Ohio’s State Tests

ITEM RELEASE

SPRING 2017

INTEGRATED MATHEMATICS I
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<td>137</td>
</tr>
</tbody>
</table>
### Integrated Math I

**Spring 2017 Item Release**

**Content Summary and Answer Key**

<table>
<thead>
<tr>
<th>Question No.</th>
<th>Item Type</th>
<th>Content Cluster</th>
<th>Content Standard</th>
<th>Answer Key</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Equation Item</td>
<td>Build new functions from existing functions</td>
<td>Identify the effect on the graph of replacing ( f(x) ) by ( f(x) + k ), ( k ) ( f(x) ), ( f(kx) ), and ( f(x + k) ) for specific values of ( k ) (both positive and negative); find the value of ( k ) given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them. ( (F.BF.3) )</td>
<td>---</td>
<td>1 point</td>
</tr>
</tbody>
</table>
| 2            | Multiple Choice | Interpret the structure of expressions | Interpret expressions that represent a quantity in terms of its context.\(^*\) \( (A.SSE.1) \)  
  a. Interpret parts of an expression, such as terms, factors, and coefficients. | B          | 1 point |
| 3            | Table Item   | Understand the concept of a function and use function notation | Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. \( (F.IF.2) \) | ---         | 1 point |
| 4            | Multiple Choice | Summarize, represent, and interpret data on two categorical and quantitative variables | Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. \( (S.ID.6) \)  
  a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models. | C          | 1 point |

\(^*\)An asterisk appears next to any standard or group of standards linked with Modeling as a conceptual category.
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<thead>
<tr>
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<tbody>
<tr>
<td>5</td>
<td>Multiple Choice</td>
<td>Interpret linear models</td>
<td>Distinguish between correlation and causation. (S.ID.9)</td>
<td>D</td>
<td>1 point</td>
</tr>
<tr>
<td>6</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. (A.REI.3)</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>7</td>
<td>Multiple Choice</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) b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.</td>
<td>C</td>
<td>1 point</td>
</tr>
<tr>
<td>8</td>
<td>Multiple Choice</td>
<td>Summarize, represent, and interpret data on a single count or measurement variable</td>
<td>Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. (S.ID.2)</td>
<td>B</td>
<td>1 point</td>
</tr>
<tr>
<td>9</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>
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<td>--------</td>
</tr>
<tr>
<td>10</td>
<td>Equation Item</td>
<td>Create equations that describe numbers or relationships</td>
<td>Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. (A.CED.2)</td>
<td>---</td>
<td>1 point</td>
</tr>
<tr>
<td>11</td>
<td>Short Response</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>
</tr>
<tr>
<td>12</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>C</td>
<td>1 point</td>
</tr>
<tr>
<td>13</td>
<td>Multi-Select 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>A, D</td>
<td>1 point</td>
</tr>
</tbody>
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# Integrated Math I
## Spring 2017 Item Release
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<tbody>
<tr>
<td>14</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>2 points</td>
</tr>
<tr>
<td>15</td>
<td>Multi-Select Item</td>
<td>Experiment with transformations in the plane</td>
<td>Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself. (G.CO.3)</td>
<td>B, C, E</td>
<td>1 point</td>
</tr>
<tr>
<td>16</td>
<td>Multiple Choice</td>
<td>Experiment with transformations in the plane</td>
<td>Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc (G.CO.1)</td>
<td>B</td>
<td>1 point</td>
</tr>
<tr>
<td>17</td>
<td>Multi-Select Item</td>
<td>Understand congruence in terms of rigid motions</td>
<td>Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent. (G.CO.7)</td>
<td>A, C, D, E</td>
<td>1 point</td>
</tr>
<tr>
<td>18</td>
<td>Equation Item</td>
<td>Use coordinates to prove simple geometric theorems algebraically</td>
<td>Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula.* (G.GPE.7)</td>
<td>---</td>
<td>1 point</td>
</tr>
</tbody>
</table>

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</tr>
</thead>
<tbody>
<tr>
<td>19</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.SSE.1) b. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret $P(1+r)^n$ as the product of $P$ and a factor not depending on $P.$</td>
<td>D</td>
<td>1 point</td>
</tr>
<tr>
<td>20</td>
<td>Multiple Choice</td>
<td>Interpret linear models</td>
<td>Compute (using technology) and interpret the correlation coefficient of a linear fit. (S.ID.8)</td>
<td>C</td>
<td>1 point</td>
</tr>
</tbody>
</table>

*An asterisk appears next to any standard or group of standards linked with Modeling as a conceptual category.
Question 1

The graphs of two functions, \( f(x) \) and \( g(x) \), where \( g(x) = f(x) + h \), are shown.

Based on the graph, what is the value of \( h \)?

\[ h = \]

Points Possible: 1

Content Cluster: Build new functions from existing functions

Content Standard: Identify the effect on the graph of replacing \( f(x) \) by \( f(x) + k \), \( k f(x) \), \( f(kx) \), and \( f(x + k) \) for specific values of \( k \) (both positive and negative); find the value of \( k \) given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them. (F.BF.3)
Scoring Guidelines

Exemplar Response

- \( h = 5 \)

Other Correct Responses

- Any equivalent value

For this item, a full-credit response includes:

- The correct value for \( h \) (1 point)
Sample Response: 1 point

The graphs of two functions, $f(x)$ and $g(x)$, where $g(x) = f(x) + h$, are shown.

Based on the graph, what is the value of $h$?

$h = 5$

Notes on Scoring

This response earns full credit (1 point) because it correctly identifies the effect of replacing the graph of $f(x)$ by the graph of $f(x) + h$.

A function that replaces $f(x)$ by $f(x) + h$ will perform a vertical translation $h$ units up. According to the graph, $f(x)$ has a $y$-intercept of 0, and $g(x)$ has a $y$-intercept of 5. This means that $g(x)$ was translated 5 units up from $f(x)$ since $5 - 0 = 5$. Therefore, $h = 5$. 
Notes on Scoring

This response earns full credit (1 point) because it correctly identifies the effect of replacing the graph of \( f(x) \) by the graph of \( f(x) + h \).

A function that replaces \( f(x) \) by \( f(x) + h \) will perform a vertical translation \( h \) units up. According to the graph, \( f(x) \) has a \( y \)-intercept of 0, and \( g(x) \) has a \( y \)-intercept of 5. This means that \( g(x) \) was translated 5 units up from \( f(x) \) since \( 5 - 0 = 5 \). Therefore, \( h = 5 \) or 5.0.
Sample Response: 0 points

The graphs of two functions, \( f(x) \) and \( g(x) \), where \( g(x) = f(x) + h \), are shown.

Based on the graph, what is the value of \( h \)?

\[ h = -5 \]

Notes on Scoring

This response earns no credit (0 points) because it incorrectly identifies the effect of replacing the graph of \( f(x) \) by the graph of \( f(x) + h \).

The student may have confused \( g(x) \) with \( f(x) \) and noticed that \( f(x) \) was translated 5 units below \( g(x) \), since \( 0 - 5 = -5 \), and made the conclusion that \( h = -5 \).
Notes on Scoring

This response earns no credit (0 points) because it incorrectly identifies the transformation of $f(x) + h$ on a graph.

The student may have found the $y$-coordinate at $x = 1$ for $g(x)$, which is $(1, 8)$, and $f(x)$, which is $(1, 3)$, and then found the ratio of $\frac{g(x)}{f(x)}$ as $\frac{8}{3}$ without realizing that the $y$-coordinates need to be subtracted in order to find the vertical translation.
Question 2

Henry places $x$ marbles into an empty bucket. Each marble has the same weight. The weight, in ounces, of the bucket and marbles can be calculated using the expression shown. $3x + 8$

What does the term 8 represent in this expression?

A the weight of each marble
B the weight of the empty bucket
C the number of marbles in the bucket
D the total weight of the bucket and marbles

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)
a. Interpret parts of an expression, such as terms, factors, and coefficients.

*An asterisk appears next to any standard or group of standards linked with Modeling as a conceptual category.

Scoring Guidelines

Rationale for Option A: This is incorrect. The student may have confused the meaning of the constant with the meaning of the coefficient.

Rationale for Option B: Key – The student noted that the variable term represented the marbles’ weight, while the constant was the bucket’s weight.

Rationale for Option C: This is incorrect. The student may have confused the meaning of the constant with the meaning of the variable.

Rationale for Option D: This is incorrect. The student may have seen that the 8 was added on and assumed it meant total weight.
Sample Response: 1 point

Henry places $x$ marbles into an empty bucket. Each marble has the same weight. The weight, in ounces, of the bucket and marbles can be calculated using the expression shown.

