| Item Position | Rationales | |
|---|---|---|
| 1 | Option B is correct | To determine which graph has a slope (steepness of a straight line when graphed on a coordinate grid) that best models the rate of 24 books in 15 weeks, the student should have first determined that the relationship between the number of books read and the number of weeks is proportional because it produces a unit rate where the ratios are equivalent for all ordered pairs on the graph. To determine the unit rate, the student could have divided the number of books read by the number of weeks, resulting in 24 ÷ 15 = 1.6 books read per week. Since the relationship is proportional, the student could have recognized that the graph contains the point (0, 0), since all proportional graphs pass through the origin, and the point (15, 24), which indicates that in 15 weeks the student read 24 books. The student then could have selected the graph that has a slope of 1.6 and contains these two points. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |
| | Option A is incorrect | The student likely chose the graph that has a constant $y$-value of 24, the given number of books read. The student needs to focus on recognizing a proportional relationship and understanding how unit rates are represented on graphs. |
| | Option C is incorrect | The student likely divided the number of weeks by the number of books read to determine the unit rate, resulting in 15 ÷ 24 = 0.625. Then the student likely chose the graph that has a slope of 0.625 and contains the points (0, 0) and (24, 15). The student needs to focus on understanding how unit rates are represented on graphs. |
| | Option D is incorrect | The student likely chose the graph that has a constant $x$-value of 15, the given number of weeks. The student needs to focus on recognizing a proportional relationship and understanding how unit rates are represented on graphs. |

| Item Position | Rationales | |
|---|---|---|
| 2 | \$900, \$5,400 | To determine the amount of interest the investment account will have earned after 5 years, the student should have used the formula for simple interest ($I = Prt$, where $I$ represents the amount of interest earned in dollars, $P$ represents the principal [initial amount], $r$ represents the interest rate as a decimal, and $t$ represents the time in years). Substituting $P = 4{,}500$, $r = 0.04$, and $t = 5$ into $I = Prt$, the student should have obtained $I = 4{,}500(0.04)(5) = 900$.<br><br>To determine the total balance on the investment account after 5 years, the student should have added the amount of interest earned to the principal amount, resulting in $4{,}500 + 900 = 5{,}400$.<br><br>The student should have then completed the sentence to state that after 5 years, Janice’s investment account will have earned \$900 in interest and will have a total balance of \$5,400. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |

| Item Position | Rationales | |
|---|---|---|
| 3 | Option A is correct | To determine which set of ordered pairs represents $y$ as a function of $x$, the student should have recognized that in a function, each $x$-value corresponds to exactly one $y$-value. Since $x = 5$ corresponds to $y = 13$, $x = 7$ corresponds to $y = 17$, $x = 9$ corresponds to $y = 21$, and $x = 11$ corresponds to $y = 25$, the student should have concluded that the set of ordered pairs $\{(5, 13), (7, 17), (9, 21), (11, 25)\}$ represents $y$ as a function of $x$. |
| | Option B is incorrect | The student likely did not recognize that $x = 5$ corresponds to two $y$-values, $y = -13$ and $y = 17$. The student needs to focus on understanding the definition of a function. |
| | Option C is incorrect | The student likely did not recognize that $x = 8$ corresponds to two $y$-values, $y = 22$ and $y = 9$. The student needs to focus on understanding the definition of a function. |
| | Option D is incorrect | The student likely did not recognize that $x = 9$ corresponds to two $y$-values, $y = 15$ and $y = 17$. The student needs to focus on understanding the definition of a function. |

| Item Position | Rationales | |
|---|---|---|
| 4 | Option D is correct | To determine which inequality is true, the student could have calculated the decimal approximation of each number and then compared the numbers on a number line. Since −0.07 and −0.7 are in decimal form, the student could have plotted points at −0.07 and −0.7 on a number line. The student then could have concluded that −0.07 > −0.7 because the point at −0.07 would be to the right of the point at −0.7 on a number line. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |
| | Option A is incorrect | The student likely did not calculate the decimal approximation of $\sqrt{10}$ and concluded that $\frac{10}{3} < 10$. The student needs to focus on comparing numbers in different forms (fractions, decimals, percentages, square roots, etc.). |
| | Option B is incorrect | The student likely compared the denominators (bottom number in a fraction), −8 and −3, and concluded that $-\frac{1}{8} < -\frac{1}{3}$ since −8 < −3. The student needs to focus on comparing numbers in different forms (fractions, decimals, percentages, square roots, etc.). |
| | Option C is incorrect | The student likely did not calculate the decimal equivalent of 150% before comparing the numbers and concluded that 150 > 2. The student needs to focus on comparing numbers in different forms (fractions, decimals, percentages, square roots, etc.). |

| Item Position | Rationales | |
|---|---|---|
| 5 | Option B is correct | To determine the slope (steepness of a straight line when graphed on a coordinate grid) and the *y*-intercept (value where a line crosses the *y*-axis [vertical number line]) of the line, the student could have first calculated the slope of the line by dividing the change in the *y*-coordinates by the change in the *x*-coordinates. The student could have substituted the coordinates of the points (−6, 3) and (6, −1) into the slope formula, $m = \frac{y_2 - y_1}{x_2 - x_1}$, resulting in $m = \frac{3 - (-1)}{-6 - 6} = \frac{4}{-12} = -\frac{1}{3}$. Next, the student could have recognized that the line passes through the *y*-axis at the point (0, 1) and concluded that the value of the *y*-intercept is 1. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |
| | Option A is incorrect | The student likely divided the change in the *x*-coordinates by the change in the *y*-coordinates when determining the slope of the line, resulting in $\frac{-12}{4} = -3$. The student needs to focus on understanding how to determine the slope of a line from a graph. |
| | Option C is incorrect | The student likely divided the change in the *x*-coordinates by the change in the *y*-coordinates when determining the slope of the line, resulting in $\frac{-12}{4} = -3$. Next, the student likely determined the *x*-intercept (value where a line crosses the *x*-axis [horizontal number line]) instead of the *y*-intercept, resulting in 3. The student needs to focus on understanding how to determine the slope and the *y*-intercept of a line from a graph. |
| | Option D is incorrect | The student likely determined the *x*-intercept instead of the *y*-intercept, resulting in 3. The student needs to focus on understanding how to determine the *y*-intercept of a line from a graph. |

| Item Position | Rationales | |
|---|---|---|
| 6 | Option C is correct | To determine the rule that describes the transformation (process that moves a geometric shape from its original position to a new position), the student should have recognized that the transformation is a translation (slide). The student should have recognized that the quadrilateral is translated 6 units to the right and 2 units down. Therefore, the $x$-coordinate is increasing by 6, represented by $x + 6$, and the $y$-coordinate is decreasing by 2, represented by $y - 2$. The student then should have concluded that the rule $(x, y) \rightarrow (x + 6, y - 2)$ describes the transformation. |
| | Option A is incorrect | The student likely made a sign error when writing the change in the $y$-coordinate in the translation, resulting in $(x, y) \rightarrow (x + 6, y + 2)$. The student needs to focus on understanding the rules for translations. |
| | Option B is incorrect | The student likely made a sign error when writing the changes in the $x$-coordinate and $y$-coordinate in the translation, resulting in $(x, y) \rightarrow (x - 6, y + 2)$. The student needs to focus on understanding the rules for translations. |
| | Option D is incorrect | The student likely made a sign error when writing the change in the $x$-coordinate in the translation, resulting in $(x, y) \rightarrow (x - 6, y - 2)$. The student needs to focus on understanding the rules for translations. |

| Item Position | Rationales | |
|---|---|---|
| 7 | A line going through (0, 0) and (3, 7) | To plot two points that represent a proportional relationship in which $y = 7$ when $x = 3$, the student should have recognized that proportional relationships increase or decrease at a constant rate and have graphs that go through the origin, (0, 0). The student could have recognized that the point (3, 7) is given in the problem and could have plotted the points (0, 0) and (3, 7) to graph the proportional relationship. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |

