Item#	Rationale	
1	Option D is correct	To determine the slope (steepness of a straight line when graphed on a coordinate grid; $m = \frac{y_2 - y_1}{x_2 - x_1}$) of the line represented by the equation $y = 12x - 19$, the student could have recalled the slope-intercept form of a linear equation, $y = mx + b$, where m represents the slope and b represents the y-intercept (value where the line crosses the y-axis). Therefore the slope of the graph is represented by the value of 12. The rationale for the correct answer 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 b in the slope-intercept form of a linear equation, $y = mx + b$, as the slope of the line represented by the graph. The student needs to focus on understanding the key parts of the slope-intercept form of a linear equation.
	Option B is incorrect	The student likely identified the slope of the line represented by the graph as the quotient (answer to a division problem) of the coefficient (a number used to multiply a variable) of the x term divided by the value of the y-intercept. The student needs to focus on understanding the key parts of the slope-intercept form of a linear equation.
	Option C is incorrect	The student likely identified the slope of the line represented by the graph as the value of the x-intercept (value where a line crosses the x-axis). To calculate the x-intercept, the student set y equal to 0, added 19 to both sides of the equation, and divided both sides of the equation by 12 to solve for x. The student needs to focus on understanding the key parts of the slope-intercept form of a linear equation.

Item#	Rationale	
2	Option F is correct	To determine the domain (all possible *x*-values) of the function (a relationship where each input has a single output) for the situation, the student should have identified all the *x*-values for which the graph has a *y*-value. The graph extends from 0 to 230 on the *x*-axis and includes all the points from 0 to 230. Therefore the domain of the function for this situation is all the values from 0 to 230, which can be represented by the inequality $0 \leq x \leq 230$. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option G is incorrect	The student likely interpreted “domain” to represent all possible *y*-values instead of all possible *x*-values of the function represented by the situation. The student identified the *y*-coordinates of the first two ordered pairs given on the graph, 6 and 36, as the *y*-value on the left and the maximum (greatest) value of the domain. The student needs to focus on understanding how to determine and express the domain of a function representing a situation.
	Option H is incorrect	The student likely interpreted “domain” to represent all possible *y*-values instead of all possible *x*-values of the function represented by the situation. The student needs to focus on understanding how to determine and express the domain of a function representing a situation.
	Option J is incorrect	The student likely interpreted “domain” to represent all possible *x*-values of the function represented by the situation but identified the *y*-coordinate, 6, instead of the *x*-coordinate, 0, of the first ordered pair $(0, 6)$ as the minimum value of the domain. The student needs to focus on understanding how to determine and express the domain of a function representing a situation.

Item#	Rationale	
3	Option D is correct	To determine what value of x makes the given equation true, the student could have solved the equation for x. To solve the equation, the student could have first distributed (multiplied) the 1.25 in front of the parentheses by the values inside the parentheses. This step results in the equation $1.25(4x) + 1.25(-10) = 7.5$, which is $5x - 12.5 = 7.5$. The student could have then added 12.5 to both sides of the equation, resulting in $5x = 20$. To solve for x, the student could have divided by 5 on both sides of the equation, resulting in $x = 4$. The rationale for the correct answer 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 distribute the 1.25 on the left side of the equation to the second term inside the parentheses, -10, resulting in the equation $1.25(4x) - 10 = 7.5$, which is $5x - 10 = 7.5$. The student likely added 10 to both sides of the equation, resulting in $5x = 17.5$. To solve for x, the student likely divided by 5 on both sides of the equation, resulting in $x = 3.5$. The student needs to focus on applying the distributive property correctly when solving equations.
	Option B is incorrect	The student likely distributed correctly but eliminated -12.5 from the left side of the equation by subtracting 12.5 on the right side of the equation, resulting in the equation $5x = -5$. To solve for x, the student likely divided by 5 on both sides of the equation, resulting in $x = -1$. The student needs to focus on isolating the variable correctly when solving equations.
	Option C is incorrect	The student likely did not distribute the 1.25 on the left side of the equation to the second term inside the parentheses, -10, resulting in the equation $1.25(4x) - 10 = 7.5$, which is $5x - 10 = 7.5$. The student likely subtracted 10 from both sides of the equation, resulting in $5x = -2.5$. To solve for x, the student likely divided by 5 on both sides of the equation, resulting in $x = -0.5$. The student needs to focus on applying the distributive property and isolating the variable correctly when solving equations.

Item#	Rationale	
4	Option G is correct	To determine the equivalent function, the student could have found the factors (numbers or expressions that can be multiplied to get another number or expression) of $x^2 + 15x - 54$. The student could have identified two factors in the form, $(Ax + B)$ and $(Cx + D)$, for which $A \cdot C = 1$, $(A \cdot D) + (B \cdot C) = 15$, and $B \cdot D = -54$. The student could have identified the two factors as $(x + 18)$ and $(x - 3)$, because $x \cdot x = x^2$, $(x \cdot (-3)) + (18 \cdot x) = 15x$, and $18 \cdot (-3) = -54$. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option F is incorrect	The student likely identified the factors as $(x + 9)$ and $(x - 6)$ and verified that $x \cdot x = x^2$ and $9 \cdot (-6) = -54$ but did not verify the middle term $((x \cdot (-6)) + (9 \cdot x) = 3x$, not $15x)$. The student needs to focus on understanding how to find the factors of an expression in the form $ax^2 + bx + c$.
	Option H is incorrect	The student likely identified the factors as $(x - 9)$ and $(x + 6)$ and verified that $x \cdot x = x^2$ and $-9 \cdot 6 = -54$ but did not verify the middle term $((x \cdot 6) + (-9 \cdot x) = -3x$, not $15x)$. The student needs to focus on understanding how to find the factors of an expression in the form $ax^2 + bx + c$.
	Option J is incorrect	The student likely identified the factors as $(x - 18)$ and $(x + 3)$ and verified that $x \cdot x = x^2$ and $-18 \cdot 3 = -54$ but did not verify the middle term $((x \cdot 3) + (-18 \cdot x) = -15x$, not $15x)$. The student needs to focus on understanding how to find the factors of an expression in the form $ax^2 + bx + c$.

Item#	Rationale	
5	Option C is correct	To determine the rate of change (constant increase or decrease), the student could have chosen two sets of values from the table and calculated the amount of change. Using the first and last set of values in the slope formula ($m = \frac{y_2 - y_1}{x_2 - x_1}$) results in $\frac{108 - 10}{15 - 1} = \frac{98}{14} = 7$. The rate of change is 7 feet per year. The rationale for the correct answer in an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option A is incorrect	The student determined the rate of change to be $24 - 10 = 14$. The student needs to focus on understanding how to find the rate of change from a table of values.
	Option B is incorrect	The student identified the rate of change to be 3, the y-intercept (value where a line crosses the y-axis) of the line represented by the table of values. The student needs to focus on understanding how to find the rate of change from a table of values.
	Option D is incorrect	The student identified the rate of change to be 10, the y-value when the x-value is equal to 1. The student needs to focus on understanding how to find the rate of change from a table of values.

