the same toy. On Monday, only assembly line M was functioning, and it made 900 toys.

On Tuesday, both assembly lines were functioning for the same amount of time. Line M made 300 toys per hour and line N made 480 toys per hour. Line N made as many toys on Tuesday as line M did over both days.

Write an equation that can be used to find the number of hours, \( t \), that the assembly lines were functioning on Tuesday.

\[
900 = 480t + 300t
\]

Notes on Scoring

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

Instead of comparing production of toys for Line N on Tuesday and the combined production for Line M on Tuesday and Monday, the student compares production for line M on Monday and the combined production for lines N and M on Tuesday.
Question 36

Select the most appropriate unit for each situation.

<table>
<thead>
<tr>
<th>Situation</th>
<th>feet minute</th>
<th>square feet minute</th>
<th>cubic feet minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate of walking to school</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate of painting a bedroom wall</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate of filling a bucket with water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate of mopping the kitchen floor</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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)*
Scoring Guidelines

Exemplar Response

Select the most appropriate unit for each situation.

<table>
<thead>
<tr>
<th>Rate of walking to school</th>
<th>feet minute</th>
<th>square feet minute</th>
<th>cubic feet minute</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate of painting a bedroom wall</td>
<td></td>
<td>✔</td>
<td></td>
</tr>
<tr>
<td>Rate of filling a bucket with water</td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Rate of mopping the kitchen floor</td>
<td></td>
<td>✔</td>
<td></td>
</tr>
</tbody>
</table>

Other Correct Responses

- N/A

For this item, a full-credit response includes:

- A correct table (1 point).
Algebra I
Spring 2018 Item Release

Question 36

Sample Responses
Sample Response: 1 point

Select the most appropriate unit for each situation.

<table>
<thead>
<tr>
<th>Rate of walking to school</th>
<th>feet minute</th>
<th>square feet minute</th>
<th>cubic feet minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rate of painting a bedroom wall</th>
<th>feet minute</th>
<th>square feet minute</th>
<th>cubic feet minute</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rate of filling a bucket with water</th>
<th>feet minute</th>
<th>square feet minute</th>
<th>cubic feet minute</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rate of mopping the kitchen floor</th>
<th>feet minute</th>
<th>square feet minute</th>
<th>cubic feet minute</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns full credit (1 point) because it shows four correctly selected units for each situation.

The rate of walking to school is the distance to school divided by the time spent on walking to school. Since in this case the distance is measured in linear units, feet, the correct selection is the first box in the top row.

The rate of painting a bedroom wall is the area of the wall divided by the time spent on painting the wall. Since in this case the area is measured in square feet, the correct selection is the second box in the second row from the top.

The rate of filling a bucket with water is measured by the volume of water divided by the time spent on filling the bucket. Since volume is measured in cubic units, or in this case in cubic feet, the correct selection is the third box in the third row from the top.

The rate of mopping the kitchen floor is the area of the floor divided by the time spent on mopping the floor. Since area is measured in square units, or in this case in square feet, the correct selection is the middle box of the bottom row.
Sample Response: 0 points

Select the most appropriate unit for each situation.

<table>
<thead>
<tr>
<th>Situation</th>
<th>feet/minute</th>
<th>square feet/minute</th>
<th>cubic feet/minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate of walking to school</td>
<td>✓</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Rate of painting a bedroom wall</td>
<td>☐</td>
<td>✓</td>
<td>☐</td>
</tr>
<tr>
<td>Rate of filling a bucket with water</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
</tr>
<tr>
<td>Rate of mopping the kitchen floor</td>
<td>☐</td>
<td>☐</td>
<td>✓</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns no credit (0 points) because out of four responses it shows one incorrectly selected unit for Rate of mopping the kitchen floor. The student may think that because mopping is done with water, and the amount of water is measured in units of volume, the correct response is cubic feet/minute instead of square feet/minute.
Sample Response: 0 points

Select the most appropriate unit for each situation.

<table>
<thead>
<tr>
<th></th>
<th>feet minute</th>
<th>square feet minute</th>
<th>cubic feet minute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rate of walking to school</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rate of painting a bedroom wall</td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Rate of filling a bucket with water</td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Rate of mopping the kitchen floor</td>
<td></td>
<td>✔</td>
<td></td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns no credit (0 points) because it shows one incorrectly selected unit for Rate of painting a bedroom wall. The student may think about the volume of the entire bedroom and use the units of volume, \( \frac{\text{cubic feet}}{\text{minute}} \), instead of \( \frac{\text{square feet}}{\text{minute}} \).
Algebra I
Spring 2018 Item Release

Question 37

Question and Scoring Guidelines
Question 37

Casey asks a random sample of students at his school about their natural hair and eye colors. The results of his survey are shown in the relative frequency table.

