Item Position	Rationale	
1	Option C is correct	To determine which expression is equivalent to $1.5(4j - 10k) - 2.5(8j + 6k)$, the student could have distributed (multiplied) the numbers in front of each set of parentheses to each term inside the parentheses, resulting in $6j - 15k - 20j - 15k$. Next, the student could have combined like terms (terms that contain the same variables raised to same powers or constant terms), resulting in $-14j - 30k$. 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 follow order of operations and combined like terms before distributing, resulting in $(1.5 - 2.5)(4j + 8j - 10k + 6k)$ or $-1(12j - 4k)$. The student then likely distributed -1 to each term inside the parentheses, resulting in $-12j + 4k$. The student needs to focus on understanding how to write equivalent expressions using the distributive property.
	Option B is incorrect	The student likely distributed correctly but ignored the negative sign when distributing to the second set of parentheses, resulting in $6j - 15k + 20j + 15k$. The student then likely combined like terms and made a sign error after combining the terms containing the variable j, resulting in $-26j$. The student needs to focus on understanding how to write equivalent expressions using the distributive property.
	Option D is incorrect	The student likely made a sign error when multiplying -2.5 by $6k$, resulting in $6j - 15k - 20j + 15k$, which leads to an incorrect simplification of $-14j$. The student needs to focus on understanding how to write equivalent expressions using the distributive property.

Item Position	Rationale	
2	Option D is correct	To determine which statement is best represented by the graph, the student could have recognized that the graph crosses the *y*-axis (vertical number line) at the point (0, 3), which makes the statement "The *y*-intercept of the graph of the function is (0, 3)" true. 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 the greatest labeled value on the *x*-axis as the value of *x* in the equation of the asymptote. The student needs to focus on understanding how to identify the key features of an exponential function when given the graph of the function.
	Option B is incorrect	The student likely interpreted the arrow on the left side of the graph, which points up, as indicating that the graph is increasing on the left side of the *y*-axis, which represents negative *x*-values. Next, the student correctly interpreted the graph on the right side of the *y*-axis, which represents positive *x*-values, as decreasing from left to right because the *y* -values decrease as the *x*-values increase. The student needs to focus on understanding how to identify the key features of an exponential function when given the graph of the function.
	Option C is incorrect	The student likely calculated the difference between the greatest and least labeled *x*-values, 4 – (–4) = 8, and interpreted that value as the *x*-intercept (value where a graph crosses the *x*-axis [horizontal number line]). The student needs to focus on understanding how to identify the key features of an exponential function when given the graph of the function.

Item Position	Rationale	
3	Option B is correct	To determine the equivalent expression, the student could have rewritten $\sqrt{50}$ as $\sqrt{25} \cdot \sqrt{2}$ and then calculated the square root (a value that when multiplied by itself is equal to the number under the radical symbol, √) of 25 to get $5 \cdot \sqrt{2}$, or $5\sqrt{2}$. 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 reversed the placement of the values after calculating the square root, resulting in $2\sqrt{5}$. The student needs to focus on understanding how to simplify square roots.
	Option C is incorrect	The student likely recognized that 50 is the product of 25 and 2 and misinterpreted the square root symbol as division by 2, resulting in 25 ÷ 2 = 12.5. The student needs to focus on understanding how to simplify square roots.
	Option D is incorrect	The student likely misinterpreted the square root operation as division and found the quotient of 50 and 2, resulting in 50 ÷2 = 25. The student needs to focus on understanding how to simplify square roots.

Item Position	Rationale	
4	Option A is correct	To determine which system of equations (two or more equations containing the same set of variables [symbols used to represent unknown numbers]) represents the system shown on the graph, the student could have used the graph to find the two equations in slope-intercept form ($y = mx + b$, where m represents the slope [steepness of a line] and b represents the value of the y-intercept [value where a graph crosses the y-axis]). To find the equation for the increasing line, the student could have used any two points on the line, such as (0, 2) and (–2, 0), to determine the slope, resulting in $m = \frac{0-2}{(-2-0)} = \frac{-2}{-2} = 1$. Next, the student could have recognized that since the graph crosses the y-axis at the point (0, 2), the value of b in the equation is 2. Since $m = 1$ and $b = 2$, the student could have written the equation of the increasing line as $y = x + 2$. To find the equation for the decreasing line, the student could have used any two points on the line, such as (3, 5) and (4, 1), to determine the slope, resulting in $m = \frac{1-5}{4-3} = -\frac{4}{1} = -4$. Next, the student could have substituted (3, 5) and $m = -4$ into $y = mx + b$ and solved for b, resulting in $5 = -4(3) + b$, or $17 = b$. Since $m = -4$ and $b = 17$, the student could have written the equation of the decreasing line as $y = -4x + 17$. 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 equation for the decreasing line by first using two points on the line, (3, 5) and (4, 1), to determine the slope, resulting in $m = \frac{1-5}{4-3} = -\frac{4}{1} = -4$. Next, the student likely determined the value of b by substituting (4, 1) and $m = -4$ into the equation $y = mx + b$, resulting in $1 = (-4)(4) + b$, or $1 = -16 + b$. Next, the student likely subtracted 16 from the left side of the equation and made a sign error to determine $b = 15$. The student needs to focus on understanding how to solve for the y-intercept in a linear equation.
	Option C is incorrect	The student likely wrote the equation of the increasing line in slope-intercept form as $y = x + 2$ but added x to the left side of the equation when trying to convert the equation from slope-intercept form to standard form, resulting $x + y = 2$. The student needs to focus on understanding how to write a linear function in standard form.

	Option D is incorrect	The student likely wrote the equation of the increasing line in slope-intercept form as $y = x + 2$ but added x to the left side of the equation when trying to convert the equation from slope-intercept form to standard form, resulting in $x + y = 2$. Next, the student likely determined the value of b in the equation of the decreasing line by finding the slope of the line (–4) and substituting point (4, 1) to solve for b in slope-intercept form. After substituting 4 for x and multiplying to get –16, the student likely incorrectly solved by subtracting 16 from the y-value (1) on the left side of the equation and made a sign error to determine $b = 15$, leading to the equation $y = -4x + 15$. The student then likely added $4x$ to the left side of the equation to yield the standard form $4x + y = 15$. The student needs to focus on understanding how to write a linear function in standard form and on understanding how to solve for the y-intercept in a linear equation.

Item Position	Rationale	
5	Option B is correct	To determine which function has a range (all possible *y*-values) that is the set of all real numbers greater than or equal to –1, the student could have determined the vertex of the graph of each function and the direction each graph is facing. Since the leading coefficient of $f(x) = x^2 + 4x + 3$ is 1, the student could have concluded that the parabola (U-shaped graph) is facing upward. Next, the student could have determined that the vertex (highest or lowest point of the curve) is at (–2, –1). Since the graph of the function is facing upward and the vertex is at (–2, –1), the student could have concluded that the function $f(x) = x^2 + 4x + 3$ has a range that is the set of all real numbers greater than or equal to –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 determined that the vertex for $f(x) = -x^2 - 1$ is at (0, –1) but did not consider the direction of the parabola. The student needs to focus on understanding how to represent the range of a quadratic function when given an equation.
	Option C is incorrect	The student likely made a sign error when determining the vertex for $f(x) = (x + 3)^2 + 1$, resulting in a vertex at (–3, –1). The student needs to focus on understanding how to find the vertex of a function written in vertex form.
	Option D is incorrect	The student likely identified the *y*-intercept (value where a graph crosses the *y*-axis [vertical number line]) of the function $f(x) = (x + 4)^2 - 17$ as the lower bound of the range. The student needs to focus on understanding how to represent the range of a quadratic function when given an equation.

Item Position	Rationale	
6	$\frac{3}{2}$, −1	To determine the equation of the function in slope-intercept form ($f(x) = mx + b$, where m represents the slope [steepness of a line] and b represents the value of the y-intercept [value where a graph crosses the y-axis]), the student could have first calculated the slope of the line. The student could have substituted any two ordered pairs from the table into the slope formula, $m = \frac{y_2-y_1}{x_2-x_1}$. Substituting the ordered pairs (4, 5) and (10, 14) into the slope formula, the student could have obtained $m = \frac{14-5}{10-4} = \frac{9}{6} = \frac{3}{2}$. Next, the student could have substituted the x- and y-coordinates of the point (4, 5) and $m = \frac{3}{2}$ into $f(x) = mx + b$ and solved for b, resulting in $5 = \frac{3}{2}(4) + b$, or $b = -1$. Since $m = \frac{3}{2}$ and $b = -1$, the student could have concluded that the equation of the function in slope-intercept form is $f(x) = \frac{3}{2}x - 1$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item Position	Rationale	
7	Option C is correct	To determine the type of linear association that exists between the number of months that had passed and the balance remaining in the account, the student should have determined the correlation coefficient (a value, represented by *r*, that measures the strength of a linear association) using the linear regression feature on a graphing calculator. The correlation coefficient that best models this set of data is $r \approx -0.991$. Since the correlation coefficient is negative and close to –1, the student should have concluded that there is a strong negative linear association.
	Option A is incorrect	The student likely took the absolute value (how far a number is from zero) of the correlation coefficient, resulting in $r \approx \|-0.991\| = 0.991$. Since this value is close 1, the student likely interpreted it to mean that the linear association is strong positive. The student needs to focus on understanding how to determine the correlation coefficient between two quantitative variables and how to interpret this quantity as a measure of the strength of the linear association.
	Option B is incorrect	The student likely identified $(1 + r)$ as the correlation coefficient, resulting in $1 + (-0.991) = 0.009$. Since this value is positive and close to zero, the student likely interpreted it to mean that the linear association is weak positive. The student needs to focus on understanding how to determine the correlation coefficient between two quantitative variables and how to interpret this quantity as a measure of the strength of the linear association.
	Option D is incorrect	The student likely identified $-(1 + r)$ as the correlation coefficient, resulting in $-[1 + (-0.991)] = -0.009$. Since this value is negative and close to zero, the student likely interpreted it to mean that the linear association is weak negative. The student needs to focus on understanding how to determine the correlation coefficient between two quantitative variables and how to interpret this quantity as a measure of the strength of the linear association.

