

Item Position	Rationales	
1	Option A is correct	To determine the best prediction for the number of snow cones sold if the daily high temperature is 100 °F, based on the scatterplot (a graph of plotted points that shows the relationship between two sets of data), the student could have drawn a line of best fit (trend line) that closely follows the pattern formed by the points on the graph, by keeping about half of 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 (79, 42) and (85, 48). Next, the student could have identified that the grid line marked 100 on the x-axis (horizontal number line), which represents 100 °F, intersects (crosses) the line of best fit when the y-coordinate is close to 60. The student could have concluded that 60 is the best prediction for the number of snow cones sold on a day when the high temperature is 100 °F. 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 that the line of best fit passes through the data points (75, 40) and (90, 58). The student likely determined that the grid line for 100 °F would intersect the trend line near the point (100, 70), and therefore 70 would be the best prediction for the number of snow cones sold on a day when the high temperature is 100 °F. 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 that the line of best fit passes through the data points (75, 40) and (79, 42) given on the graph. The student likely determined that the grid line for 100 °F would intersect the trend line near the point (100, 50), and therefore 50 would be the best prediction for the number of snow cones sold on a day when the high temperature is 100 °F. 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 used the data point for the highest recorded temperature, which shows 55 snow cones sold on a day when the high temperature was 95 °F. The student likely determined that the number of snow cones sold on a day that when the high temperature is 100 °F would be the same as the number sold on a day when it is 95 °F, and therefore 55 is a reasonable prediction for the number of snow cones sold if the daily high temperature is 100 °F. 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	
2	4, 5	To determine which two consecutive numbers the value of $\sqrt{21}$ is between on the number line, the student could have determined that the perfect squares (numbers that can be expressed as the product of two equal integers) closest to 21 are 16 and 25, and therefore, the value of $\sqrt{21}$ must be between the values of $\sqrt{16}$ and $\sqrt{25}$. The student then could have evaluated $\sqrt{16} = 4$ and $\sqrt{25} = 5$ and therefore concluded that the value of $\sqrt{21}$ must be between the consecutive numbers 4 and 5. 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 rule best represents the dilation that was applied to pentagon $MNPQR$ to create pentagon $M'N'P'Q'R'$, 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 with the origin (the point of intersection of the axes in a coordinate system) as the center of dilation means that the coordinates of each point on the dilated figure will be the product (result of a multiplication expression) of the scale factor and the coordinates of the corresponding point on the original figure. The student could have compared the ordered pairs that represent the vertices (points where two or more rays or line segments intersect) of pentagon $MNPQR$ and the corresponding vertices of pentagon $M'N'P'Q'R'$. Since point P is represented by the ordered pair $(2.5, 1)$, and point P' is represented by the ordered pair $(5, 2)$, the student could have determined the scale factor of the dilation by dividing the value of each coordinate of the dilated pentagon by the corresponding coordinate of the original pentagon, resulting in a scale factor of $\frac{5}{2.5} = 2$ or $\frac{2}{1} = 2$. The student should have concluded that the rule $(x, y) \rightarrow (2x, 2y)$ describes the dilation. 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 recognized that point N' , $(0, 4)$, is 2 units above corresponding point N , $(0, 2)$. The student likely wrote the rule for a translation (slide) 2 units up, resulting in $(x, y) \rightarrow (x, y + 2)$. 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 recognized that point N , $(0, 2)$, is 2 units below point N' , $(0, 4)$. The student likely wrote the rule for a translation (slide) 2 units down, resulting in $(x, y) \rightarrow (x, y - 2)$. 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 divided the x - and y -coordinates of point P by the x - and y -coordinates of point P' , resulting in $\frac{2.5}{5} = \frac{1}{2}$. The student likely concluded that the rule $(x, y) \rightarrow (\frac{1}{2}x, \frac{1}{2}y)$ describes the dilation. The student needs to focus on understanding the effect a dilation by

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		a given scale factor has on a figure and how to determine the rule to explain the effect.
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Item Position	Rationales	
4	Option D is correct	To determine which equation represents the linear relationship shown in the table, the student could have determined the slope (steepness of a straight line when graphed on a coordinate grid), m , and y -intercept (value where a line crosses the y -axis), b , and substituted the values into the slope-intercept form for a linear equation, $y = mx + b$. The student could have used the first two points in the table, $(-6, 0.5)$ and $(0, 2.5)$, and the slope formula, $m = \frac{y_2 - y_1}{x_2 - x_1}$, to determine the slope of the line, resulting in $m = \frac{2.5 - 0.5}{0 - (-6)} = \frac{2}{6} = \frac{1}{3}$. Next, the student could have recognized that the y -coordinate of the second point in the table, $(0, 2.5)$, represents the y -intercept, b . The student then could have rewritten 2.5 as a fraction, $\frac{5}{2}$, and then substituted $m = \frac{1}{3}$ and $b = \frac{5}{2}$ into the slope-intercept equation, resulting in $y = \frac{1}{3}x + \frac{5}{2}$. 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 y -value from the first point in the table, 0.5, or $\frac{1}{2}$, as the y -intercept, resulting in the equation $y = \frac{1}{3}x + \frac{1}{2}$. 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 table.
	Option B is incorrect	The student likely substituted the y -intercept for m and substituted the slope for b , in the slope-intercept formula, resulting in $y = \frac{5}{2}x + \frac{1}{3}$. 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 table.
	Option C is incorrect	The student likely used the y -value from the second point in the table, $(0, 2.5)$, or $\frac{5}{2}$, as the slope and the y -value from the first point in the table, 0.5, or $\frac{1}{2}$, as the y -intercept, resulting in $y = \frac{5}{2}x + \frac{1}{2}$. 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 table.

Item Position	Rationales	
5	Option B is correct	To determine the value of x in meters, the student should have recognized that x represents the length of a leg of the right triangle. 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 a right triangle and c represents the length of the hypotenuse (the longest side, opposite the 90° angle in the right triangle). The student could have recognized that one leg of the triangle has a length of 2.1 meters, and the hypotenuse of the triangle has a length of 3.5 meters. The student could have substituted $a = 2.1$ and $c = 3.5$ into $a^2 + b^2 = c^2$, resulting in $2.1^2 + b^2 = 3.5^2$, or $4.41 + b^2 = 12.25$. Next, the student could have solved for b^2 by subtracting 4.41 from both sides of the equation, resulting in $b^2 = 7.84$. The student then could have solved for b by taking the square root of both sides of the equation, resulting in $b = \sqrt{7.84} = 2.8$, which means that $x = 2.8$ m. 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 substituted $a = 2.1$ and $c = 3.5$ into $a^2 + b^2 = c^2$, resulting in $2.1^2 + b^2 = 3.5^2$, or $4.41 + b^2 = 12.25$, but then added 4.41 to 12.25 instead of subtracting, resulting in $b^2 = 16.66$. The student then likely took the square root of both sides of the equation, resulting in $b = \sqrt{16.66} \approx 4.1$, and concluded that $x \approx 4.1$ m. 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 given side lengths of the triangle, resulting in $3.5 - 2.1 = 1.4$ m. The student needs to focus on understanding how to apply the Pythagorean theorem with the given information.
	Option D is incorrect	The student likely added the given side lengths of the triangle, resulting in $3.5 + 2.1 = 5.6$ m. The student needs to focus on understanding how to apply the Pythagorean theorem with the given information.