$3x + 8$

What does the term 8 represent in this expression?

- $\text{A}$ the weight of each marble
- $\text{B}$ the weight of the empty bucket
- $\text{C}$ the number of marbles in the bucket
- $\text{D}$ the total weight of the bucket and marbles
Question and Scoring Guidelines
Question 3

Ryan works for a delivery service. The function \( f(n) \) is used to calculate his daily pay, in dollars, on a day when he makes \( n \) deliveries.

\[ f(n) = 7n + 96 \]

Use the function to complete the table shown.

<table>
<thead>
<tr>
<th>Number of Deliveries</th>
<th>Daily Pay (dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>145</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

<table>
<thead>
<tr>
<th>Number of Deliveries</th>
<th>Daily Pay (dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>96</td>
</tr>
<tr>
<td>5</td>
<td>131</td>
</tr>
<tr>
<td>7</td>
<td>145</td>
</tr>
</tbody>
</table>

Other Correct Responses

- Any equivalent values

For this item, a full-credit response includes:

- Three correct values (1 point)
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Question 3

Sample Responses
Sample Response: 1 point

Ryan works for a delivery service. The function \( f(n) \) is used to calculate his daily pay, in dollars, on a day when he makes \( n \) deliveries.

\[ f(n) = 7n + 96 \]

Use the function to complete the table shown.

<table>
<thead>
<tr>
<th>Number of Deliveries</th>
<th>Daily Pay (dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>96</td>
</tr>
<tr>
<td>5</td>
<td>131</td>
</tr>
<tr>
<td>7</td>
<td>145</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns full credit (1 point) because it shows three correct values of the inputs/outputs of a function inserted in the table.

The Number of Deliveries, \( n \), is the input of the function \( f(n) = 7n + 96 \). The Daily Pay, \( f(n) \), in dollars, is the output of the function. To find the Daily Pay for \( n = 0 \), or \( f(0) \), substitute 0 into the equation for \( n \) to get \( f(0) = 7(0) + 96 \), so \( f(0) = 96 \). To find the Daily Pay for \( n = 5 \), or \( f(5) \), substitute 5 into the equation for \( n \) to get \( f(5) = 7(5) + 96 \), so \( f(5) = 131 \). To find the Number of Deliveries when the Daily Pay equals 145, substitute 145 in for \( f(n) \) to get \( 145 = 7n + 96 \). Then solve the equation by subtracting 96 from both sides to get \( 49 = 7n \). Then divide both sides by 7, \( \frac{49}{7} = \frac{7n}{7} \), which results in \( n = 7 \).
Sample Response: 1 point

Ryan works for a delivery service. The function \( f(n) \) is used to calculate his daily pay, in dollars, on a day when he makes \( n \) deliveries.

\[ f(n) = 7n + 96 \]

Use the function to complete the table shown.

<table>
<thead>
<tr>
<th>Number of Deliveries</th>
<th>Daily Pay (dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>96.00</td>
</tr>
<tr>
<td>5</td>
<td>131.00</td>
</tr>
<tr>
<td>7</td>
<td>145</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns full credit (1 point) because it shows three correct values of the inputs/outputs of a function inserted in the table.

The Number of Deliveries, \( n \), is the input of the function \( f(n) = 7n + 96 \). The Daily Pay, \( f(n) \), in dollars, is the output of the function. To find the Daily Pay for \( n = 0 \), or \( f(0) \), substitute 0 into the equation for \( n \) to get \( f(0) = 7(0) + 96 \), so \( f(0) = 96 \). To find the Daily Pay for \( n = 5 \), or \( f(5) \), substitute 5 into the equation for \( n \) to get \( f(5) = 7(5) + 96 \), so \( f(5) = 131 \). To find the Number of Deliveries when the Daily Pay equals 145, substitute 145 in for \( f(n) \) to get \( 145 = 7n + 96 \). Then solve the equation by subtracting 96 from both sides to get \( 49 = 7n \). Then divide both sides by 7, \( \frac{49}{7} = \frac{7n}{7} \), which results in \( n = 7 \). Equivalent values of 96.00, 131.00, and 7.00 also earn full credit.
Sample Response: 0 points

Ryan works for a delivery service. The function $f(n)$ is used to calculate his daily pay, in dollars, on a day when he makes $n$ deliveries.

$$f(n) = 7n + 96$$

Use the function to complete the table shown.

<table>
<thead>
<tr>
<th>Number of Deliveries</th>
<th>Daily Pay (dollars)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0</td>
</tr>
<tr>
<td>5</td>
<td>35</td>
</tr>
<tr>
<td>7</td>
<td>145</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns no credit (0 points) because out of three required values, it shows two incorrect values of the inputs/outputs of a function inserted in the table.

The student is correct that when the Number of Deliveries is 7, the correct Daily Pay is $145. However, the student incorrectly calculated the Daily Pay at $0, when the Number of Deliveries is 0. For $f(0)$ the Daily Pay should be $96, not $0. The student also incorrectly calculated the Daily Pay at $35, when the Number of Deliveries is 5. For $f(5)$ the Daily Pay should be $131, not $35. The student may have ignored that a constant of $96 is added to $7n$ when substituting $0$ and $5$ in for $n$.

Students need to get all three values correct in order to get full credit for this item.
Sample Response: 0 points

Ryan works for a delivery service. The function $f(n)$ is used to calculate his daily pay, in dollars, on a day when he makes $n$ deliveries.

$f(n) = 7n + 96$

Use the function to complete the table shown.

<table>
<thead>
<tr>
<th>Number of Deliveries</th>
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</thead>
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</tr>
<tr>
<td>5</td>
<td>131</td>
</tr>
<tr>
<td>49</td>
<td>145</td>
</tr>
</tbody>
</table>

Notes on Scoring

This response earns no credit (0 points) because out of three required values, it shows one incorrect value of the inputs/outputs of a function inserted in the table.

The Daily Pay of $96 for 0 deliveries is correct. The Daily Pay of $131 for 5 deliveries is correct. However, the number of deliveries for $145 is incorrect. The student may have forgotten to divide by 7 when solving $f(n) = 7n + 96$ for $n$.

Students need to get all three values correct in order to get full credit for this item.
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Question 4

Question and Scoring Guidelines
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)

a. Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.
Scoring Guidelines

**Rationale for Option A:** This is incorrect. The student may have confused a square root model with a quadratic model.

**Rationale for Option B:** This is incorrect. The student may have thought that since the data was not perfectly linear, a quadratic model would be best.

**Rationale for Option C:** Key – The student correctly identified that the data in the scatterplot represented half of a U-shape, which would be best modeled by a quadratic function.

**Rationale for Option D:** This is incorrect. The student may have confused a linear model with negative-slope with a model represented by quadratic function.

**Sample Response: 1 point**
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Question 5

Question and Scoring Guidelines
Question 5

A store manager records the total visitors and sales, in dollars, for 10 days. The data are shown in the scatter plot.

What conclusion can the store manager draw based on the data?

- A. An increase in sales causes a decrease in visitors.
- B. An increase in visitors causes an increase in sales.
- C. An increase in sales is correlated with a decrease in visitors.
- D. An increase in visitors is correlated with an increase in sales.

**Points Possible:** 1

**Content Cluster:** Interpret linear models

**Content Standard:** Distinguish between correlation and causation. (S.ID.9)

**Scoring Guidelines**

**Rationale for Option A:** This is incorrect. The student may have confused an increase in visitors with a decrease in visitors and thought that a positive trend in the data was enough to show causation.

**Rationale for Option B:** This is incorrect. The student may have incorrectly thought that a positive trend in the data was enough to show causation.

**Rationale for Option C:** This is incorrect. The student may have correctly noticed that a trend in the data can imply correlation, but confused an increase in visitors with a decrease in visitors.

**Rationale for Option D: Key** – The student correctly noticed that a positive trend in the data implies a direct correlation.
Sample Response: 1 point

A store manager records the total visitors and sales, in dollars, for 10 days. The data are shown in the scatter plot.

What conclusion can the store manager draw based on the data?

A. An increase in sales causes a decrease in visitors.
B. An increase in visitors causes an increase in sales.
C. An increase in sales is correlated with a decrease in visitors.
D. An increase in visitors is correlated with an increase in sales.
Question 6

An equation is shown.

\[3x + \frac{4}{5} = 7 - 2x\]

What is the solution to the equation?

\[x = \]

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)
Scoring Guidelines

Exemplar Response

- $\frac{31}{25}$

Other Correct Responses

- Any equivalent values

For this item, a full-credit response includes:

- A correct value (1 point)
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Question 6

Sample Responses
Sample Response: 1 point

An equation is shown.