Item Position	Rationale	
8	Option A is correct	To determine the equation in slope-intercept form (*y* = *mx* + *b*, where *m* represents the slope [steepness of a line] and *b* represents the value of the *y*-intercept [value where a graph crosses the *y*-axis]) of the line, the student could have first recognized that the slope of the line is $m = -\frac{2}{11}$. Next, the student could have substituted the *x*- and *y*-coordinates of the given point, (22, 5), and $m = -\frac{2}{11}$ into *y* = *mx* + *b* and solved for *b*, resulting in $5 = -\frac{2}{11}(22) + b$, or *b* = 9. Since $m = -\frac{2}{11}$ and *b* = 9, the student could have concluded that the equation of the line is $y = -\frac{2}{11}x + 9$. 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 4 from the left side of the equation instead of adding 4 to the left side of the equation when solving for *b*, resulting in *b* = 1. Next, the student likely substituted $m = -\frac{2}{11}$ and *b* = 1 into *y* = *mx* + *b*, resulting in $y = -\frac{2}{11}x + 1$. The student needs to focus on understanding the arithmetic of solving equations and understanding how to write the equation of a line in slope-intercept form when given the slope and a point.
	Option C is incorrect	The student likely made a sign error when solving for *b,* resulting in *b* = –9. Next, the student likely substituted $m = -\frac{2}{11}$ and *b* = –9 into *y* = *mx* + *b*, resulting in $y = -\frac{2}{11}x - 9$. The student needs to focus on understanding the arithmetic of solving equations and understanding how to write the equation of a line in slope-intercept form when given the slope and a point.
	Option D is incorrect	The student likely subtracted 5 from 4 on the left side of the equation instead of adding 5 and 4 when solving for *b*, resulting in *b* = –1. Next, the student likely substituted $m = -\frac{2}{11}$ and *b* = –1 into *y* = *mx* + *b*, resulting in $y = -\frac{2}{11}x - 1$. The student needs to focus on understanding the arithmetic of solving equations and understanding how to write the equation of a line in slope-intercept form when given the slope and a point.

Item Position	Rationale	
9	Option C is correct	To determine which statement about the zeros (*x*-values when *y* is equal to zero) of the function is true, the student could have solved the equation $h(x) = 0$. To determine the solutions to $h(x) = 0$, the student could have set each factor equal to zero and solved for *x*. To solve $x - 5 = 0$, the student could have added 5 to both sides of the equation, resulting in $x = 5$. To solve $x + 7 = 0$, the student could have subtracted 7 from both sides of the equation, resulting in $x = -7$. The student could have concluded that the zeros of the function are –7 and 5 because $h(-7) = 0$ and $h(5) = 0$. 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 solved the equation $h(x) = 0$ correctly but multiplied each solution of the equation by 3 because 3 is a factor of $h(x)$, resulting in $x = -7(3) = -21$ and $x = 5(3) = 15$. The student needs to focus on understanding the relationship between the factors and the zeros of a quadratic function.
	Option B is incorrect	The student likely identified the zeros of the function as the constant values inside the factors. The student then likely multiplied each zero by 3 because 3 is a factor of $h(x)$, resulting in $x = 7(3) = 21$ and $x = -5(3) = -15$. The student needs to focus on understanding the relationship between the factors and the zeros of a quadratic function.
	Option D is incorrect	The student likely identified the zeros of the function as the constant values inside the factors. The student needs to focus on understanding the relationship between the factors and the zeros of a quadratic function.

Item Position	Rationale	
10	Option B is correct	To determine which graph best represents the solution set of the inequality $3y - 2x \leq -6$, the student should have first recognized that the boundary line (a solid or dashed line representing the edge of the solution set of a linear inequality) of the solution set is solid since the inequality is inclusive. To graph the boundary line, the student could have found the *x*- and *y*-intercepts of the line. To find the *y*-intercept (value where a graph crosses the *y*-axis [vertical number line]) of the line, the student could have substituted $x = 0$ into the equation $3y - 2x = -6$ and solved for *y*, resulting in $3y - 2(0) = -6$, $3y = -6$, or $y = -2$. Since the value of the *y*-intercept is -2, the boundary line passes through the point $(0, -2)$. To find the *x*-intercept (value where a graph crosses the *x*-axis [horizontal number line]) of the line, the student could have substituted $y = 0$ into the equation $3y - 2x = -6$ and solved for *x*, resulting in $3(0) - 2x = -6$, $-2x = -6$, or $x = 3$. Since the value of the *x*-intercept is 3, the boundary line passes through the point $(3, 0)$. To determine the region containing the solution set of the inequality, the student could have substituted the test point $(0, 0)$ into the inequality, resulting in $3(0) - 2(0) \leq -6$, or $0 \leq -6$. Since $0 \leq -6$ is not a true statement, the student could have concluded that the region containing the point $(0, 0)$ should not be shaded, and therefore shaded the region without point $(0, 0)$. 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 graphed the correct boundary line but concluded that the region containing the point $(0, 0)$ should be shaded. The student likely substituted the test point $(0, 0)$ into the inequality, resulting in $3(0) - 2(0) \leq -6$ or $0 \leq -6$. The student then likely interpreted the inequality symbol as "greater than or equal to" instead of "less than or equal to" and therefore concluded that the statement was true. The student needs to focus on understanding how the inequality symbol affects the graph of the solution set of a linear inequality.
	Option C is incorrect	The student likely switched the coordinates of the *x*- and *y*-intercepts and graphed the boundary line going through the points $(0, 3)$ and $(-2, 0)$. The student also likely interpreted the inequality symbol as representing a non-inclusive inequality instead of an inclusive inequality and concluded that the line should be dashed. Next, the student likely substituted the test point $(0, 0)$ into the inequality, resulting in $3(0) - 2(0) \leq -6$. Since $0 \leq -6$ is not a true statement, the student likely concluded that the region containing the point $(0, 0)$ should not be shaded. The student needs to focus

		on graphing the boundary line of the solution set of a linear inequality using *x*- and *y*-intercepts and understanding how the inequality symbol affects the boundary line of the solution set of a linear inequality.
	Option D is incorrect	The student likely switched the coordinates of the *x*- and *y*-intercepts and graphed the boundary line going through the points (0, 3) and (–2, 0). The student also likely interpreted the inequality symbol as representing a non-inclusive inequality instead of an inclusive inequality and concluded that the line should be dashed. Next, the student likely substituted the test point (0, 0) into the inequality, resulting in $3(0) – 2(0) \leq –6$ or $0 \leq –6$. The student then likely misinterpreted the direction of the inequality symbol and therefore concluded that the statement was true and that the region containing the point (0, 0) should be shaded. The student needs to focus on graphing the boundary line of the solution set of a linear inequality using *x*- and *y*-intercepts, identifying a point that satisfies the inequality and understanding how the inequality symbol affects the graph of the boundary line of the solution set of a linear inequality.

Item Position	Rationale	
11	Option C is correct	To determine the value of *x* in the solution to the system of equations (two or more equations containing the same set of variables [symbols used to represent unknown numbers]), the student could have used the substitution method to solve the system. The student could have substituted *y* = –6*x* + 2 into the equation 3*x* – 5*y* = 12 , resulting in 3*x* – 5(–6*x* + 2) = 12. The student then could have multiplied each term inside the parentheses by –5, resulting in 3*x* + 30*x* – 10 = 12. Next, the student could have combined like terms (terms that contain the same variables raised to the same powers or constant terms) on the left side of the equation, resulting in 33*x* – 10 = 12. The student then could have added 10 to both sides of the equation, resulting in 33*x* – 10 + 10 = 12 + 10, or 33*x* = 22. Last, the student could have divided both sides of the equation by 33, resulting in $\frac{33x}{33}=\frac{22}{33}$, or $x=\frac{2}{3}$. 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 multiplied only the last term in the parentheses by –5 in the equation 3*x* – 5(–6*x* + 2) = 12 instead of multiplying each term by –5, resulting in 3*x* – 6*x* – 10 = 12. Next, the student likely combined like terms on the left side of the equation but made a sign error when combining the *x*-terms, resulting in 3*x* – 10 = 12. The student then likely added 10 to both sides of the equation, resulting in 3*x* – 10 + 10 = 12 + 10, or 3*x* = 22. Finally, the student likely divided both sides of the equation by 3, resulting in $\frac{3x}{3}=\frac{22}{3}$, or $x=\frac{22}{3}$. The student needs to focus on understanding how to complete all the steps to calculate the solution to a system of equations.
	Option B is incorrect	The student likely did not multiply each term inside the parentheses by –5 in the equation 3*x* – 5(–6*x* + 2) = 12 and solved the equation 3*x* – 6*x* + 2 = 12. Next, the student likely combined like terms on the left side of the equation, resulting in –3*x* + 2 = 12. The student then likely subtracted 2 from both sides of the equation, resulting in –3*x* + 2 – 2 = 12 – 2, or –3*x* = 10. Finally, the student likely divided both sides of the equation by –3, resulting in $\frac{-3x}{-3}=\frac{10}{-3}$, or $x=-\frac{10}{3}$. The student needs to focus on understanding how to complete all the steps to calculate the solution to a system of equations.
	Option D is incorrect	The student likely ignored the last term in the parentheses in the equation 3*x* – 5(–6*x* + 2) = 12, resulting in 3*x* + 30*x* = 12. Next, the student likely subtracted 30*x* from 12 and omitted the variable,

		resulting in $3x = -18$. Finally, the student likely divided by 3, resulting in $\frac{3x}{3} = \frac{-18}{3}$, or $x = \frac{-18}{3}$. The student needs to focus on understanding how to complete all the steps to calculate the solution to a system of equations.

Item Position	Rationale	
12	Option D is correct	To determine the vertex (highest or lowest point of the curve) of *g*, the student could have first recognized that the vertex of $f(x) = x^2$ is (0, 0). The student could have interpreted $g(x) = f(x + 8.7)$ as the result of shifting the graph of *f* to the left 8.7 units. The student could have concluded that the vertex of *g* is located 8.7 units to the left of the vertex of *f*, at (–8.7, 0). 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 interpreted $g(x) = f(x + 8.7)$ as the result of shifting the graph of *f* up 8.7 units. The student then likely concluded that the vertex of *g* is at (0, 8.7). The student needs to focus on understanding how changes to a function affect the graph of the function.
	Option B is incorrect	The student likely interpreted $g(x) = f(x + 8.7)$ as the result of shifting the graph of *f* down 8.7 units. The student then likely concluded that the vertex of *g* is at (0, –8.7). The student needs to focus on understanding how changes to a function affect the graph of the function.
	Option C is incorrect	The student likely interpreted $g(x) = f(x + 8.7)$ as the result of shifting the graph of *f* to the right 8.7 units. The student then likely concluded that the vertex of *g* is at (8.7, 0). The student needs to focus on understanding how changes to a function affect the graph of the function.