<table>
<thead>
<tr>
<th>Hair Color</th>
<th>Brown</th>
<th>Blue</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>0.225</td>
<td>0.000</td>
<td>0.025</td>
<td>0.250</td>
</tr>
<tr>
<td>Brown</td>
<td>0.350</td>
<td>0.125</td>
<td>0.100</td>
<td>0.575</td>
</tr>
<tr>
<td>Red</td>
<td>0.025</td>
<td>0.000</td>
<td>0.025</td>
<td>0.050</td>
</tr>
<tr>
<td>Blonde</td>
<td>0.050</td>
<td>0.075</td>
<td>0.000</td>
<td>0.125</td>
</tr>
<tr>
<td>Total</td>
<td>0.650</td>
<td>0.200</td>
<td>0.150</td>
<td>1.000</td>
</tr>
</tbody>
</table>

In the sample, there are 4 more students with brown hair and blue eyes than blonde hair and blue eyes.

How many total students have black hair?

Points Possible: 1

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)
Scoring Guidelines

Exemplar Response

• 20

Other Correct Responses

• Any equivalent value

For this item, a full-credit response includes:

• The correct value (1 point).
Sample Response: 1 point

Casey asks a random sample of students at his school about their natural hair and eye colors. The results of his survey are shown in the relative frequency table.

<table>
<thead>
<tr>
<th>Hair Color</th>
<th>Brown</th>
<th>Blue</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>0.225</td>
<td>0.000</td>
<td>0.025</td>
<td>0.250</td>
</tr>
<tr>
<td>Brown</td>
<td>0.350</td>
<td>0.125</td>
<td>0.100</td>
<td>0.575</td>
</tr>
<tr>
<td>Red</td>
<td>0.025</td>
<td>0.000</td>
<td>0.025</td>
<td>0.050</td>
</tr>
<tr>
<td>Blonde</td>
<td>0.050</td>
<td>0.075</td>
<td>0.000</td>
<td>0.125</td>
</tr>
<tr>
<td>Total</td>
<td>0.650</td>
<td>0.200</td>
<td>0.150</td>
<td>1.000</td>
</tr>
</tbody>
</table>

In the sample, there are 4 more students with black hair and blue eyes than blonde hair and blue eyes.

How many total students have black hair?

20
Notes on Scoring

This response earns full credit (1 point) because it shows a correct number of students with black hair. One way to find the number of students with black hair is first to determine the total number of students at the school, and then use information in the frequency table showing that the number of students with black hair is 0.25 of the total number of students (row 1, column 4).

Let \( x \) represent the total number of students. The relative frequency of students with brown hair and blue eyes (row 2, column 2) is 0.125, so the number of students with brown hair and blue eyes is 0.125\( x \).

The relative frequency of students with blonde hair and blue eyes (row 4, column 2) is 0.075, so the number of students with blonde hair and blue eyes is 0.075\( x \).

Since in the sample there are 4 more students with brown hair and blue eyes than students with blonde hair and blue eyes, the situation can be modeled by the equation:

\[
0.125x = 0.075x + 4
\]

\[
0.125x - 0.075x = 4
\]

\[
0.05x = 4
\]

\[
\frac{0.05x}{0.05} = \frac{4}{0.05}
\]

\[
x = 80
\]

Since the relative frequency of students with black hair is 0.25 and the total number of students is 80, the number of students with black hair is 0.25\( \cdot 80 \) or 20.
Sample Response: 0 points

Casey asks a random sample of students at his school about their natural hair and eye colors. The results of his survey are shown in the relative frequency table.

<table>
<thead>
<tr>
<th>Hair Color</th>
<th>Eye Color</th>
<th>Brown</th>
<th>Blue</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>0.225</td>
<td>0.000</td>
<td>0.025</td>
<td>0.250</td>
<td></td>
</tr>
<tr>
<td>Brown</td>
<td>0.350</td>
<td>0.125</td>
<td>0.100</td>
<td>0.575</td>
<td></td>
</tr>
<tr>
<td>Red</td>
<td>0.025</td>
<td>0.000</td>
<td>0.025</td>
<td>0.050</td>
<td></td>
</tr>
<tr>
<td>Blonde</td>
<td>0.050</td>
<td>0.075</td>
<td>0.000</td>
<td>0.125</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>0.650</td>
<td>0.200</td>
<td>0.150</td>
<td>1.000</td>
<td></td>
</tr>
</tbody>
</table>

In the sample, there are 4 more students with brown hair and blue eyes than blonde hair and blue eyes.