3x + \frac{4}{5} = 7 - 2x

What is the solution to the equation?

x = \frac{31}{25}

Notes on Scoring

This response earns full credit (1 point) because it shows the correct solution when solving linear equations in one variable.

To find a solution, the linear equation must be rearranged to isolate x. It can be solved in many ways. One way to solve the equation 3x + \frac{4}{5} = 7 - 2x is to add 2x to both sides to get 3x + (2x) + \frac{4}{5} = 7 - 2x + (2x), which simplifies to 5x + \frac{4}{5} = 7. Then, -\frac{4}{5} could be added to both sides of the equation to get 5x + \frac{4}{5} + (-\frac{4}{5}) = 7 + (-\frac{4}{5}), which simplifies to 5x = 6 \frac{1}{5} or 5x = \frac{31}{5}. The next step is to multiply both sides by \frac{1}{5} to get (\frac{1}{5})(5x) = (\frac{31}{5})(\frac{1}{5}), which simplifies to x = \frac{31}{25}.  
Sample Response: 1 point

An equation is shown.

\[3x + \frac{4}{5} = 7 - 2x\]

What is the solution to the equation?

\[x = \frac{16}{25}\]

Notes on Scoring

This response earns full credit (1 point) because it shows the correct solution when solving linear equations in one variable.

To find a solution, the linear equation must be rearranged to isolate \(x\). It can be solved in many ways. One way to solve the equation \(3x + \frac{4}{5} = 7 - 2x\) is to add \(2x\) to both sides to get \(3x + (2x) + \frac{4}{5} = 7 - 2x + (2x)\), which simplifies to \(5x + \frac{4}{5} = 7\). Then, \(-\frac{4}{5}\) could be added to both sides of the equation to get \(5x + \frac{4}{5} + (-\frac{4}{5}) = 7 + (-\frac{4}{5})\), which simplifies to \(5x = 6\frac{1}{5}\) or \(5x = \frac{31}{5}\). The next step is to multiply both sides by \(\frac{1}{5}\) to get \(\left(\frac{1}{5}\right)(5x) = \left(\frac{31}{5}\right)\left(\frac{1}{5}\right)\), which simplifies to \(x = \frac{31}{25}\), which is equivalent to \(1\frac{6}{25}\).
Sample Response: 0 points

An equation is shown.

\[ 3x + \frac{4}{5} = 7 - 2x \]

What is the solution to the equation?

\[ x = \frac{31}{5} \]

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect solution when solving linear equations in one variable.

To find a solution, the linear equation must be rearranged to isolate \( x \). It can be solved in many ways. One way to solve the equation \( 3x + \frac{4}{5} = 7 - 2x \) is to add \( 2x \) to both sides to get \( 3x + (2x) + \frac{4}{5} = 7 - 2x + (2x) \), which simplifies to \( 5x + \frac{4}{5} = 7 \). Then, \( -\frac{4}{5} \) could be added to both sides of the equation to get \( 5x + \frac{4}{5} + \left(-\frac{4}{5}\right) = 7 + \left(-\frac{4}{5}\right) \), which simplifies to \( 5x = 6\frac{1}{5} \) or \( 5x = \frac{31}{5} \). The student may have ended his or her solution without multiplying each side by \( \frac{1}{5} \).
Sample Response: 0 points

An equation is shown.
3x + \frac{4}{5} = 7 - 2x

What is the solution to the equation?

x = \frac{3}{17}

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect solution when solving linear equations in one variable.
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Question 7

Question and Scoring Guidelines
Question 7

Some values for a function are shown in the table.

<table>
<thead>
<tr>
<th>$x$</th>
<th>$f(x)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>50</td>
</tr>
</tbody>
</table>

Which statement best describes the function?

(A) It is linear because $f(x)$ increases by a constant amount compared to $x$.
(B) It is linear because $f(x)$ increases by a constant percentage compared to $x$.
(C) It is not linear because $f(x)$ does not increase by a constant amount compared to $x$.
(D) It is not linear because $f(x)$ does not increase by a constant percentage compared to $x$.

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)

b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
Scoring Guidelines

Rationale for Option A: This is incorrect. The student may have only looked at the change in \( f(x) \), and not the change in \( x \), that appears to be a constant amount (\( 25 - 0 = 25 \) and \( 50 - 25 = 25 \)) instead of finding the ratio of differences of \( f(x) \) and \( x \), \( \frac{f(x_2) - f(x_1)}{x_2 - x_1} \) that is not a constant amount.

Rationale for Option B: This is incorrect. The student may have only considered the change in \( f(x) \), and not the change in \( x \), which appears to be a constant amount (\( 25 - 0 = 25 \) and \( 50 - 25 = 25 \)). He or she may have thought that \( f(x) \) is a linear function that increases by a constant percentage mistaking the definition of exponential function for the definition of linear function.

Rationale for Option C: Key – The student realized that since the rate of change between the two pairs of points is not a constant amount, \( \frac{50 - 25}{3 - 2} = \frac{25}{1} \) and \( \frac{25 - 0}{2 - 0} = \frac{25}{2} \), the function \( f(x) \) is not linear.

Rationale for Option D: This is incorrect. The student may have realized that \( f(x) \) is not linear, but used terminology related to exponential functions rather than terminology for linear functions.
Sample Response: 1 point

Some values for a function are shown in the table.

<table>
<thead>
<tr>
<th>$x$</th>
<th>$f(x)$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>3</td>
<td>50</td>
</tr>
</tbody>
</table>

Which statement best describes the function?

A. It is linear because $f(x)$ increases by a constant amount compared to $x$.
B. It is linear because $f(x)$ increases by a constant percentage compared to $x$.
C. It is not linear because $f(x)$ does not increase by a constant amount compared to $x$.
D. It is not linear because $f(x)$ does not increase by a constant percentage compared to $x$.
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Question 8

Question and Scoring Guidelines
Question 8

Which statistical measure changes when every number in a data set is increased by 10?

A  range
B  mean
C  standard deviation
D  interquartile range

Points Possible: 1

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

Content Standard: Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets. (S.ID.2)
Scoring Guidelines

Rationale for Option A: This is incorrect. The student may have thought that since each value was increased by 10, the range would also increase, but neglected to consider that the increases of 10 would cancel each other when subtracting the minimum from the maximum to calculate the range.

Rationale for Option B: Key – The student correctly determined that the mean of the data set would increase because if every data point increases by 10 and the number of data points remains the same, the average increases.

Rationale for Option C: This is incorrect. The student may have thought that since each value increased by 10, the standard deviation would also increase, but because the mean would increase by 10 and each data point increases by 10, the increases cancel each other when finding the difference between each data point and the mean to calculate the deviation.

Rationale for Option D: This is incorrect. The student may have thought that since all data points increased by 10, the interquartile range would also increase but neglected to consider that the increases of 10 to the first and third quartiles would cancel each other when finding their difference to calculate the interquartile range.

Sample Response: 1 point

Which statistical measure changes when every number in a data set is increased by 10?

A. range

B. mean

C. standard deviation

D. interquartile range
Question 9

Question and Scoring Guidelines
Question 9

What two numbers have a sum of 217 and a difference of 85?

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

- 151
- 66

Other Correct Responses

- Any equivalent value

For this item, a full-credit response includes:

- The correct values (1 point)
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Question 9

Sample Responses
Sample Response: 1 point

What two numbers have a sum of 217 and a difference of 85?

151

66
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 that can be used to solve this problem.

The sum of two numbers that have a sum of 217 can be written by the linear equation \( x + y = 217 \), where \( x \) represents the first number and \( y \) represents the second number. Two numbers that have a difference of 85 can be written by the linear equation \( x - y = 85 \).

There are many ways to solve systems of equations. One method is to use the elimination method to add the equations and eliminate one variable:

\[
\begin{align*}
\quad x + y &= 217 \\
+ x - y &= 85 \\
\hline
2x + 0 &= 302
\end{align*}
\]

This simplifies to \( 2x = 302 \). By dividing each side by 2, \( \frac{2x}{2} = \frac{302}{2} \), the result is \( x = 151 \). Then, substitute 151 in for \( x \) in the first equation to get \( 151 + y = 217 \). After subtracting 151 from both sides to get \( 151 - 151 + y = 217 - 151 \), \( y \) is found to equal 66. Therefore, the two numbers are 151 and 66.
Sample Response: 1 point

What two numbers have a sum of 217 and a difference of 85?

66

151
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 that can be used to solve this problem.