Item Position	Rationale	
13	Option C is correct	To determine the rate of change (constant rate of increase or decrease) of *y* with respect to *x*, the student could have written the equation in slope-intercept form (*y* = *mx* + *b*, where *m* represents the slope [steepness of a line] and *b* represents the value of the *y*-intercept [value where a graph crosses the *y*-axis]). First, the student could have subtracted *x* from both sides of the equation, resulting in $x - x + 7y = -14 - x$, or $7y = -x - 14$. Next, the student could have divided both sides of the equation by 7, resulting in $\frac{7y}{7} = \frac{-x}{7} - \frac{14}{7}$, or $y = -\frac{1}{7}x - 2$. Last, the student should have recognized that the slope of the line, $m = -\frac{1}{7}$, also represents the rate of change of *y* with respect to *x* for the function. 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 switched the order of division when dividing both sides of the equation by 7, resulting in $y = -\frac{7}{1}x - \frac{7}{14}$ or $y = -7x - \frac{1}{2}$. The student then likely identified the rate of change as $m = -7$. The student needs to focus on understanding how to write a linear function in slope-intercept form when given the function in a different form.
	Option B is incorrect	The student likely added *x* to the right side of the equation instead of subtracting *x* when moving the term across the equal sign, resulting in $7y = x - 14$. The student then likely switched the order of division when dividing both sides of the equation by 7, resulting in $y = \frac{7}{1}x - \frac{7}{14}$ or $y = 7x - \frac{1}{2}$. Next, the student likely identified the rate of change as $m = 7$. The student needs to focus on understanding how to write a linear function in slope-intercept form when given the function in a different form.
	Option D is incorrect	The student likely added *x* to the right side of the equation instead of subtracting *x* when moving the term across the equal sign, resulting in $7y = x - 14$. The student then likely divided both sides of the equation by 7, resulting in $y = \frac{1}{7}x - 2$. Next, the student likely identified the rate of change as $m = \frac{1}{7}$. The student needs to focus on understanding how to write a linear function in slope-intercept form when given the function in a different form.

Item Position	Rationale	
14	Option B is correct	To determine the inequality that represents the situation, the student should have recognized that x represents the number of pounds of apples, and y represents the number of pounds of blueberries that the baker can order. The student should have identified that each pound of apples costs \$2.50, which can be represented by $2.5x$. The student should have also identified that each pound of blueberries costs \$3.00, which can be represented by $3y$. The student then should have represented the total cost of the apples and blueberries by the expression $2.5x + 3y$. Finally, the student should have interpreted the phrase “does not want to spend more than \$75.00” as “less than or equal to,” resulting in the inequality $2.5x + 3y \leq 75$.
	Option A is incorrect	The student likely added the costs per pound of apples and blueberries, resulting in $2.5 + 3 = 5.5$. The student then likely represented the total cost of the apples and blueberries by the expression $5.5x + 5.5y$. Next, the student likely interpreted the phrase “does not want to spend more than \$75.00” as “greater than or equal to” instead of “less than or equal to,” resulting in the inequality $5.5x + 5.5y \geq 75$. The student needs to focus on understanding how to write a linear inequality from a verbal description.
	Option C is incorrect	The student likely switched the coefficients of x and y, resulting in $3x + 2.5y \leq 75$. The student needs to focus on understanding how to write a linear inequality from a verbal description.
	Option D is incorrect	The student likely interpreted the phrase “does not want to spend more than \$75.00” as “greater than or equal to” instead of “less than or equal to,” resulting in the inequality $2.5x + 3y \geq 75$. The student needs to focus on understanding how to write a linear inequality from a verbal description.

Item Position	Rationale	
15	Point at (0, –3)	To determine which location best represents the *y*-intercept of the quadratic function, the student could have determined the location of the point where the graph of the function crosses the *y*-axis (vertical number line), which is (0, –3). This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item Position	Rationale	
16	Option D is correct	To determine the range (all possible *y*-values) of the function for the situation, the student should have recognized that the situation represents a linear function with discrete values since the number of people purchasing tickets for the amusement park is represented by the set of whole numbers from 1 to 4. The student should have also recognized that the values of the total cost in dollars, *c*, represent the range of the function. Since the function contains discrete values, the student should have concluded that the range of the function for this situation is {64.95, 109.90, 154.85, 199.80}.
	Option A is incorrect	The student likely confused the range with the domain (all possible *x*-values) and did not consider that the values of the function should be discrete. Therefore, the student likely identified the values of the domain of a linear function that is bounded and continuous, resulting in $1 \le p \le 4$. The student needs to focus on understanding how to identify the domain and range of a linear function with discrete values.
	Option B is incorrect	The student likely did not consider that the values of the function should be discrete and identified the values of the range of a linear function that is bounded and continuous, resulting in $64.95 \le c \le 199.80$. The student needs to focus on understanding how to identify the domain and range of a linear function with discrete values.
	Option C is incorrect	The student likely identified the values of the domain instead of the range, resulting in {1, 2, 3, 4}. The student needs to focus on understanding how to identify the domain and range of a linear function with discrete values.

Item Position	Rationale	
17	68 and any equivalent values are correct	To determine the value of $f(-1)$, the student should have substituted $x = -1$ into the function (relationship where each input value has a single output value) and then simplified the function, resulting in $f(-1) = 3(-1 - 4)^2 - 7 = 3(-5)^2 - 7 = 3(25) - 7 = 75 - 7 = 68$.

Item Position	Rationale	
18	Option C is correct	To determine which function represents the relation shown in the table, the student should have recognized that the relation is represented by an exponential function in the form of $P(x) = ab^x$, where a is the y-intercept (value where a graph crosses the y-axis [vertical number line]), b is the common factor (constant rate by which successive values increase or decrease), and x is the variable (symbol used to represent an unknown number). The student could have determined that $a = 90$ since the y-intercept of the function is located at (0, 90). Next, the student could have determined the common factor, b, by dividing each value of $P(x)$ by the previous value of $P(x)$, resulting in $b = \frac{90}{270} = \frac{30}{90} = \frac{10}{30} = \frac{1}{3}$. The student could have then substituted $a = 90$ and $b = \frac{1}{3}$ into the equation $P(x) = ab^x$, resulting in $P(x) = 90\left(\frac{1}{3}\right)^x$. 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 identified the value of a as the value of $P(x)$ when $x = 1$ instead of when $x = 0$, resulting in $a = 30$. Next, the student likely substituted $a = 30$ and $b = \frac{1}{3}$ into the equation $P(x) = ab^x$, resulting in $P(x) = 30\left(\frac{1}{3}\right)^x$. The student needs to focus on understanding how to write an exponential function in the form $P(x) = ab^x$ when given a table.
	Option B is incorrect	The student likely determined the common factor, b, by dividing each value of $P(x)$ by the subsequent value of $P(x)$, resulting in $b = \frac{270}{90} = \frac{90}{30} = \frac{30}{10} = 3$. Next, the student likely substituted $a = 90$ and $b = 3$ into the equation $P(x) = ab^x$, resulting in $P(x) = 90(3)^x$. The student needs to focus on understanding how to write an exponential function in the form $P(x) = ab^x$ when given a table.
	Option D is incorrect	The student likely identified the value of a as the value of $P(x)$ when $x = 1$ instead of when $x = 0$, resulting in $a = 30$. Next, the student likely determined the common factor, b, by dividing each value of $P(x)$ by the subsequent value of $P(x)$, resulting in $b = \frac{270}{90} = \frac{90}{30} = \frac{30}{10} = 3$. Finally, the student likely substituted $a = 30$ and $b = 3$ into the equation $P(x) = ab^x$, resulting in $P(x) = 30(3)^x$. The student needs to focus on understanding how to write an exponential function in the form $P(x) = ab^x$ when given a table.

Item Position	Rationale	
19	Option C is correct	To determine which value best represents the zero (*x*-value where *y* is equal to zero) of the function, the student could have determined the location of the *x*-intercept (point where the line crosses the *x*-axis [horizontal number line]) of the line, which is (–5, 0). Since $x = -5$ when $y = 0$, the student could have concluded that the zero of the function is –5. 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 interpreted the zero of the function as representing the slope (steepness of a line), which is 2. The student needs to focus on understanding how to identify key features of a linear function when given a graph of the function.
	Option B is incorrect	The student likely interpreted the zero of the function as representing the *y*-value where the line crosses the *y*-axis (vertical number line), which is 10. The student needs to focus on understanding how to identify key features of a linear function when given a graph of the function.
	Option D is incorrect	The student likely interpreted the zero of the function as representing the opposite value of the slope of the line, which is –2. The student needs to focus on understanding how to identify key features of a linear function when given a graph of the function.

Item Position	Rationale	
20	Option D is correct	To determine which expression is a factor of $5x^2 - 30x - 80$, the student could have found the factors (numbers or expressions that can be multiplied to get another number or expression) of the expression. The student could have first factored out the greatest common factor (largest factor that divides evenly into all the terms), 5, from each term, resulting in $5(x^2 - 6x - 16)$. Next, the student could have determined that the factors of x^2 are x and x and written x as the first term in each binomial factor. The student then could have determined that the second terms in the binomial factors are –8 and 2 since their product is –16 (the constant term in the expression $x^2 - 6x - 16$) and their sum is –6 (the coefficient of the linear term in the expression $x^2 - 6x - 16$). Next, the student could have written the factors as $5(x - 8)(x + 2)$. Finally, the student could have recognized that $(x - 8)$ is one of the factors of the given expression. 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 that two factors of –16 are –4 and 4 but disregarded the coefficient of the linear term of the expression, resulting in $5(x - 4)(x + 4)$. The student needs to focus on understanding how to factor an expression of the form $ax^2 + bx + c$.
	Option B is incorrect	The student likely made a sign error when factoring, resulting in $5(x + 8)(x - 2)$. The student needs to focus on understanding how to factor an expression of the form $ax^2 + bx + c$.
	Option C is incorrect	The student likely determined that two factors of –16 are –4 and 4 but disregarded the coefficient of the linear term of the expression, resulting in $5(x - 4)(x + 4)$. The student needs to focus on understanding how to factor an expression of the form $ax^2 + bx + c$.