Item Position	Rationales	
6	Option C 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 the assembly line that moves items 6 feet every 15 seconds, the student could have first determined that the relationship between the number of feet the line moves and the number of seconds is proportional and represents a unit rate, and that the ratio of the y-coordinate to the x-coordinate is equivalent for all ordered pairs on the graph. To determine the unit rate, the student could have divided the number of feet the assembly line moves by the number of seconds, resulting in $\frac{6}{15} = \frac{2}{5}$ foot per second. Since the relationship is proportional, and all proportional graphs pass through the origin, the student could have recognized that the graph contains the point $(0, 0)$. The student could have recognized that since the unit rate is $\frac{2}{5}$, the graph has a slope of $\frac{2}{5}$ and contains the point $(5, 2)$. 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 x-value of 6, the given number of feet. The student needs to focus on understanding how unit rates are represented on graphs.
	Option B is incorrect	The student likely divided the number of seconds by the number of feet the assembly line moves, resulting in $\frac{15}{6} = \frac{5}{2}$. The student likely chose the graph that has a slope of $\frac{5}{2}$ and contains the points $(0, 0)$ and $(2, 5)$. The student needs to focus on understanding how unit rates are represented on graphs.
	Option D is incorrect	The student likely used the information given to create an ordered pair, $(15, 6)$, and identified a non-proportional relationship that includes the point $(15, 6)$. The student needs to focus on understanding how unit rates are represented on graphs.

Item Position	Rationales	
7	Option D is correct	To determine the measurement closest to the volume of the soap bubble in cubic millimeters, the student should have substituted the radius (distance from the center of the sphere to a point on the sphere) of the sphere into the formula for the volume of a sphere, $V = \frac{4}{3}\pi r^3$, where V represents volume and r represents radius. To calculate the radius, the student should have divided the given diameter (straight line that goes through the center of the sphere and connects two points on the sphere), 9 millimeters, by 2, resulting in $\frac{9}{2} = 4.5$ mm. The student then should have substituted $r = 4.5$ into the formula for the volume of a sphere, resulting in $V = \frac{4}{3}\pi(4.5)^3 \approx 382 \text{ mm}^3$.
	Option A is incorrect	The student likely used the formula for the area of a circle, $A = \pi r^2$, where A represents the area of the circle and r represents the radius, instead of the formula for the volume of a sphere. The student likely used the given diameter as the radius and substituted $r = 9$ into the formula for the area of a circle, resulting in $A = \pi(9)^2 \approx 254 \text{ mm}^2$. The student needs to focus on understanding the formula for the volume of a sphere.
	Option B is incorrect	The student likely did not multiply by pi (π) in the formula for the volume of a sphere, resulting in $V = \frac{4}{3}(4.5)^3 \approx 122 \text{ mm}^3$. The student needs to focus on understanding the formula for the volume of a sphere.
	Option C is incorrect	The student likely used the formula for the area of a circle, $A = \pi r^2$, and substituted $r = 4.5$ into that formula, resulting in $A = \pi(4.5)^2 \approx 64 \text{ mm}^2$. The student needs to focus on understanding the formula for the volume of a sphere.

Item Position	Rationales	
8	8, 4	To determine the original amount of the chemical in the tank, the student could have first calculated the rate at which the chemical is pumped. To determine that rate in liters per minute, the student could have determined the rate of change (ratio of the change in y-values to the change in x-values) of the number of liters of the chemical in the tank with respect to the number of minutes. To determine the rate of change, the student could have divided the change in y-values by the change in x-values using any two ordered pairs from the table. Using the ordered pairs (2, 16) and (5, 28), the student could have determined that the change in the y-values is $28 - 16 = 12$, and the change in x-values is $5 - 2 = 3$. Next, the student could have divided the change in y-values by the change in x-values, resulting in $\frac{12}{3} = 4$ liters per minute.
		To determine the volume of the chemical already in the tank before pumping began, the student could have determined the initial value (the value of y when $x = 0$) by substituting the slope (rate of change) and a pair of x- and y-values from the table into the slope-intercept formula, $y = mx + b$, where m represents the rate of change and b represents the initial value, and then solving for b. Using the point (2, 16), the student could have substituted $m = 4$, $x = 2$, $y = 16$ into the formula, resulting in $16 = 4(2) + b$. The student then could have solved for b by multiplying 4 by 2 and subtracting the product (result of a multiplication expression) from both sides of the equation, resulting in $8 = b$. The student could have concluded that the original amount of chemical in the tank was 8 liters. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item Position	Rationales	
9	Option A is correct	To determine the measurement closest to the height of the rectangular prism in centimeters, the student should have used the formula for the total surface area (the sum [the result when two or more quantities are added together] of the areas of the faces of a three-dimensional figure) of a prism, $S = Ph + 2B$, where S represents the total surface area, P represents the perimeter of the base, h represents the height, and B represents the area of the base. The student should have determined that the perimeter of the rectangular base is the sum of the side lengths: $P = 8 + 6 + 8 + 6 = 28$ centimeters. The student then should have found the area of the base by multiplying the length by the width, resulting in $(8)(6) = 48$ square centimeters. The student then should have substituted $S = 362$, $P = 28$, and $B = 48$ into the surface area formula, resulting in $362 = 28h + 2(48)$. The student should have solved the equation for h by multiplying 2 by 48 and subtracting the product (result of a multiplication expression) from both sides of the equation. This results in the equation $266 = 28h$. The student then should have divided both sides of the equation by 28, resulting in $h = 9.5$ centimeters.
	Option B is incorrect	The student likely used the formula for the lateral surface area of a prism, $S = Ph$, and substituted $S = 362$ and $P = 28$ into the formula, resulting in $362 = 28h$. The student then likely solved for h by dividing both sides of the equation by 28, resulting in approximately 12.9 centimeters. The student needs to focus on understanding and properly applying the formula for the total surface area of a figure.
	Option C is incorrect	The student likely used the formula for the volume of a rectangular prism, $V = Bh$, where V represents the volume of the prism, B represents the area of the base, and h represents the height. The student likely substituted $V = 362$ and $B = 48$ into the formula, resulting in $362 = 48h$. The student then likely solved for h by dividing both sides of the equation by 48, resulting in approximately 7.5 centimeters. The student needs to focus on understanding and properly applying the formula for the total surface area of a figure.
	Option D is incorrect	The student likely substituted $S = 362$, $P = 28$, and $B = 48$ into the formula for the total surface area of a prism but did not multiply B by 2 before solving for h, resulting in $362 = 28h + 48$. The student then likely subtracted 48 from both sides of the equation, resulting in $314 = 28h$, and then divided both sides of the equation by 28, resulting in approximately 11.2 centimeters. The student needs to focus on