The sum of two numbers that have a sum of 217 can be written by the linear equation \( x + y = 217 \), where \( x \) represents the first number and \( y \) represents the second number. Two numbers that have a difference of 85 can be written by the linear equation \( x - y = 85 \). There are many ways to solve systems of equations. One method is to use the elimination method to add the equations and eliminate one variable:

\[
\begin{align*}
  x + y &= 217 \\
  + x - y &= 85 \\
  \hline
  2x + 0 &= 302
\end{align*}
\]

This simplifies to \( 2x = 302 \). By dividing each side by 2, \( \frac{2x}{2} = \frac{302}{2} \), the result is \( x = 151 \). Then, substitute 151 in for \( x \) in the first equation to get \( 151 + y = 217 \). After subtracting 151 from both sides to get \( 151 - 151 + y = 217 - 151 \), \( y \) is found to equal 66. Therefore, the two numbers are 66 and 151, or 151 and 66. It does not matter which number goes into which box.
Sample Response: 0 points

Notes on Scoring

This response earns no credit (0 points) because it shows two incorrect numbers representing a solution of a system of two linear equations in two variables that can be used to solve this problem.

The student may have not understood that he or she needed to write two equations to represent the problem and instead added 217 and 85 to get 302. Then, he or she may have subtracted 85 from 217 to get 132.
Sample Response: 0 points

What two numbers have a sum of 217 and a difference of 85?

146
61

Notes on Scoring

This response earns no credit (0 points) because it shows two incorrect numbers representing a solution of a system of two linear equations in two variables that can be used to solve this problem.

The student may have misread the problem and found two numbers whose sum is 207, instead of 217, and whose difference is 85.
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Question 10

Question and Scoring Guidelines
Question 10

Stephanie adds pennies, nickels and quarters to a scale until the mass of the combined coins is 75 grams. Each penny has a mass of 2.5 grams, each nickel has a mass of 5 grams and each quarter has a mass of 5.7 grams.

Create an equation to model this situation, where \( x \) is the number of pennies, \( y \) is the number of nickels and \( z \) is the number of quarters that Stephanie can put on the scale so that the mass of the combined coins is exactly 75 grams.

Points Possible: 1

Content Cluster: Create equations that describe numbers or relationships

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

Scoring Guidelines

Exemplar Response

- \( 2.5x + 5y + 5.7z = 75 \)

Other Correct Responses

- Any equivalent equation

For this item, a full-credit response includes:

- The correct equation (1 point)
Integrated Math I
Spring 2017 Item Release

Question 10

Sample Responses
Sample Response: 1 point

Stephane adds pennies, nickels and quarters to a scale until the mass of the combined coins is 75 grams. Each penny has a mass of 2.5 grams, each nickel has a mass of 5 grams and each quarter has a mass of 5.7 grams.

Create an equation to model this situation, where \( x \) is the number of pennies, \( y \) is the number of nickels and \( z \) is the number of quarters that Stephanie can put on the scale so that the mass of the combined coins is exactly 75 grams.

\[
2.5x + 5y + 5.7z = 75
\]

Notes on Scoring

This response earns full credit (1 point) because it shows a correct equation to represent the relationships between quantities.

The mass of each coin type is equal to the mass of the coin times the number of coins. Since \( x \) is the number of pennies, the mass of all the pennies is represented by \( 2.5x \). Since \( y \) is the number of nickels, the mass of all the nickels is represented by \( 5y \). Since \( z \) is the number of quarters, the mass of all the quarters is represented by \( 5.7z \). The mass of all the pennies plus the mass of all the nickels plus the mass of all the quarters equals the total mass of all the coins, which is 75, so \( 2.5x + 5y + 5.7z = 75 \) is an equation that models the situation.
Sample Response: 1 point

Stephanie adds pennies, nickels and quarters to a scale until the mass of the combined coins is 75 grams. Each penny has a mass of 2.5 grams, each nickel has a mass of 5 grams and each quarter has a mass of 5.7 grams.

Create an equation to model this situation, where \(x\) is the number of pennies, \(y\) is the number of nickels and \(z\) is the number of quarters that Stephanie can put on the scale so that the mass of the combined coins is exactly 75 grams.

\[
75 = 5.7z + 5y + 2.5x
\]

Notes on Scoring

This response earns full credit (1 point) because it shows a correct equation to represent the relationships between quantities.

The mass of each coin type is equal to the mass of the coin times the number of coins. Since \(x\) is the number of pennies, the mass of all the pennies is represented by \(2.5x\). Since \(y\) is the number of nickels, the mass of all the nickels is represented by \(5y\). Since \(z\) is the number of quarters, the mass of all the quarters is represented by \(5.7z\). The mass of all the pennies plus the mass of all the nickels plus the mass of all the quarters equals the total mass of all the coins, which is 75, so \(2.5x + 5y + 5.7z = 75\) is an equation that models the situation. The equation can also be written as \(75 = 2.5x + 5y + 5.7z\).
Sample Response: 0 points

Stephanie adds pennies, nickels and quarters to a scale until the mass of the combined coins is 75 grams. Each penny has a mass of 2.5 grams, each nickel has a mass of 5 grams and each quarter has a mass of 5.7 grams.

Create an equation to model this situation, where \( x \) is the number of pennies, \( y \) is the number of nickels and \( z \) is the number of quarters that Stephanie can put on the scale so that the mass of the combined coins is exactly 75 grams.

\[ x + y + z = 75 \]

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect equation to represent the relationships between quantities.

The student knew that he or she needed to add the three types of coins to get the combined mass of all the coins but did not take into account the mass of each coin.
Sample Response: 0 points

Stephanie adds pennies, nickels and quarters to a scale until the mass of the combined coins is 75 grams. Each penny has a mass of 2.5 grams, each nickel has a mass of 5 grams and each quarter has a mass of 5.7 grams.

Create an equation to model this situation, where \( x \) is the number of pennies, \( y \) is the number of nickels and \( z \) is the number of quarters that Stephanie can put on the scale so that the mass of the combined coins is exactly 75 grams.

\[ 5.7x + 5y + 2.5z = 75 \]

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect equation to represent the relationships between quantities.

The student knew that he or she needed to add the mass of each of the three types of coins to get the combined mass of all the coins. However, the student assigned the wrong masses to the pennies and quarters.
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Question 11

Question and Scoring Guidelines
Two freight trains are traveling to Columbus, Ohio. A graph is shown representing each train’s remaining distance to Columbus over time.

A. Compare the distances relative to Columbus from which the trains begin their trip.
B. Tom claims both trains traveled at the same speed over a certain interval. Sara claims that both trains traveled at different speeds the entire time. Justify which claim is correct.

Type your answer in the space provided.

**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)

*An asterisk appears next to any standard or group of standards linked with Modeling as a conceptual category.*
Scoring Guidelines

Score Point | Description
--- | ---
2 points | Response includes the following correct Initial Position with a correct Maximum Speed.

**Initial Position:**

a) Train B is closer to Columbus than Train A at 6:00 a.m.

**Maximum Speed:**

b) Since the speed of an object is measured by dividing the distance the object travels by the time it takes the object to travel that distance, the speed of each train is the slope of each train’s graph. Tom is correct since the graph of each train has the same slope when both trains are moving.

1 point | Response includes the correct Initial Position listed above with an incorrect or missing Maximum Speed or vice versa.

0 points | The response does not meet the criteria required to earn one point. The response indicates inadequate or no understanding of the task and/or the idea or concept needed to answer the item. It may only repeat information given in the test item. The response may provide an incorrect solution/response and the provided supportive information may be irrelevant to the item, or possibly, no other information is shown. The student may have written on a different topic or written, “I don't know.”
Integrated Math I
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Question 11

Sample Responses
Sample Response: 2 points

Two freight trains are traveling to Columbus, Ohio. A graph is shown representing each train’s remaining distance to Columbus over time.

![Graph showing distance from Columbus over time for two trains]

A. Compare the distances relative to Columbus from which the trains begin their trip.

B. Tom claims both trains traveled at the same speed over a certain interval. Sara claims that both trains traveled at different speeds the entire time. Justify which claim is correct.

Type your answer in the space provided.

A. Train A started the trip 1,800 miles away from Columbus, where train B started 600 miles closer to the city.
B. Tom's claim is correct. The lines on the graph are parallel, which means the 2 trains were traveling at the same speed. Train B must have started later than Train A since the line on the graph shows that the train did not move for 7 hours.
Notes on Scoring

This response earns full credit (2 points) because it shows a correct interpretation of the graphs of two functions in terms of the context.