Item Position	Rationale	
21	Option A is correct	To determine which equation represents the axis of symmetry (an imaginary vertical line that goes through the vertex of a parabola [U-shaped graph]) of the graph of *f*, the student could have determined that the vertex (highest or lowest point of the curve) of the graph is located at (–5, –7). Next, the student could have recognized that the axis of symmetry is represented by the equation $x = h$, where h represents the x-coordinate of the vertex. Therefore, the student could have concluded that the equation of the axis of symmetry of the graph of f is $x = –5$. 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 recognized that the x- and y-coordinates of the point (–3, –3) are the same and concluded that the equation of the axis of symmetry is $x = –3$. The student needs to focus on understanding how to identify the key features of a quadratic function when given a graph of the function.
	Option C is incorrect	The student likely represented the axis of symmetry by the equation $y = k$, where k represents the y-coordinate of the vertex, resulting in $y = –7$. The student needs to focus on understanding how to identify the key features of a quadratic function when given a graph of the function.
	Option D is incorrect	The student likely recognized that the labeled points (–8, 2) and (–2, 2) have the same y-coordinate and concluded that the equation of the axis of symmetry is $y = 2$. The student needs to focus on understanding how to identify the key features of a quadratic function when given a graph of the function.

Item Position	Rationale	
22	$-\frac{3}{5}$, 3	To determine the equation of line *p* in slope-intercept form ($y = mx + b$, where *m* represents the slope [steepness of a line] and *b* represents the value of the *y*-intercept [value where a graph crosses the *y*-axis]), the student should have recognized that line *n* and line *p* are parallel lines (lines that do not intersect [cross] and are always the same distance from each other). The student should have determined from the given equation that the slope of line *n* is $m = -\frac{3}{5}$. Since parallel lines have the same slope, the student should have then determined that line *p* has a slope of $m = -\frac{3}{5}$. Next, the student could have substituted the *x*- and *y*-coordinates of the given point, (15, –6), and $m = -\frac{3}{5}$ into $y = mx + b$ and solved for *b*, resulting in $-6 = -\frac{3}{5}(15) + b$, or $b = 3$. Since $m = -\frac{3}{5}$ and $b = 3$, the student could have concluded that the equation of line *p* is $y = -\frac{3}{5}x + 3$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item Position	Rationale	
23	Option C is correct	To determine which expression is equivalent to $(2k^2 – 3m)(3k – 4)$, the student could have multiplied each term in the factor $(2k^2 – 3m)$ by each term in the factor $(3k – 4)$, resulting in $2k^2(3k – 4) – 3m(3k – 4)$, or $6k^3 – 8k^2 – 9km + 12m$. 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 multiplied only the first terms and the last terms in the two factors, resulting in $2k^2(3k) – 3m(–4)$ or $6k^3 + 12m$. The student needs to focus on understanding how to find the product of two binomials.
	Option B is incorrect	The student likely determined that the product of $2k^2$ and $–4$ is $–8k^3$ instead of $–8k^2$ and determined that the product of $–3m$ and $–4$ is $12km$ instead of $12m$, resulting in $6k^3 – 8k^3 – 9km + 12km$. Next, the student likely combined like terms (terms that contain the same variables raised to the same powers or constant terms), resulting in $–2k^3 + 3km$. The student needs to focus on understanding how to find the product of two binomials.
	Option D is incorrect	The student likely determined that the product of $2k^2$ and $3k$ is $6k^2$ instead of $6k^3$ and made a sign error when multiplying $–3m$ and $–4$, resulting in $6k^2 – 8k^2 – 9km – 12m$. Next, the student likely combined like terms, resulting in $–2k^2 – 9km – 12m$. The student needs to focus on understanding how to find the product of two binomials.

Item Position	Rationale	
24	Option D is correct	To determine which statement about the system of equations (two or more equations containing the same set of variables [symbols used to represent unknown numbers]) is true, the student could have used the substitution method to solve the system. The student could have substituted $y = -0.5x + 4$ into the equation $3x + 6y = 24$ and solved for x, resulting in $3x + 6(-0.5x + 4) = 24$ or $3x - 3x + 24 = 24$. Next, the student could have combined like terms (terms that contain the same variables raised to the same powers or constant terms) on the left side of the equation, resulting in $24 = 24$. Since the x-terms were eliminated when like terms were combined, and the resulting equation yielded a true statement, the student could have concluded that the system has infinitely many solutions. 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 solved the system of equations correctly but interpreted the equation $24 = 24$ to mean that the system has no solutions since the x-terms were eliminated. The student needs to focus on understanding how to complete all the steps to calculate the solution to a system of equations.
	Option B is incorrect	The student likely found a solution, such as (0, 4), that yields a true statement for both equations but did not consider that additional solutions were possible. The student needs to focus on understanding how to complete all the steps to calculate the solution to a system of equations.
	Option C is incorrect	The student likely found two solutions, such as (0, 4) and (8, 0), that yield a true statement for both equations but did not consider that additional solutions were possible. The student needs to focus on understanding how to complete all the steps to calculate the solution to a system of equations.

Item Position	Rationale	
25	Option B is correct	To determine which predictions are true based on the line of best fit, the student could have first used a graphing calculator to generate the function using linear regression (a method of determining a linear function, $y = ax + b$, where a and b are real numbers). The linear function that best models the data is $y = –9.298x + 167.122$. Substituting $x = 6$ into the regression equation, the student should have obtained $y = –9.298(6) + 167.122 \approx 111$. The student then could have concluded that approximately 111 lunch specials would be sold if the price were \$6.00. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option E is correct	To determine which predictions are true based on the line of best fit, the student could have first used a graphing calculator to generate the function using linear regression (a method of determining a linear function, $y = ax + b$, where a and b are real numbers). The linear function that best models the data is $y = –9.298x + 167.122$. Substituting $x = 15$ into the regression equation, the student should have obtained $y = –9.298(15) + 167.122 \approx 28$. The student then could have concluded that approximately 28 lunch specials would be sold if the price were \$15.00. 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 107 by 6.5 to determine the unit rate, resulting in 16.462 lunches sold per dollar. Next, the student likely substituted $x = 5$ into the equation $y = 16.462x$, resulting in $y = 16.462(5) \approx 82$. The student then likely concluded that approximately 82 lunch specials would be sold if the price were \$5.00. The student needs to focus on understanding how to write a linear function that was generated using linear regression.
	Option C is incorrect	The student likely used the graphing calculator to generate a linear regression using only the last two ordered pairs in the table, resulting in $y = –11.667x + 189.083$. Next, the student likely substituted $x = 7.5$ into the regression equation, resulting in $y = –11.667(7.5) + 189.083 \approx 102$. The student then likely concluded that approximately 102 lunch specials would be sold if the price were \$7.50. The student needs to focus on understanding how to write a linear function that was generated using linear regression.
	Option D is incorrect	The student likely divided 65 by 11 to determine the unit rate, resulting in 5.909 lunches sold per dollar. Next, the student likely substituted $x = 12.5$ into the equation $y = 5.909x$, resulting in

		$y = 5.909(12.5) \approx 74$. The student then likely concluded that approximately 74 lunch specials would be sold if the price were $12.50. The student needs to focus on understanding how to write a linear function that was generated using linear regression.

Item Position	Rationale	
26	Option C is correct	To determine the width of the deck in feet, the student could have first recognized that one side of the equation must be set equal to zero. The student could have subtracted 108 from both sides of the equation, resulting in $x(x + 3) – 108 = 108 – 108$, or $x(x + 3) – 108 = 0$. The student then could have multiplied each term inside the parentheses by x, resulting in the quadratic equation $x^2 + 3x – 108 = 0$. Next, the student could have found the binomial factors (numbers or expressions that can be multiplied to get another number or expression) of $x^2 + 3x – 108$. The student could have determined that the factors of x^2 are x and x and written x as the first term in each binomial factor. The student then could have determined that the second terms in the binomial factors are 12 and –9 since their product is –108 (the constant term in the expression) and their sum is 3 (the coefficient of the linear term in the expression. The student could have written the equation as $(x + 12)(x – 9) = 0$. Next, the student could have set each factor equal to zero and solved each equation for x. To solve $x + 12 = 0$, the student could have subtracted 12 from both sides of the equation, resulting in $x = –12$. To solve $x – 9 = 0$, the student could have added 9 to both sides of the equation, resulting in $x = 9$. Since the width, x, must be positive number, the student could have concluded that the width of the deck is 9 feet. 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 that two factors of –108 are –6 and 18 but disregarded the value of the linear term of the expression, resulting in $(x – 6)(x + 18) = 0$. Next, the student likely set each factor equal to zero and solved each equation for x. To solve $x – 6 = 0$, the student likely added 6 to both sides of the equation, resulting in $x = 6$. To solve $x + 18 = 0$, the student likely subtracted 18 from both sides of the equation, resulting in $x = –18$. Since x must be positive, the student likely concluded that the width of the deck is 6 feet. The student needs to focus on understanding how to find the factors and solutions of a quadratic equation.
	Option B is incorrect	The student likely determined that two factors of –108 are –4 and 27 but disregarded the value of the linear term of the expression, resulting in $(x – 4)(x + 27) = 0$. Next, the student likely set each factor equal to zero and solved each equation for x. To solve $x – 4 = 0$, the student likely added 4 to both sides of the equation, resulting in $x = 4$. To solve $x + 27 = 0$, the student likely subtracted 27 from both sides of the equation, resulting in $x = –27$. Since x must be positive, the student likely concluded that the

		width of the deck is 4 feet. The student needs to focus on understanding how to find the factors and solutions of a quadratic equation.
	Option D is incorrect	The student likely set each of the given factors equal to zero and solved each equation for *x*. To solve $x + 3 = 0$, the student likely added 3 to the right side of the equation when moving the 3 across the equal sign, resulting in $x = 3$. The student needs to focus on understanding how to find the factors and solutions of a quadratic equation and understanding the arithmetic of solving equations.