| Item Position | Rationales | |
|---|---|---|
| 8 | Option C is correct | To use the scatterplot (a graph of plotted points that shows the relationship between two sets of data) to determine the best prediction for the amount of revenue in dollars the business will receive in a week when $1,000 is spent on advertising, the student could have drawn a line of best fit that closely follows the pattern formed by the points on the graph, by keeping about half the points above the line and the other half below the line. The student could have determined that the line of best fit could pass through the points (250, 3,600) and (800, 10,000). Next, the student could have identified where the grid line marked 1,000 on the *x*-axis (horizontal number line), which represents $1,000 spent on advertising, intersects (crosses) the line of best fit and determined that the amount of revenue in dollars would have a value between 12,000 and 13,500. The student then could have predicted that the amount of revenue the business will receive in a week when $1,000 is spent on advertising is about $13,000. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |
| | Option A is incorrect | The student likely used the greatest value labeled on the *y*-axis (vertical number line), 15,000, to predict the amount of revenue in dollars the business will receive in a week when $1,000 is spent on advertising. The student needs to focus on understanding how to draw a line of best fit and use the line of best fit to make a prediction. |
| | Option B is incorrect | The student likely underestimated the slope (steepness of a straight line when graphed on a coordinate grid) of the line of best fit by using the points (675, 9,150) and (800, 10,000) and concluded that the amount of revenue in dollars the business will receive in a week when $1,000 is spent on advertising would have a value close to $11,000. The student needs to focus on understanding how to draw a line of best fit and use the line of best fit to make a prediction. |
| | Option D is incorrect | The student likely confused the given *x*-value of 1,000 with the *y*-value of 10,000 and located the rightmost point plotted in the scatterplot, (800, 10,000). The student then likely multiplied 800 by 10 since the given *y*-value, 10,000, is 10 times the given *x*-value, resulting in 800(10) = 8,000. The student needs to focus on understanding how to draw a line of best fit and use the line of best fit to make a prediction. |

| Item Position | Rationales | |
|---|---|---|
| 9 | 12 and any equivalent values are correct | To determine the height of the prism, the student should have used the formula for the lateral surface area (the sum of the areas of the lateral rectangular faces in a prism) of a prism ($S = Ph$, where $S$ represents the lateral surface area, $P$ represents the perimeter of the base, and $h$ represents the height). The student should have determined that the perimeter of the triangular base of the prism is the sum of the side lengths: $P = 6 + 7 + 8 = 21$ feet. Substituting $S = 252$ and $P = 21$ into $S = Ph$, the student should have obtained the equation $252 = 21h$. Next, the student should have solved the equation for $h$ by dividing both sides of the equation by 21, resulting in $12 = h$. Last, the student should have concluded that the height of the prism is 12 feet. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |

| Item Position | Rationales | |
|---|---|---|
| 10 | Option D is correct | To determine the value of $x$ that makes the equation true, the student should have solved the equation for $x$. First, the student should have distributed (multiplied) the number in front of the parentheses to each term inside the parentheses, resulting in $-6x + 8 = 2x - 24$. Next, the student should have subtracted $2x$ from both sides of the equation, resulting in $-8x + 8 = -24$. The student then should have subtracted 8 from both sides of the equation, resulting in $-8x = -32$. Last, the student should have divided both sides of the equation by −8, resulting in $x = 4$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |
| | Option A is incorrect | The student likely distributed only to the first term in the parentheses, resulting in $-6x + 8 = 2x - 12$. Next, the student likely subtracted $2x$ from both sides of the equation, resulting in $-8x + 8 = -12$. Then the student likely subtracted 8 from both sides of the equation, resulting in $-8x = -20$. Last, the student likely divided both sides of the equation by −8 but made a sign error when dividing by −8, resulting in $x = -2.5$. The student needs to focus on understanding the arithmetic for solving equations. |
| | Option B is incorrect | The student likely distributed only to the first term in the parentheses, resulting in $-6x + 8 = 2x - 12$. Next, the student likely subtracted $2x$ from both sides of the equation, resulting in $-8x + 8 = -12$. Then the student likely subtracted 8 from both sides of the equation, resulting in $-8x = -20$. Last, the student likely divided both sides of the equation by −8, resulting in $x = 2.5$. The student needs to focus on understanding the arithmetic for solving equations. |
| | Option C is incorrect | The student likely made a sign error when dividing both sides of the equation by −8, resulting in $x = -4$. The student needs to focus on understanding the arithmetic for solving equations. |

| Item Position | Rationales | |
|---|---|---|
| 11 | 70.56, 8.4 | To complete the sentences about the area and perimeter of the two parallelograms, the student should have recognized that the dimensions of the smaller parallelogram are being enlarged by a scale factor of 8.4 to create the dimensions of the larger parallelogram. If the base and height of the smaller parallelogram are $x$ and $y$, then the student could have recognized that the base and height of the larger parallelogram are $8.4x$ and $8.4y$. Next, the student could have determined that the area of the smaller parallelogram is $xy$, and the area of the larger parallelogram is $(8.4x)(8.4y) = 70.56xy$. The student then could have concluded that the area of the larger parallelogram is 70.56 times the area of the smaller parallelogram.<br><br>If the base and height of the smaller parallelogram are $x$ and $y$, then the student could have recognized that the base and height of the larger parallelogram are $8.4x$ and $8.4y$. Next, the student could have determined that the perimeter of the smaller parallelogram is $2x + 2y$, and the perimeter of the larger parallelogram is $2(8.4x) + 2(8.4y)$, or $8.4(2x + 2y)$. The student then could have concluded that the perimeter of the larger parallelogram is 8.4 times the perimeter of the smaller parallelogram.<br><br>This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |

| Item Position | Rationales | |
|---|---|---|
| 12 | Option A is correct | To determine which situation represents a proportional relationship, the student could have recognized that proportional relationships increase or decrease at a constant rate and have graphs that go through the origin, (0, 0). Based on this definition, the student should have concluded that a key on a map represents a proportional relationship since the relationship increases at a constant rate of $12 \div \frac{1}{2} = 24$ miles per inch. |
| | Option B is incorrect | The student likely confused a proportional relationship with a subtractive relationship. The student likely concluded that using a coupon could be represented by a proportional relationship with a constant rate of $2.28 \div 1 = 2.28$; however, using a coupon would reduce the total cost by $1.00, thus making it a non-proportional relationship. The equation that represents the relationship is $y = 2.28x - 1$, which does not produce a graph that goes through the origin. The student needs to focus on understanding the definition of a proportional relationship. |
| | Option C is incorrect | The student likely recognized that the first two ordered pairs represent a relationship where each $x$-value increases by a factor of 4.25 to obtain the corresponding $y$-value, but did not check to see if the third ordered pair represents the same rate of change. The third ordered pair represents a relationship where the $x$-value increases by a factor of 4.45 to obtain the corresponding $y$-value, which is different from the rate for the first two ordered pairs. The student needs to focus on understanding the definition of a proportional relationship. |
| | Option D is incorrect | The student likely determined that the $y$-values in the table increase by 3 and concluded that the relationship between $x$ and $y$ must also increase at a constant rate, making it a proportional relationship. The student needs to focus on understanding the definition of a proportional relationship. |

| Item Position | Rationales | |
|---|---|---|
| 13 | Option C is correct | To determine which statement is true, the student could have recognized that the length of *PR* is 2 units and that the length of *P′R′* is 6 units. Since the length of *P′R′* is 3 times the length of *PR*, the student could have determined that *P′R′* = 3(*PR*). Next, the student could have recalled that corresponding sides of dilated (enlarged or reduced in size) figures are proportional and determined that triangle *PQR* was dilated by a scale factor of 3 to create triangle *P′Q′R′*. Therefore, the student could have concluded that *P′Q′* = 3(*PQ*). This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |
| | Option A is incorrect | The student likely transposed the image and preimage when determining which triangle was dilated, resulting in triangle *PQR* being dilated by a scale factor of $\frac{1}{3}$ to create triangle *P′Q′R′*. The student needs to focus on understanding the attributes of a two-dimensional figure and its dilation on a coordinate plane. |
| | Option B is incorrect | The student likely recognized that the two triangles are similar figures (figures with corresponding angles that are equal and corresponding sides that are proportional) but inverted the corresponding side lengths in the ratio on the right side of the proportion, resulting in $\frac{PR}{P'R'} = \frac{R'Q'}{RQ}$. The student needs to focus on understanding the attributes of a two-dimensional figure and its dilation on a coordinate plane. |
| | Option D is incorrect | The student likely confused the definition of congruent (figures that have the same shape and size) with the definition of similar. The student needs to focus on understanding the attributes of a two-dimensional figure and its dilation on a coordinate plane. |