A. The graph shows that Train A begins its trip at 1,800 miles and Train B begins its trip at 1,200 miles from Columbus. Therefore, Train B is closer to Columbus than Train A by 600 miles (1800 − 1200 = 600).

B. The y-value of each point on the line on the grid represents the train’s remaining distance to Columbus. The slope (the rate of change) of each line represents the speed of the corresponding train. Because lines are parallel over the certain interval of time, their slopes are equal and the trains travel with equal speeds over that interval of time.

There is an interval on the graph between 1:00 p.m. and 6:00 p.m. where both lines are parallel, so the trains have the same speed over that interval. Therefore, Tom is correct that both trains traveled the same speed over a certain interval of time. Sara is incorrect. She may have thought that since Train A arrives to Columbus first, it went faster than Train B.
Sample Response: 2 points

Two freight trains are traveling to Columbus, Ohio. A graph is shown representing each train’s remaining distance to Columbus over time.

Two Trains Traveling to Columbus, Ohio

A. Compare the distances relative to Columbus from which the trains begin their trip.

B. Tom claims both trains traveled at the same speed over a certain interval. Sara claims that both trains traveled at different speeds the entire time. Justify which claim is correct.

Type your answer in the space provided.

Train A is further away from Columbus than Train B. Tom is right, both trains are moving at the same speed over a certain interval. Train A is moving 150 miles an hour from 10 a.m. to 2 p.m. Train B is moving 150 miles an hour from 1 to 3 p.m. These are both 4 hour windows and they are both moving 150 miles per hour.
Notes on Scoring

This response earns full credit (2 points) because it shows a correct interpretation of the graphs of two functions in terms of the context.

A. The graph shows that Train A begins its trip at 1,800 miles from Columbus and Train B begins its trip at 1,200 miles from Columbus. Therefore, Train A is farther from Columbus than Train B by 600 miles ($1800 - 1200 = 600$).

B. On the graph, the speeds of the trains are represented by the slopes of the lines. The line representing the remaining distance of Train A has a constant slope, which can be calculated by $\left| \frac{1200 - 1800}{10:00 \text{ a.m.} - 6:00 \text{ a.m.}} \right|$ and is equivalent to $\left| \frac{-600}{4} \right|$, which simplifies to 150 miles per hour. Since the graph representing Train B is a horizontal line from 6:00 a.m. to 1:00 p.m., Train B does not start moving until 1:00 p.m. After 1:00 p.m., Train B has a constant speed (rate of change), which can be calculated by $\left| \frac{1200 - 600}{1:00 \text{ p.m.} - 5:00 \text{ p.m.}} \right|$ or $\left| \frac{600}{4} \right|$ and which simplifies to 150 miles per hour. Therefore, Tom is correct that both trains have the same speed of 150 miles per hour between 1:00 p.m. and 6:00 p.m.
Two freight trains are traveling to Columbus, Ohio. A graph is shown representing each train’s remaining distance to Columbus over time.

A. Compare the distances relative to Columbus from which the trains begin their trip.

B. Tom claims both trains traveled at the same speed over a certain interval. Sara claims that both trains traveled at different speeds the entire time. Justify which claim is correct.

Type your answer in the space provided.

Tom is correct. They do not travel the same speed the whole time but from 1:00 pm to 6:00 pm the travel at the same speed. I know this because the lines are parallel in that time period.
Notes on Scoring

This response earns partial credit (1 point) because it shows only one correct interpretation of the graphs of two functions in terms of the context.

A. The student did not answer the first question.

B. The height (y-value) of each line on the grid denotes the train's remaining distance to Columbus. The slope (the rate of change) of each line represents the speed of the corresponding train. Because lines are parallel over the certain interval of time, their slopes are equal and the trains travel with equal speeds over that interval of time.

There is an interval on the graph between 1:00 p.m. and 6:00 p.m. where both lines are parallel, so the trains have the same speed over that interval. Therefore, Tom is correct that both trains traveled the same speed over a certain interval of time. Sara may have thought that since Train A arrives to Columbus first, it went faster than Train B.
Sample Response: 1 point

Two freight trains are traveling to Columbus, Ohio. A graph is shown representing each train’s remaining distance to Columbus over time.

A. Compare the distances relative to Columbus from which the trains begin their trip.

B. Tom claims both trains traveled at the same speed over a certain interval. Sara claims that both trains traveled at different speeds the entire time. Justify which claim is correct.

Type your answer in the space provided.

Train A distance is going to be longer than train B. Sara is correct because they took different paths and they got there at different times.
Notes on Scoring

This response earns partial credit (1 point) because it shows a partially correct interpretation of the graphs of two functions in terms of the context.

A. The student is correct that Train A is at a farther distance from Columbus than Train B. The graph shows that Train A begins its trip at 1,800 miles and Train B begins its trip at 1,200 miles from Columbus. Therefore, Train B is closer to Columbus than Train A by 600 miles (1800 − 1200 = 600).

B. The student is incorrect because he or she confused arrival time with the speed (slope of a line).
Sample Response: 1 point

Two freight trains are traveling to Columbus, Ohio. A graph is shown representing each train’s remaining distance to Columbus over time.

Two Trains Traveling to Columbus, Ohio

<table>
<thead>
<tr>
<th>Distance from Columbus, Ohio (miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
</tr>
<tr>
<td>1800</td>
</tr>
<tr>
<td>1600</td>
</tr>
<tr>
<td>1400</td>
</tr>
<tr>
<td>1200</td>
</tr>
<tr>
<td>1000</td>
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<tr>
<td>800</td>
</tr>
<tr>
<td>600</td>
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<tr>
<td>400</td>
</tr>
<tr>
<td>200</td>
</tr>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>6:00 a.m.</td>
</tr>
<tr>
<td>7:00 a.m.</td>
</tr>
<tr>
<td>8:00 a.m.</td>
</tr>
<tr>
<td>9:00 a.m.</td>
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<tr>
<td>10:00 a.m.</td>
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<tr>
<td>11:00 a.m.</td>
</tr>
<tr>
<td>12:00 p.m.</td>
</tr>
<tr>
<td>1:00 p.m.</td>
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<tr>
<td>2:00 p.m.</td>
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<tr>
<td>3:00 p.m.</td>
</tr>
<tr>
<td>4:00 p.m.</td>
</tr>
<tr>
<td>5:00 p.m.</td>
</tr>
<tr>
<td>6:00 p.m.</td>
</tr>
</tbody>
</table>

**Key**
- **Train A**
- **Train B**

A. Compare the distances relative to Columbus from which the trains begin their trip.

B. Tom claims both trains traveled at the same speed over a certain interval. Sara claims that both trains traveled at different speeds the entire time. Justify which claim is correct.

Type your answer in the space provided.

A. Train A was farther away from Columbus than Train B.

B. Sara’s claim is correct because Train B was traveling at a slower speed than Train A but then started going the same speed at 1:00 p.m.
Notes on Scoring

This response earns partial credit (1 point) because it shows a partially correct interpretation of the graphs of two functions in terms of the context.

A. The student is correct that Train A is at a farther distance from Columbus than Train B. The graph shows that Train A begins its trip at 1,800 miles and Train B begins its trip at 1,200 miles from Columbus. Therefore, Train A was farther from Columbus than Train B by 600 miles (1800 − 1200 = 600).

B. The student is incorrect; Train B was not traveling at a slower speed initially. Instead, Train B was stopped until 1:00 p.m. From 1:00 p.m. until 6:00 p.m., the graphs are parallel, so the trains were going at the same speeds. Therefore, Tom is correct.
Sample Response: 0 points

Two freight trains are traveling to Columbus, Ohio. A graph is shown representing each train’s remaining distance to Columbus over time.

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect interpretation of the graphs of two functions in terms of the context.
Sample Response: 0 points

Two freight trains are traveling to Columbus, Ohio. A graph is shown representing each train’s remaining distance to Columbus over time.

**Two Trains Traveling to Columbus, Ohio**

**Key**
- **Blue line**: Train A
- **Red line**: Train B

**A.** Compare the distances relative to Columbus from which the trains begin their trip.

**B.** Tom claims both trains traveled at the same speed over a certain interval. Sara claims that both trains traveled at different speeds the entire time. Justify which claim is correct.

Type your answer in the space provided.

If the trains were to travel different speeds the entire time the lines would be parallel on the graph and wouldn’t intercept there for tom is correct.

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect interpretation of the graphs of two functions in terms of the context.
Sample Response: 0 points

Two freight trains are traveling to Columbus, Ohio. A graph is shown representing each train’s remaining distance to Columbus over time.