Item#	Rationale	
6	Option F is correct	To determine the equation of a line in slope-intercept form ($y = mx + b$, where m represents the slope (steepness of a straight line when graphed on a coordinate grid; $m = \frac{y_2 - y_1}{x_2 - x_1}$) and b represents the y-intercept (value where a line crosses the y-axis)), the student could have found the slope of the line using the coordinates of the two given points. The student could have substituted the x- and y-coordinates of $(-4, 2)$ and $(12, 6)$ into the slope formula, resulting in $\frac{6 - 2}{12 - (-4)} = \frac{4}{16} = 0.25$. Next the student could have substituted the x- and y-values of the point $(12, 6)$ and $m = 0.25$ into the point-slope formula, $y - y_1 = m(x - x_1)$, resulting in $y - 6 = 0.25(x - 12)$. Next the student could have distributed 0.25 to the terms inside the parentheses, resulting in $y - 6 = 0.25x - 3$. Finally the student could have added 6 to both sides of the equation, resulting in $y = 0.25x + 3$. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option G is incorrect	The student likely found the correct slope but misidentified $(-4, 2)$ as (y, x), substituting the point $(2, -4)$ and $m = 0.25$ into the point-slope formula, resulting in $y - (-4) = 0.25(x - 2)$. The student likely then distributed 0.25 to the terms inside the parentheses, resulting in $y + 4 = 0.25x - 0.5$. Lastly the student likely subtracted 4 from both sides of the equation, resulting in $y = 0.25x - 4.5$. The student needs to focus on understanding how to identify the x- and y-coordinates of an ordered pair.
	Option H is incorrect	The student likely calculated the slope as $m = \frac{x_2 - x_1}{y_2 - y_1}$, resulting in $m = \frac{12 - (-4)}{6 - 2} = \frac{16}{4} = 4$. The student likely then substituted the point $(-4, 2)$ and $m = 4$ into the point-slope formula, resulting in $y - 2 = 4(x - (-4))$. The student likely then distributed 4 to the terms inside the parentheses, resulting in $y - 2 = 4x + 16$. Lastly the student likely added 2 to both sides of the equation, resulting in $y = 4x + 18$. The student needs to focus on understanding how to calculate the slope of a line.

Item#	Rationale	
	Option J is incorrect	The student likely calculated the slope as $m = \frac{x_2 - x_1}{y_2 - y_1}$, resulting in $m = \frac{12 - (-4)}{6 - 2} = \frac{16}{4} = 4$. The student likely then substituted the point $(12, 6)$ and $m = 4$ into the point-slope formula, resulting in $y - 6 = 4(x - 12)$. The student likely then distributed 4 to the terms inside the parentheses, resulting in $y - 6 = 4x - 48$. Lastly the student likely added 6 to both sides of the equation, resulting in $y = 4x - 42$. The student needs to focus on understanding how to calculate the slope of a line.

Item#	Rationale	
7	Option C is correct	To determine which graph best represents the equation $-5y = -6x + 15$, the student could have first isolated the y on one side of the equation by dividing both sides of the equation by -5, resulting in $y = \frac{6}{5}x - 3$. Next the student could have verified the line will cross the y-axis (vertical) at $(0, -3)$ and will have a slope (steepness of a straight line when graphed on a coordinate grid; $m = \frac{y_2 - y_1}{x_2 - x_1}$) of $\frac{6}{5}$. The rationale for the correct answer 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 sign errors on the slope and y-intercept (value where a line crosses the y-axis) when isolating y, resulting in $y = -\frac{6}{5}x + 3$ instead of $y = \frac{6}{5}x - 3$. The student needs to focus on understanding how to solve for y and how to graph linear functions on the coordinate plane in order to identify key features of the line.
	Option B is incorrect	The student likely made a sign error on the slope when isolating y, resulting in $y = -\frac{6}{5}x - 3$ instead of $y = \frac{6}{5}x - 3$. The student needs to focus on understanding how to solve for y and how to graph linear functions on the coordinate plane in order to identify key features of the line.
	Option D is incorrect	The student likely made a sign error on the y-intercept (value where a line crosses the y-axis) when isolating y, resulting in $y = \frac{6}{5}x + 3$ instead of $y = \frac{6}{5}x - 3$. The student needs to focus on understanding how to solve for y and how to graph linear functions on the coordinate plane in order to identify key features of the line.

Item#	Rationale	
8	Option G is correct	To determine the annual profit (difference between the amount earned and the amount spent in producing something) in dollars a baker makes if the baker sells 400 pies, the student could have substituted 400 for n in the function $p(n) = 52n - 0.05n^2$, resulting in $p(400) = 52(400) - 0.05(400)^2 = 20{,}800 - 8{,}000 = 12{,}800$. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option F is incorrect	The student likely did not square 400 in the second term of the function, calculating $p(400) = 52(400) - 0.05(400) = 20{,}780$. The student needs to focus on understanding how to solve a function, expressed in function notation $(p(n))$, when given a value from the domain (all possible n-values).
	Option H is incorrect	The student likely added the two terms of the function, calculating $p(400) = 52(400) + 0.05(400)^2 = 28{,}800$. The student needs to focus on understanding how to solve a function, expressed in function notation $(p(n))$, when given a value from the domain (all possible n-values).
	Option J is incorrect	The student likely multiplied 400 by 2 instead of squaring 400 in the second term of the function, calculating $p(400) = 52(400) - 0.05(400)(2) = 20{,}760$. The student needs to focus on understanding how to solve a function, expressed in function notation $(p(n))$, when given a value from the domain (all possible n-values).

Item#	Rationale	
9	Option A is correct	To determine which function is represented by the graph, the student could have determined that the graph can be represented by an exponential function, $g(x) = ab^x$, where a is the y-intercept (value where the graph crosses the y-axis), b is the decay factor (constant rate that a value is decreased by over a period of time), and x is the variable (symbol used to represent an unknown number). To write the exponential function, the student could have identified 6 as the y-intercept. Next the student could have determined the decay factor as $\frac{1}{3}$ by dividing each y-coordinate by the previous y-coordinate of the ordered pairs (–1, 18), (0, 6), and (1, 2); $\left(6 \div 18 = \frac{1}{3} \text{ and } 2 \div 6 = \frac{1}{3}\right)$. The student could have then determined the exponential function to be $g(x) = 6\left(\frac{1}{3}\right)^x$. The rationale for the correct answer 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 identified the correct y-intercept but calculated the decay factor by dividing each y-coordinate by the next y-coordinate of the ordered pairs ((–1, 18), (0, 6), and (1, 2); $(18 \div 6 = 3 \text{ and } 6 \div 2 = 3)$), resulting in the exponential function $g(x) = 6(3)^x$. The student needs to focus on understanding how to find the decay factor of an exponential function when given a graph.
	Option C is incorrect	The student likely identified the correct y-intercept and decay factor but identified $g(x) = a - b^x$ as representing an exponential function. The student needs to focus on understanding how to set up an exponential function when given a graph.
	Option D is incorrect	The student likely identified the correct y-intercept but identified the decay factor by dividing each y-coordinate by the next y-coordinate of the ordered pairs ((–1, 18), (0, 6), and (1, 2); $(18 \div 6 = 3 \text{ and } 6 \div 2 = 3)$) and identified $g(x) = a - b^x$ as representing an exponential function. The student needs to focus on understanding how to find the decay factor and how to set up an exponential function when given a graph.