| Item Position | Rationales | |
|---|---|---|
| 14 | 49, 0.65, 60, 0.55 and any equivalent values are correct | To write an inequality that represents the situation, the student should have first recognized that $x$ represents the number of miles that the moving truck travels. Next, the student should have interpreted the verbal description “$49.00 plus $0.65 per mile” as the expression $49 + 0.65x$, which represents the total cost of renting a moving truck from Company A. The student then should have interpreted the verbal description “$60.00 plus $0.55 per mile” as $60 + 0.55x$, which represents the total cost of renting a moving truck from Company B. Last, the student should have compared the two expressions by interpreting the verbal description “the cost of renting a moving truck from Company A is greater than the cost from Company B” as $49 + 0.65x > 60 + 0.55x$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |

| Item Position | Rationales | |
|---|---|---|
| 15 | Option D is correct | To determine the measurement that is closest to the length of line segment *LN*, the student could have first determined that line segment *LN* can be seen as the hypotenuse of right triangle *KLN*, where point *K* is located at (–2, –1) and line segments *KL* and *KN* are the legs of the triangle. By counting the units between the endpoints of the legs of the triangle, the student could have determined that the distance between points *K* and *L* is 6 units, and the distance between points *K* and *N* is 9 units. The student then could have substituted $a = 6$ and $b = 9$ to represent the lengths of line segments *KL* and *KN*, respectively, into the Pythagorean theorem ($a^2 + b^2 = c^2$, where *a* and *b* represent the lengths of the legs of a right triangle and *c* represents the length of the hypotenuse [the longest side, opposite the 90° angle in a right triangle]) and solved for *c* to determine the length of line segment *LN*, resulting in $6^2 + 9^2 = c^2$; $36 + 81 = c^2$; $117 = c^2$; $c = \sqrt{117} \approx 11$. Therefore, the student could have concluded that the length of line segment *LN* is approximately 11 units. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |
| | Option A is incorrect | The student likely found the length of line segment *KN* in triangle *KLN*, where *K* is located at (–2, –1), resulting in 9 units. The student needs to focus on understanding how to apply the Pythagorean theorem to determine the distance between two points on a coordinate plane. |
| | Option B is incorrect | The student likely found the distance between the endpoints of line segments *KN* and *KL* in triangle *KLN*, where *K* is located at (–2, –1), resulting in 9 units and 6 units, respectively. The student then likely added the two distances, resulting in 9 + 6 = 15 units. The student needs to focus on understanding how to apply the Pythagorean theorem to determine the distance between two points on a coordinate plane. |
| | Option C is incorrect | The student likely found the distance between the endpoints of line segments *KN* and *KL* in triangle *KLN*, where *K* is located at (–2, –1), resulting in 9 units and 6 units, respectively. The student then likely substituted the values in the Pythagorean theorem but subtracted the squares instead of adding, resulting in $9^2 - 6^2 = c^2$; $81 - 36 = c^2$; $45 = c^2$; $c = \sqrt{45} \approx 7$. The student needs to focus on understanding how to apply the Pythagorean theorem to determine the distance between two points on a coordinate plane. |

| Item Position | Rationales | |
|---|---|---|
| 16 | 1.25, 0.75 | To determine an equation in slope-intercept form (*y* = *mx* + *b*, where *m* represents the slope [steepness of a straight line when graphed on a coordinate grid] and *b* represents the *y*-intercept [value where a line crosses the *y*-axis {vertical number line}]), the student could have first substituted the coordinates of the points (1, 2) and (5, 7) into the slope formula, $m = \frac{y_2 - y_1}{x_2 - x_1}$, resulting in $m = \frac{7-2}{5-1} = \frac{5}{4} = 1.25$. Next, the student could have determined the *y*-intercept by substituting the slope and the coordinates of one of the points into *y* = *mx* + *b* and solving the equation for *b*, resulting in 2 = 1.25(1) + *b*; 2 = 1.25 + *b*; *b* = 0.75. Last, the student could have substituted *m* = 1.25 and *b* = 0.75 into the slope-intercept equation, resulting in *y* = 1.25*x* + 0.75. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |

| Item Position | Rationales | |
|---|---|---|
| 17 | Option B is correct | To determine the rule that represents the dilation, the student should have understood that when a figure is dilated (enlarged or reduced in size), its measurements increase or decrease based on the scale factor (ratio of the length of a side of the dilated figure to the length of the corresponding [paired] side of the original figure). A dilation by a scale factor of *k* with the center of dilation at the origin (the point represented by (0, 0), where the *x*-axis [horizontal number line] and *y*-axis [vertical number line] on a coordinate grid intersect [cross]) means that the distance between the origin and any point on the dilated figure is *k* times the distance between the origin and the corresponding point on the original figure. The scale factor, *k*, can be determined by dividing the coordinates of a point on the dilated triangle by the coordinates of the corresponding point on the original triangle. Dividing the coordinates of the vertex (−10, 15) of triangle *M′N′P′* by the coordinates of the corresponding vertex, (−4, 6), of triangle *MNP* results in $k = (-10) \div (-4) = 2.5$ and $k = 15 \div 6 = 2.5$.The student should have concluded that the rule $(x, y) \rightarrow (2.5x, 2.5y)$ describes the dilation. |
| | Option A is incorrect | The student likely determined the scale factor, *k*, by dividing the coordinates of a vertex of the original triangle by the coordinates of the corresponding vertex of the dilated triangle, resulting in $k = (-4) \div (-10) = \frac{2}{5}$ and $k = 6 \div 15 = \frac{2}{5}$. The student then likely concluded that the rule $(x, y) \rightarrow \left(\frac{2}{5}x, \frac{2}{5}y\right)$ describes the dilation. The student needs to focus on understanding the effect a dilation by a given scale factor has on a figure and how to determine the rule to explain the effect. |
| | Option C is incorrect | The student likely determined that the *x*-coordinate of the ordered pair (−4, 6) is 6 units greater than the *x*-coordinate of the ordered pair (−10, 15) and applied 6 as the scale factor, *k*. The student then likely concluded that the rule $(x, y) \rightarrow (6x, 6y)$ describes the dilation. The student needs to focus on understanding the effect a dilation by a given scale factor has on a figure and how to determine the rule to explain the effect. |
| | Option D is incorrect | The student likely reversed the order of dilation and concluded that it was a reduction rather than an enlargement. The student then likely found the scale factor, *k*, by finding the difference in the *x*-coordinates from the ordered pairs (−4, 6) and (−10, 15), resulting in $-4 - (-10) = 6$, and then used $\frac{1}{6}$, the reciprocal of 6, as the scale factor that would reduce the size of the original figure. The student then likely concluded that the rule $(x, y) \rightarrow \left(\frac{1}{6}x, \frac{1}{6}y\right)$ describes the dilation. The student needs to focus on understanding the effect a dilation by a given scale factor has on a figure and how to determine the rule to explain the effect. |