Item Position	Rationale	
27	Option B is correct	To determine the slope (steepness of a line) of the line represented in the table, the student could have used any two ordered pairs from the table and applied the slope formula, $m = \frac{y_2 - y_1}{x_2 - x_1}$. Substituting the ordered pairs (–4, 23) and (–1, 15) into the slope formula, the student could have obtained $m = \frac{15-23}{-1-(-4)} = -\frac{8}{3}$. 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 switched the order of the subtraction when calculating the change in *y*, resulting in $m = \frac{23-15}{-1-(-4)} = \frac{8}{3}$. The student needs to focus on understanding how to use the formula for the slope of a line when given a table.
	Option C is incorrect	The student likely calculated the slope as the change in the *x*-values divided by the change in the *y*-values and switched the order of the subtraction when calculating the change in *y*, resulting in $m = \frac{-1-(-4)}{23-15} = \frac{3}{8}$. The student needs to focus on understanding how to use the formula for the slope of a line when given a table.
	Option D is incorrect	The student likely calculated the slope as the change in the *x*-values divided by the change in the *y*-values, resulting in $m = \frac{-1-(-4)}{15-23} = -\frac{3}{8}$. The student needs to focus on understanding how to use the formula for the slope of a line when given a table.

Item Position	Rationale	
28	$\frac{1}{3}$, 15	To determine an equivalent form of the expression $\frac{2x^{12}}{6x^{-3}}$, the student could have first divided the coefficients, resulting in $\frac{1}{3} \cdot \frac{x^{12}}{x^{-3}}$, or $\frac{x^{12}}{3x^{-3}}$. Next, the student could have applied the quotient of powers property $\left(\frac{a^m}{a^n} = a^{m-n}\right)$, resulting in $\frac{1}{3}x^{12-(-3)}$, or $\frac{1}{3}x^{15}$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item Position	Rationale	
29	Option B is correct	To determine the value of *z* that makes the equation $\frac{4}{3}z + 6 = -4\left(\frac{1}{6}z + 9\right)$ true, the student could have first multiplied each term inside the parentheses on the right side of the equation by –4, resulting in $\frac{4}{3}z + 6 = -\frac{2}{3}z - 36$. Next, the student could have added $\frac{2}{3}z$ to both sides of the equation, resulting in $\frac{4}{3}z + 6 + \frac{2}{3}z = -\frac{2}{3}z - 36 + \frac{2}{3}z$, or 2*z* + 6 = –36. The student then could have subtracted 6 from both sides of the equation, resulting in 2*z* + 6 – 6 = –36 – 6, or 2*z* = –42. Last, the student could have divided both sides of the equation by 2, resulting in $\frac{2x}{2} = \frac{-42}{2}$, or *x* = –21. 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 multiplied only the first term in the parentheses on the right side of the equation by –4, resulting in $\frac{4}{3}z + 6 = -\frac{2}{3}z + 9$. Next, the student likely added $\frac{2}{3}z$ to both sides of the equation, resulting in $\frac{4}{3}z + 6 + \frac{2}{3}z = -\frac{2}{3}z + 9 + \frac{2}{3}z$, or 2*z* + 6 = 9. The student then likely subtracted 6 from both sides of the equation, resulting in 2*z* + 6 – 6 = 9 – 6, or 2*z* = 3. Last, the student likely divided both sides of the equation by 2, resulting in $\frac{2x}{2} = \frac{3}{2}$, or $x = \frac{3}{2}$. The student needs to focus on understanding the arithmetic of solving equations.
	Option C is incorrect	The student likely multiplied only the first term in the parentheses on the right side of the equation by 4 instead of by –4, resulting in $\frac{4}{3}z + 6 = \frac{2}{3}z + 9$. Next, the student likely subtracted $\frac{2}{3}z$ from both sides of the equation, resulting in $\frac{4}{3}z + 6 - \frac{2}{3}z = \frac{2}{3}z + 9 - \frac{2}{3}z$, or $\frac{2}{3}z + 6 = 9$. The student then likely subtracted 6 from both sides of the equation, resulting in $\frac{2}{3}z + 6 - 6 = 9 - 6$, or $\frac{2}{3}z = 3$. Last, the student likely multiplied both sides of the equation by $\frac{3}{2}$, resulting in $\frac{3}{2}\left(\frac{2}{3}x\right) = \frac{3}{2}(3)$, or $x = \frac{9}{2}$. The student needs to focus on understanding the arithmetic of solving equations.
	Option D is incorrect	The student likely did not apply inverse operations when moving terms across the equal sign, resulting in $\frac{4}{3}z - \frac{2}{3}z = -36 + 6$, or $\frac{2}{3}z = -30$. Next, the student likely multiplied both sides of the equation by $\frac{3}{2}$, resulting in $\frac{3}{2}\left(\frac{2}{3}x\right) = \frac{3}{2}(-30)$, or *x* = –45. The student needs to focus on understanding the arithmetic of solving equations.

Item Position	Rationale	
30	Dashed line going through (0, –3) and (1, 2); shading the area that includes the point (0, 0)	To determine the solution set for the linear inequality $y > 5x - 3$, the student could have first recognized that the graph of the boundary line is dashed since the inequality is non-inclusive. Next, the student could have recognized that the graph of the dashed boundary line $y = 5x - 3$ has a slope (steepness of a line) of 5 and a y-intercept (value where a graph crosses the y-axis (vertical number line)] of –3. The student could have plotted the point (0, –3) since the y-intercept is –3. The student then could have used the slope of 5 to determine that the point (1, 2) also lies on the boundary line since the point (1, 2) is 5 units up from and 1 unit to the right of the point (0, –3). To determine which region contains the solution set for the inequality, the student could have selected a test point at (0, 0). Substituting the test point (0, 0) into the inequality, the student should have obtained $0 > 5(0) - 3$, or $0 > -3$. Since $0 > -3$ is a true statement, the student could have concluded that the region containing the point (0, 0) should be shaded. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item Position	Rationale	
31	Option D is correct	To determine which equation is equivalent to 5*x* – 8*y* = 40 when solved for *y*, the student could have first subtracted 5*x* from both sides of the equation, resulting in 5*x* – 8*y* – 5*x* = 40 – 5*x*, or –8*y* = –5*x* + 40. Next, the student could have divided each term in the equation by –8, resulting in $\frac{-8y}{-8} = \frac{-5x}{-8} + \frac{40}{-8}$, or $y = \frac{5}{8}x - 5$. 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 solved the equation for *x* instead of *y* by first adding 8*y* to both sides of the equation, resulting in 5*x* – 8*y* + 8*y* = 40 + 8*y*, or 5*x* = 8*y* + 40. Next, the student likely divided each term on the right side of the equation by –5 instead of by 5, resulting in $x = \frac{8y}{-5} + \frac{40}{-5}$, or $x = -\frac{8}{5}y - 8$. Last, the student likely transposed the *x* and *y* in the equation since the equation was supposed to be solved for *y*, resulting in $y = -\frac{8}{5}x - 8$. The student needs to focus on understanding the arithmetic of solving linear equations.
	Option B is incorrect	The student likely made a sign error when dividing by –8, resulting in $y = -\frac{5}{8}x + 5$. The student needs to focus on understanding the arithmetic of solving linear equations.
	Option C is incorrect	The student likely solved the equation for *x* instead of *y* by first adding 8*y* to both sides of the equation, resulting in 5*x* – 8*y* + 8*y* = 40 + 8*y*, or 5*x* = 8*y* + 40. Next, the student likely divided each term in the equation by 5, resulting in $\frac{5x}{5} = \frac{8y}{5} + \frac{40}{5}$, or $x = \frac{8}{5}y + 8$. Last, the student likely transposed the *x* and *y* in the equation since the equation was supposed to be solved for *y*, resulting in $y = \frac{8}{5}x + 8$. The student needs to focus on understanding the arithmetic of solving linear equations.

Item Position	Rationale	
32	Option A is correct	To determine the domain (all possible *x*-values) of the part of the quadratic function graphed on the grid, the student should have identified all values of *x* for which the graph has a *y*-value. The student should have recognized that the graph of the parabola (U-shaped graph) contains the closed point (5, 5) on the right and extends to the left from that point. Thus, the student should have concluded that the domain of the part of the quadratic function graphed on the grid is all real numbers less than or equal to 5.
	Option B is incorrect	The student likely identified the *x*-coordinate of the vertex (highest or lowest point of the curve) as the least value of the domain. The student needs to focus on understanding how to represent the domain of a quadratic function when given a part of the graph.
	Option C is incorrect	The student likely identified the range (all possible *y*-values) of the part of the quadratic function graphed on the grid. The student needs to focus on understanding how to represent the domain of a quadratic function when given a part of the graph.
	Option D is incorrect	The student likely identified the domain of an unbounded quadratic function. The student needs to focus on understanding how to represent the domain of a quadratic function when given a part of the graph.

Item Position	Rationale	
33	An exponential curve going through (0, 6) and (1, 2) with an asymptote of $y = 0$	To graph the function $f(x) = 6\left(\frac{1}{3}\right)^x$, the student should have first recognized that the equation represents an exponential function. The student then could have identified two points on the graph of the exponential function. For the first point, the student could have substituted $x = 0$ into the function to obtain the point (0, 6). For the second point, the student could have substituted $x = 1$ into the function to obtain the point (1, 2). Last, the student could have recognized that the graph extends infinitely to the left and the right and never crosses the *x*-axis (horizontal axis), so the graph of the function has an asymptote at $y = 0$ and has no *x*-intercepts (points where the curve touches the *x*-axis). This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item Position	Rationale	
34	Option C is correct	To determine which system of equations (two or more equations containing the same set of variables [symbols used to represent unknown numbers]) can be used to find the length and width of the garden in meters, the student should have written one equation that represents the perimeter and one equation that represents the given relationship between the length and the width. The student should have recognized from the given information that x represents the width of the garden in meters, and y represents the length of the garden in meters. Next, the student should have set up the first equation as $2x + 2y = 48$ since the perimeter of the garden is 48 meters, and the perimeter of a rectangle is the sum of twice the width and twice the length. Last, the student should have set up the second equation as $y = 2x + 6$ since 6 more than twice the width is represented by $2x + 6$.
	Option A is incorrect	The student correctly set up the first equation, which represents the perimeter of the garden, as $2x + 2y = 48$, but likely switched the numbers in the second equation, resulting in $y = 6x + 2$. The student needs to focus on understanding how to write a system of equations from a verbal description.
	Option B is incorrect	The student correctly set up the second equation, which represents the given relationship between the length and width of the garden, as $y = 2x + 6$. The student then likely did not recognize that the perimeter of a rectangle is the sum of twice the width and twice the length and did not multiply the variables in the first equation by 2, resulting in $x + y = 48$. The student needs to focus on understanding how to write a system of equations from a verbal description.
	Option D is incorrect	The student likely did not recognize that the perimeter of a rectangle is the sum of twice the width and twice the length and did not multiply the variables in the first equation by 2, resulting in $x + y = 48$. The student also likely switched the numbers in the second equation, resulting in $y = 6x + 2$. The student needs to focus on understanding how to write a system of equations from a verbal description.