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		understanding and properly applying the formula for the total surface area of a figure.
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Item Position	Rationales	
10	Non-proportional, Proportional, Proportional, Non-proportional	To determine whether the discount “Buy 2 shirts, get 1 shirt free” represents a proportional relationship or non-proportional relationship, the student should have recognized that proportional relationships increase or decrease at a constant rate and have graphs that go through the origin (the point of intersection of the axes in a coordinate system), (0, 0). The student could have developed a table of ordered pairs (x, y) to represent the situation, where x represents the number of shirts and y represents the total cost. Since the price of each shirt is \$8.00 and with every 2 shirts purchased, 1 shirt is free, the student could have determined that the points (0, 0), (1, 8), (2, 16), (3, 16), (4, 24), (5, 32), and (6, 32) represent the situation. The student could have recognized that these points do not increase at a constant rate, and therefore the relationship is non-proportional. To determine whether the discount “\$1.50 off each shirt” represents a proportional relationship or non-proportional relationship, the student could have determined that \$1.50 off each shirt creates a rate of \$6.50 per shirt and that if 0 shirts were purchased, the cost would be \$0.00. Since the situation has a constant rate and the graph of the line representing this situation passes through the origin, the relationship is proportional. To determine whether the discount “10% off the total amount of each purchase” represents a proportional relationship or non-proportional relationship, the student could have determined that 10% off the total amount of each purchase would create a rate of $8(1 - 0.1) = \\$7.20$ per shirt, and that if 0 shirts were purchased, the cost would be \$0.00. Since the situation has a constant rate and the graph of the line representing this situation passes through the origin, the relationship is proportional. To determine whether the discount “\$2.00 off the total amount of each purchase” represents a proportional relationship or non-proportional relationship, the student could have developed a table to represent the situation, where the cost of each purchase was \$2.00 off the total. The student could have determined that the points (0, 0), (1, 6), (2, 14), (3, 22), and (4, 30) represent the situation. The student could have recognized that these points do not increase at a constant rate, and therefore the relationship is non-proportional.

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		This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
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Item Position	Rationales	
11	Option B is correct	To determine the balance in Ms. Gleason's account at the end of 6 years, the student should have used the formula for compound interest, $A = P(1 + r)^t$, where A represents the account balance in dollars, P represents the principal in dollars, r represents the interest rate in decimal form, and t represents time in years. The student should have found the ending balance after 6 years by substituting $P = 4,800$, $r = 0.006$, and $t = 6$ into the formula, resulting in $A = (4,800)(1.006)^6 \approx \$4,975.41$.
	Option A is incorrect	The student likely moved the decimal point one place to the left when converting 0.6% to a decimal value, resulting in $A = (4,800)(1.06)^6 \approx \$6,808.89$. 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 simple interest, $I = Prt$, where I represents the interest earned, P represents the principal in dollars, r represents the interest rate in decimal form, and t represents time in years. The student likely moved the decimal point one place to the left when converting 0.6% to a decimal and substituted $P = 4,800$, $r = 0.06$, and $t = 6$ into the simple interest formula, resulting in $I = (4,800)(0.06)(6) = \$1,728$. The student then likely added the interest earned to the initial principal, resulting in $1,728 + 4,800 = \$6,528.00$. The student needs to focus on attending to the details of the question in the problem and understanding how to calculate compound interest.
	Option D is incorrect	The student likely used the formula for simple interest and substituted $P = 4,800$, $r = 0.006$, and $t = 6$ into the formula $I = Prt$, resulting in $I = (4,800)(0.006)(6) = \172.80 . The student then likely added the interest earned to the initial principal, resulting in $172.80 + 4,800 = \$4,972.80$. 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	
12	Option D is correct	To determine the value of y when $x = 12\frac{3}{8}$, the student should have used the direct variation formula, $y = kx$, where k represents the constant of proportionality, to find the missing value. The student first should have substituted $x = 2\frac{1}{4}$ and $y = \frac{2}{3}$ into the direct variation formula, resulting in $\frac{2}{3} = 2\frac{1}{4}k$. The student should have solved for k by dividing both sides of the equation by $2\frac{1}{4}$, resulting in $k = \frac{8}{27}$. The student then should have concluded that the equation representing this relationship is $y = \frac{8}{27}x$. Next, the student should have substituted $x = 12\frac{3}{8}$ into the equation $y = \frac{8}{27}x$ to determine the value of y , resulting in $y = \frac{8}{27}\left(12\frac{3}{8}\right) = 3\frac{2}{3}$.
	Option A is incorrect	The student likely reversed the given values of x and y and substituted $x = \frac{2}{3}$ and $y = 2\frac{1}{4}$ into the direct variation formula, resulting in $2\frac{1}{4} = \frac{2}{3}k$. The student then likely solved for k by dividing both sides of the equation by $\frac{2}{3}$, resulting in $k = 3\frac{3}{8}$. The student likely considered $3\frac{3}{8}$ to be the value of y when $x = 12\frac{3}{8}$. The student needs to focus on understanding the application of direct variation.
	Option B is incorrect	The student likely reversed the given values of x and y and substituted $x = \frac{2}{3}$ and $y = 2\frac{1}{4}$ into the direct variation formula, resulting in $2\frac{1}{4} = \frac{2}{3}k$. The student then likely solved for k by dividing both sides of the equation by $\frac{2}{3}$, resulting in $k = 3\frac{3}{8}$. The student then likely concluded that the equation representing this relationship is $y = 3\frac{3}{8}x$. Next, the student likely substituted $x = \frac{2}{3}$ into the equation $y = 3\frac{3}{8}x$ to determine the value of y , resulting in $y = 3\frac{3}{8}\left(\frac{2}{3}\right) = 2\frac{1}{4}$. The student needs to focus on understanding the application of direct variation.
	Option C is incorrect	The student likely used the given x -values and substituted $x = 2\frac{1}{4}$ and $y = 12\frac{3}{8}$ into the direct variation formula, resulting in $12\frac{3}{8} = 2\frac{1}{4}k$. The student likely solved for k by dividing both sides of the equation by $2\frac{1}{4}$, resulting in $k = 5\frac{1}{2}$, and then likely considered $5\frac{1}{2}$ to be the value of y when $x = 12\frac{3}{8}$. The student needs to focus on understanding the application of direct variation.