| Item Position | Rationales | |
|---|---|---|
| 18 | Option D is correct | To determine which pair of points could be added to the graph to suggest a linear relationship, the student should have understood that a linear relationship between *x* and *y* resembles a straight line. The student should have recognized that the relationship between *x* and *y* appears to be a positive linear relationship, where the value of *y* increases as the value of *x* increases. On the scatterplot (graph of plotted points that show the relationship between two sets of data), the student could have drawn a line of best fit that closely follows the pattern formed by the points on the graph, by keeping about half the points above the line and the other half below the line. The student could have determined that the line of best fit could pass through the points (2, 2) and (7, 6). Next, the student could have determined that the points (5, 4) and (6, 6) are the pair of points that most closely follow the pattern of the line of best fit. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |
| | Option A is incorrect | The student likely confused a linear relationship with a nonlinear relationship (a relationship between *x* and *y* that does not resemble a straight line) and chose points that suggest a nonlinear relationship. The student needs to focus on understanding how to recognize linear and nonlinear relationships in a scatterplot. |
| | Option B is incorrect | The student likely interpreted the four points (2, 1), (2, 2), (2, 3), and (2, 8) as suggesting a linear relationship because they form a vertical line. The student needs to focus on understanding how to recognize linear and nonlinear relationships in a scatterplot. |
| | Option C is incorrect | The student likely determined that a line of best fit would pass through the points (3, 4) and (4, 3). This would form a negative linear relationship, where the value of *y* decreases as the value of *x* increases. The student then likely concluded that (2, 5) and (6, 1) are the pair of points that most closely follow the pattern of the line of best fit. The student needs to focus on understanding how to recognize linear and nonlinear relationships in a scatterplot. |

| Item Position | Rationales | |
|---|---|---|
| 19 | Option A is correct | To determine the length of the other leg of the right triangle, the student could have applied the Pythagorean theorem ($a^2 + b^2 = c^2$, where *a* and *b* represent the lengths of the legs of a right triangle and *c* represents the length of the hypotenuse [the longest side, opposite the 90° angle in the right triangle]). From the information given in the problem, the student could have substituted $a = 12$ and $c = 13.6$ into $a^2 + b^2 = c^2$, resulting in $12^2 + b^2 = 13.6^2$, or $144 + b^2 = 184.96$. Next, the student could have solved for $b^2$ by subtracting 144 from both sides of the equation, resulting in $b^2 = 40.96$. The student then could have solved for *b* taking the square root of both sides of the equation, resulting in $b = \sqrt{40.96}$, or $b = 6.4$. Last, the student could have concluded that the length of the other leg of the triangle is 6.4 feet. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |
| | Option B is incorrect | The student likely added the length of the given leg and the length of the hypotenuse, resulting in $12 + 13.6 = 25.6$. The student needs to focus on understanding how to apply the Pythagorean theorem with the given information. |
| | Option C is incorrect | The student likely subtracted the length of the given leg from the length of the hypotenuse, resulting in $13.6 - 12 = 1.6$. The student needs to focus on understanding how to apply the Pythagorean theorem with the given information. |
| | Option D is incorrect | The student likely subtracted the length of the given leg from the length of the hypotenuse, resulting in $13.6 - 12 = 1.6$, and then multiplied the difference by 2, resulting in $1.6(2) = 3.2$. The student needs to focus on understanding how to apply the Pythagorean theorem with the given information. |

| Item Position | Rationales | |
|---|---|---|
| 20 | Option C is correct | To determine how many lawns Malik can mow in 7.5 hours, the student should have first recognized that the number of lawns he mows varies directly with the number of hours he works, and then used the direct variation formula ($y = kx$, where $k$ represents the constant of proportionality). Since Malik mowed 4 lawns in 5 hours, the student could have substituted $y = 4$ and $x = 5$ into $y = kx$ and solved for $k$ to determine the constant of proportionality, resulting in $4 = 5k$, or $k = 0.8$. The student then could have concluded that the equation representing this relationship is $y = 0.8x$. Next, the student could have substituted $x = 7.5$ into $y = 0.8x$ to determine the value of $y$, resulting in $y = 0.8(7.5)$, or $y = 6$. Last, the student should have concluded that Malik can mow 6 lawns if he works for 7.5 hours. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |
| | Option A is incorrect | The student likely misinterpreted direct variation as an additive relationship instead of a multiplicative relationship. The student likely substituted $y = 4$ and $x = 5$ into $y = x + k$ and solved for $k$, resulting in $4 = 5 + k$, or $k = -1$. The student then likely substituted $x = 7.5$ into $y = x - 1$ to determine the value of $y$, resulting in $y = 7.5 - 1$, or $y = 6.5$. The student needs to focus on understanding the application of direct variation. |
| | Option B is incorrect | The student likely determined the difference between the numbers of hours worked, $7.5 - 5 = 2.5$, and then multiplied the result by the number of lawns mowed, resulting in $2.5(4) = 10$. The student needs to focus on understanding the application of direct variation. |
| | Option D is incorrect | The student likely set up a proportion but made an error placing the values in the proportion, resulting in $\frac{4}{5} = \frac{7.5}{x}$. The student then likely solved the proportion for $x$ by multiplying both sides of the proportion by $5x$, resulting in $4x = 37.5$. Next, the student likely solved for $x$ by dividing both sides of the proportion by 4, resulting in $x = 9.375$. The student needs to focus on understanding the application of direct variation. |

| Item Position | Rationales | |
|---|---|---|
| 21 | Option B is correct | To determine the volume of the sphere in cubic centimeters in terms of $\pi$, the student should have used the formula for the volume of a sphere ($V = \frac{4}{3}\pi r^3$, where *r* represents the radius [distance from the center of a sphere to a point on the sphere]). To calculate the radius, the student should have divided the diameter (length of a straight line that goes through the center of a sphere and connects two points on the sphere) by 2, resulting in $r = 6 \div 2$, or $r = 3$. Next, the student should have substituted $r = 3$ into the formula, resulting in $V = \frac{4}{3}\pi(3)^3$, or $V = 36\pi$. The student then should have concluded that the volume of the sphere in terms of $\pi$ is $36\pi$ cubic centimeters. |
| | Option A is incorrect | The student likely squared the radius instead of cubing it when evaluating the volume formula, resulting in $V = \frac{4}{3}\pi(3)^2$, or $V = 12\pi$. The student needs to focus on understanding the formula for the volume of a sphere. |
| | Option C is incorrect | The student likely confused diameter with radius and substituted $r = 6$ into the volume formula. The student then likely squared the *r*-value instead of cubing it when evaluating the volume formula, resulting in $V = \frac{4}{3}\pi(6)^2$, or $V = 48\pi$. The student needs to focus on understanding the formula for the volume of a sphere. |
| | Option D is incorrect | The student likely confused diameter with radius and substituted $r = 6$ into the volume formula, resulting in $V = \frac{4}{3}\pi(6)^3$, or $V = 288\pi$. The student needs to focus on understanding the formula for the volume of a sphere. |

| Item Position | Rationales | |
|---|---|---|
| 22 | Option A is correct | To determine the value of $x$, the student should have recognized that the measures of the two angles are equal and set up the equation $\frac{1}{8}x + 61 = \frac{3}{4}x - 27$. To solve for $x$, the student could have first added 27 to both sides of the equation, resulting in $\frac{1}{8}x + 88 = \frac{3}{4}x$. Next, the student could have subtracted $\frac{1}{8}x$ from both sides of the equation, resulting in $88 = \frac{5}{8}x$. The student then could have multiplied both sides of the equation by $\frac{8}{5}$, resulting in $\frac{704}{5} = x$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |
| | Option B is incorrect | The student likely subtracted 27 from the left side of the equation, resulting in $\frac{1}{8}x + 34 = \frac{3}{4}x$. Next, the student likely added $\frac{1}{8}x$ to the right side of the equation, resulting in $34 = \frac{7}{8}x$. The student then likely multiplied both sides of the equation by $\frac{8}{7}$, resulting in $\frac{272}{7} = x$. The student needs to focus on understanding the arithmetic of solving equations. |
| | Option C is incorrect | The student likely added 27 to the left side of the equation, resulting in $\frac{1}{8}x + 88 = \frac{3}{4}x$. Next, the student likely added $\frac{1}{8}x$ to the right side of the equation, resulting in $88 = \frac{7}{8}x$. The student then likely multiplied both sides of the equation by $\frac{8}{7}$, resulting in $\frac{704}{7} = x$. The student needs to focus on understanding the arithmetic of solving equations. |
| | Option D is incorrect | The student likely subtracted 27 from the left side of the equation, resulting in $\frac{1}{8}x + 34 = \frac{3}{4}x$. Next, the student likely subtracted $\frac{1}{8}x$ from both sides of the equation, resulting in $34 = \frac{5}{8}x$. The student then likely multiplied both sides of the equation by $\frac{8}{5}$, resulting in $\frac{272}{5} = x$. The student needs to focus on understanding the arithmetic of solving equations. |