How many total students have black hair?

40

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect number of students with black hair. The student may determine that there are 80 students, but then incorrectly calculate 0.25 \cdot 80 to be 40 rather than 25.
Sample Response: 0 points

Casey asks a random sample of students at his school about their natural hair and eye colors. The results of his survey are shown in the relative frequency table.

<table>
<thead>
<tr>
<th>Hair Color</th>
<th>Brown</th>
<th>Blue</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>0.225</td>
<td>0.000</td>
<td>0.025</td>
<td>0.250</td>
</tr>
<tr>
<td>Brown</td>
<td>0.350</td>
<td>0.125</td>
<td>0.100</td>
<td>0.575</td>
</tr>
<tr>
<td>Red</td>
<td>0.025</td>
<td>0.000</td>
<td>0.025</td>
<td>0.050</td>
</tr>
<tr>
<td>Blonde</td>
<td>0.050</td>
<td>0.075</td>
<td>0.000</td>
<td>0.125</td>
</tr>
<tr>
<td>Total</td>
<td>0.650</td>
<td>0.200</td>
<td>0.150</td>
<td>1.000</td>
</tr>
</tbody>
</table>

In the sample, there are 4 more students with brown hair and blue eyes than blonde hair and blue eyes.

How many total students have black hair?

\[
\frac{250}{0.05} = 50
\]

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect number of students with black hair. The student may think that the number of students with black hair can be found by dividing the total relative frequency of students with black hair, 0.250, by the difference between 0.125 and 0.075, or the relative frequency of students with brown hair/blue eyes and the relative frequency of students with blonde hair/blue eyes. The student may not take into consideration that the difference of those two samples should be 4 and the number of students must be represented by a whole number, not a complex fraction like \(\frac{250}{0.05}\).
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Question 38

Question and Scoring Guidelines
Question 38

A system of equations is given.

\[ y = x^2 - 9 \]
\[ y = -2x - 1 \]

What is one solution to the system of equations?

(______, ______)

Points Possible: 1

Content Cluster: Solve systems of equations.

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

Exemplar Response

- (-4, 7)

Other Correct Responses

- (2, -5)

For this item, a full-credit response includes:

- A correct ordered pair solution (1 point).
Sample Response: 1 point

A system of equations is given.

\[ y = x^2 - 9 \]
\[ y = -2x - 1 \]

What is one solution to the system of equations?

\[ (\quad , \quad ) \]
Notes on Scoring

This response earns full credit (1 point) because it shows a correct solution to a system consisting of a linear equation and a quadratic equation in two variables.

There are many methods to solve systems of equations, including substitution. To solve by substitution, first substitute $x^2 - 9$ for $y$ in the equation $y = -2x - 1$. The resulting equation becomes $x^2 - 9 = -2x - 1$.

Next, apply the Addition Property of Equality by adding $2x + 1$ to both sides of the equation to obtain $x^2 + 2x - 8 = 0$. Then, factor the quadratic trinomial on the left side of the equation. When factorization is complete, the equation becomes $(x + 4)(x - 2) = 0$.

By the Zero-Product Property, for the product $(x + 4)(x - 2)$ to be equal to 0, one of the factors must be equal to 0, so $x + 4 = 0$ or $x - 2 = 0$.

Then solve each linear equation for $x$, so that $x = -4$ or $x = 2$. Since the solution to the system of two equations with two variables is the set of ordered pairs consisting of the $x$-value and the $y$-value, the final step of the solution process is to substitute the $x$-values, one at a time, into one of the original equations to determine the corresponding $y$-values. For example, when substituting $x = -4$ into $y = -2x - 1$, the $y$-value is 7, and the solution to the system is $(-4, 7)$.

When substituting $x = 2$ into $y = -2x - 1$, the $y$-value is $-5$, and the solution is $(2, -5)$.

This system has two solutions, but for full credit, the item asks for only one correct ordered pair.
Sample Response: 1 point

A system of equations is given.

\[ y = x^2 - 9 \]
\[ y = -2x - 1 \]

What is one solution to the system of equations?

(2, -5)

Notes on Scoring

This response earns full credit (1 point) because it shows one out of two correct solutions to the system consisting of a linear equation and a quadratic equation in two variables.
Sample Response: 0 points

A system of equations is given.

\[ y = x^2 - 9 \]
\[ y = -2x - 1 \]

What is one solution to the system of equations?

\[ (-5, 2) \]

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect solution to the system consisting of a linear equation and a quadratic equation in two variables. The system has two solutions, (2, -5) and (-4, 7). This response reverses the order of the coordinates for \( x \) and \( y \) of the first solution and is therefore an incorrect solution.
Sample Response: 0 points

A system of equations is given.

\[ y = x^2 - 9 \]
\[ y = -2x - 1 \]

What is one solution to the system of equations?