Item Position	Rationales	
13	$1.8, \sqrt{3}, 167\%, \frac{3}{2}$	To determine the placement of the values in order from greatest to least, the student could have first converted each value in the list to a decimal representation. The decimal representations are: $167\% = 1.67$; 1.8; $\frac{3}{2} = 1.5$; and $\sqrt{3} \approx 1.732$. Since $1.8 > 1.732 > 1.67 > 1.5$, the student could have concluded that the values in order from least to greatest are $1.8, \sqrt{3}, 167\%, \frac{3}{2}$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item Position	Rationales	
14	Option B is correct	To determine the amount of total sales that would make the monthly earnings at Company P and at Company Q be equal, the student could have written two expressions (the sum [the result when two or more quantities are added together] of products of numbers and variables) that describe the total monthly earnings at the two companies. Since Genevieve would earn \$1,462.50 plus 4% of her total sales each month, x, at Company P, the student could have determined that the expression representing the amount in dollars that Genevieve would earn each month at Company P is $0.04x + 1,462.50$. Since she would earn \$871.20 plus 6.5% of her total sales each month, x, at Company Q, the student could have determined that the expression representing the amount she would earn each month at Company Q is $0.065x + 871.20$. To determine the amount of sales in dollars, x, required for the monthly earnings to be equal at the two companies, the student could have set these expressions equal to each other, resulting in the equation $0.04x + 1,462.50 = 0.065x + 871.20$. To solve this equation for x, the student could have first subtracted $0.04x$ from both sides of the equation, resulting in $1,462.50 = 0.025x + 871.20$, and then subtracted 871.20 from both sides of the equation, resulting in $591.30 = 0.025x$. Next, the student could have solved for x by dividing both sides of the equation by 0.025, resulting in $23,652.00 = x$. The student could have determined that when the amount of total sales is \$23,652.00, the monthly earnings at the two companies will be equal. 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 added the monthly salaries at the two companies, $1,462.50 + 871.20 = 2,333.7$, and multiplied by the sum of the given percentages, $4 + 6.5$, resulting in $(2,333.7)(10.5)$. The student likely made a place-value error by transposing the digits in the ten-thousands place and ones place of the product, resulting in \$23,504.85. The student needs to focus on using the proper steps to solve an equation.
	Option C is incorrect	The student likely set up the correct equation, $0.04x + 1,462.50 = 0.065x + 871.20$, but did not use inverse operations when solving. The student likely added $0.04x$ and $0.065x$ and set the sum equal to the sum of 1,462.50 and 871.20, resulting in $0.105x = 2,333.7$. The student then likely divided both sides of the equation by 0.105, resulting in approximately \$22,225.7. The student then likely made a rounding error and determined that the 5 should round up to a 6, and a 6 should be placed before the 7,

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		resulting in \$22,226.67. The student needs to focus on using the proper steps to solve an equation.
	Option D is incorrect	The student likely recognized that the percentages would need to be converted to decimals by moving the decimal point but applied this concept to both the monthly amounts earned and the percentages. The student likely moved the decimal points in \$1,462.50 and \$871.20 one place to the right, resulting in \$14,625 and \$8,712, and then added those values, resulting in $14,625 + 8,712 = \$23,337$. The student then likely converted 4% to 0.04 and incorrectly converted 6.5% to 0.06. The student likely added these two decimals, resulting in $0.04 + 0.06 = 0.10$, and moved the decimal point one place to the right, resulting in 1. The student likely added \$23,337 and 1 for a final result of \$23,338.00. The student needs to focus on using the proper steps to solve an equation.

Item Position	Rationales	
15	Option C is correct	To determine which statement best explains why the balance of the investment account will continue to increase over time, the student should have recognized that the account earns 3.2% interest compounded annually and that a deposit of \$600.00 is made each year. Therefore, the student should have concluded that the balance increases when deposits are made and when interest is earned.
	Option A is incorrect	The student likely concluded that the balance of the account increases only when deposits are made, disregarding the interest earned. The student needs to focus on understanding different ways account balances can grow over time.
	Option B is incorrect	The student likely concluded that the balance of the account increases only when interest is earned, disregarding the deposits made. The student needs to focus on understanding different ways account balances can grow over time.
	Option D is incorrect	The student likely determined that there was not enough information to determine why the balance of the account increases. The student needs to focus on understanding different ways account balances can grow over time.

Item Position	Rationales	
16	Second option is correct	To determine which rules could describe the transformation, the student should have recognized that the transformation that would move one vertex of a triangle from Quadrant I to Quadrant IV could be a translation, a rotation 90° clockwise about the origin (the point of intersection of the axes in a coordinate system), or a reflection over the x -axis. The student then should have recognized that the rule $(x,y) \rightarrow (y,-x)$ represents a rotation 90° clockwise about the origin, which would move one vertex of the triangle from Quadrant I to Quadrant IV.
	Fourth option is correct	To determine which rules could describe the transformation, the student should have recognized that the transformation that would move one vertex of a triangle from Quadrant I to Quadrant IV could be a translation, a rotation 90° clockwise about the origin (the point of intersection of the axes in a coordinate system), or a reflection over the x -axis. The student then should have recognized that the rule $(x,y) \rightarrow (x,-y)$ represents a reflection over the x -axis, which would move one vertex of the triangle from Quadrant I to Quadrant IV.
	First option is incorrect	The student likely determined that the rule $(x,y) \rightarrow (-x,y)$ represents a reflection over the x -axis instead of a reflection over the y -axis. The student needs to focus on interpreting the rules for transformations.
	Option C is incorrect	The student likely determined that a rotation of 180° , represented by the rule $(x,y) \rightarrow (-x,-y)$, would move one vertex of a triangle from Quadrant I to Quadrant IV. The student needs to focus on interpreting the rules for transformations.
	Fifth option is incorrect	The student likely determined that the rule $(x,y) \rightarrow (-y,x)$ represents a rotation 90° clockwise about the origin instead of a rotation 90° counterclockwise about the origin. The student needs to focus on interpreting the rules for transformations.

Item Position	Rationales	
17	Option D is correct	To determine which proportion shows that the slope (steepness of a straight line when graphed on a coordinate grid) of $\overline{LN}$ is equal to the slope of $\overline{NW}$, the student could have determined the slope of each line segment using the formula for slope of a line, $m = \frac{y_2 - y_1}{x_2 - x_1}$. For $\overline{LN}$, which has endpoints $(-4, 5)$ and $(-1, 3)$, the student could have written the slope as $m = \frac{3-5}{-1+4} = -\frac{2}{3}$. For $\overline{NW}$, which has endpoints $(-1, 3)$ and $(5, -1)$, the student could have written the slope as $m = \frac{-1-3}{5+1} = -\frac{4}{6} = -\frac{2}{3}$. Therefore, the proportion $\frac{3-5}{-4+4} = \frac{-1-3}{5+1}$ shows that the slopes of the two line segments are equal. 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 compared the slopes of $\overline{LM}$ and $\overline{WV}$. The student likely wrote the slope of $\overline{LM}$, which has endpoints $(-4, 5)$ and $(-1, 5)$, as $m = \frac{5-5}{-1+4} = \frac{0}{3} = 0$, and the slope of $\overline{WV}$, which has endpoints $(5, -1)$ and $(-1, 5)$, as $m = \frac{-1+1}{5+1} = \frac{0}{6} = 0$. The student needs to focus on using the correct sides of the triangle to show that the slopes are equal.
	Option B is incorrect	The student likely found the sum (the result when two or more quantities are added together) of the y-values and the sum of the x-values when calculating the slopes. The student likely wrote the slope of $\overline{LN}$, which has endpoints $(-4, 5)$ and $(-1, 3)$, as $m = \frac{3+5}{-1+(-4)} = \frac{3+5}{-1-4} = -\frac{8}{5}$, and the slope of $\overline{NW}$, which has endpoints $(-1, 3)$ and $(5, -1)$, as $m = \frac{-1+3}{5-1} = \frac{2}{4} = \frac{1}{2}$. The student likely did not notice that the values of the expressions are not equal. The student needs to focus on correctly using the formula for the slope of a line.
	Option C is incorrect	The student likely compared the slopes of $\overline{MN}$ and $\overline{VN}$. The student likely wrote the slope of $\overline{MN}$, which has endpoints $(-1, 5)$ and $(-1, 3)$, as $m = \frac{5-3}{-1+1} = \frac{2}{0}$, which is undefined, and wrote the slope of $\overline{VN}$, which has endpoints $(-1, -1)$ and $(-1, 3)$, as $m = \frac{-1-3}{-1+1} = -\frac{4}{0}$, which is also undefined. The student needs to focus on using the correct sides of the triangle to show that the slopes are equal.