| **Item Position** | **Rationales** | |
|---|---|---|
| 23 | 6, 17 | To determine the measures of the missing lengths, $v$ and $p$, the student should have applied the Pythagorean theorem ($a^2 + b^2 = c^2$, where $a$ and $b$ represent the lengths of the legs of the right triangle and $c$ represents the length of the hypotenuse [the longest side, opposite the 90° angle in the right triangle]).<br><br>To determine the measure of the missing vertical length, $v$, the student should have first recognized that one of the leg lengths of the right triangle containing $v$ is 8 inches and the hypotenuse is 10 inches. The student then could have substituted $a = 8$ and $c = 10$ into $a^2 + b^2 = c^2$, resulting in $8^2 + b^2 = 10^2$, or $64 + b^2 = 100$. Next, the student could have solved for $b^2$ by subtracting 64 from both sides of the equation, resulting in $b^2 = 36$. The student then could have solved for $b$ by taking the square root of both sides of the equation, resulting in $b = \sqrt{36}$, or $b = 6$. Last, the student could have concluded that the measure of the missing vertical length, $v$, is 6 inches.<br><br>To determine the measure of the missing side length, $p$, the student should have first recognized that the leg lengths of the right triangle containing $p$ are 8 inches and 15 inches. The student then could have substituted $a = 8$ and $b = 15$ into $a^2 + b^2 = c^2$, resulting in $8^2 + 15^2 = c^2$, or $64 + 225 = c^2$. Next, the student could have solved the equation for $c^2$ by adding the numbers, resulting in $289 = c^2$. The student then could have solved for $c$ by taking the square root of both sides of the equation, resulting in $c = \sqrt{289}$, or $c = 17$. Last, the student could have concluded that the measure of the missing side length, $p$, is 17 inches.<br><br>This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |

| Item Position | Rationales | |
|---|---|---|
| 24 | Option C is correct | To determine how the number 27,000,000 is written in scientific notation, the student should have moved the decimal point 7 places to the left to create the number 2.7, which is between 1 and 10, and used the number of places the decimal point was moved to the left as the power of 10, resulting in $2.7 \times 10^7$. |
| | Option A is incorrect | The student likely moved the decimal point 6 places to the left to create a number between 0 and 100, instead of creating a number between 1 and 10, resulting in $27 \times 10^6$. The student needs to focus on understanding how to write numbers in scientific notation. |
| | Option B is incorrect | The student likely moved the decimal point 6 places to the left to create a number between 0 and 100, instead of creating a number between 1 and 10. The student then likely wrote the exponent of 10 as a negative value since the decimal point was moved to the left, resulting in $27 \times 10^{-6}$. The student needs to focus on understanding how to write numbers in scientific notation. |
| | Option D is incorrect | The student likely wrote the exponent of 10 as a negative value since the decimal point was moved to the left, resulting in $2.7 \times 10^{-7}$. The student needs to focus on understanding how to write numbers in scientific notation. |

| Item Position | Rationales | |
|---|---|---|
| 25 | $7.5^2$, 4.5 OR 4.5, $7.5^2$ | To complete the equation that represents *V*, the volume of the swimming pool in cubic feet, the student should have used the formula for the volume of a cylinder ($V = Bh$, where *B* represents the area of the base and *h* represents the height). To determine the area of the base, *B*, the student should have recognized that the base of a cylinder is a circle and used the formula for the area of a circle ($A = \pi r^2$, where *r* represents the radius [distance from the center of a circle to a point on the circle]). Since the diameter (length of a straight line that goes through the center of a circle and connects two points on the circle) of the circular base is given, the student should have determined the radius by dividing the diameter by 2, resulting in $r = 15 \div 2$, or $r = 7.5$. Next, the student should have substituted $r = 7.5$ into the area formula to determine the area of the base, resulting in $A = \pi(7.5^2)$. Since the area of the base is represent by *B*, the student should have substituted $B = \pi(7.5^2)$ and $h = 4.5$ into the volume formula, resulting in $V = \pi(7.5^2)(4.5)$ or $V = \pi(4.5)(7.5^2)$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |

| Item Position | Rationales | |
|---|---|---|
| 26 | Option A is correct | To determine the difference between the amounts of interest earned from simple interest and from compound interest at the same rate, the student could have first determined the amount that would be earned from simple interest at a 2% annual rate by using the formula for simple interest ($I = Prt$, where $I$ represents the earned interest in dollars, $P$ represents the principal [initial amount] in dollars, $r$ represents the interest rate as a decimal, and $t$ represents the time in years). Substituting $P = 500$, $r = 0.02$, and $t = 2$ into $I = Prt$, the student could have obtained $I = 500(0.02)(2) = 20$. The student then could have determined that the simple interest earned would be \$20.<br><br>Next, the student could have determined the balance after 2 years for the account that earns compound interest, by using the formula for compound interest ($A = P(1 + r)^t$, where $A$ represents the account balance in dollars, $P$ represents the principal, $r$ represents the interest rate as a decimal, and $t$ represents the time in years). Substituting $P = 500$, $r = 0.02$, and $t = 2$ into $A = P(1 + r)^t$, the student could have obtained $A = 500(1 + 0.02)^2 = 520.2$, which means that the account balance would be \$520.20. To determine the interest earned on the compound interest account, the student could have subtracted the principal from the account balance, resulting in $520.20 - 500 = 20.2$. The student then could have determined that the compound interest account would earn \$20.20 in interest.<br><br>To determine the difference between the amounts of earned interest, the student could have subtracted the simple interest earned from the compound interest earned, resulting in $20.20 - 20 = 0.20$. The student then could have concluded that Jack would earn \$0.20 more in interest on the account earning compound interest than he would if he earned simple interest at a 2% annual rate.<br><br>This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |
| | Option B is incorrect | The student likely calculated the simple interest earned using $t = 1$ instead of $t = 2$, resulting in $I = 500(0.02)(1) = 10$. Next, the student likely calculated the compound interest earned using $t = 2$, resulting in $I = 500(1 + 0.02)^2 - 500 = 20.2$. The student then likely subtracted the simple interest earned from the compound interest earned, resulting in $20.2 - 10 = 10.2$. The student then likely concluded that the account would earn \$10.20 more in compound interest than it would in simple interest. The student needs to focus on attending to the details of the question in the problem. |
| | Option C is incorrect | The student likely chose the amount of simple interest earned, resulting in \$20.00. The student needs to focus on attending to the details of the question in the problem. |
| | Option D is incorrect | The student likely chose the amount of compound interest earned but made an error when placing the decimal point, resulting in \$2.02 rather than \$20.20. The student needs to focus on attending to the details of the question in the problem and understanding how to calculate compound interest. |