A. Compare the distances relative to Columbus from which the trains began their trip.

B. Tom claims both trains traveled at the same speed over a certain interval. Sara claims that both trains traveled at different speeds the entire time. Justify which claim is correct.

Type your answer in the space provided.

Notes on Scoring

This response earns no credit (0 points) because it shows an incorrect interpretation of the graphs of two functions in terms of the context.
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Question 12

Question and Scoring Guidelines
Question 12

Which graph represents a function whose domain is the set of non-negative real numbers?

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)

*An asterisk appears next to any standard or group of standards linked with Modeling as a conceptual category.
Scoring Guidelines

Rationale for Option A: This is incorrect. The student may have understood that this graph represents a function, but confused the domain, the set of $x$-coordinates, of all real numbers, with the range, the set of $y$-coordinates, of all non-negative real numbers.

Rationale for Option B: This is incorrect. The student may have understood that the domain is the set of non-negative $x$-values, but overlooked the fact that this is not the graph of a function.

Rationale for Option C: Key – The student correctly understood that the graph satisfies the requirements of a function where each $x$-coordinate corresponds to only one $y$-coordinate and that the domain is represented by the set of non-negative $x$-coordinates.

Rationale for Option D: This is incorrect. The student may have understood that this graph represents a function, but overlooked the fact that the domain, the set of $x$-coordinates, is all non-positive real numbers and the range is all non-negative real numbers.

Sample Response: 1 point
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Question 13

Question and Scoring Guidelines
Question 13

The points (0, 1) and (1, 4) are contained in the graph of an equation with only two variables, x and y. Select all of the true statements.

☐ There is exactly one equation in the form $y = mx + b$ that contains these points.
☐ There are two equations in the form $y = mx + b$ that contain these points.
☐ There are no equations in the form $y = a \cdot b^x$ that contain these points.
☐ There is exactly one equation in the form $y = a \cdot b^x$ that contains these points.
☐ There is more than one equation in the form $y = a \cdot b^x$ that contains these points.

**Points Possible: 1**

**Content Strand:** 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)*
Scoring Guidelines

Rationale for First Option: **Key** – The student correctly understood that two points determine a unique line that has a unique equation for a line, \( y = 3x + 1 \), in slope-intercept form.

Rationale for Second Option: This is incorrect. The student may have thought that you could find a different equation for each point, but two points form a unique line which can only have a unique equation.

Rationale for Third Option: This is incorrect. The student may have thought that the two points determine a line, so the two points could not be part of a curve.

Rationale for Fourth Option: **Key** – The student correctly understood that there is a unique exponential equation of the form \( y = a \cdot b^x \) that passes through the given points, \( y = 4^x \).

Rationale for Fifth Option: This is incorrect. The student may have imagined different curves pass through the two points, believing that more than one could be exponential, without attempting to find the values of \( a \) and \( b \).

Sample Response: 1 point

The points (0, 1) and (1, 4) are contained in the graph of an equation with only two variables, \( x \) and \( y \).
Select all of the true statements.

- [ ] There is exactly one equation in the form \( y = mx + b \) that contains these points.
- [ ] There are two equations in the form \( y = mx + b \) that contain these points.
- [ ] There are no equations in the form \( y = a \cdot b^x \) that contain these points.
- [x] There is exactly one equation in the form \( y = a \cdot b^x \) that contains these points.
- [ ] There is more than one equation in the form \( y = a \cdot b^x \) that contains these points.
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Question 14

Question and Scoring Guidelines
Trent plants a sunflower that is 6 inches tall. The sunflower is expected to grow at an average rate of 1.5 inches per day during the next month.

A. Create an equation that Trent can use to find the number of days, $x$, it will take the sunflower to grow to a height of 45 inches.

B. How many days will it take the sunflower to grow to a height of 45 inches?

<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>0</td>
<td>-</td>
<td>sin</td>
<td>cos</td>
</tr>
</tbody>
</table>

**Points Possible:** 2

**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. \( \text{(A.CED.1)} \)
Scoring Guidelines

Exemplar Response

- A. \(1.5x + 6 = 45\)
- B. 26

Other Correct Responses

- Any equivalent equation for part A except \(x = 26\)
  \(x = 26\) is also accepted for part B

For this item, a full-credit response includes:

- A correct equation (1 point);
  AND
- The correct value (1 point).
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Question 14

Sample Responses
Trent plants a sunflower that is 6 inches tall. The sunflower is expected to grow at an average rate of 1.5 inches per day during the next month.

A. Create an equation that Trent can use to find the number of days, x, it will take the sunflower to grow to a height of 45 inches.

B. How many days will it take the sunflower to grow to a height of 45 inches?

A. \[ 1.5x + 6 = 45 \]

B. 26 days

**Notes on Scoring**

This response earns full credit (2 points) because it shows a correct linear equation in one variable that describes a relationship and was used correctly to solve a problem.

A. The situation can be represented by a linear equation because it has a constant rate of change. One form of a linear equation is \( y = mx + b \), where \( b \) is the initial height of the plant, \( m \) is the average growth rate, \( x \) is the number of growing days, and \( y \) is the total height of the plant. Since the sunflower is already 6 inches tall, 6 would be the initial height, or the \( b \) term. The average growth rate of 1.5 would be the \( m \) term. The total plant height of 45 would be the \( y \) term, so the equation is \( 1.5x + 6 = 45 \).

B. To find the number of days that it will take the sunflower to grow to 45 inches, the equation needs to be solved for \( x \). The first step is to subtract 6 from each side to get \( 1.5x + 6 - 6 = 45 - 6 \), which simplifies to \( 1.5x = 39 \). The second step is to divide each side by 1.5, so \( \frac{1.5x}{1.5} = \frac{39}{1.5} \), which results in 26 days.
Sample Response: 2 points

Trent plants a sunflower that is 6 inches tall. The sunflower is expected to grow at an average rate of 1.5 inches per day during the next month.

A. Create an equation that Trent can use to find the number of days, $x$, it will take the sunflower to grow to a height of 45 inches.

B. How many days will it take the sunflower to grow to a height of 45 inches?

\[
A. \quad 1.5x + 6 = 45
\]

\[
B. \quad x = 26 \quad \text{days}
\]

Notes on Scoring

This response earns full credit (2 points) because it shows a correct linear equation in one variable that describes a relationship and was used correctly to solve a problem.

A. The situation can be represented by a linear equation because it has a constant rate of change. One form of a linear equation is $y = mx + b$, where $b$ is the initial height of the plant, $m$ is the average growth rate, $x$ is the number of growing days, and $y$ is the total height of the plant. Since the sunflower is already 6 inches tall, 6 would be the initial height, or the $b$ term. The average growth rate of 1.5 would be the $m$ term. The total plant height of 45 would be the $y$ term, so the equation is $1.5x + 6 = 45$.

B. To find the number of days that it will take the sunflower to grow to 45 inches, the equation needs to be solved for $x$. The first step is to subtract 6 from each side to get $1.5x + 6 - 6 = 45 - 6$, which simplifies to $1.5x = 39$. The second step is to divide each side by 1.5, so $\frac{1.5x}{1.5} = \frac{39}{1.5}$, which results in 26 days, or $x = 26$ days.
Sample Response: 1 point

Trent plants a sunflower that is 6 inches tall. The sunflower is expected to grow at an average rate of 1.5 inches per day during the next month.

A. Create an equation that Trent can use to find the number of days, x, it will take the sunflower to grow to a height of 45 inches.

B. How many days will it take the sunflower to grow to a height of 45 inches?

A. \[1.5x + 6 = 45\]

B. 34 \textit{days}

Notes on Scoring

This response earns partial credit (1 point) because it shows a correct linear equation in one variable that describes a relationship, but the equation was solved incorrectly.

A. The situation can be represented by a linear equation because it has a constant rate of change. One form of a linear equation is \[y = mx + b\], where \(b\) is the initial height of the plant, \(m\) is the average growth rate, \(x\) is the number of growing days, and \(y\) is the total height of the plant. Since the sunflower is already 6 inches tall, 6 would be the initial height, or the \(b\) term. The average growth rate of 1.5 would be the \(m\) term. The total plant height of 45 would be the \(y\) term, so the equation is \[1.5x + 6 = 45\].

B. The student solved the equation incorrectly. When solving the equation, the student may have added 6 to both sides, instead of subtracting 6, to get \[1.5x + 6 + 6 = 45 + 6\], which simplifies to \[1.5x = 51\]. Then, the student may have divided each side by 1.5 to get \[\frac{1.5x}{1.5} = \frac{54}{1.5}\] which incorrectly resulted in 34 days.
Trent plants a sunflower that is 6 inches tall. The sunflower is expected to grow at an average rate of 1.5 inches per day during the next month.