Item Position	Rationales	
18	6.7, 5	To determine how the population is written in scientific notation, the student should have moved the decimal point 5 places to the left to create the number 6.7, which is between 1 and 10, and used the number of places the decimal point moved to the left as the power of 10, resulting in 6.7×10^5. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item Position	Rationales	
19	Option C is correct	To determine which set of ordered pairs does NOT represent 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 $x = 0$ corresponds to both $y = 5$ and $y = 7$, the student should have concluded that the set of ordered pairs $\{(-2, 3), (0, 5), (0, 7), (2, 9)\}$ does not represent y as a function of x .
	Option A is incorrect	The student likely recognized that the y -value of $y = 2$ corresponds to the x -values of $x = 0$, $x = 3$, $x = 6$, and $x = 9$, and determined that the ordered pairs did not represent y as a function of x . The student needs to focus on understanding the definition of a function.
	Option B is incorrect	The student likely determined that a set of ordered pairs with all negative x - and y -values could not represent y as a function of x . The student needs to focus on understanding the definition of a function.
	Option D is incorrect	The student likely determined that a set of ordered pairs where the x -values are equal to the y -values could not represent y as a function of x . The student needs to focus on understanding the definition of a function.

Item Position	Rationales	
20	Option A is correct	To determine which measurement is closest to the distance between the points in units, the student could have first determined that line segment PQ can be seen as the hypotenuse of a right triangle, where the vertex (points where two or more rays or line segments intersect) of the right angle would be located at $(11, 8)$. By counting units between the endpoints of the legs of the triangle, the student could have determined that the distance between the endpoints of the horizontal leg of the triangle is 10 units, and the distance between the endpoints of the vertical leg of the triangle is 6 units. The student could have substituted $a = 10$ and $b = 6$ into the Pythagorean theorem, $a^2 + b^2 = c^2$, where the variables 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 of the 90° angle), resulting in $10^2 + 6^2 = c^2$. The student then could have solved by finding the sum (the result when two or more quantities are added together) of 10^2 and 6^2 , resulting in $136 = c^2$, and then found the square root of both sides of the equation, resulting in $12 \approx c$. The student could have concluded that the distance between points P and Q is approximately 12 units. 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 mean (average) of the horizontal distance between the two points, 10, and the vertical distance between the two points, 6, by adding the values and dividing by 2, resulting in $\frac{6+10}{2} = \frac{16}{2} = 8$ units. The student needs to focus on understanding how to apply the Pythagorean theorem to determine the distance between two points.
	Option C is incorrect	The student likely added the horizontal distance, 10, and the vertical distance, 6 between points P and Q to determine the distance between the two points, resulting in 16 units. The student needs to focus on understanding how to apply the Pythagorean theorem to determine the distance between two points.
	Option D is incorrect	The student likely recognized the ordered pairs that represent point P , $(1, 8)$, and point Q , $(11, 14)$, and subtracted each x -value from the corresponding y -value, $8 - 1 = 7$ and $14 - 11 = 3$. The student then likely added 7 and 3, resulting in $7 + 3 = 10$ units. The student needs to focus on understanding how to apply the Pythagorean theorem to determine the distance between two points.

Item Position	Rationales	
21	Option D is correct	To determine the situation that can be represented by the inequality $40 + 8x > 60 + 4x$, the student should have first identified that the expression on the left side of the inequality has a rate of 8 and an initial value of 40, and that this expression must be greater than the expression on the right side, which has a rate of 4 and an initial value of 60. The student should have identified that the expression $40 + 8x$ can represent the situation in which Carmen began with \$40 saved and plans to save \$8 per week for x weeks, and that the expression $60 + 4x$ can represent the situation in which Dante began with \$60 saved and plans to save \$4 each week for x weeks. The student then should have recognized that the situation asks for the number of weeks, x , after which Carmen will have saved more money than Dante. This situation is represented by the inequality $40 + 8x > 60 + 4x$.
	Option A is incorrect	The student likely switched the rate and the initial value on each side of the inequality. The student needs to focus on understanding how to write a corresponding real-world problem when given a one-variable inequality with variables on both sides of the equation.
	Option B is incorrect	The student likely switched the rate and the initial value on each side of the inequality and switched which expression should be greater than the other. The student needs to focus on understanding how to write a corresponding real-world problem when given a one-variable inequality with variables on both sides of the equation.
	Option C is incorrect	The student likely switched which expression should be greater than the other. The student needs to focus on understanding how to write a corresponding real-world problem when given a one-variable inequality with variables on both sides of the equation.

Item Position	Rationales	
22	45 or any equivalent value	To determine the volume of the cone in cubic inches, in terms of π, the student should have used the formula for the volume of a cone, $V = \frac{1}{3}\pi r^2 h$, where V is the volume of the cone, r is the radius (distance from the center of a circle to a point on the circle) of the circular base, and h is the height of the cone. The student should have substituted $r = 3$ and $h = 15$ in the formula, resulting in $V = \frac{1}{3}\pi(3)^2(15) = \pi(45)$ or 45π cubic inches. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item Position	Rationales	
23	Option C is correct	To determine which equation can be used to find the total cost in dollars, y , of a gift basket that contains packaging material and x pears, 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), or rate of change, and b represents the y -intercept (value where a line crosses the y -axis [vertical number line]), or initial value. The student could have recognized that the rate of change (constant rate of increase or decrease) of the total cost of the gift basket is the cost per pear, $\frac{6.50}{5} = \$1.30$, which would be represented in the equation as 1.3. The student then could have recognized that the initial value (the value of y when $x = 0$) is the total cost of a gift basket containing 0 pears and is equal to the sum of the costs of the empty basket and the packaging material, resulting in $9.00 + 3.00 = \$12.00$. The student could have recognized that the rate of change is represented by m , the slope, and the initial value is represented by b , the y -intercept. The student could have substituted $m = 1.3$ and $b = 12$ into $y = mx + b$, resulting in $y = 1.3x + 12$. 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 cost of the empty basket as the initial value, excluding the cost of the packaging material, resulting in $y = 1.3x + 9$. 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 used the given cost of 5 pears, \$6.50, as the rate of change instead of calculating the price per pear, resulting in $y = 6.5x + 12$. 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 D is incorrect	The student likely used the given cost of 5 pears, \$6.50, as the rate of change instead of calculating the price per pear and used the cost of the packaging material as the initial value, excluding the cost of the empty basket, resulting in $y = 6.5x + 3$. 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.