Item#	Rationale	
10	Option J is correct	To determine the equation of a line perpendicular (a line meeting another line at a right angle, or 90°) to another line, the student could have recalled that if the slope (steepness of a straight line when graphed on a coordinate grid; $m = \frac{y_2 - y_1}{x_2 - x_1}$) of a line is m, then the slope perpendicular to it is $-\frac{1}{m}$. The equation $y = -\frac{4}{9}x + 5$ has a slope of $-\frac{4}{9}$; therefore the slope of a line perpendicular to it is $\frac{9}{4}$. To determine the y-intercept (value where a line crosses the y-axis) of the perpendicular line, the student could have substituted $\frac{9}{4}$ for the slope (m) and the point $(36, 0)$ for the x- and y-values in the slope-intercept form ($y = mx + b$). This produces the equation $0 = \frac{9}{4}(36) + b$. The student could have then multiplied $\frac{9}{4}$ by 36, resulting in $0 = 81 + b$. The student could have then subtracted 81 from both sides of the equation, resulting in $-81 = b$. Therefore the slope-intercept form of the equation of the perpendicular line is $y = \frac{9}{4}x - 81$. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option F is incorrect	The student likely identified the slope of the line perpendicular to the given line as $\frac{4}{9}$ but used $-\frac{4}{9}$ to determine the y-intercept of the line perpendicular to the given line. The student needs to focus on understanding how to determine the slope of a line perpendicular to a given line.
	Option G is incorrect	The student likely identified the slope of the line perpendicular to the given line as $\frac{4}{9}$ and used $\frac{4}{9}$ to determine the y-intercept of the line perpendicular to the given line. The student needs to focus on understanding how to determine the slope of a line perpendicular to a given line.

Item#	Rationale	
	Option H is incorrect	The student likely identified the slope of the line perpendicular to the given line correctly as $\frac{9}{4}$ but used $-\frac{9}{4}$ to determine the y-intercept of the line perpendicular to the given line. The student needs to focus on understanding how to determine the slope of a line perpendicular to a given line.

Item#	Rationale	
11	Option C is correct	To determine the domain (all possible *x*-values) of the function (a relationship where each input has a single output), the student could have identified all the *x*-values for which the graph has a *y*-value. The graph goes from 0 on the left to 50 on the right, making the domain all real numbers greater than or equal to 0 and less than or equal to 50. To determine the range (all possible *y*-values), the student could have identified all the *y*-values for which the graph has an *x*-value. The graph goes from 0 on the lowest point to 100 on the highest point, making the range all real numbers greater than or equal to 0 and less than or equal to 100.
	Option A is incorrect	The student likely reversed the relationship between domain and range. The student needs to focus on understanding how to identify the domain and range from the graph of a function.
	Option B is incorrect	The student likely identified domain as the slope (steepness of a straight line when graphed on a coordinate grid; $m = \frac{y_2 - y_1}{x_2 - x_1}$) and range as the *y*-intercept (value where a line crosses the *y*-axis) of the line representing the function. The student needs to focus on understanding how to identify the domain and range from the graph of a function.
	Option D is incorrect	The student likely identified domain as the *y*-intercept (value where a line crosses the *y*-axis) and range as the slope (steepness of a straight line when graphed on a coordinate grid; $m = \frac{y_2 - y_1}{x_2 - x_1}$) of the line representing the function. The student needs to focus on understanding how to identify the domain and range from the graph of a function.

Item#	Rationale	
12	Option H is correct	To determine which graph best represents $g(x)$, the student could have first identified $f(x) = x^2$ (also known as f) as the quadratic parent function. The student could have realized that $f(x + 2)$ represents the graph of the quadratic parent function shifting 2 units to the left horizontally. Then the student could have realized that -5 in $g(x) = f(x + 2) - 5$ represents the graph shifting 5 units down vertically after the previous shift of 2 units to the left horizontally. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option F is incorrect	The student likely identified the correct shift for $f(x + 2)$ but identified -5 in $g(x) = f(x + 2) - 5$ as a shift 5 units up vertically. The student needs to focus on understanding how transformations affect the graph of the quadratic parent function on a coordinate grid.
	Option G is incorrect	The student likely identified the correct shift for -5 in $g(x) = f(x + 2) - 5$ but identified $f(x + 2)$ as a shift 2 units to the right horizontally. The student needs to focus on understanding how transformations affect the graph of the quadratic parent function on a coordinate grid.
	Option J is incorrect	The student likely identified $f(x + 2)$ as a shift 2 units to the right horizontally and -5 in $g(x) = f(x + 2) - 5$ as a shift 5 units up vertically. The student needs to focus on understanding how transformations affect the graph of the quadratic parent function on a coordinate grid.

Item#	Rationale	
13	Option B is correct	To determine the equivalent expression, the student could have divided 45 by 15 and used the quotient of powers property $\left(\frac{a^m}{a^n} = a^{(m-n)}\right)$, resulting in $3 \cdot m^{(-6-(-2))} \cdot p^{(2-8)} \cdot v^{(12-(-4))} = m^{(-6+2)} \cdot p^{(2-8)} \cdot v^{(12+4)} = 3m^{-4}p^{-6}v^{16}$. Then the student could have used the negative exponent property $\left(a^{-n} = \frac{1}{a^n}\right)$, resulting in $3 \cdot \frac{1}{m^4} \cdot \frac{1}{p^6} \cdot v^{16} = \frac{3v^{16}}{m^4p^6}$. The rationale for the correct answer 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 45 by 15 correctly but calculated the exponents of the variables as $m^{(-6-2)} \cdot p^{(2-8)} \cdot v^{(12-4)}$, resulting in $3 \cdot m^{(-8)} \cdot p^{(-6)} \cdot v^{(8)} = \frac{3v^8}{m^8p^6}$. The student needs to focus on understanding how to apply the properties of exponents to simplify expressions.
	Option C is incorrect	The student likely subtracted 15 from 45 and divided the exponents of each variable, resulting in $\frac{(45-15) \cdot m^{\left(\frac{-6}{-2}\right)} \cdot v^{\left(\frac{12}{-4}\right)}}{p^{\left(\frac{8}{2}\right)}} = \frac{30m^3}{p^4v^3}$. The student needs to focus on understanding how to apply the properties of exponents to simplify expressions.
	Option D is incorrect	The student likely subtracted 15 from 45, divided the exponents of each variable, and misinterpreted the negatives with the exponents, resulting in $\frac{(45-15) \cdot m^{\left(\frac{-6}{-2}\right)} \cdot v^{\left(\frac{12}{-4}\right)}}{p^{\left(\frac{8}{2}\right)}} = \frac{30 \cdot m^{(-3)} \cdot v^{(3)}}{p^4} = \frac{30v^3}{m^3p^4}$. The student needs to focus on understanding how to apply the properties of exponents to simplify expressions.

Item#	Rationale	
14	4.5 and any equivalent values are correct	To determine the positive solution to the equation, the student could have solved the equation for a positive value of x. First the student could have subtracted 135 from both sides of the equation, resulting in $4x^2 + 12x - 135 = 0$. Then the student could have found the factors (numbers or expressions that can be multiplied to get another number or expression) of $4x^2 + 12x - 135$. The student could have identified two factors in the form, $(Ax + B)$ and $(Cx + D)$, for which $A \cdot C = 4$, $(A \cdot D) + (B \cdot C) = 12$, and $B \cdot D = -135$. The student could have identified the two factors as $(2x - 9)$ and $(2x + 15)$, because $2x \cdot 2x = 4x^2$, $(2x \cdot 15) + (-9 \cdot 2x) = 12x$, and $-9 \cdot 15 = -135$. Then the student could have set the factor of $2x - 9$ equal to 0 to determine the positive solution to the equation, resulting in $2x - 9 = 0$. The student could have then added 9 to both sides of the equation, resulting in $2x = 9$. Lastly the student could have divided both sides of the equation by 2, resulting in $x = \frac{9}{2} = 4.5$. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.