\((-1.633, -6.333)\)

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect solution to the system consisting of a linear equation and a quadratic equation in two variables. The student may accidentally change the linear equation \(y = -2x - 1\) to the quadratic equation \(y = 2x^2 - 1\) and solve the wrong system of equations.
An equation is given.

\[ A = 4\pi r^2 \]

Solve the equation for \( r \).

(A) \( r = \sqrt{\frac{4\pi}{A}} \)

(B) \( r = \sqrt{\frac{A}{4\pi}} \)

(C) \( r = \frac{4\pi A}{2} \)

(B) \( r = \frac{A}{2\pi} \)

**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. For example, rearrange Ohm's law \( V = IR \) to highlight resistance \( R \). (A.CED.4)
Scoring Guidelines

Rationale for Option A: In the attempt to isolate \( r^2 \), the student may incorrectly divide both sides of the equation by \( A \), instead of dividing both sides of the equation by \( 4\pi \), and then takes the square root to solve the equation for \( r \).

Rationale for Option B: Key - The student correctly solves the equation for \( r \) by dividing both sides of the equation by \( 4\pi \) to get \( r^2 = \frac{A}{4\pi} \) and then by taking the square root of both sides, \( \sqrt{\frac{A}{4\pi}} \) or \( \sqrt{\frac{A}{4\pi}} = r \).

Rationale for Option C: In an attempt to isolate \( r^2 \), the student may incorrectly multiply the left side of the equation by \( 4\pi \) and divide the right side of the equation by \( 4\pi \) to get \( 4\pi A = r^2 \). Then, the student may divide the left side by 2 instead of taking the square root of both sides to get \( r = \frac{4\pi A}{2} \).

Rationale for Option D: In the attempt to isolate \( r^2 \), the student may correctly divide both sides of the equation by \( 4\pi \) to get \( r^2 = \frac{A}{4\pi} \), but then instead of applying the square root to both sides, the student may incorrectly take the square root of the number 4 to get \( r = \frac{A}{2\pi} \).
Sample Response: 1 point

An equation is given.

\[ A = 4\pi r^2 \]

Solve the equation for \( r \).

A) \[ r = \sqrt{\frac{4\pi}{A}} \]

B) \[ r = \sqrt{\frac{A}{4\pi}} \]

C) \[ r = \frac{4\pi A}{2} \]

D) \[ r = \frac{A}{2\pi} \]
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Question 42

Question and Scoring Guidelines
Question 42

An equation is shown.

\[16x^2 + 10x - 27 = -6x + 5\]

What are the solutions to this equation?

\[x = \quad \]
\[x = \quad \]

Points Possible: 1

Content Cluster: Solve equations and inequalities in one variable.

Content Standard: Solve quadratic equations in one variable. b. Solve quadratic equations by inspection (e.g., for \(x^2 = 49\), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as \(a \pm bi\) for real numbers \(a\) and \(b\). (A.REI.4b)
Scoring Guidelines

Exemplar Response

• \( X = 1 \)
  \( X = -2 \)

Other Correct Responses

• Any equivalent values

For this item, a full-credit response includes:

• Two correct values (1 point).
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Question 42

Sample Responses
Sample Response: 1 point

An equation is shown.

\[16x^2 + 10x - 27 = -6x + 5\]

What are the solutions to this equation?

\[x = 1\]

\[x = -2\]
Notes on Scoring

This response earns full credit (1 point) because it shows two correct solutions to the quadratic equation.

There are many methods to solve a quadratic equation. One of them requires initially rearranging the given equation to the standard form $16x^2 + 16x - 32 = 0$, then factoring the greatest common factor (GCF) out to obtain $16(x^2 + x - 2) = 0$ and then factoring the quadratic trinomial as $16(x + 2)(x - 1) = 0$.

Next, by the Zero-Product Property, for the product $(x + 2)(x - 1)$ to be equal to 0, one of the factors must be equal to 0, so $x + 2 = 0$ or $x - 1 = 0$.

Then each linear equation is solved for $x$, so that $x = -2$ or $x = 1$.