Item Position	Rationales	
24	Option A is correct	To determine which values could represent the areas of Square 1 and Square 2 in square centimeters, 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 a square formed on each side of the triangle. Therefore, the student should have recognized the need to use the Pythagorean theorem, $a^2 + b^2 = c^2$, where the variables 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), to answer the question. The student should have recognized that the areas of Square 1 and Square 2 are represented by the values a^2 and b^2 , and the area of Square 3 is represented by c^2 . Since the sum (the result when two or more quantities are added together) of the areas of Square 1 and Square 2 must equal the area of Square 3 according to the Pythagorean theorem, the student should have used the given side length, 14 centimeters, to find the area of Square 3 and then determined which two values have a sum equal to the area of Square 3. To find the area of Square 3, the student should have multiplied the base and the height of the square, resulting in $(14)(14) = 196$ square centimeters. The student then should have determined that when the area of Square 1 is 78 cm^2 and the area of Square 2 is 118 cm^2 , the sum of the areas equals 196 cm^2 .
	Option B is incorrect	The student likely selected an option in which $a + b = c$. The student likely recognized that if the area of Square 1 is 25, then the side length of Square 1 is $\sqrt{25} = 5$, represented by a , and if the area of Square 2 is 81, then the side length of Square 2 is $\sqrt{81} = 9$, represented by b . The student then likely determined that $5 + 9 = 14$, the given side length of Square 3. The student needs to focus on using models and diagrams to explain the Pythagorean theorem.
	Option C is incorrect	The student likely selected an option in which $a + b = c$. The student likely recognized that if the area of Square 1 is 36, then the side length of Square 1 is $\sqrt{36} = 6$, represented by a , and if the area of Square 2 is 64, then the side length of Square 2 is $\sqrt{64} = 8$, represented by b . The student then likely determined that $6 + 8 = 14$, the given side length of Square 3. The student needs to focus on using models and diagrams to explain the Pythagorean theorem.
	Option D is incorrect	The student likely determined that Square 2 must have an area that is twice the area of Square 1 and that $(60)(2) = 120$. The student needs to focus on using

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		models and diagrams to explain the Pythagorean theorem.
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Item Position	Rationales	
25	Option C is correct	To determine which values best represent 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. Since the line contains the points (0, 3) and (4, 0), the student could have substituted those coordinates into the slope formula, $m = \frac{y_2 - y_1}{x_2 - x_1}$, resulting in $m = \frac{0 - 3}{4 - 0} = -\frac{3}{4}$. Next, the student could have recognized that, since the line crosses the y -axis at the point (0, 3), the value of the y -intercept is 3. 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 x -intercept, 4, instead of the y -intercept. The student needs to focus on understanding how to determine the y -intercept of a line from a graph.
	Option B is incorrect	The student likely divided the change in x -coordinates by the change in the y -coordinates when determining the slope of the line, resulting in $-\frac{4}{3}$, and used the x -intercept, 4, instead of the y -intercept. The student needs to focus on understanding how to determine the slope and y -intercept of a line from a graph.
	Option D is incorrect	The student likely divided the change in x -coordinates by the change in the y -coordinates when determining the slope of the line, resulting in $-\frac{4}{3}$. The student needs to focus on understanding how to determine the slope of a line from a graph.

Item Position	Rationales	
26	Option D is correct	To determine the ordered pair that represents the coordinates of vertex Q' , 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 student should have recognized that the coordinates of vertex Q' would be k times the coordinates of vertex Q , resulting in $(4k, -k)$.
	Option A is incorrect	The student likely determined that a dilation about the origin with a scale factor of k meant k was subtracted from the x - and y -coordinates of vertex Q , resulting in $(4 - k, -1 - k)$. The student needs to focus on understanding the effect a dilation by a given scale factor has on a figure.
	Option B is incorrect	The student likely determined that a dilation about the origin with a scale factor of k meant k was added to the x - and y -coordinates of vertex Q , resulting in $(4 + k, -1 + k)$. The student needs to focus on understanding the effect a dilation by a given scale factor has on a figure.
	Option C is incorrect	The student likely determined that a dilation about the origin with a scale factor of k meant the x -coordinate of vertex Q was divided by k , and the y -coordinate was multiplied by k , resulting in $(\frac{4}{k}, -k)$. The student needs to focus on understanding the effect a dilation by a given scale factor has on a figure.

Item Position	Rationales	
27	Option A is correct	To determine the measurement closest to the length of the diagonal of the screen, the student should have first recognized that the diagonal of the screen is the hypotenuse (the longest side, opposite the 90° angle in a right triangle) of a right triangle, with the screen width and length representing the legs of the right triangle. The student then should have applied the Pythagorean theorem, $a^2 + b^2 = c^2$, where the variables 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 diagonal. Substituting $a = 8.5$ and $b = 6.35$, the lengths of the two legs, into the formula, the student could have obtained $8.5^2 + 6.35^2 = 112.5725 = c^2$. Taking the square root of both sides of the equation results in $c = \sqrt{112.5725} \approx 10.6$ cm.
	Option B is incorrect	The student likely multiplied the width and length of the screen by 2, instead of squaring each of them, and found the sum (the result when two or more quantities are added together) to calculate the length of the diagonal, resulting in $(8.5)(2) + (6.35)(2) = 29.7$ cm. The student needs to focus on understanding how to apply the Pythagorean theorem with the given information.
	Option C is incorrect	The student likely added the width and length of the screen to find the length of the diagonal, resulting in $8.5 + 6.35 \approx 14.9$ cm. The student needs to focus on understanding how to apply the Pythagorean theorem with the given information.
	Option D is incorrect	The student likely determined that the longest given measurement (8.5) represented the hypotenuse of the right triangle and that the diagonal represented one of the legs. The student likely substituted $a = 6.35$ and $c = 8.5$ into the Pythagorean theorem, resulting in $6.35^2 + b^2 = 8.5^2$; $b^2 = 31.9275$; $b = \sqrt{31.9275} \approx 5.7$ cm.

Item Position	Rationales	
28	Option B is correct	To determine the solution to the equation $10x - 8 = 5x$, the student could have first subtracted $10x$ from both sides of the equation, resulting in $-8 = -5x$. The student then could have divided both sides of the equation by -5 , resulting in $\frac{-8}{-5} = x$, or $\frac{8}{5} = x$. 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 subtracted $10x$ from both sides of the equation correctly but divided both sides of the equation by -8 , resulting in $\frac{-5}{-8}$, or $\frac{5}{8}$. The student needs to focus on understanding the arithmetic for solving equations.
	Option C is incorrect	The student likely added $10x$ to the right side of the equation and ignored the subtraction sign before the 8 , resulting in $8 = 15x$, or $\frac{8}{15} = x$. The student needs to focus on understanding the arithmetic for solving equations.
	Option D is incorrect	The student likely added $10x$ to the right side of the equation and ignored the subtraction sign before the 8 , resulting in $8 = 15x$. The student then likely divided 15 by 8 , resulting in $\frac{15}{8}$. The student needs to focus on understanding the arithmetic for solving equations.