Item#	Rationale	
15	Option B is correct	To determine the inequality representing all possible combinations of x, the number of sausage links, and y, the number of briskets cooked on the grill, the student could have first identified that each sausage link weighed 2 pounds and each brisket weighed 6 pounds, represented by the expressions $2x$ and $6y$. So the total number of pounds of sausage links and briskets cooked on the grill could be represented by the expression $2x + 6y$. Then the student could have realized the phrase "no more than" can be represented by the inequality symbol "$\leq$", so the phrase "no more than 120" can be represented by "≤ 120". Therefore all possible combinations of x and y could be represented by the inequality $2x + 6y \leq 120$. The rationale for the correct answer 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 reversed the coefficients (a number used to multiply a variable) representing the weights of each sausage link and each brisket and identified the phrase "no more than" as being represented by the inequality symbol "$<$," resulting in $6x + 2y < 120$. The student needs to focus on understanding how to write a linear inequality given a real-world situation.
	Option C is incorrect	The student reversed the coefficients (a number used to multiply a variable) representing the weights of each sausage link and each brisket and identified the phrase "no more than" as being represented by the inequality symbol "$>$," resulting in $6x + 2y > 120$. The student needs to focus on understanding how to write a linear inequality given a real-world situation.
	Option D is incorrect	The student identified the coefficients (a number used to multiply a variable) representing the weights of each sausage link and each brisket correctly but identified the phrase "no more than" as being represented by the inequality symbol "$\geq$," resulting in $2x + 6y \geq 120$. The student needs to focus on understanding how to write a linear inequality given a real-world situation.

Item#	Rationale	
16	Option H is correct	To determine the equivalent expression, the student could have used the associative property, $a + (b + c) = (a + b) + c$, to remove the parentheses, resulting in the expression $10 + 7r - r^2 - 6r^2 - 18 + 5r$. Next the student could have combined like terms (terms that contain the same variables raised to the same powers), resulting in $(-r^2 - 6r^2) + (7r + 5r) + (10 - 18) = -7r^2 + 12r - 8$. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option F is incorrect	The student likely made sign errors when combining the r-terms $(7r - 5r)$ and constants $(18 - 10)$, resulting in the expression $-7r^2 + 2r + 8$. The student needs to focus on understanding how to combine like terms in polynomials.
	Option G is incorrect	The student likely made sign errors when combining the r^2-terms $(r^2 + 6r^2)$ and constants $(18 - 10)$, resulting in the expression $7r^2 + 12r + 8$. The student needs to focus on understanding how to combine like terms in polynomials.
	Option J is incorrect	The student likely made sign errors when combining the r^2-terms $(r^2 + 6r^2)$ and r-terms $(7r - 5r)$, resulting in the expression $7r^2 + 2r - 8$. The student needs to focus on understanding how to combine like terms in polynomials.

Item#	Rationale	
17	Option D is correct	To determine which graph represents the solution set of $y > 3x - 4$, the student could have determined that the ">" symbol means "greater than," which can be represented by a dashed line (to indicate no points on the line are part of the solution set) and a shaded area of the graph. The dashed line should cross the y-axis (vertical axis) at -4 and should have a slope (steepness of a straight line when graphed on a coordinate grid; $m = \frac{y_2 - y_1}{x_2 - x_1}$) of 3. The student could have determined the area to be shaded by substituting an ordered pair, such as the origin $(0, 0)$, into the inequality $y > 3x - 4$ to test for a true statement. Since $0 > 3(0) - 4$ is equivalent to $0 > -4$, which is a true statement, the origin should be included in the shaded part of the graph. The rationale for the correct answer 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 correctly identified a line with the correct slope (3) and y-intercept (-4). The student identified the inequality symbol ">" as meaning "less than or equal to," which could be represented by a solid line (to indicate points on the line are part of the solution set) and the shaded part of the graph that does not include the origin $(0, 0)$, interpreting $0 > -4$ as not being a true statement. The student needs to focus on understanding how inequality symbols affect the graph of the solution set of a linear inequality.
	Option B is incorrect	The student correctly identified a line with the correct slope (3) and y-intercept (-4). The student identified the inequality symbol ">" as meaning "greater than or equal to," which could be represented by a solid line (to indicate points on the line are part of the solution set) and the shaded part of the graph that does include the origin $(0, 0)$, correctly interpreting $0 > -4$ as a true statement. The student needs to focus on understanding how inequality symbols affect the graph of the solution set of a linear inequality.

Item#	Rationale	
	Option C is incorrect	The student correctly identified a line with the correct slope (3) and *y*-intercept (-4). The student identified the inequality symbol "$>$" as meaning "less than," which could be represented by a dashed line (to indicate no points on the line are part of the solution set) and the shaded part of the graph that does not include the origin $(0, 0)$, interpreting $0 > -4$ as not being a true statement. The student needs to focus on understanding how inequality symbols affect the graph of the solution set of a linear inequality.

Item#	Rationale	
18	Option G is correct	To determine the best interpretation of one of the values in the function $b(x) = 850(1.025)^x$, the student could have recognized that in an exponential function written in the form $b(x) = ac^x$, a represents the initial value, c is 1 plus the rate that the value is increased (when $c > 1$) or 1 minus the factor that the value is decreased (when $c < 1$), and x is the variable (symbol used to represent an unknown number). In this situation, the variable x represents the number of years. In $b(x) = 850(1.025)^x$, 850 is the initial value, and because $1.025 > 1$, 0.025 represents an increase rate of 0.025 each year, or 2.5% each year. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option F is incorrect	The student likely identified the rate in the situation as $1 - 0.025 = 0.975$, which represents a decrease rate of 97.5% each year. The student needs to focus on interpreting the meaning of the values of a and c of exponential functions in the form $b(x) = ac^x$.
	Option H is incorrect	The student likely identified the value of c as the initial balance and misidentified the decimal as a comma (1,025). The student needs to focus on interpreting the meaning of the values of a and c of exponential functions in the form $b(x) = ac^x$.
	Option J is incorrect	The student likely identified the phrase “at the end of one year” as representing the initial value (850) of the exponential function. The student needs to focus on interpreting the meaning of the values of a and c of exponential functions in the form $b(x) = ac^x$.

Item#	Rationale	
19	Option B is correct	To determine which function (a relationship where each input has a single output) best models the data, the student could have used a graphing calculator to generate the function using quadratic regression (a method of determining the parabola (U-shaped graph) of best fit). The function that best models the data is $n(t) = 0.072t^2 - 0.15t + 2.73$. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option A is incorrect	The student likely used the quadratic regression feature on the graphing calculator but reversed the x- and y-values shown in the table. The student needs to focus on understanding how to use technology to determine a quadratic function that best fits a table of data.
	Option C is incorrect	The student likely used the quadratic regression feature on the graphing calculator but reversed the x- and y-values shown in the table, identifying the quadratic function as $n(t) = at^2 + c$, since all the x- and y-values are located in the first quadrant of a coordinate plane (area of a plane where all the x- and y-values are positive). The student needs to focus on understanding how to use technology to determine a quadratic function that best fits a table of data.
	Option D is incorrect	The student likely used the quadratic regression feature on the graphing calculator correctly but identified the quadratic function as $n(t) = at^2 + c$, since all the x- and y-values are located in the first quadrant of a coordinate plane (area of a plane where all the x- and y-values are positive). The student needs to focus on understanding how to use technology to determine a quadratic function that best fits a table of data.
20	-0.2 and any equivalent values are correct	To determine the rate of change (constant increase or decrease), the student could have substituted the ordered pairs given in the graph, $(-3, 3.6)$ and $(5, 2)$, into the formula for slope (steepness of a straight line when graphed on a coordinate grid; $m = \frac{y_2 - y_1}{x_2 - x_1}$), resulting in $\frac{2 - 3.6}{5 - (-3)} = \frac{-1.6}{8} = -0.2$. The rate of change is -0.2. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.