A. Create an equation that Trent can use to find the number of days, \( x \), it will take the sunflower to grow to a height of 45 inches.

\[
1.5x + 6 = 45
\]

B. How many days will it take the sunflower to grow to a height of 45 inches?

\[
B. \quad 58.5 \quad \text{days}
\]

Notes on Scoring

This response earns partial credit (1 point) because it shows a correct linear equation in one variable that describes a relationship, but the equation was solved incorrectly.

A. The situation can be represented by a linear equation because it has a constant rate of change. One form of a linear equation is \( y = mx + b \), where \( b \) is the initial height of the plant, \( m \) is the average growth rate, \( x \) is the number of growing days, and \( y \) is the total height of the plant. Since the sunflower is already 6 inches tall, 6 would be the initial height, or the \( b \) term. The average growth rate of 1.5 would be the \( m \) term. The total plant height of 45 would be the \( y \) term, so the equation is \( 1.5x + 6 = 45 \).

B. The student solved the equation incorrectly. To find the number of days that it will take the sunflower to grow to 45 inches, the equation needs to be solved for \( x \). The first step is to subtract 6 from each side to get \( 1.5x + 6 - 6 = 45 - 6 \), which simplifies to \( 1.5x = 39 \). However, then the student may have multiplied the right side by 1.5, instead of dividing the both sides by 1.5, to get an incorrect response of \( 39(1.5) = 58.5 \).
Sample Response: 1 point

Trent plants a sunflower that is 6 inches tall. The sunflower is expected to grow at an average rate of 1.5 inches per day during the next month.

A. Create an equation that Trent can use to find the number of days, x, it will take the sunflower to grow to a height of 45 inches.
B. How many days will it take the sunflower to grow to a height of 45 inches?

A. $1.5x = 45$
B. 30 $days$

Notes on Scoring

This response earns partial credit (1 point) because it shows an incorrect linear equation in one variable that describes a relationship, but it uses the equation correctly to solve a problem.

A. The student created an incorrect equation. He or she may have not realized that 6 inches represents the initial height in the equation. The equation should be $1.5x + 6 = 45$.

B. The student correctly solved his or her equation for x by dividing 45 by 1.5 to get 30 days.
Sample Response: 1 point

Trent plants a sunflower that is 6 inches tall. The sunflower is expected to grow at an average rate of 1.5 inches per day during the next month.

A. Create an equation that Trent can use to find the number of days, \( x \), it will take the sunflower to grow to a height of 45 inches.

B. How many days will it take the sunflower to grow to a height of 45 inches?

\[
\begin{align*}
A. \quad 1.5x - 6 &= 45 \\
B. \quad 34 \quad \text{days}
\end{align*}
\]

Notes on Scoring

This response earns partial credit (1 point) because it shows an incorrect linear equation in one variable that describes a relationship, but it uses the equation correctly to solve a problem.

A. The student created an incorrect equation. He or she may have subtracted the initial height of the plant instead of adding it to the daily growth of the plant. The equation should be \(1.5x + 6 = 45\).

B. The student correctly solved his or her equation for \(x\) by adding 6 to both sides of the equation \(1.5x - 6 + 6 = 45 + 6\) to get \(1.5x = 51\). Then, he or she correctly divided each side by 1.5 to get \(\frac{1.5x}{1.5} = \frac{51}{1.5}\), which results in 34 days.
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Question 15

Question and Scoring Guidelines
Question 15

Rhombus PQRS is shown on the coordinate plane. Points M and N are midpoints of their respective sides.

Select all of the transformations that map the rhombus onto itself.

☐ a 90° clockwise rotation around the center of the rhombus
☐ a 180° clockwise rotation around the center of the rhombus
☐ a reflection across PR
☐ a reflection across NM
☐ a reflection across QS

Points Possible: 1

Content Strand: Experiment with transformation in the plane

Content Standard: Given a rectangle, parallelogram, trapezoid, or regular polygon, describe the rotations and reflections that carry it onto itself. (G.CO.3)
Scoring Guidelines

Rationale for First Option: This is incorrect. The student may have been thinking of a square, for which a 90-degree rotation works, overlooking the fact that even though the diagonals of the rhombus are perpendicular, their lengths are not equal, and therefore, vertexes cannot coincide after the 90° rotation around the center of the rhombus.

Rationale for Second Option: Key – The student correctly recognized that since the pairs of opposite vertices are equidistant from the center of the rhombus, a 180-degree rotation will map opposite vertices onto themselves and the entire rhombus onto itself.

Rationale for Third Option: Key – The student correctly recognized that the symmetry in the rhombus allows the reflection across a diagonal to map the figure onto itself, because diagonals of a rhombus are perpendicular and bisect each other.

Rationale for Fourth Option: This is incorrect. The student may have been thinking perhaps of a square or rectangle where the line connecting the midpoints of opposite sides is an axis of symmetry because it would bisect the sides and be perpendicular to the sides. However, this is a rhombus that is not a square, so that does not apply.

Rationale for Fifth Option: Key – The student correctly recognized that the symmetry in the rhombus allows the reflection across a diagonal to map the figure onto itself, because diagonals of a rhombus are perpendicular and bisect each other.
Rhombus PQRS is shown on the coordinate plane. Points M and N are midpoints of their respective sides.

Select all of the transformations that map the rhombus onto itself.

- [ ] a 90° clockwise rotation around the center of the rhombus
- [X] a 180° clockwise rotation around the center of the rhombus
- [X] a reflection across PR
- [ ] a reflection across NM
- [X] a reflection across QS
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Question 16

Question and Scoring Guidelines
Question 16

Kevin asked Olivia what parallel lines are. Olivia responded, “They are lines that never intersect.” What important piece of information is missing from Olivia’s response?

A. The lines must be straight.
B. The lines must be coplanar.
C. The lines can be noncoplanar.
D. The lines form four right angles.

Points Possible: 1

Content Cluster: Experiment with transformations in the plane

Content Standard: Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc. (G.CO.1)
Scoring Guidelines

Rationale for Option A: This is incorrect. The student may have thought it was necessary to define the lines as being straight, not remembering that all lines are always straight.

Rationale for Option B: Key – The student correctly noted that the two lines must also be in the same plane (coplanar) in order to be considered parallel lines. If the lines are in different planes, they could still never intersect, but not be considered parallel (skew lines).

Rationale for Option C: This is incorrect. The student may have thought that lines in two different planes that never intersect are considered parallel simply because they never intersect. However, the student did not think about skew lines, which are lines in two different planes that never intersect and are not parallel.

Rationale for Option D: This is incorrect. The student may have confused the definition of parallel lines with perpendicular lines, which would form four right angles when they intersect.

Sample Response: 1 point
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Question 17

Question and Scoring Guidelines
Question 17

Triangle ABC is reflected across the line y = 2x to form triangle RST. Select all of the true statements.

- $\overline{AB} = \overline{RS}$
- $\overline{AB} = 2 \cdot \overline{RS}$
- $\triangle ABC \sim \triangle RST$
- $\triangle ABC \cong \triangle RST$
- $m \angle BAC = m \angle SRT$
- $m \angle BAC = 2 \cdot m \angle SRT$

Points Possible: 1

Content Strand: Understand congruence in terms of rigid motions

Content Standard: Use the definition of congruence in terms of rigid motions to show that two triangles are congruent if and only if corresponding pairs of sides and corresponding pairs of angles are congruent. (G.CO.7)
Scoring Guidelines

Rationale for First Option: **Key** – The student recognized that a reflection is a rigid motion, so the corresponding parts in the two triangles are congruent, and identified a pair of corresponding sides.

Rationale for Second Option: This is incorrect. The student may have thought that reflection is not always a rigid motion and when a figure is reflected across a line $y=2x$, a dilation by a scale factor 2 should be applied to the sides.

Rationale for Third Option: **Key** – The student correctly identified that since a reflection is a rigid motion, the corresponding parts in the two triangles are congruent and since the triangles would be congruent, they would also be similar with scale factor 1.

Rationale for Fourth Option: **Key** – The student recognized that since a reflection is a rigid motion, the corresponding parts in the two triangles are congruent and therefore, the triangles are congruent. Since all of the parts of the two triangles are congruent, the two triangles themselves are congruent.

Rationale for Fifth Option: **Key** – The student recognized that a reflection is a rigid motion, so the corresponding parts in the two triangles are congruent; therefore he or she identified a pair of corresponding angles.