Item Position	Rationales	
29	Preserves Congruence, Preserves Congruence, Does Not Preserve Congruence, Preserves Congruence	To determine whether the transformation “dilation by a scale factor of 1” applied to a quadrilateral on a coordinate grid preserves congruence or does not preserve congruence, the student should have recalled that a transformation preserves congruence if the image is the same size and shape as the pre-image. A dilation (resize) by a scale factor of 1 produces an image that is the same size and shape as the pre-image. Therefore, the student should have concluded that this transformation preserves congruence. To determine whether the transformation “$(x, y) \rightarrow (x + 2, y + 2)$” applied to a quadrilateral on a coordinate grid preserves congruence or does not preserve congruence, the student should have recalled that $(x, y) \rightarrow (x + 2, y + 2)$ describes a translation (slide), which produces an image that is the same size and shape as the pre-image. Therefore, the student should have concluded that this transformation preserves congruence. To determine whether the transformation “$(x, y) \rightarrow (3x, 3y)$” applied to a quadrilateral on a coordinate grid preserves congruence or does not preserve congruence, the student should have recalled that $(x, y) \rightarrow (3x, 3y)$ describes a dilation by a scale factor of 3, which produces an image that is the same shape as the pre-image but is enlarged in size. Therefore, the student should have concluded that this transformation does not preserve congruence. To determine whether the transformation “180° counterclockwise rotation about the origin” applied to a quadrilateral on a coordinate grid preserves congruence or does not preserve congruence, the student should have recalled that a rotation (circular movement) of 180° counterclockwise about the origin produces an image that is the same size and shape as the pre-image. Therefore, the student should have concluded that this transformation preserves congruence. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item Position	Rationales	
30	Option A is correct	To determine the y -coordinate of the ordered pair that represents the solution to both equations, the student should have identified the intersection point of the two lines and found the y -coordinate of that point. The student should have identified that the intersection point of the two lines is $(2, 3)$ and determined that the y -coordinate of the ordered pair that represents the solution to both equations is 3.
	Option B is incorrect	The student likely identified the y -value of the y -intercept (the point of the graph of a function where the x -value is 0) of the line that represents the equation $y = x + 1$. The student likely determined that the y -coordinate of the ordered pair that represents the solution to both equations is 1. The student needs to focus on identifying the point of intersection of two intersecting lines.
	Option C is incorrect	The student likely identified the x -coordinate of the intersection point, 2, as the y -coordinate. The student needs to focus on identifying the point of intersection of two intersecting lines.
	Option D is incorrect	The student likely identified the y -value of the y -intercept of the line that represents the equation $y = 2x - 1$. The student likely determined that the y -coordinate of the ordered pair that represents the solution to both equations is -1 . The student needs to focus on identifying the point of intersection of two intersecting lines.

Item Position	Rationales	
31	\$210.00, \$217.44	To determine how much interest Henri will earn over a period of 3 years if the bank account earns 3.5% simple interest, 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. The student should have substituted $P = 2,000.00$, $r = 0.035$, and $t = 3$ into the formula, resulting in $I = (2,000.00)(0.035)(3) = \\210.00. To determine how much interest Henri will earn over a period of 3 years if the bank account earns 3.5% interest compounded annually, the student should have used 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. The student should have substituted $P = 2,000.00$, $r = 0.035$, and $t = 3$ into the formula, resulting in $A = (2,000.00)(1 + 0.035)^3 \approx \\$2,217.44$, which means that the account balance would be approximately \$2,217.44 after 3 years. To determine the interest earned if the account earns compound interest, the student could have subtracted the principal from the account balance, resulting in $2,217.44 - 2,000.00 = \\$217.44$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item Position	Rationales	
32	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, the student should have first determined that the relationship between the pounds of ice the ice maker produces and the number of hours 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 pounds of ice produced by the number of hours, resulting in $\frac{17.5}{5} = 3.5$ pounds of ice produced per hour.. The student could have recognized that since the graph contains the point (10, 35), the slope is $\frac{35}{10} = 3.5$, which models the rate 3.5 pounds of ice produced per hour. 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 number of hours by the number of pounds of ice produced, resulting in $\frac{5}{17.5} = \frac{2}{7}$. Then the student likely chose the graph that has a slope of $\frac{2}{7}$ and contains the points (0, 0) and (35, 10). The student needs to focus on understanding how unit rates are represented on graphs.
	Option C is incorrect	The student likely used the number of hours given, 5, as the unit rate, and selected a graph that has a slope of 5 and goes through points (0, 0) and (5, 25). The student needs to focus on understanding how unit rates are represented on graphs.
	Option D is incorrect	The student likely used the number of hours given, 5, as the denominator (the bottom number of a fraction) of the unit rate, and selected a graph that has a slope of $\frac{1}{5}$ and goes through points (0, 0) and (25, 5).The student needs to focus on understanding how unit rates are represented on graphs.

Item Position	Rationales	
33	2.25 ² , 10	To determine the equation that represents V, the volume of the container in cubic inches, the student should have used the formula for the volume of a cylinder, $V = Bh$, where V represents the volume, 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 A represents the area and 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 2 times the radius, the student should have determined the radius by dividing the diameter by 2, resulting in $\frac{4.5}{2} = 2.25$ inches. Next, the student should have substituted $r = 2.25$ into the area formula to determine the area of the base, resulting in $A = \pi(2.25^2)$. The student then should have substituted $B = \pi(2.25^2)$ and $h = 10$ into the volume formula, resulting in $V = \pi(2.25^2)(10)$ or $V = \pi(10)(2.25^2)$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item Position	Rationales	
34	Option D is correct	To determine which graph on a coordinate grid represents y as a function of x (a relationship in which each input [x -value] has a single output [y -value]), the student should have visualized each graph and determined that a line parallel to the x -axis (horizontal number line) would contain points where each x -value corresponds to only one y -value.
	Option A is incorrect	The student likely visualized only the vertices (points where two or more rays or line segments intersect) of a triangle in which each x -value results in only one y -value, disregarding the points that make up the sides of the triangle. The student needs to focus on understanding the definition of a function and being able to identify one on a graph.
	Option B is incorrect	The student likely considered only the point at the center of the circle, disregarding the points on the circle, and determined that the x -value would result in only one y -value. The student needs to focus on understanding the definition of a function and being able to identify one on a graph.
	Option C is incorrect	The student likely confused the meaning of y -axis (vertical number line) with the meaning of x -axis and determined that two different points on the y -axis would have x -values that each result in only one y -value. The student needs to focus on understanding the definition of a function and being able to identify one on a graph.

Item Position	Rationales	
35	Option B is correct	To determine the mean absolute deviation (the sum of the absolute values of the differences between each data point of a given set and the mean of that data set, divided by the number of data points) of the numbers in the list, the student should have first calculated the mean (average) of the numbers of visitors to the museum on 5 days last week by adding the values and then dividing by the number of days, resulting in $\frac{95+88+93+86+88}{5} = 90$. Then the student should have found the absolute value of the difference between each number and the mean and added the results together: $ 95 - 90 + 88 - 90 + 93 - 90 + 86 - 90 + 88 - 90 = 5 + 2 + 3 + 4 + 2 = 16$. Finally, the student then should have divided 16 by 5, resulting in $\frac{16}{5} = 3.2$.
	Option A is incorrect	The student likely found the median (middle number in a set of data when the set is ordered by value) by ordering the numbers from least to greatest (86, 88, 88, 93, 95) and selecting the middle number, 88. The student needs to focus on applying the process for calculating the mean absolute deviation.
	Option C is incorrect	The student likely determined the mean of the data set, 90. The student needs to focus on applying the process for calculating the mean absolute deviation.
	Option D is incorrect	The student likely used the median, 88, instead of the mean, to calculate the mean absolute deviation, resulting in $ 95 - 88 + 88 - 88 + 93 - 88 + 86 - 88 + 88 - 88 = 7 + 0 + 5 + 2 + 0 = 14$. The student then likely divided by 5, resulting in $\frac{14}{5} = 2.8$. The student needs to focus on applying the process for calculating the mean absolute deviation.