Item#	Rationale	
21	Option A is correct	To determine which graph best represents the equation $y = -x^2 + 6x - 1$, the student could have first identified the equation as being in the standard form of a quadratic equation $(y = ax^2 + bx + c)$; therefore $a = -1$, $b = 6$, and $c = -1$. Then the student could have solved for the axis of symmetry $\left(x = \frac{-b}{2a}\right)$ of the graph, resulting in $x = \frac{-6}{2(-1)} = \frac{-6}{-2} = 3$. Then the student could have solved for the y-value of the vertex (high or low point of the curve) by substituting $x = 3$ into the equation, resulting in $y = -(3)^2 + 6(3) - 1 = 8$. Then the student could have solved for the y-intercept (value where a graph crosses the y-axis) by substituting $x = 0$ into the equation, resulting in $y = -(0)^2 + 6(0) - 1 = -1$. Lastly the student could have identified the parabola (U-shaped graph) that has an axis of symmetry at $x = 3$ and a vertex at $(3, 8)$ and that crosses the y-axis (vertical) at -1. The rationale for the correct answer 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 a parabola with the correct y-intercept but with an axis of symmetry at $x = -3$ and a vertex at $(-3, -10)$. The student needs to focus on understanding how to graph a quadratic function on the coordinate plane and identifying key features of the graph.
	Option C is incorrect	The student likely graphed a parabola that has an axis of symmetry at $x = -3$ and a vertex at $(-3, -8)$ and that crosses the y-axis at 1. The student needs to focus on understanding how to graph a quadratic function on the coordinate plane and identifying key features of the graph.
	Option D is incorrect	The student likely graphed a parabola that has the correct axis of symmetry, but with a vertex at $(3, 10)$, and that crosses the y-axis at 1. The student needs to focus on understanding how to graph a quadratic function on the coordinate plane and identifying key features of the graph.

Item#	Rationale	
22	Option H is correct	To determine the best prediction of the number of clicks on the advertisement if 1,500 people visited the website, the student could have first used a graphing calculator to generate the function using linear regression (a method of determining the line of best fit). The function that best models the data is $y = 0.0519x + 5.5393$. Next the student could have substituted 1,500 for x in the function and solved for y, resulting in $y = 0.0519(1{,}500) + 5.5393 = 83.3893$. Therefore 83 represents the best prediction of the number of clicks on the advertisement if 1,500 people visit the website. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option F is incorrect	The student likely calculated the slope (steepness of a straight line when graphed on a coordinate grid; $m = \frac{y_2 - y_1}{x_2 - x_1}$) of the linear function using the first and last ordered pairs in the table, (153, 14) and (1,106, 63), resulting in $m = \frac{63 - 14}{1{,}106 - 153} \approx 0.0514$. Then the student likely multiplied the slope by 1,500 and rounded the product (answer) to the nearest digit, resulting in $0.0514 \cdot 1{,}500 = 77.1 \rightarrow 77$. The student needs to focus on understanding how to make predictions for real-world problems represented by linear functions.
	Option G is incorrect	The student likely set up a proportion (comparison of two ratios) using the first ordered pair in the table (153, 14) and the value of 1,500, resulting in $\frac{153}{14} = \frac{1{,}500}{y}$. Then the student likely cross-multiplied the proportion, resulting in $153y = 21{,}000$. Lastly the student likely divided both sides of the equation by 153 and rounded the quotient (answer) to the nearest digit, resulting in $y = \frac{21{,}000}{153} \approx 137.25 \rightarrow 137$. The student needs to focus on understanding how to make predictions for real-world problems represented by linear functions.

Item#	Rationale	
	Option J is incorrect	The student likely multiplied each value of the ordered pair (307, 21) by 5, since the product (answer) of 307 and 5 is 1,535, which is close to 1,500. The product of 21 and 5 is 105. The student needs to focus on understanding how to make predictions for real-world problems represented by linear functions.

Item#	Rationale	
23	Option D is correct	To determine which equation is best represented by the graph, the student could have found the slope (steepness of a line when graphed on a coordinate grid; $m = \frac{y_2 - y_1}{x_2 - x_1}$) and a point to substitute into the point-slope form of a line, $y - y_1 = m(x - x_1)$. The slope can be found by calculating the change in y-values over the change in x-values, $m = \frac{2 - (-3)}{7 - 0} = \frac{2 + 3}{7} = \frac{5}{7}$. The equation can be completed by substituting in (7, 2) for x_1 and y_1, resulting in $y - 2 = \frac{5}{7}(x - 7)$. The rationale for the correct answer 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 calculated the slope as $m = \frac{x_2 - x_1}{y_2 - y_1} = \frac{0 - 7}{-3 - 2} = \frac{-7}{-5} = \frac{7}{5}$ and added x_1 and y_1 in the point-slope form of a line instead of subtracting, resulting in $y + 2 = \frac{7}{5}(x + 7)$. The student needs to focus on understanding how to write a linear equation in point-slope form given a graph of the line.
	Option B is incorrect	The student likely used the point-slope form of a line to represent the equation of the graph but calculated the slope as $m = \frac{x_2 - x_1}{y_2 - y_1} = \frac{0 - 7}{-3 - 2} = \frac{-7}{-5} = \frac{7}{5}$, resulting in $y - 2 = \frac{7}{5}(x - 7)$. The student needs to focus on understanding how to write a linear equation in point-slope form given a graph of the line.
	Option C is incorrect	The student likely used the point-slope form of a line to represent the equation of the graph but added x_1 and y_1 in the point-slope form of a line instead of subtracting, resulting in $y + 2 = \frac{5}{7}(x + 7)$. The student needs to focus on understanding how to write a linear equation in point-slope form given a graph of the line.

Item#	Rationale	
24	Option H is correct	To determine the equivalent expression, the student could have applied the power of a power property $\left((a^m)^n = a^{mn}\right)$, resulting in $x^{1 \bullet 2} \cdot y^{-6 \bullet 2} = x^2y^{-12}$. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option F is incorrect	The student squared (multiplied a number by itself) the exponents (numbers raised to a power) of 1 and –(6) inside the parentheses, resulting in $x^{(1)^2} \cdot y^{-(6)^2} = x^1y^{-36} = xy^{-36}$. The student needs to focus on understanding how to use the properties of exponents to simplify expressions with powers raised to a power.
	Option G is incorrect	The student squared (multiplied a number by itself) the exponents (numbers raised to a power) of 1 and –6 inside the parentheses, resulting in $x^{(1)^2} \cdot y^{(-6)^2} = x^1y^{36} = xy^{36}$. The student needs to focus on understanding how to use the properties of exponents to simplify expressions with powers raised to a power.
	Option J is incorrect	The student did not include the negative sign with 6 when multiplying the exponents (numbers raised to a power) of the variable (symbol used to represent an unknown number) y, resulting in $x^{1 \bullet 2} \cdot y^{6 \bullet 2} = x^2y^{12}$. The student needs to focus on understanding how to use the properties of exponents to simplify expressions with powers raised to a power.