| Item Position | Rationales | |
|---|---|---|
| 27 | Option A is correct | To determine the measurement that is closest to the side length of Square Z, the student should have recognized that the diagram shows a right triangle (closed figure with three sides and one 90° angle) in the middle with squares formed by each side of the triangle. The student should have recognized that one side of Square X and one side of Square Y form the legs of the right triangle and that one side of Square Z forms the hypotenuse (the longest side, opposite the 90° angle in the right triangle) of the right triangle. Since the areas of Square X and Square Y are given, the student could have determined the side lengths of Square X and Square Y by taking the square root of each area. The side length of Square X is $\sqrt{441}$ = 21 centimeters, and the side length of Square Y is $\sqrt{400}$ = 20 centimeters. The student then could have used the Pythagorean theorem ($a^2 + b^2 = c^2$, where $a$ and $b$ represent the lengths of the legs of the right triangle and $c$ represents the length of the hypotenuse) to determine the length of the hypotenuse of the right triangle. Substituting $a = 21$ and $b = 20$ into $a^2 + b^2 = c^2$, the student could have obtained $21^2 + 20^2 = c^2$, $441 + 400 = c^2$, or $841 = c^2$. Next, the student could have solved for $c$ by taking the square root of both sides of the equation, resulting in $c = \sqrt{841} = 29$. The student then could have concluded that the side length of Square Z is 29 centimeters since one side of Square Z forms the hypotenuse of the right triangle. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |
| | Option B is incorrect | The student likely subtracted the area of Square Y from the area of Square X, resulting in 441 − 400 = 41. The student needs to focus on attending to the details of the question in the problem and understanding how to apply the Pythagorean theorem with the given information. |
| | Option C is incorrect | The student likely determined the side length of Square X and added that to the area of Square Y, resulting in 21 + 400 = 421. The student needs to focus on attending to the details of the question in the problem and understanding how to apply the Pythagorean theorem with the given information. |
| | Option D is incorrect | The student likely added the area of Square X and the area of Square Y, resulting in 441 + 400 = 841. The student needs to focus on attending to the details of the question in the problem and understanding how to apply the Pythagorean theorem with the given information. |

| Item Position | Rationales | |
|---|---|---|
| 28 | Option B is correct | To determine which line has a slope (steepness of a straight line graphed on a coordinate grid) that best represents Dillon's speed in miles per hour, the student should have first determined that the relationship between the distance traveled in miles and the time in hours is proportional and therefore produces a unit rate where the ratios of $y$ to $x$ are equivalent for all ordered pairs $(x, y)$ on the graph. To determine the unit rate, the student could have divided the distance traveled in miles by the time in hours, resulting in $6 \div 0.5 = 12$ miles per hour. Since the relationship is proportional, the student could have recognized that the graph contains the point (0, 0), since all graphs of proportional relationships pass through the origin, and the point (5, 60), which indicates that in 5 hours Dillon would travel 60 miles. Therefore, the student then could have selected the graph that contains these two points, which has a slope of 12. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |
| | Option A is incorrect | The student likely used the given distance traveled, 6 miles, as the unit rate and chose the graph that passes through the points (0, 0) and (5, 30), which has a slope of 6. The student needs to focus on understanding how unit rates are represented on graphs. |
| | Option C is incorrect | The student likely used the given time, 0.5 hour, as the unit rate. The student then likely did not recognize that the scale of the $y$-axis (vertical number line) is 10 units and used rise over run to determine which graph has a slope of 0.5, or $\frac{1}{2}$. Since the point (2, 10) has a rise of 1 lattice point and a run of 2 lattice points from the point (0, 0), the student likely concluded that the graph that passes through the points (0, 0) and (2, 10) has a slope of 0.5, or $\frac{1}{2}$. The student needs to focus on understanding how unit rates are represented on graphs. |
| | Option D is incorrect | The student likely multiplied the given distance traveled by the given time to determine the unit rate but used 5 instead of 0.5, resulting in $6(5) = 30$. The student then likely chose the graph that passes through the points (0, 0) and (1, 30), which has a slope of 30. The student needs to focus on understanding how unit rates are represented on graphs. |

| Item Position | Rationales | |
|---|---|---|
| 29 | Option C is correct | To determine the rule that best represents the dilation, the student should have understood that when a figure is dilated (enlarged or reduced in size), its measurements increase or decrease based on the scale factor (ratio of the length of a side of the dilated figure to the length of the corresponding [paired] side of the original figure). A dilation by a scale factor of *k* with the center of dilation at the origin (the point represented by (0, 0), where the *x*-axis [horizontal number line] and *y*-axis [vertical number line] on a coordinate grid intersect [cross]) means that the distance between the origin and any point on the dilated figure is *k* times the distance between the origin and the corresponding point on the original figure. The scale factor, *k*, can be determined by dividing the coordinates of a point on quadrilateral *P′Q′R′T′* by the coordinates of the corresponding point on quadrilateral *PQRT*. Dividing the coordinates of point *P′*(8, 16) by the coordinates of point *P*(3, 6) results in $k = (8) \div (3) = \frac{8}{3}$ and $k = 16 \div 6 = \frac{8}{3}$. The student then should have concluded that the rule $(x, y) \rightarrow \left(\frac{8}{3}x, \frac{8}{3}y\right)$ describes the dilation. |
| | Option A is incorrect | The student likely determined the difference between each coordinate of a point on the dilated quadrilateral and the corresponding coordinate of the corresponding point on the original quadrilateral. The student likely subtracted the *x*-coordinate of point *P*(3, 6) from the *x*-coordinate of point *P′*(8, 16), resulting in 8 – 3 = 5. Next, the student likely subtracted the *y*-coordinate of point *P* from the *y*-coordinate of point *P′*, resulting in 16 – 6 = 10. The student then likely concluded that the rule $(x, y) \rightarrow (x + 5, y + 10)$ describes the dilation. The student needs to focus on understanding the effect a dilation by a given scale factor has on a figure and how to determine the rule to explain the effect. |
| | Option B is incorrect | The student likely determined the difference between each coordinate of a point on the original quadrilateral and the corresponding coordinate of the corresponding point on the dilated quadrilateral. The student likely subtracted the *x*-coordinate of point *P′* from the *x*-coordinate of point *P*, resulting in 3 – 8 = –5. Next, the student likely subtracted the *y*-coordinate of point *P′* from the *y*-coordinate of point *P*, resulting in 6 – 16 = –10. The student then likely concluded that the rule $(x, y) \rightarrow (x - 5, y - 10)$ describes the dilation. The student needs to focus on understanding the effect a dilation by a given scale factor has on a figure and how to determine the rule to explain the effect. |
| | Option D is incorrect | The student likely determined the scale factor, *k*, by dividing the value of each coordinate of point *P*(3, 6) by the value of the corresponding coordinate of point *P′*(8, 16), resulting in $k = 3 \div 8 = \frac{3}{8}$ and $k = 6 \div 16 = \frac{3}{8}$. The student then likely concluded that the rule $(x, y) \rightarrow \left(\frac{3}{8}x, \frac{3}{8}y\right)$ describes the dilation. The student needs to focus on understanding the effect a dilation by a given scale factor has on a figure and how to determine the rule to explain the effect. |

| Item Position | Rationales | |
|---|---|---|
| 30 | \$14.25, \$25.00 | To determine the hourly wage and the cost of the uniform, the student could have first determined the rate of change (constant rate of increase or decrease) of the paycheck amount with respect to the number of hours worked. To determine the rate of change, the student should have divided the change in the $y$-values by the change in the $x$-values using any two ordered pairs from the table. Using the ordered pairs (2, 3.50) and (5, 46.25), the student could have determined that the change in the $y$-values is $46.25 - 3.50 = 42.75$ and the change in the $x$-values is $5 - 2 = 3$. Next, the student could have divided the change in the $y$-values by the change in the $x$-values, resulting in $42.75 \div 3 = 14.25$. The student then could have concluded that the hourly wage is \$14.25 per hour.<br><br>Next, the student could have determined the initial value (the value of $y$ when $x = 0$), which represents the cost of the uniform, by subtracting twice the value of the rate of change from the $y$-value when $x = 2$, resulting in $3.50 - 2(14.25) = -25$. Since the cost of the uniform is taken out of the first paycheck, the student could have concluded that the cost of the uniform is \$25.00.<br><br>This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |

| Item Position | Rationales | |
|---|---|---|
| 31 | Option D is correct | To determine the best prediction from the scatterplot (a graph of plotted points that shows the relationship between two sets of data) for the value of $y$ when $x = 10$, the student could have first drawn a line of best fit that closely follows the pattern formed by the points on the graph, by keeping about half the points above the line and the other half below the line. The student could have determined that the line of best fit could pass through the points (1, 1.2) and (9, 7.8). Next, the student could have identified where the grid line marked $x = 10$ intersects (crosses) the line of best fit and determined that the corresponding $y$-value is between 8 and 9. The student then could have concluded that $y \approx 8$ when $x = 10$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |
| | Option A is incorrect | The student likely underestimated the slope (steepness of a straight line when graphed on a coordinate grid) of the line of best fit, using the points (1.5, 1.2) and (7.5, 5.2), and determined that the $y$-value when $x = 10$ is between 6 and 7. The student then likely concluded that $y \approx 6.5$ when $x = 10$. The student needs to focus on understanding how to draw a line of best fit and use the line of best fit to make a prediction. |
| | Option B is incorrect | The student likely overestimated the slope of the line of best fit, using the points (1, 1.2) and (5.5, 5.4), and determined that the $y$-value when $x = 10$ is between 9 and 10. The student then likely concluded that $y \approx 10$ when $x = 10$. The student needs to focus on understanding how to draw a line of best fit and use the line of best fit to make a prediction. |
| | Option C is incorrect | The student likely determined the value of $x$ when $y = 10$. The student likely determined that the line of best fit would pass through the points (1, 1.2) and (9, 7.8). Then the student likely identified where the grid line marked $y = 10$ intersects the line of best fit and determined that the corresponding $x$-value is between 12 and 13. The student then likely concluded $x \approx 12.5$ when $y = 10$. The student needs to focus on understanding how to draw a line of best fit and using the line of best fit to make a prediction. |

| Item Position | Rationales | |
|---|---|---|
| 32 | (–*x*, *y*), (*y*, –*x*) | To determine the rule that represents each transformation in the table, the student should have recognized that the first transformation in the table is a reflection (flip) across the *y*-axis (vertical number line). The student should have recognized that the rule (*x*, *y*) → (–*x*, *y*) describes this transformation.<br><br>Next, the student should have recognized that the second transformation in the table is a rotation (circular movement) of 90° clockwise about the origin (the point where the *x*-axis [horizontal number line] and the *y*-axis [vertical number line] on a coordinate grid intersect [cross]). The student should have recognized that the rule (*x*, *y*) → (*y*, –*x*) describes this transformation.<br><br>This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |

| Item Position | Rationales | |
|---|---|---|
| 33 | Option A is correct | To determine the statement that best describes the graph, the student should have recognized that each *x*-coordinate on the line corresponds to exactly one *y*-coordinate; for example, the points (0, 1), (2, 0), and (4, –1) each have an *x*-coordinate, {0, 2, 4}, that corresponds to exactly one *y*-coordinate, {1, 0, –1}, respectively. The student then could have concluded that the graph represents *y* as function of *x* because each *x*-value corresponds to exactly one *y*-value. |
| | Option B is incorrect | The student likely confused the definition of a function with the definition of a non-function (a relation in which an *x*-coordinate could correspond to multiple *y*-coordinates). The student needs to focus on understanding the definition of a function. |
| | Option C is incorrect | The student likely did not recognize that the graph of a non-vertical line represents a function and concluded that the graph does not represent *y* as a function of *x* because each *x*-value corresponds to exactly one *y*-value. The student needs to focus on understanding the definition of a function. |
| | Option D is incorrect | The student likely used the points (0, 1) and (2, 0) from the graph to determine the relationship but transposed the coordinates of (2, 0), making it (0, 2). The student then likely determined that when $x = 0$ there are two corresponding *y*-values, {1, 2}, represented in the ordered pairs (0, 1) and (0, 2), and concluded that the graph does not represent *y* as a function of *x* because each *x*-value corresponds to multiple *y*-values. The student needs to focus on understanding the definition of a function. |

| Item Position | Rationales | |
|---|---|---|
| 34 | Bank Y, \$222.63 | To determine at which bank Mr. Jiménez will pay less interest and how much less interest he will pay, the student first could have determined the amount of interest paid with each bank loan offer using the formula for simple interest ($I = Prt$, where $I$ represents the earned interest in dollars, $P$ represents the principal [initial amount] in dollars, $r$ represents the interest rate as a decimal, and $t$ represents the time in years).<br><br>For the loan offer at Bank X, the student could have substituted $P = 6{,}850$, $r = 0.035$, and $t = 5$ into $I = Prt$, resulting in $I = 6{,}850(0.035)(5) = 1{,}198.75$. The student then could have determined that Mr. Jiménez would pay \$1,198.75 in interest with the loan offer at Bank X.<br><br>For the loan offer at Bank Y, the student could have substituted $P = 6{,}850$, $r = 0.0475$, and $t = 3$ into $I = Prt$, resulting in $I = 6{,}850(0.0475)(3) = 976.125$. The student then could have determined that Mr. Jiménez would pay approximately \$976.12 in interest with the loan offer at Bank Y.<br><br>Since $976.12 < 1{,}198.75$, the student could have concluded that Mr. Jiménez will pay less interest at Bank Y.<br><br>To determine how much less interest he will pay, the student could have subtracted the interest paid on the loan at Bank Y from the interest paid on the loan at Bank X, resulting in $1{,}198.75 - 976.12 = 222.63$. The student then could have concluded that Mr. Jiménez will pay \$222.63 less interest over the life of the loan at Bank Y.<br><br>This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |

| Item Position | Rationales | |
|---|---|---|
| 35 | Option A is correct | To determine which measurement is closest to the diameter (length of a straight line that goes through the center of a circle and connects two points on the circle) of the base of the cone, the student should have used the formula for the volume of a cone ($V = \frac{1}{3}Bh$, where $B$ represents the area of the base and $h$ represents the height). To determine the area of the base, $B$, the student should have recognized that the base of a cone is circular and used the formula for the area of a circle ($A = \pi r^2$, where $r$ represents the radius [distance from the center of a circle to a point on the circle]). Substituting $V = 1{,}647$, $B = \pi r^2$, and $h = 13$ into $V = \frac{1}{3}Bh$, the student could have obtained the equation $1{,}647 = \frac{1}{3}\pi r^2(13)$, or $1{,}647 \approx 13.6r^2$. Next, the student could have solved for $r^2$ by dividing both sides of the equation by 13.6, resulting in $121.1 \approx r^2$. The student then could have solved for $r$ by taking the square root of both sides of the equation, resulting in $r \approx \sqrt{121.1} \approx 11$. The student then could have determined that the radius of the base of the cone is approximately 11 centimeters. To determine the measurement closest to the diameter, the student should have multiplied the radius by 2, resulting in $11(2) = 22$. The student then could have concluded that the diameter of the base of the cone is approximately 22 centimeters. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |
| | Option B is incorrect | The student likely determined the measure of the radius instead of the diameter, resulting in 11 centimeters. The student needs to focus on attending to the details of the question in the problem. |
| | Option C is incorrect | The student likely used the formula for the volume of a cylinder ($V = Bh$) instead of the volume of a cone, resulting in $1{,}647 = \pi r^2(13)$, or $1{,}647 \approx 40.8r^2$. The student likely solved for $r^2$ by dividing both sides of the equation by 40.8, resulting in $40.4 \approx r^2$. Next, the student likely solved for $r$ by taking the square root of both sides of the equation, resulting in $r \approx \sqrt{40.4} \approx 6.36$. The student then likely multiplied the value of $r$ by 2 to determine the diameter, resulting in $6.36(2) \approx 12.7$ centimeters. The student needs to focus on understanding the formula for the volume of a cone. |
| | Option D is incorrect | The student likely used the formula for the volume of a cylinder ($V = Bh$) to calculate the radius instead of using the formula for the volume of a cone to calculate the diameter, resulting in $1{,}647 = \pi r^2(13)$, or $1{,}647 \approx 40.8r^2$. The student likely solved for $r^2$ by dividing both sides of the equation by 40.8, resulting in $40.4 \approx r^2$. Next, the student likely solved for $r$ by taking the square root of both sides of the equation, resulting in $r \approx \sqrt{40.4} \approx 6.4$ centimeters. The student needs to focus on understanding the formula for the volume of a cone. |