Item Position	Rationale	
35	Option D is correct	To determine which graph best represents a line that has a slope of $\frac{2}{3}$ and a *y*-intercept of 4, the student could have first recognized that the graph of the line passes through the *y*-axis (vertical number line) at the point (0, 4) since the *y*-intercept is 4. Next, the student could have used the slope (steepness of a line) of $\frac{2}{3}$ to find that the point (3, 6) also lies on the line since the point (3, 6) is 2 units up from and 3 units to the right of the point (0, 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 interpreted the *y*-intercept as the point where the line crosses the *x*-axis (horizontal number line) instead of the *y*-axis, resulting in the point (4, 0). Next, the student likely used the slope of $\frac{2}{3}$ to find another point on the line but moved 2 units down, instead of 2 units up, and 3 units to the right, resulting in the point (7, –2). The student needs to focus on understanding how to graph a line when given key features of a linear function.
	Option B is incorrect	The student likely recognized that the graph of the line passes through the point (0, 4). Next, the student likely used the slope of $\frac{2}{3}$ to find another point on the line but moved 2 units down, instead of 2 units up, and 3 units to the right, resulting in the point (3, 2). The student needs to focus on understanding how to graph a line when given key features of a linear function.
	Option C is incorrect	The student likely interpreted the *y*-intercept as the point where the line crosses the *x*-axis (horizontal number line) instead of the *y*-axis, resulting in the point (4, 0). Next, the student liked used the slope of $\frac{2}{3}$ to determine that the point (7, 2) also lies on the line since the point (7, 2) is 2 units up from and 3 units to the right of the point (4, 0). The student needs to focus on understanding how to graph a line when given key features of a linear function.

Item Position	Rationale	
36	−3, 2	To determine the solutions to the equation $(2x + 1)^2 = 25$, the student could have used the square root method to solve the equation. The student could have removed the square on the left side of the equation by taking the square root of both sides of the equation, resulting in $\sqrt{(2x+1)^2} = \pm\sqrt{25}$, or $2x + 1 = \pm 5$. Next, the student could have written the equation $2x + 1 = \pm 5$ as two separate equations and solved each equation for x. To solve $2x + 1 = 5$, the student could have subtracted 1 from both sides of the equation, resulting in $2x + 1 - 1 = 5 - 1$, or $2x = 4$. The student then could have divided both sides of the equation by 2, resulting in $\frac{2x}{2} = \frac{4}{2}$, or $x = 2$. To solve $2x + 1 = -5$ the student could have subtracted 1 from both sides of the equation, resulting in $2x + 1 - 1 = -5 - 1$, or $2x = -6$. The student then could have divided both sides of the equation by 2, resulting in $\frac{2x}{2} = \frac{-6}{2}$, or $x = -3$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item Position	Rationale	
37	Option B is correct	To determine the domain (all possible *x*-values) of the function for the situation, the student should have identified all values of *x* for which the graph has a *y*-value. The graph extends from the point (0, 62,500) to (10, 0) and includes all *x*-values between $x = 0$ and $x = 10$. Therefore, the student should have concluded that the domain of the function is represented by the inequality $0 \le x \le 10$.
	Option A is incorrect	The student likely identified the correct values for the domain but used *y* instead of *x* to represent the domain of the function, resulting in $0 \le y \le 10$. The student needs to focus on understanding how to represent the domain of a linear function when given a part of the graph.
	Option C is incorrect	The student likely identified the range (all possible *y*-values) for the situation, resulting in $0 \le y \le 62{,}500$. The student needs to focus on understanding how to represent the domain of a linear function when given a part of the graph.
	Option D is incorrect	The student likely used the correct variable to represent the domain of the function but identified the values of the range, resulting in $0 \le x \le 62{,}500$. The student needs to focus on understanding how to represent the domain of a linear function when given a part of the graph.

Item Position	Rationale	
38	Option A is correct	To determine which graph best represents the solution set for the system of inequalities $y < x + 4$ and $y \leq -2x - 2$, the student could have graphed each boundary line and then determined the region containing the solution set to the system. To graph the inequality $y < x + 4$, the student could have recognized that the graph of the line $y = x + 4$ has a slope (steepness of a line) of 1 and a y-intercept (value where a graph crosses the y-axis [vertical number line]) of 4. The student should have also recognized that the boundary line of the graph is dashed since the inequality is non-inclusive. To graph the inequality $y \leq -2x - 2$, the student could have recognized that the graph of the line $y = -2x - 2$ has a slope of –2 and a y-intercept of –2. The student should have also recognized that the graph of the boundary line is solid since the inequality is inclusive. To determine the region containing the solution set to the system, the student could have selected a test point at (–2, 0). Substituting the test point (–2, 0) into each inequality, the student could have obtained $0 < -2 + 4$ and $0 \leq -2(-2) - 2$. Since $0 < 4$ and $0 \leq 2$ are true statements, the student could have concluded that the region containing the point (–2, 0) should be shaded. 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 graphed the correct boundary lines but interpreted the inequalities as “greater than” instead of “less than” when substituting the test point (–1, 4) into each inequality. The student then likely concluded that, since $4 > 3$ and $4 \geq 0$ are true statements, the region containing the point (–1, 4) should be shaded. The student needs to focus on understanding how the inequality symbol affects the graph of the solution set to each inequality in a system of inequalities.
	Option C is incorrect	The student likely identified the correct region containing the solution set but interpreted both inequalities as inclusive, thus concluding that both boundary lines are solid. The student needs to focus on understanding how the inequality symbol affects the graph of the solution set to each inequality in a system of inequalities.
	Option D is incorrect	The student likely interpreted both inequalities as non-inclusive and concluded that both boundary lines are dashed. Next, the student likely interpreted the inequalities as “greater than” instead of “less

		than" when substituting the test point (–1, 4) into each inequality. The student then likely concluded that, since 4 > 3 and 4 > 0 are true statements, the region containing the point (–1, 4) should be shaded. The student needs to focus on understanding how the inequality symbol affects the graph of the solution set to each inequality in a system of inequalities.

Item Position	Rationale	
39	right, up	To complete the sentence that describes the transformation, the student could have first identified $f(x) = x^2$ as the quadratic parent function. The student could have recognized that from the function rule $g(x) = f(x – 6)$, $f(x – 6)$ represents a horizontal shift of 6 units to the right and that "+ 2" represents a vertical shift of 2 units up. Thus, the student could have concluded that the graph of f is translated 6 units right and 2 units up to create the graph of g. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.

Item Position	Rationale	
40	Option D is correct	To determine the first four terms in the sequence generated using the equation $a_n = 1.1a_{(n-1)}$, where $a_1 = 100$ and n is a whole number greater than 1, the student could have recognized that the sequence is geometric (a sequence of numbers where the ratio between every two consecutive terms is the same) since $a_{(n-1)}$, the previous term, is multiplied by 1.1. Since $a_1 = 100$, the student could have multiplied 100 by 1.1 to find a_2, resulting in $a_2 = 1.1(100) = 110$. Next, the student could have multiplied 110 by 1.1 to find a_3, resulting in $a_3 = 1.1(110) = 121$. Last, the student could have multiplied 121 by 1.1 to find a_4, resulting in $a_4 = 1.1(121) = 133.1$. The student then could have concluded that the first four terms of the sequence are {100, 110, 121, 133.1}. 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 multiplied the previous term in the sequence by 1.1 to find the next term but then added the previous term to the product, resulting in $a_2 = 1.1(100) + 100 = 110 + 100 = 210$, $a_3 = 1.1(210) + 210 = 231 + 210 = 441$, and $a_4 = 1.1(441) + 441 = 485.1 + 441 = 926.1$. The student likely then concluded that the first four terms of the sequence are {100, 210, 441, 926.1}. The student needs to focus on understanding how to identify terms of a geometric sequence.
	Option B is incorrect	The student likely multiplied the previous term in the sequence by 1.1 to find the next term but then subtracted 1 from the product, resulting in $a_2 = 1.1(100) - 1 = 110 - 1 = 109$, $a_3 = 1.1(109) - 1 = 119.9 - 1 = 118.9$, and $a_4 = 1.1(118.9) - 1 = 130.79 - 1 = 129.79$. The student likely then concluded that the first four terms of the sequence are {100, 109, 118.9, 129.79}. The student needs to focus on understanding how to identify terms of a geometric sequence.
	Option C is incorrect	The student likely added 1.1 to the previous term in the sequence to find the next term, resulting in $a_2 = 100 + 1.1 = 101.1$, $a_3 = 101.1 + 1.1 = 102.2$, and $a_4 = 102.2 + 1.1 = 103.3$. The student likely then concluded that the first four terms of the sequence are {100, 101.1, 102.2, 103.3}. The student needs to focus on understanding how to identify terms of a geometric sequence.