Item#	Rationale	
25	Option A is correct	To determine the number of courses completed worth 3 credits, the student could have set up and solved a system of linear equations (two or more linear equations containing the same set of variables (symbols used to represent unknown numbers)). Using the variables t as "the number of courses completed worth 3 credits" and f as "the number of courses completed worth 4 credits," the equation for the total number of courses completed is $t + f = 18$, and the equation relating to the total number of credits earned is $3t + 4f = 59$. Next the student could have subtracted t from both sides of the first equation to solve for f, resulting in $f = 18 - t$. Using the substitution method, the student could have substituted $f = 18 - t$ into the second equation, resulting in $3t + 4(18 - t) = 59$. The student could have then distributed (multiplied) the 4 to the terms inside the parentheses, resulting in $3t + 72 - 4t = 59$. The student could have then combined the like terms (terms that contain the same variables raised to the same powers), resulting in $72 - t = 59$. The student could have then subtracted 72 from both sides of the equation, resulting in $-t = -13$. Lastly, the student could have divided both sides of the equation by -1, resulting in $t = 13$. Therefore the number of courses completed worth 3 credits is 13. The rationale for the correct answer 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 set up and solved the system of linear equations for the number of courses completed worth 4 credits instead of the number of courses completed worth 3 credits. The student needs to focus on understanding how to interpret and solve a system of equations given verbal descriptions.
	Option C is incorrect	The student likely set up and solved the system of linear equations for the number of courses completed worth 4 credits and then calculated the total number of credits earned from the courses worth 4 credits ($4f = 4 \cdot 5 = 20$). The student needs to focus on understanding how to interpret and solve a system of equations given verbal descriptions.
	Option D is incorrect	The student likely set up and correctly solved the system of linear equations for the number of courses completed worth 3 credits but then calculated the total number of credits earned from the courses worth 3 credits ($3t = 3 \cdot 13 = 39$). The student needs to focus on understanding how to interpret the verbal descriptions of a system of equations.

Item#	Rationale	
26	Option J is correct	To determine the zero (input value, x, that produces an output value, y, of 0) of linear function f, the student could have plotted the point $(1, -9)$ on the coordinate grid and drawn a line that goes through that point and has a slope (steepness of a line when graphed on a coordinate grid; $m = \frac{y_2 - y_1}{x_2 - x_1}$) of -3. Then the student could have identified the x-value where the line crosses the x-axis (horizontal), which is -2. Therefore the zero of f is -2. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option F is incorrect	The student likely drew a line with the correct slope but through a point plotted at $(-1, 9)$ instead of $(1, -9)$, resulting in the line crossing the x-axis at 2. The student needs to focus on understanding how to plot points on a coordinate grid and identifying key features of linear functions.
	Option G is incorrect	The student likely drew a line with the correct slope but through a point plotted at $(1, 9)$ instead of $(1, -9)$, resulting in the line crossing the x-axis at 4. The student needs to focus on understanding how to plot points on a coordinate grid and identifying key features of linear functions.
	Option H is incorrect	The student likely interpreted the zero of the function as representing the y-intercept (value where a line crosses the y-axis) of the line. The student needs to focus on understanding how to identify key features of linear functions.
27	29 and any equivalent values are correct	The student could have realized $h(x) = 29(5.2)^x$ represents an exponential function, $h(x) = ab^x$, where a is the y-intercept (value where a graph crosses the y-axis), b is the growth factor, and x is the variable (symbol used to represent an unknown number). Therefore the value of the y-intercept of the graph of $h(x) = 29(5.2)^x$ is 29. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.

Item#	Rationale	
28	Option H is correct	To determine which function is best represented by the graph, the student could have identified the solutions (x-values when y is equal to 0) of the function as u and v and used the solutions to construct and simplify the equation of a quadratic function using $h(x) = (x - u)(x - v)$. The solutions can be identified by where the parabola (U-shaped graph) crosses the x-axis (at $x = 0$ and $x = 6$). Letting $u = 0$ and $v = 6$, the student could have substituted those values into the equation $h(x) = (x - u)(x - v)$, resulting in $h(x) = (x - 0)(x - 6)$. The student could have then multiplied the expressions $(x - 0)$ and $(x - 6)$, resulting in $h(x) = x^2 - 6x - 0x + 0$. Lastly the student could have combined like terms (terms that contain the same variables raised to the same powers), resulting in $h(x) = x^2 - 6x$. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option F is incorrect	The student likely identified the solutions of the function as the x- and y-coordinates of the vertex but identified the ordered pair of the vertex (high or low point of the curve) as $(-3, -9)$ instead of $(3, -9)$. The student likely substituted those values for b and c in the standard form of a quadratic equation $\left(h(x) = ax^2 + bx + c\right)$, resulting in $h(x) = x^2 - 3x - 9$. The student needs to focus on understanding how to identify the solutions of a quadratic function and write the equation of the function using those solutions.
	Option G is incorrect	The student likely identified the solutions of the function as the x- and y-coordinates of the vertex (high or low point of the curve), $(3, -9)$, and substituted those values for b and c in the standard form of a quadratic equation $\left(h(x) = ax^2 + bx + c\right)$, resulting in $h(x) = x^2 + 3x - 9$. The student needs to focus on understanding how to identify the solutions of a quadratic function and write the equation of the function using those solutions.
	Option J is incorrect	The student identified the correct solutions of the function but substituted the solutions into the equation $h(x) = (x + u)(x + v)$, resulting in $h(x) = (x + 0)(x + 6)$. The student likely multiplied the expressions $(x + 0)$ and $(x + 6)$, resulting in $h(x) = x^2 + 6x + 0x + 0$. Lastly the student likely combined like terms, resulting in $h(x) = x^2 + 6x$. The student needs to focus on understanding how to write the equation of a quadratic function using the solutions of the function.

Item#	Rationale	
29	Option C is correct	To determine the equivalent expression, the student could have found the factors (numbers or expressions that can be multiplied to get another number or expression) of $24x^2 - 22x + 5$. To find the factors, the student could have determined that $24x^2$ is equal to $12x \cdot 2x$ and written $12x$ and $2x$ as the first term in each factor. The student could have then determined that the second terms of the factors are -5 and -1 because their product (answer when multiplying) is 5 (last term in the expression given), and $(12x \cdot (-1)) + (-5 \cdot 2x) = -12x - 10x = -22x$ (number in the middle term in the expression given). The student could have then written the two factors as $(12x - 5)(2x - 1)$. The rationale for the correct answer 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 verified that $12x \cdot 2x = 24x^2$ and $5 \cdot 1 = 5$ but did not verify the middle term of the expression: $(12x \cdot 1) + (5 \cdot 2x) = 12x + 10x = 22x$. The student needs to focus on understanding how to factor trinomials in the form $ax^2 + bx + c$.
	Option B is incorrect	The student likely verified that $8x \cdot 3x = 24x^2$ and $-5 \cdot (-1) = 5$ but did not verify the middle term of the expression: $(8x \cdot (-1)) + (-5 \cdot 3x) = -8x - 15x = -23x$. The student needs to focus on understanding how to factor trinomials in the form $ax^2 + bx + c$.
	Option D is incorrect	The student likely verified that $8x \cdot 3x = 24x^2$ and $5 \cdot 1 = 5$ but did not verify the middle term of the expression: $(8x \cdot 1) + (5 \cdot 3x) = 8x + 15x = 23x$. The student needs to focus on understanding how to factor trinomials in the form $ax^2 + bx + c$.