Another method is to use a graphing utility to graph the function $y = 16x^2 + 16x - 32$ and then determine the x-intercepts of the graph. The x-coordinates, -2 and 1, of x-intercepts (-2, 0) and (1, 0) represent the solutions of the equation $16x^2 + 16x - 32 = 0$. 
Sample Response: 1 point

An equation is shown.

\[ 16x^2 + 10x - 27 = -6x + 5 \]

What are the solutions to this equation?

\[ x = -2 \]

\[ x = 1 \]

Notes on Scoring

This response earns full credit (1 point) because it shows two correct solutions to the quadratic equation written in the different order.
Sample Response: 0 points

An equation is shown.

\[16x^2 + 10x - 27 = -6x + 5\]

What are the solutions to this equation?

\[x = \frac{1 - \sqrt{129}}{8}, \frac{1 + \sqrt{129}}{8}\]

Notes on Scoring

This response earns no credit (0 points) because it shows two incorrect solutions to the given quadratic equation. The student may initially try to rearrange the given equation into the standard form but may subtract 6x from both sides instead of adding 6x to both sides to get \(16x^2 + 4x - 32 = 0\) instead of \(16x^2 + 16x - 32 = 0\). Next, the student may make an error while solving an incorrect quadratic equation \(16x^2 + 4x - 32 = 0\) using the quadratic formula.
Sample Response: 0 points

An equation is shown.

\[16x^2 + 10x - 27 = -6x + 5\]

What are the solutions to this equation?

\[x = \boxed{1}\]

\[x = \boxed{-1}\]

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect solution to the given quadratic equation. The student may initially rearrange the given equation into the standard form \(16x^2 + 16x - 32 = 0\) and then attempt factoring the left side of the equation to obtain \(16(x^2 + x - 2) = 0\).

Next, the student may factor the quadratic trinomial further to obtain an incorrect equation \(16(x + 1)(x - 1) = 0\) instead of \(16(x + 2)(x - 1) = 0\). Next, the student may use the Zero-Product Property to get that \(x + 1 = 0\) or \(x - 1 = 0\) and then solve for \(x\) to get \(x = -1\) or \(x = 1\).
**Question 43**

Emerson has $120. Each week, he saves an additional $15.

Write a function $f(x)$ that models the total amount of money Emerson has after $x$ weeks.

$$f(x) = \_\_\_\_\_\_\_\_\_\_\_\_$$

**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 (including reading these from a table). *(F.LE.2)*
Scoring Guidelines

Exemplar Response

- \( f(x) = 15x + 120 \)

Other Correct Responses

- Any equivalent function

For this item, a full-credit response includes:

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

Emerson has $120. Each week, he saves an additional $15.

Write a function $f(x)$ that models the total amount of money Emerson has after $x$ weeks.

$$f(x) = 15x + 120$$

Notes on Scoring

This response earns full credit (1 point) because it shows a correct function modeling the total amount of money saved after $x$ weeks.

Since Emerson saves the same amount each week, the situation is represented by the linear model $f(x) = mx + b$, where $m$ stands for the constant amount of money saved per week and $b$ stands for the initial amount of money. Since Emerson saves $15 each week, 15 is substituted in the equation for $m$. The initial amount of money is $120$, so 120 is substituted in the function model for $b$. Therefore, the function modeling this situation is $f(x) = 15x + 120$. 

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Sample Response: 1 point

Emerson has $120. Each week, he saves an additional $15.

Write a function \( f(x) \) that models the total amount of money Emerson has after \( x \) weeks.

\[
f(x) = 120 + 15x
\]

Notes on Scoring

This response earns full credit (1 point) because it shows a correct equivalent function modeling the total amount of money after \( x \) weeks. By the Commutative Property of Addition, the right side of the function written in the reverse order of terms represents an equivalent expression.
Sample Response: 0 points

Emerson has $120. Each week, he saves an additional $15.

Write a function $f(x)$ that models the total amount of money Emerson has after $x$ weeks.

$$f(x) = 135x$$

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect function modeling the total amount of money after $x$ weeks. The student may incorrectly combine unlike terms, 120 and 15$x$, after writing an initially correct expression $120 + 15x$ to obtain an incorrect function $f(x) = 135x$. 
Sample Response: 0 points

Emerson has $120. Each week, he saves an additional $15.

Write a function $f(x)$ that models the total amount of money Emerson has after $x$ weeks.

$$f(x) = x + 15$$

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect function modeling the total amount of money after $x$ weeks. The student may not realize that the constant amount of money, 15 dollars, saved per week represents the slope $m$ in the linear model $y = mx + b$ and $b$ stands for the initial amount of money. Instead, the student uses 15 for the initial amount, focusing on the word “additional” by placing the 15 behind the plus sign.