Item Position	Rationale	
41	Option A is correct	To determine the quadratic function in standard form ($f(x) = ax^2 + bx + c$, where a, b, and c are real numbers), the student could have first written the function in vertex form ($f(x) = a(x – h)^2 + k$, where (h, k) is the vertex [highest or lowest point of the curve] and a is the coefficient of the quadratic term). From the given information, the vertex of the function is (h, k) = (5, –1). The student could have substituted the values of h and k into $f(x) = a(x – h)^2 + k$, resulting in $f(x) = a(x – 5)^2 + (–1) = a(x – 5)^2 – 1$. Next, the student could have solved for a by substituting the coordinates of the additional point, (3, –17), into the function $f(x) = a(x – 5)^2 – 1$, resulting in $–17 = a(3 – 5)^2 – 1$, $–17 = a(–2)^2 – 1$, $–17 = 4a – 1$, $–16 = 4a$, or $a = –4$. The student then could have substituted the value of a into the function $f(x) = a(x – 5)^2 – 1$, resulting in $f(x) = –4(x – 5)^2 – 1$. After writing the quadratic function in vertex form, the student could have written the function in standard form by first expanding the expression that is squared, resulting in $f(x) = –4(x – 5)(x – 5) – 1$. The student then could have multiplied each term in (x – 5) by each term in (x – 5), resulting in $f(x) = –4(x^2 – 5x – 5x + 25) – 1 = –4(x^2 – 10x + 25) – 1$. Next, the student could have multiplied each term in ($x^2 – 10x + 25$) by –4, resulting in $f(x) = –4x^2 + 40x – 100 – 1$. Last, the student could have combined like terms (terms that contain the same variables raised to same powers or constant terms), resulting in $f(x) = –4x^2 + 40x – 101$. 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 1 from 17 instead of adding 1 and –17 when solving for a in the vertex form, resulting in $–17 = a(3 – 5)^2 – 1$, $–17 = a(–2)^2 – 1$, $–17 = 4a – 1$, $17 – 1 = 4a$, $16 = 4a$, or $a = 4$. The student likely obtained the function $f(x) = 4(x – 5)^2 – 1$. Next, the student likely expanded the expression that is squared, resulting in $f(x) = 4(x – 5)(x – 5) – 1$. Next, the student likely multiplied each term in (x – 5) by each term in (x – 5), resulting in $f(x) = 4(x^2 – 10x + 25) – 1$. Next, the student likely multiplied each term in ($x^2 – 10x + 25$) by 4, resulting in $f(x) = 4x^2 – 40x + 100 – 1$. Lastly, the student likely combined like terms, resulting in $f(x) = 4x^2 – 40x + 99$. The student needs to focus on understanding how to write quadratic functions in vertex form and standard form.
	Option C is incorrect	The student likely squared each term in (x – 5) instead of expanding the group of terms that is squared, resulting in $f(x) = –4(x^2 + 25) – 1$. Next, the student likely multiplied each term in

		$(x^2 + 25)$ by –4, resulting in $f(x) = –4x^2 – 100 – 1$. Last, the student likely combined like terms, resulting in $f(x) = –4x^2 – 101$. The student needs to focus on understanding how to write quadratic functions in vertex form and standard form.
	Option D is incorrect	The student likely subtracted 1 from 17 instead of adding 1 and –17 when solving for a in the vertex form, resulting in $–17 = a(3 – 5)^2 – 1$, $–17 = a(–2)^2 – 1$, $–17 = 4a – 1$, $17 – 1 = 4a$, $16 = 4a$, or $a = 4$. The student likely obtained the function $f(x) = 4(x – 5)^2 – 1$. Next, the student likely squared each term in $(x – 5)$ instead of expanding the group of terms that is squared, resulting in $f(x) = 4(x^2 + 25) – 1$. Next, the student likely multiplied each term in $(x^2 + 25)$ by 4, resulting in $f(x) = 4x^2 + 100 – 1$. Last, the student likely combined like terms, resulting in $f(x) = 4x^2 + 99$. The student needs to focus on understanding how to write quadratic functions in vertex form and standard form.

Item Position	Rationale	
42	Option C is correct	To determine the equation that is best represented by the graph, the student could have used the slope-intercept form of a linear equation ($y = mx + b$, where m represents the slope [steepness of a line] and b represents the value of the y-intercept [value where a graph crosses the y-axis]). The student could have used any two points on the graph, such as (–6, 1) and (9, 6), to determine the slope of the line. Substituting the points (–6, 1) and (9, 6) into the slope formula, $m = \frac{y_2 - y_1}{x_2 - x_1}$, the student could have obtained $m = \frac{6-1}{9-(-6)} = \frac{5}{15} = \frac{1}{3}$. Next, the student could have recognized that the line intersects (crosses) the y-axis (vertical number line) at (0, 3) and concluded that $b = 3$. The student then could have substituted $m = \frac{1}{3}$ and $b = 3$ into $y = mx + b$, resulting in $y = \frac{1}{3}x + 3$. Last, the student could have factored $\frac{1}{3}$ from each term on the right side of the equation, resulting in $y = \frac{1}{3}(x + 9)$. 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 x by the change in y to find the slope of the line, resulting in $m = \frac{9-(-6)}{6-1} = \frac{15}{5} = 3$. Next, the student likely recognized that the line intersects the y-axis at (0, 3) and concluded that $b = 3$. The student then likely substituted $m = 3$ and $b = 3$ into $y = mx + b$, resulting in $y = 3x + 3$. Last, the student likely factored out 3 from each term on the right side of the equation, resulting in $y = 3(x + 1)$. The student needs to focus on understanding how to calculate the slope of a line when given a graph.
	Option B is incorrect	The student likely divided the change in x by the change in y to find the slope of the line, resulting in $m = \frac{9-(-6)}{6-1} = \frac{15}{5} = 3$. Next, the student likely recognized that the line intersects the y-axis at (0, 3) and concluded that $b = 3$. The student then likely substituted $m = 3$ and $b = 3$ into $y = mx + b$, resulting in $y = 3x + 3$. Lastly, the student likely factored out a 3 from only the first term on the right side of the equation instead of factoring out 3 from each term on the right side of the equation, resulting in $y = 3(x + 3)$. The student needs to focus on understanding how to calculate the slope of a line when given a graph and how to factor an expression of the form $ax + b$.
	Option D is incorrect	The student likely identified the correct equation of the line in slope-intercept form, $y = \frac{1}{3}x + 3$, but factored out $\frac{1}{3}$ from only the first term on the right side of the equation instead of factoring out $\frac{1}{3}$ from each term on the right side of the equation, resulting in

		$y = \frac{1}{3}(x + 3)$. The student needs to focus on understanding how to factor an expression of the form $ax + b$.

Item Position	Rationale	
43	Option A is correct	To determine the exponential function that best models the data, the student could have used a graphing calculator to generate the function using exponential regression (a method of determining an exponential function, $y = ab^x$, where a and b are real numbers). The exponential function that best models the data is $y = 72(0.6)^x$. 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 determined the value of b by dividing the y-values corresponding to $x = 0$ and $x = 1$, resulting in $b = \frac{43.2}{72} = 0.6$. Next, the student likely identified the value of a as the value of y when $x = 1$ instead of when $x = 0$, resulting in $a = 43.2$. The student then likely concluded that the function $y = 43.2(0.6)^x$ best models the data in the table. The student needs to focus on understanding how to write an exponential function that was generated using exponential regression.
	Option C is incorrect	The student likely used the exponential regression feature on a graphing calculator correctly but subtracted the value of b from 1, resulting in $y = 72(1 – 0.6)^x$ or $y = 72(0.4)^x$. The student needs to focus on understanding how to write an exponential function that was generated using exponential regression.
	Option D is incorrect	The student likely determined the value of b by dividing the value of y when $x = 1$ by the value of y when $x = 0$, but subtracted the result from 1, resulting in $b = 1 - \frac{43.2}{72} = 1 - 0.6 = 0.4$. Next, the student likely identified the value of a as the value of y when $x = 1$ instead of when $x = 0$, resulting in $a = 43.2$. The student then likely concluded that the function $y = 43.2(0.4)^x$ best models the data in the table. The student needs to focus on understanding how to write an exponential function that was generated using exponential regression.

Item Position	Rationale	
44	Option B is correct	To determine which expressions are equivalent to $6x^2 + 3x - 9$, the student could have found the factors (numbers or expressions that can be multiplied to get another number or expression) of the expression. The student could have factored out the greatest common factor (largest factor that divides evenly into all the terms), 3, from each term, resulting in $3(2x^2 + x - 3)$. This is an efficient way to solve the problem; however, other methods could be used to solve the problem correctly.
	Option D is correct	To determine which expressions are equivalent to $6x^2 + 3x - 9$, the student could have found the factors of the expression. The student could have first factored out the greatest common factor, 3, from each term, resulting in $3(2x^2 + x - 3)$. Next, to factor $2x^2 + x - 3$, the student could have multiplied $2x^2$ by -3, resulting in $-6x^2$. The student then could have identified two terms that have a product of $-6x^2$ and a sum of x, which are $3x$ and $-2x$. Then the student could have rewritten the expression in expanded form using these two terms, resulting in $3(2x^2 + 3x - 2x - 3)$. The student then could have grouped the first two terms and the last two terms of the expression and factored out the greatest common factor from each group of terms, resulting in $3[x(2x + 3) - 1(2x + 3)]$. Next, the student could have factored out the binomial $(2x + 3)$ from the expression, resulting in the factored form $3(2x + 3)(x - 1)$. 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 made a sign error when factoring out the greatest common factor from each term, resulting in $-3(2x^2 + x + 3)$. The student needs to focus on understanding how to factor an expression of the form $ax^2 + bx + c$.
	Option C is incorrect	The student likely determined that two factors of $2x^2$ are $2x$ and x and that two factors of -3 are -3 and 1 but disregarded the value of the linear term of the quadratic expression, resulting in $3(2x - 3)(x + 1)$. The student needs to focus on understanding how to factor an expression of the form $ax^2 + bx + c$.
	Option E is incorrect	The student likely made a sign error when factoring out the greatest common factor from each term, resulting in $-3(2x^2 + x + 3)$. The student then likely determined that two factors of $2x^2$ are $2x$ and x and that two factors of 3 are -3 and -1 but disregarded the value of the linear term of the quadratic expression, resulting in $-3(2x - 3)(x - 1)$. The student needs to focus on understanding how to factor an expression of the form $ax^2 + bx + c$.