Item#	Rationale	
30	Option J is correct	To determine which system of equations is represented by the graph, the student could have recognized that the equations are written in slope-intercept form ($y = mx + b$, in which m represents the slope (steepness of a straight line when graphed on a coordinate grid; $m = \frac{y_2 - y_1}{x_2 - x_1}$) and b represents the y-intercept (value where a line crosses the y-axis) of each line). To write the equation of the line that contains the points located at $(-1, 3)$ and $(1, 5)$, the student could have first calculated the slope of the line ($m = \frac{5 - 3}{1 - (-1)} = \frac{2}{2} = 1$). The student could have then substituted 1 for m and the point $(1, 5)$ for x and y into the slope-intercept form to solve for b, resulting in $5 = 1 \cdot 1 + b \rightarrow 5 = 1 + b \rightarrow 4 = b$. The equation in slope-intercept form is $y = x + 4$. To write the equation of the line that contains the points located at $(-4, 4)$ and $(-1, -2)$, the student could have first calculated the slope of the line ($m = \frac{-2 - 4}{-1 - (-4)} = \frac{-6}{3} = -2$). The student could have then substituted -2 for m and the point $(-4, 4)$ for x and y into the slope-intercept form to solve for b, resulting in $4 = -2 \cdot (-4) + b \rightarrow 4 = 8 + b \rightarrow -4 = b$. The equation in slope-intercept form is $y = -2x - 4$. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option F is incorrect	The student likely made a sign error when calculating the slope of each line ($m_1 = \frac{5 - 3}{1 - (-1)} = \frac{2}{-2} = -1$ and $m_2 = \frac{-2 - 4}{-1 - (-4)} = \frac{-6}{-3} = 2$) and identified the value of each b as the x-intercept (value where a line crosses the x-axis) ($b_1 = -4$ and $b_2 = -2$), resulting in the equations $y = -x - 4$ and $y = 2x - 2$. The student needs to focus on understanding how to write a system of two linear equations in slope-intercept form when given a graph.
	Option G is incorrect	The student likely identified the y-intercept of each line correctly but made a sign error when calculating the slope of each line ($m_1 = \frac{5 - 3}{1 - (-1)} = \frac{2}{-2} = -1$ and $m_2 = \frac{-2 - 4}{-1 - (-4)} = \frac{-6}{-3} = 2$), resulting in the equations $y = -x + 4$ and $y = 2x - 4$. The student needs to focus on understanding how to write a system of two linear equations in slope-intercept form when given a graph.

Item#	Rationale	
	Option H is incorrect	The student likely calculated the slope of each line correctly but identified the value of each b as the x-intercept (value where a line crosses the x-axis) ($b_1 = -4$ and $b_2 = -2$), resulting in the equations $y = x - 4$ and $y = -2x - 2$. The student needs to focus on understanding how to write a system of two linear equations in slope-intercept form when given a graph.

Item#	Rationale	
31	Option B is correct	To determine the function, the student could have determined that the relationship can be represented by an exponential function, $f(x) = ab^x$, where a is the initial value, b is the common factor, and x is the variable (symbol used to represent an unknown number). To write the exponential function, the student could have identified 18 as the initial value (the value of $f(x)$ when $x = 0$). Next the student could have determined the common factor of $\frac{6}{5}$ by dividing each $f(x)$-value by the previous $f(x)$-value ($\frac{15}{12.5} = \frac{6}{5}$, $\frac{18}{15} = \frac{6}{5}$, $\frac{21.6}{18} = \frac{6}{5}$, $\frac{25.92}{21.6} = \frac{6}{5}$). The student could have then determined the exponential function to be $f(x) = 18\left(\frac{6}{5}\right)^x$. The rationale for the correct answer 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 initial value as the $f(x)$-value when $x = -1$ and determined the common factor by dividing each $f(x)$-value by the next $f(x)$-value ($\frac{12.5}{15} = \frac{5}{6}$, $\frac{15}{18} = \frac{5}{6}$, $\frac{18}{21.6} = \frac{5}{6}$, $\frac{21.6}{25.92} = \frac{5}{6}$), resulting in the exponential function $f(x) = 15\left(\frac{5}{6}\right)^x$. The student needs to focus on understanding how to find the initial value and common factor of an exponential function from a given table of values.
	Option C is incorrect	The student likely calculated the common factor correctly but identified the initial value as the $f(x)$-value when $x = -1$, resulting in the exponential function $f(x) = 15\left(\frac{6}{5}\right)^x$. The student needs to focus on understanding how to find the initial value of an exponential function from a given table of values.

Item#	Rationale	
	Option D is incorrect	The student likely identified the initial value correctly but determined the common factor by dividing each $f(x)$-value by the next $f(x)$-value ($\frac{12.5}{15} = \frac{5}{6}$, $\frac{15}{18} = \frac{5}{6}$, $\frac{18}{21.6} = \frac{5}{6}$, $\frac{21.6}{25.92} = \frac{5}{6}$), resulting in the exponential function $f(x) = 18\left(\frac{5}{6}\right)^x$. The student needs to focus on understanding how to find the common factor of an exponential function from a given table of values.

Item#	Rationale	
32	Option F is correct	To determine which function models the situation, the student could have found the slope (steepness of a line when graphed on a coordinate grid; $m = \frac{y_2 - y_1}{x_2 - x_1}$) and y-intercept (value where a line crosses the y-axis; b) of the line represented by the given table and substituted those values into the slope-intercept form of a linear equation ($y = mx + b$). The student could have found the slope by using the first and last sets of values of the table in the slope formula, resulting in $m = \frac{3 - 21}{7 - 1} = \frac{-18}{6} = -3$. The student could have then substituted -3 for m and the point $(1, 21)$ for x and y into the slope-intercept form to solve for b, resulting in $21 = -3 \cdot 1 + b \rightarrow 21 = -3 + b \rightarrow 24 = b$. Since y is represented by $f(n)$ and x is represented by n in this situation, the function is $f(n) = -3n + 24$. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option G is incorrect	The student likely calculated the slope as $m = \frac{x_2 - x_1}{y_2 - y_1}$ using the first and second sets of values of the table, resulting in $m = \frac{3 - 1}{15 - 21} = \frac{2}{-6} = -\frac{1}{3}$. Then the student likely substituted $-\frac{1}{3}$ for m and the point $(3, 15)$ for x and y into the slope-intercept form to solve for b, resulting in $15 = -\frac{1}{3} \cdot 3 + b \rightarrow 15 = -1 + b \rightarrow 16 = b$. The function is $f(n) = -\frac{1}{3}n + 16$. The student needs to focus on understanding how to write linear functions in slope-intercept form given a table of values.
	Option H is incorrect	The student likely calculated the slope correctly but reversed the values of x and y of the point $(1, 21)$ in the slope-intercept form when solving for b, resulting in $1 = -3 \cdot 21 + b \rightarrow 1 = -63 + b \rightarrow 64 = b$. The function is $f(n) = -3n + 64$. The student needs to focus on understanding how to write linear functions in slope-intercept form given a table of values.

Item#	Rationale	
	Option J is incorrect	The student likely calculated the slope as $m = \frac{x_2 - x_1}{y_2 - y_1}$ using the second and third sets of values of the table, resulting in $m = \frac{6 - 3}{6 - 15} = \frac{3}{-9} = -\frac{1}{3}$. Then the student likely substituted the value of the x-intercept (value where a line crosses the x-axis), 8, for b instead of the value of the y-intercept. The function is $f(n) = -\frac{1}{3}n + 8$. The student needs to focus on understanding how to write linear functions in slope-intercept form given a table of values.