Rationale for Sixth Option: This is incorrect. The student may have thought that reflection is not always a rigid motion and when a figure is reflected across a line $y=2x$, a dilation by a scale factor 2 should be applied to the angle measures.
Triangle ABC is reflected across the line $y = 2x$ to form triangle RST.
Select all of the true statements.

- $AB = RS$ [✓]
- $AB = 2 \cdot RS$ [ ]
- $\triangle ABC \sim \triangle RST$ [✓]
- $\triangle ABC \cong \triangle RST$ [✓]
- $m \angle BAC = m \angle SRT$ [✓]
- $m \angle BAC = 2 \cdot m \angle SRT$ [ ]
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Question 18

Question and Scoring Guidelines
Parallelogram ABCD has vertices A (1, 1), B (17, 1), C (22, 13), and D (6, 13).

What is the perimeter, in units, of parallelogram ABCD?

**Points Possible:** 1

**Content Cluster:** Use coordinates to prove simple geometric theorems algebraically

**Content Standard:** Use coordinates to compute perimeters of polygons and areas of triangles and rectangles, e.g., using the distance formula. *(G.GPE.7)*
Scoring Guidelines

Exemplar Response

- 58

Other Correct Responses

- Any equivalent value

For this item, a full-credit response includes:

- The correct value (1 point)
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Question 18

Sample Responses
Sample Response: 1 point

Parallelogram ABCD has vertices A (1, 1), B (17, 1), C (22, 13), and D (6, 13).

What is the perimeter, in units, of parallelogram ABCD?

58

Notes on Scoring

This response earns full credit (1 point) because coordinates were correctly used to compute the perimeter of a parallelogram.

The student may have realized that in a parallelogram opposite sides are congruent (\( \overline{AB} = \overline{CD} \) and \( \overline{BC} = \overline{DA} \)). So he or she may have used the distance formula to find the lengths of \( \overline{AB} \) and \( \overline{BC} \). The length of \( \overline{AB} \) is \( \sqrt{(17 - 1)^2 + (1 - 1)^2} \), which equals \( \sqrt{(16)^2 + (0)^2} = \sqrt{16^2} = 16 \). The length of \( \overline{BC} \) is \( \sqrt{(22 - 17)^2 + (13 - 1)^2} \), which equals \( \sqrt{(5)^2 + (12)^2} = \sqrt{25 + 144} = \sqrt{169} = 13 \). Then to find the perimeter he or she added the lengths of all the sides, 16 + 13 + 16 + 13, to get 58.
Sample Response: 1 point

Parallelogram ABCD has vertices A (1, 1), B (17, 1), C (22, 13), and D (6, 13). What is the perimeter, in units, of parallelogram ABCD?

58.0

Notes on Scoring

This response earns full credit (1 point) because coordinates were correctly used to compute the perimeter of a parallelogram.

The student may have realized that in a parallelogram opposite sides are congruent (\(AB = CD\) and \(BC = DA\)). So he or she may have used the distance formula to find the lengths of \(AB\) and \(BC\). The length of \(AB\) is \(\sqrt{(17 - 1)^2 + (1 - 1)^2}\), which equals \(\sqrt{16^2 + 0^2} = \sqrt{16^2} = 16\). The length of \(BC\) is \(\sqrt{(22 - 17)^2 + (13 - 1)^2}\), which equals \(\sqrt{(5)^2 + (12)^2} = \sqrt{25 + 144} = \sqrt{169} = 13\). Then to find the perimeter they added the lengths of all the sides, 16 + 13 + 16 + 13, to get 58 or 58.0.
Sample Response: 0 points

Parallelogram ABCD has vertices A (1, 1), B (17, 1), C (22, 13), and D (6, 13).

What is the perimeter, in units, of parallelogram ABCD?

29

Notes on Scoring

This response earns no credit (0 points) because although coordinates were used, the perimeter was computed incorrectly.

The student may have realized that in a parallelogram opposite sides are congruent ($\overline{AB} = \overline{CD}$ and $\overline{BC} = \overline{DA}$). So he or she may have used the distance formula to find the lengths of $\overline{AB}$ and $\overline{BC}$. The length of $\overline{AB}$ is $\sqrt{(17 - 1)^2 + (1 - 1)^2}$, which equals $\sqrt{16^2 + 0^2} = \sqrt{16^2} = 16$. The length of $\overline{BC}$ is $\sqrt{(22 - 17)^2 + (13 - 1)^2}$, which equals $\sqrt{5^2 + 12^2} = \sqrt{25 + 144} = \sqrt{169} = 13$. The student may have added only two sides of the parallelogram ($16 + 13$) to get 29.
Sample Response: 0 points

Parallelogram ABCD has vertices A (1, 1), B (17, 1), C (22, 13), and D (6, 13).

What is the perimeter, in units, of parallelogram ABCD?

64

Notes on Scoring

This response earns no credit (0 points) because coordinates were incorrectly used to compute the perimeter of a parallelogram.
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Question 19

Question and Scoring Guidelines
Question 19

Isaac deposits money into a new bank account that earns interest. He does not make any other deposits. The expression shows the total amount of money in his account after the deposit.

200(1 + 0.08)^n

What does the number 200 represent in this situation?

A. the percent interest earned annually
B. the number of times interest is compounded
C. the total amount of money in the account after n years
D. the original amount of money deposited into the account

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. For example, interpret P(1+r)^n as the product of P and a factor not depending on P.

*An asterisk appears next to any standard or group of standards linked with Modeling as a conceptual category.
Scoring Guidelines

**Rationale for Option A:** This is incorrect. The student may have confused the meaning of percent interest, 0.08, with the meaning of the original amount of money deposited into the account, 200.

**Rationale for Option B:** This is incorrect. The student may have confused the meaning of the exponent $n$ for the meaning of the original amount of money deposited into the account. He or she may have also not recognized that $n$ represents the number of years and not the number of times, 1, the interest was compounded.

**Rationale for Option C:** This is incorrect. The student may have confused the meaning of the entire expression for the meaning of the original amount of money deposited into the account, 200.

**Rationale for Option D:** **Key** – The student may have correctly recognized that the expression for the compound interest is $P(1+\frac{r}{k})^{kn}$, where $P$ is the original amount or a principle, $n$ is number of years, and $k$ is the number of times interest is compounded per year. In this situation, since the interest is compounded yearly (one time per year), the number of compounds, $k$, equals to 1, the formula simplifies to $P(1+r)^n$. Since Isaac deposited money into a new bank account, $n = 0$ and the amount in the account was $200(1 + 0.08)^0 = 200 \cdot 1 = 200$. Therefore, 200 represents the original amount of money deposited into the account.

**Sample Response: 1 point**

Isaac deposits money into a new bank account that earns interest. He does not make any other deposits. The expression shows the total amount of money in his account $n$ years after the deposit.

$200(1 - 0.08)^n$

What does the number 200 represent in this situation?

- [ ] the percent interest earned annually
- [ ] the number of times interest is compounded
- [x] the total amount of money in the account after $n$ years
- [ ] the original amount of money deposited into the account
A linear model is used to display the scores of a baseball team’s games using the batting averages of its top player. The correlation coefficient for the linear model is 0.37.

Which statement about the linear model is true?

A. The correlation coefficient represents a strong, positive linear relationship.
B. The correlation coefficient represents a strong, negative linear relationship.
C. The correlation coefficient represents a weak, positive linear relationship.
D. The correlation coefficient represents a weak, negative linear relationship.

**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)*
Scoring Guidelines

Rationale for Option A: This is incorrect. The student may have thought a small absolute value of the correlation coefficient indicates a strong relationship. However, the strength of a relationship is determined by its proximity to 0, with values near 0 being weak.

Rationale for Option B: This is incorrect. The student may have misinterpreted a small correlation coefficient as being both a strong and negative relationship. However, negative linear relationships are denoted by a negative correlation coefficient, and a strong linear relationship is determined by its proximity to 1.

Rationale for Option C: Key – The student correctly interpreted the correlation coefficient. The sign of the correlation coefficient 0.37 (positive) determines the sign of the relationship (positive) and the proximity of its value to 0 determines the strength of the relationship. Since 0.37 is closer to 0 than it is to 1, the correlation is weak.

Rationale for Option D: This is incorrect. The student may have thought a small absolute value of the correlation coefficient indicates a negative relationship. However, it is the sign of the correlation coefficient, not its proximity to zero that determines the sign of the relationship.

Sample Response: 1 point

A linear model is used to display the scores of a baseball team’s games using the batting averages of its top player. The correlation coefficient for the linear model is 0.37.

Which statement about the linear model is true?

A. The correlation coefficient represents a strong, positive linear relationship.
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