| Item Position | Rationales | |
|---|---|---|
| 36 | Option A is correct | To determine which statement about the equation is true, the student should have recognized that non-proportional relationships have graphs that do not pass through the origin, (0, 0). The student could have substituted $x = 0$ into the equation and obtained $y = \frac{1}{2}(0) - 0.5$, or $y = -0.5$. The student could have concluded that the graph contains the point (0, −0.5) and not the point (0, 0). The student then could have concluded that the equation describes a non-proportional relationship because the point (0, −0.5) is a solution. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |
| | Option B is incorrect | The student likely interpreted a non-proportional relationship as having a fractional slope (steepness of a straight line when graphed on a coordinate grid). The student needs to focus on understanding the definitions of proportional and non-proportional relationships. |
| | Option C is incorrect | The student likely multiplied by −0.5 instead of subtracting 0.5 when substituting $x = 0$ into the equation, resulting in $y = \frac{1}{2}(0)(-0.5)$, or $y = 0$. The student then likely concluded that the equation describes a proportional relationship (a relationship in which the graph increases or decreases at a constant rate and passes through the origin) because the point (0, 0) is a solution. The student needs to focus on understanding the definitions of proportional and non-proportional relationships. |
| | Option D is incorrect | The student likely recognized that the graph of the equation would increase at a constant rate and concluded that the equation describes a proportional relationship because it has a constant slope of $\frac{1}{2}$. However, the student likely did not recognize that the graph would pass through the point (0, −0.5) instead of the point (0, 0). The student needs to focus on understanding the definitions of proportional and non-proportional relationships. |

| Item Position | Rationales | |
|---|---|---|
| 37 | Option B is correct | To determine the total surface area (the sum of the areas of the surfaces of a three-dimensional figure) of the rectangular prism, the student could have used the formula for the total surface area of a prism ($S = Ph + 2B$, where $S$ represents the total surface area, $P$ represents the perimeter of the base, $B$ represent the area of the base, and $h$ represents the height). The student could have determined that the perimeter of the base of the rectangular prism is $P = 2(12) + 2(24) = 72$ inches. The student could have determined that the area of the base of the rectangular prism is $B = 12(24) = 288$ square inches. Substituting $P = 72$, $B = 288$, and $h = 12$ into $S = Ph + 2B$, the student could have obtained $S = 72(12) + 2(288) = 1{,}440$. The student then could have concluded that the total surface area of the rectangular prism is 1,440 square inches. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |
| | Option A is incorrect | The student likely determined the lateral surface area (the sum of the areas of the lateral rectangular faces in a prism) of the rectangular prism using the formula $S = Ph$. Substituting $P = 72$ and $h = 12$ into $S = Ph$, the student likely obtained $S = 72(12) = 864$ square inches. The student needs to focus on understanding the formula for the total surface area of a prism. |
| | Option C is incorrect | The student likely did not multiply the area of the base by 2, resulting in $S = 72(12) + (288) = 1{,}152$ square inches. The student needs to focus on understanding the formula for the total surface area of a prism. |
| | Option D is incorrect | The student likely determined the volume of the rectangular prism using the formula $V = Bh$. Substituting $B = 288$ and $h = 12$ into $V = Bh$, the student likely obtained $V = 288(12) = 3{,}456$. The student needs to focus on understanding the formula for the total surface area of a prism. |

| Item Position | Rationales | |
|---|---|---|
| 38 | Option D is correct | To determine which list of values is ordered from least to greatest, the student could have first converted each value in the list to a decimal representation. The decimal representations are: 7.42; $\frac{38}{5}$ = 7.6; $\sqrt{61}$ ≈ 7.8; and 745% = 7.45. Since 7.42 < 7.45 < 7.6 < 7.8, the student could have concluded that the list of values in order from least to greatest is 7.42, 745%, $\frac{38}{5}$, $\sqrt{61}$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly. |
| | Option A is incorrect | The student likely ignored the percent sign and used 745 instead of 7.45 when converting 745% to a decimal representation. The student then likely ordered the list of values from least to greatest. The student needs to focus on determining the values of different types of numbers (percentages, fractions, square roots, etc.) and ordering the numbers by value. |
| | Option B is incorrect | The student likely reversed the order and chose the list of values ordered from greatest to least. The student needs to focus on ordering numbers according to the details in the problem. |
| | Option C is incorrect | The student likely ignored the percent sign and used 745 instead of 7.45 when converting 745% to a decimal representation. The student then likely ordered the list of values from greatest to least. The student needs to focus on determining the values of different types of numbers (percentages, fractions, square roots, etc.) and ordering the numbers according to the details in the problem. |

| Item Position | Rationales | |
|---|---|---|
| 39 | Option C is correct | To determine which transformation does NOT preserve congruence, the student should have recognized that a transformation preserves congruence if the image is the same size and shape as the pre-image. The student should have determined that a dilation (resize) by a scale factor of 4 with the origin, (0, 0), as the center of dilation produces a figure that is the same shape but is enlarged in size. The student should have concluded that a dilation with a scale factor of 4 does not preserve congruence. |
| | Option A is incorrect | The student likely misunderstood the effect a reflection (flip) has on a figure and interpreted a reflection over the $x$-axis as not preserving congruence. The student needs to focus on understanding when a transformation preserves and does not preserve congruence. |
| | Option B is incorrect | The student likely misunderstood the effect a reflection has on a figure and interpreted a reflection over the $y$-axis as not preserving congruence. The student needs to focus on understanding when a transformation preserves and does not preserve congruence. |
| | Option D is incorrect | The student likely misunderstood the effect a rotation (circular movement) has on a figure and interpreted a clockwise rotation with center (0, 0) as not preserving congruence. The student needs to focus on understanding when a transformation preserves and does not preserve congruence. |

| Item Position | Rationales | |
|---|---|---|
| 40 | Option D is correct | To determine which function can be used to find *c*, the total cost in dollars to make *p* products, the student could have represented the situation with a linear equation in slope-intercept form ($y = mx + b$, where *m* represents the slope [steepness of a straight line when graphed on a coordinate grid] and *b* represents the *y*-intercept [value where a line crosses the *y*-axis {vertical number line}]). The student could have recognized that the rate of change (constant rate of increase or decrease) of the cost per product is $15.25 and can be represented as $m = 15.25$. The student then could have recognized that the fixed cost, or initial value (the value of *y* when $x = 0$), is $3,050 and can be represented as $b = 3{,}050$. Substituting $m = 15.25$ and $b = 3.050$ into $y = mx + b$, the student could have obtained the equation $y = 15.25x + 3{,}050$. Since the dependent variable, *c*, represents the total cost and the independent variable, *p*, represents the number of products, the student could have concluded that the function $c = 15.25p + 3{,}050$ represents this situation. |
| | Option A is incorrect | The student likely divided the fixed cost by the cost per product to determine the value of *m*, resulting in $m = 3{,}050 \div 15.25 = 200$. Next, the student likely substituted $m = 200$ and $b = 3{,}050$ into $y = mx + b$, resulting in the equation $y = 200x + 3{,}050$. The student then likely rewrote the equation using the variables *c* and *p*, resulting in $c = 200p + 3{,}050$. The student needs to focus on understanding how to write an equation in the form $y = mx + b$ to model a linear relationship between two quantities from a verbal description. |
| | Option B is incorrect | The student likely divided the fixed cost by the cost per product to determine the value of *b*, resulting in $b = 3{,}050 \div 15.25 = 200$. Next, the student likely substituted $m = 15.25$ and $b = 200$ into $y = mx + b$, resulting in the equation $y = 15.25x + 200$. The student then likely rewrote the equation using the variables *c* and *p*, resulting in $c = 15.25p + 200$. The student needs to focus on understanding how to write an equation in the form $y = mx + b$ to model a linear relationship between two quantities from a verbal description. |
| | Option C is incorrect | The student likely switched the values for the rate of change and the fixed cost, resulting in $c = 3{,}050p + 15.25$. The student needs to focus on understanding how to write an equation in the form $y = mx + b$ to model a linear relationship between two quantities from a verbal description. |