Item Position	Rationale	
45	Option D is correct	To determine which statement is true about the system of equations (two or more equations containing the same set of variables [symbols used to represent unknown numbers]), the student could have written each of the given equations in slope-intercept form ($y = mx + b$, where m represents the slope [steepness of a line] and b represents the value of the y-intercept [value where a graph crosses the y-axis]). The first equation, $x + y = –8$, in slope-intercept form is $y = –x – 8$. The second equation, $2x + 2y = 10$, in slope-intercept form is $y = –x + 5$. The student then could have recognized that, since the two equations in the system have the same slope but different y-intercept values, the graphs of the equations form parallel lines (lines that do not intersect [cross] and are always the same distance from each other). Last, the student could have concluded that, since the graphs of the equations form parallel lines, the system of equations has no solution. 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 recognized that the two equations in the system have the same slope but did not compare the y-intercept values and concluded that the system of equations has infinitely many solutions. The student needs to focus on understanding how to determine the solution to a system of equations using a graph.
	Option B is incorrect	The student likely identified the y-intercept value of each line in the system of equations. The graph of the first equation, $x + y = –8$, has a y-intercept value of –8. The graph of the second equation, $2x + 2y = 10$, has a y-intercept value of 5. The student then likely concluded that the system of equations has only one solution at (–8, 5). The student needs to focus on understanding how to determine the solution to a system of equations using a graph.
	Option C is incorrect	The student likely identified the y-intercept value of each line in the system of equations. The graph of the first equation, $x + y = –8$, has a y-intercept value of –8. The graph of the second equation, $2x + 2y = 10$, has a y-intercept value of 5. The student then likely concluded that the system of equations has only one solution at (5, –8). The student needs to focus on understanding how to determine the solution to a system of equations using a graph.

Item Position	Rationale	
46	Option A is correct	To determine the value of *v* that makes the equation $\frac{v-6}{5}=\frac{v+10}{2}$ true, the student could have first multiplied both sides of the equation by 10, resulting in $10\left(\frac{v-6}{5}\right)=10\left(\frac{v+10}{2}\right)$, or 2(*v* – 6) = 5(*v* + 10). Next, the student could have distributed (multiplied) the numbers in front of the parentheses to each term inside the parentheses, resulting in 2*v* – 12 = 5*v* + 50. The student then could have added 12 to both sides of the equation and subtracted 5*v* from both sides of the equation, resulting in 2*v* – 12 + 12 – 5*v* = 5*v* + 50 + 12 – 5*v*, or –3*v* = 62. Last, the student could have divided both sides of the equation by –3, resulting in $\frac{-3v}{-3}=\frac{62}{-3}$ or $v=-\frac{62}{3}$. 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 distributed only to the first term in each set of parentheses in the equation 2(*v* – 6) = 5(*v* + 10), resulting in 2*v* – 6 = 5*v* + 10. The student then likely added 6 to both sides of the equation and subtracted 5*v* from both sides of the equation, resulting in 2*v* – 6 + 6 – 5*v* = 5*v* + 10 + 6 – 5*v*, or –3*v* = 16. Last, the student likely divided both sides of the equation by –3, resulting in $\frac{-3v}{-3}=\frac{16}{-3}$ or $v=-\frac{16}{3}$. The student needs to focus on understanding the arithmetic of solving equations.
	Option C is incorrect	The student likely added 5*v* to the left side of the equation and subtracted 12 from the right side of the equation 2*v* – 12 = 5*v* + 50 when moving terms across the equal sign, resulting in 2*v* + 5*v* = 50 – 12 or 7*v* = 38. The student then likely divided both sides of the equation by 7, resulting in $\frac{7v}{7}=\frac{38}{7}$ or $v=\frac{38}{7}$. The student needs to focus on understanding the arithmetic of solving equations.
	Option D is incorrect	The student likely multiplied the variable term on each side of the given equation by the opposite side’s denominator (bottom number in a fraction) and then added the opposite side’s denominator to the constant term, resulting in 2*v* – 6 + 2 = 5*v* + 10 + 5, or 2*v* – 4 = 5*v* + 15. The student then likely added 5*v* to the left side of the equation and subtracted 4 from the right side of the equation when moving terms across the equal sign, resulting in 2*v* + 5*v* = 15 – 4, or 7*v* = 11. Last, the student likely divided both sides of the equation by 7, resulting in $\frac{7v}{7}=\frac{11}{7}$, or $v=\frac{11}{7}$. The student needs to focus on understanding the arithmetic of solving equations.

Item Position	Rationale	
47	Option B is correct	To determine the function that can be used to determine *A*, the amount in the account after *t* years, the student could have used an exponential function of the form $A(t) = ab^t$, where *a* is the initial value (starting value), *b* is the common factor (constant rate by which successive values increase or decrease), and *t* is the variable (symbol used to represent an unknown number). From the given information, the student could have determined that the initial amount deposited into the money market account was $2,500, so $a = 2{,}500$. The student should have recognized that since the account balance increases at a rate of 0.5% each year, this situation represents exponential growth, with a growth factor of $b = 1 + 0.005$, or $b = 1.005$. Substituting $a = 2{,}500$ and $b = 1.005$ into the exponential function $A(t) = ab^t$, the student could have obtained $A(t) = 2{,}500(1.005)^t$. 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 identified the correct initial value, $a = 2{,}500$, but used the growth rate, 0.5%, as the growth factor and ignored the percent symbol, resulting in $A(t) = 2{,}500(0.5)^t$. The student needs to focus on understanding how to determine the common factor of an exponential function from the given information.
	Option C is incorrect	The student likely identified the growth rate, 0.5%, as a rate of change (constant rate of increase or decrease), ignored the percent symbol, and represented the situation with a linear function instead of an exponential function, resulting in $A(t) = 2{,}500 + 0.50t$. The student needs to focus on understanding how to identify and write exponential functions in the form of $A(t) = ab^t$ and determine the common factor of an exponential function from the given information.
	Option D is incorrect	The student likely multiplied the growth factor, 1.005, by *t* instead of raising it to a power of *t*, resulting in $A(t) = 2{,}500(1.005)t$. The student needs to focus on understanding how to identify and write exponential functions in the form of $A(t) = ab^t$.

Item Position	Rationale	
48	Option A is correct	To determine the equivalent expression, the student could have first applied the negative exponent property ($a^{-n} = \frac{1}{a^n}$), resulting in $\frac{1}{(6y^3)^2 y}$. Next, the student could have applied the power of a power property ($(a^m)^n = a^{mn}$), resulting in $\frac{1}{6^2 y^{3(2)} y}$, or $\frac{1}{36y^6 y}$. Last, the student could have applied the product of powers property ($a^m a^n = a^{m+n}$), resulting in $\frac{1}{36y^{6+1}}$, or $\frac{1}{36y^7}$. 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 exponents instead of multiplying the exponents when applying the power of a power property, resulting in $\frac{1}{6^2 y^{3+2} y}$, or $\frac{1}{36y^5 y}$. The student then likely applied the product of powers property, resulting in $\frac{1}{36y^{5+1}}$, or $\frac{1}{36y^6}$. The student needs to focus on understanding how to use the properties of exponents to simplify expressions.
	Option C is incorrect	The student likely multiplied the coefficient, 6, by 2 instead of squaring it when applying the power of a power property, resulting in $\frac{1}{6(2)y^{3(2)} y}$, or $\frac{1}{12y^{3(2)} y}$. The student then likely applied the product of powers property, resulting in $\frac{1}{12y^{6+1}}$, or $\frac{1}{12y^7}$. The student needs to focus on understanding how to use the properties of exponents to simplify expressions.
	Option D is incorrect	The student likely added the exponents instead of multiplying the exponents and multiplied the coefficient, 6, by 2 instead of squaring it when applying the power of a power property, resulting in $\frac{1}{6(2)y^{3+2} y}$, or $\frac{1}{12y^5 y}$. The student then likely applied the product of powers property, resulting in $\frac{1}{12y^{5+1}}$, or $\frac{1}{12y^6}$. The student needs to focus on understanding how to use the properties of exponents to simplify expressions.

Item Position	Rationale	
49	26,080, decreasing, 15%	To complete the sentences so that they best interpret the values in the function, the student should have recognized that in an exponential function $P(t) = ab^t$, a is the initial value (starting value), b is the common factor (constant rate by which successive values increase or decrease), and t is the variable (symbol used to represent an unknown number). In this situation, the variable t represents the number of years since 2010. In $P(t) = 26{,}080(0.85)^t$, the student should have recognized that the initial population of the town in 2010 was 26,080. The student should have also recognized that the population is decreasing at a rate of 15% per year, because $b = 0.85$ represents the decay factor and $1 – 0.85 = 0.15$, or 15%, represents the decay rate.

Item Position	Rationale	
50	Option A is correct	To determine the rate of change (constant rate of increase or decrease) of the student's distance from home in miles with respect to time in minutes, the student could have chosen two points from the graph and calculated the rate of change. The student could have used the ordered pairs (0, 6) and (4, 3), and applied the slope formula, $m = \frac{y_2 - y_1}{x_2 - x_1}$, resulting in $m = \frac{3-6}{4-0} = -\frac{3}{4}$. Since the rate of change is negative, this indicates that the student's distance from home is decreasing at a rate of $\frac{3}{4}$ mile per minute. 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 divided the change in *x* by the change in *y* to find the slope of the line, resulting in $m = \frac{4-0}{3-6} = -\frac{4}{3}$. The student then likely interpreted the negative rate of change as a decrease of $\frac{4}{3}$ miles per minute. The student needs to focus on understanding that the rate of change of a linear relationship is equal to the change in the values of the dependent variable divided by the corresponding change in the values of the independent variable.
	Option C is incorrect	The student likely switched the order of the subtraction when calculating the change in *y*, resulting in $m = \frac{6-3}{4-0} = \frac{3}{4}$. The student then likely interpreted the positive rate of change as an increase of $\frac{3}{4}$ mile per minute. The student needs to focus on understanding that the rate of change of a linear relationship is equal to the change in the values of the dependent variable divided by the corresponding change in the values of the independent variable.
	Option D is incorrect	The student likely divided the change in *x* by the change in *y* to find the slope of the line and switched the order of the subtraction when calculating the change in *y*, resulting in $m = \frac{4-0}{6-3} = \frac{4}{3}$. The student then likely interpreted the positive rate of change as an increase of $\frac{4}{3}$ miles per minute. The student needs to focus on understanding that the rate of change of a linear relationship is equal to the change in the values of the dependent variable divided by the corresponding change in the values of the independent variable.