Item Position	Rationales	
36	Option A is correct	To determine which table shows a proportional relationship between x and y , the student could have recognized the table where the ratio $\frac{y}{x}$ is equivalent for each row. The student could have calculated the ratios $\frac{1.5}{1}$, $\frac{3}{2}$, $\frac{4.5}{3}$, and $\frac{6}{4}$ and determined that each value is equivalent to 1.5. 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 that since the difference between the x -value and y -value is equivalent for every row of the table, the relationship is proportional: $4.5 - 3 = 1.5$, $7 - 5.5 = 1.5$, $9.5 - 8 = 1.5$, and $12 - 10.5 = 1.5$. The student needs to focus on understanding the definition of a proportional relationship and applying it to determine whether a table represents a proportional relationship.
	Option C is incorrect	The student likely compared the ratio $\frac{y}{x}$ for the values in the first three rows of the table but did not check the fourth row. The ratios $\frac{1.5}{3}$, $\frac{2.5}{5}$, and $\frac{3.5}{7}$ are equivalent to 0.5, but $\frac{4.5}{10}$ is not. The student needs to focus on understanding the definition of a proportional relationship and applying it to determine whether a table represents a proportional relationship.
	Option D is incorrect	The student likely determined that a table shows a proportional relationship between x and y when the ratio $\frac{y}{x}$ is a different value for each row. The student needs to focus on understanding the definition of a proportional relationship and applying it to determine whether a table represents a proportional relationship.

Item Position	Rationales	
37	7, 123	To determine the best estimate for the number of speakers, x, at a meeting that is 80 minutes long using the scatterplot (a graph of plotted points that shows 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 be represented by the equation $y = 8x + 27$ and passes through the points (1, 35) and (8, 91). Next, the student could have identified where the grid line marked 80 on the y-axis (vertical number line), which represents a meeting lasting 80 minutes, intersects (crosses) the line of best fit and determined that the number of speakers for an 80-minute meeting would be about 7. To determine the best estimate for the length in minutes, y, for a meeting with 12 speakers using the scatterplot, the student could have estimated where the grid line marked 12 on the x-axis (horizontal number line), which represents 12 speakers, would intersect the line of best fit and determined that a meeting with 12 speakers would last about 123 minutes. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item Position	Rationales	
38	Option D is correct	To determine which measurement is closest to the lateral surface area (total amount of space covered by the surface, not including the bases) of the cylinder in square inches, the student could have used the formula for the lateral surface area of a cylinder, $S = 2\pi rh$, where S represents the lateral surface area, r represents the radius of the base (distance from the center of a circle to a point on the circle), and h represents the height. The student could have substituted $r = 4.6$ and $h = 9.3$ into the formula, resulting in $S = 2\pi(4.6)(9.3) \approx 268.8$ 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 used the formula for the total surface area of a cylinder, $S = 2\pi rh + 2\pi r^2$. The student likely substituted $r = 4.6$ and $h = 9.3$ into the formula, resulting in $S = 2\pi(4.6)(9.3) + 2\pi(4.6^2) \approx 401.7$ square inches. The student needs to focus on understanding how to properly apply the formula for the lateral surface area of a figure.
	Option B is incorrect	The student likely used the formula for the volume of a cylinder, $V = Bh$, where V is the volume, B is the area of the base, and h is the height. The student likely determined the area of the base, B , by recognizing the base of a cylinder is a circle and using the formula for the area of a circle, $A = \pi r^2$, where A represents the area and r represents the radius. The student likely substituted $r = 4.6$ into the area formula to determine the area of the base, resulting in $A = \pi(4.6^2)$. Since the area of the base is represented by B , the student likely substituted $B = \pi(4.6^2)$ and $h = 9.3$ into the volume formula, resulting in $V = \pi(4.6^2)(9.3) \approx 618.2$ square inches. The student needs to focus on understanding how to properly apply the formula for the lateral surface area of a figure.
	Option C is incorrect	The student likely calculated the combined area of the two bases of the cylinder. The student likely multiplied the area of one base by 2, resulting in $A = 2\pi(4.6^2) \approx 133.0$ square inches. The student needs to focus on understanding how to properly apply the formula for the lateral surface area of a figure.

Item Position	Rationales	
39	Option D is correct	To determine which value of x makes the inequality $x \geq \frac{11}{3}$ true, the student could have converted each value to an approximate decimal form. The inequality $x \geq \frac{11}{3}$ is equivalent to $x \geq 3.\bar{6}$, so only values greater than or equal to $3.\bar{6}$ will satisfy the inequality. The decimal approximation for $\sqrt{15}$ is 3.873, which is greater than $3.\bar{6}$. 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 incorrectly converted $\frac{11}{3}$ to the decimal form 3.11 and compared it to π , which is approximately 3.14. 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 11% to $\frac{11}{3}$ without converting 11% to its equivalent decimal form and determined that 11 is greater than $3.\bar{6}$. The student needs to focus on comparing numbers in different forms (fractions, decimals, percentages, square roots, etc.).
	Option C is incorrect	The student likely compared the denominators (the bottom number in a fraction) of $\frac{11}{30}$ and $\frac{11}{3}$ and determined that 30 is greater than 3. The student needs to focus on comparing numbers in different forms (fractions, decimals, percentages, square roots, etc.).

Item Position	Rationales	
40	Option C is correct	To determine the rule that describes the transformation, the student should have recognized that the triangle is being translated (transformed by a slide) 2 units to the left and 4 units up. Therefore, the x -coordinate is decreasing by 2, and the y -coordinate is increasing by 4. The student then should have concluded that the rule $(x,y) \rightarrow (x - 2, y + 4)$ describes this translation.
	Option A is incorrect	The student likely determined that a translation 2 units to the left and 4 units up would cause both the x -coordinate and the y -coordinate to decrease, resulting in the rule $(x,y) \rightarrow (x - 2, y - 4)$. The student needs to focus on understanding the rules for translations.
	Option B is incorrect	The student likely determined that a translation 2 units to the left and 4 units up would cause both the x -coordinate and the y -coordinate to increase, resulting in the rule $(x,y) \rightarrow (x + 2, y + 4)$. The student needs to focus on understanding the rules for translations.
	Option D is incorrect	The student likely determined that a translation 2 units to the left would cause the x -coordinate to increase, and a translation 4 units up would cause the y -coordinate to decrease, resulting in the rule $(x,y) \rightarrow (x + 2, y - 4)$. The student needs to focus on understanding the rules for translations.