Item#	Rationale	
33	Option D is correct	To determine the best statement about the transformation of the graph of $f(x) = x^2$ to the graph of $g(x) = f(x) - 9$, the student could have recognized that subtracting 9 from $f(x)$ makes the parabola (U-shaped graph) shift from the origin $(0, 0)$ down 9 units to $(0, -9)$. The student could have then realized that the y-values of the ordered pairs $(0, 0)$ and $(0, -9)$ represent the y-intercept (value where a graph crosses the y-axis) of each graph. So on a coordinate grid, the y-intercept of the graph of $g(x)$ is 9 units below the y-intercept of the graph of $f(x)$. The rationale for the correct answer 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 -9 as representing a reflection (flip) of the parabola over the x-axis (horizontal). 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 identified the vertex (high or low point of the curve) of the graph of $f(x)$ correctly but interpreted -9 as representing a translation (shift) of the vertex 9 units to the right instead of 9 units down. 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 -9 as representing a reflection (flip) of the parabola over the y-axis (vertical). The student needs to focus on understanding how changes to a function affect the graph of the function.
34	43 and any equivalent values are correct	To determine the value of p in the equivalent expression x^p, the student could have first applied the power of a power property, $(a^m)^n = a^{mn}$, to simplify $(x^7)^3 = x^{21}$. The student could have then applied the product of powers property, $a^m a^n = a^{(m+n)}$, resulting in $(x^{22})(x^{21}) = x^{22+21} = x^{43}$. Therefore the value of p is 43. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.

Item#	Rationale	
35	Option D is correct	To determine which statement is true about linear function k, the student could have plotted the points $(-7, 0)$ and $(1, 8)$ on the coordinate grid and drawn a line passing through the two points, recognizing the x-intercept (value where a line crosses the x-axis) of the graph as -7. The rationale for the correct answer 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 calculating the slope (steepness of a straight line when graphed on a coordinate grid; $m = \frac{y_2 - y_1}{x_2 - x_1}$) of the line, resulting in $m = \frac{8-0}{1-7} = \frac{8}{-6} = -\frac{4}{3}$. The student needs to focus on understanding the key features of linear functions graphed on a coordinate grid.
	Option B is incorrect	The student identified a point representing the opposite values of the x- and y-coordinates of the point $(1, 8)$ as being on the graph of linear function k. The student needs to focus on understanding the key features of linear functions graphed on a coordinate grid.
	Option C is incorrect	The student identified the zero (value of a function when $y = 0$) as the y-intercept (value where a line crosses the y-axis) of linear function k. The student needs to focus on understanding the key features of linear functions graphed on a coordinate grid.

Item#	Rationale	
36	Option F is correct	To determine the equivalent expression, the student could have realized that $21d$ is the common factor (a number or expression that divides another number or expression) of $210d^2$ and $-63d$. Because $21 \cdot 10 = 210$ and $d \cdot d = d^2$, $210d^2$ can be expressed as $21d(10d)$. Similarly, $-63d$ can be expressed as $21d(-3)$. The student could have recognized the common factor as $21d$ and subtracted the other two terms to indicate that $210d^2 - 63d$ is equal to $21d(10d - 3)$. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option G is incorrect	The student likely identified the common factor of $21d$ correctly but made a sign error when factoring out $21d$ from $-63d$, resulting in $21d(10d + 3)$. The student needs to focus on understanding how to multiply negative and positive numbers.
	Option H is incorrect	The student likely factored out $21d$ from the expression but misidentified the common factor as only representing the coefficient (a number used to multiply a variable) of 21. The student also likely made a sign error when factoring out $21d$ from $-63d$, resulting in $21(10d + 3)$. The student needs to focus on understanding how to use the distributive property and multiply negative and positive numbers.
	Option J is incorrect	The student likely factored out $21d$ from the expression but misidentified the common factor as only representing the coefficient (a number used to multiply a variable) of 21, resulting in $21(10d - 3)$. The student needs to focus on understanding how to use the distributive property.

Item#	Rationale	
37	Option C is correct	To determine the x-value of 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 find the value of x. First the student could have substituted the second equation, $y = -5x + 32$, for y in the first equation, $3x - 5y = 22$, resulting in $3x - 5(-5x + 32) = 22$. Then the student could have distributed (multiplied) -5 to both terms inside the parentheses, resulting in $3x + 25x - 160 = 22$. Then the student could have combined the x-terms, resulting in $28x - 160 = 22$. Then the student could have added 160 to both sides of the equation, resulting in $28x = 182$. Lastly the student could have divided by 28 on both sides of the equation, resulting in $x = 6.5$. The rationale for the correct answer 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 subtracting 160 from both sides of the equation, $28x = -182$, resulting in $x = -6.5$. 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 made sign errors and calculated the y-value instead of the x-value in the solution to the system of equations, $y = 5(6.5) - 32$, resulting in $y = 0.5$. 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 calculated the y-value instead of the x-value in the solution to the system of equations, $y = -5(6.5) + 32$, resulting in $y = -0.5$. The student needs to focus on understanding how to complete all the steps to calculate the solution to a system of equations.

Item#	Rationale	
38	Option G is correct	To determine which graph best represents the equation, the student could have calculated the values of y for several values of x and determined which graph includes those values. Using the values of 0, 1, and 2 for x yields the points $(0, 10)$, $(1, 8.5)$, and $(2, 7.225)$, which are all on this graph. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option F is incorrect	The student likely made sign errors on the x-values when identifying the points on the coordinate grid, using the points $(-1, 8.5)$ and $(-2, 7.225)$. The student needs to focus on understanding how to identify graphs of exponential equations.
	Option H is incorrect	The student likely added 1 to 0.85 in the given equation, identifying the graph of $y = 10(1.85)^x$. The student needs to focus on understanding how to identify graphs of exponential equations.
	Option J is incorrect	The student likely subtracted 0.85 in the given equation from 1, identifying the graph of $y = 10(0.15)^x$. The student needs to focus on understanding how to identify graphs of exponential equations.

Item#	Rationale	
39	Option A is correct	To determine the rate of change (constant increase or decrease) of y with respect to x, the student could have chosen two sets of values from the table and calculated the amount of change. The student could have used the first and last sets of values from the table in the slope formula $\left(m = \frac{y_2 - y_1}{x_2 - x_1}\right)$, resulting in $m = \frac{15 - 96}{-2 - (-20)} = \frac{-81}{18} = -\frac{9}{2}$. Therefore the rate of change is $-\frac{9}{2}$. The rationale for the correct answer 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 made sign errors and reversed the rate of change, solving $m = \frac{x_2 - x_1}{y_2 - y_1} = \frac{2 - 20}{15 - 96} = \frac{-18}{-81} = \frac{2}{9}$. The student needs to focus on understanding how to find the rate of change from a table.
	Option C is incorrect	The student likely reversed the rate of change, solving $m = \frac{x_2 - x_1}{y_2 - y_1} = \frac{-2 - (-20)}{15 - 96} = \frac{18}{-81} = -\frac{2}{9}$. The student needs to focus on understanding how to find the rate of change from a table.
	Option D is incorrect	The student likely made sign errors when calculating the rate of change, solving $m = \frac{y_2 - y_1}{x_2 - x_1} = \frac{15 - 96}{2 - 20} = \frac{-81}{-18} = \frac{9}{2}$. The student needs to focus on understanding how to find the rate of change from a table.

Item#	Rationale	
40	Option J is correct	To determine which value of x is a solution to the equation, the student could have found the factors (numbers or expressions that can be multiplied to get another number or expression) of $5x^2 - 36x + 36$ and solved the factors for x. The student could have determined that $5x^2$ is equal to $5x \cdot x$ and written $5x$ and x as the first terms in the factors. The student could have then determined that the second terms of the factors are -6 and -6 because their product (answer when multiplying) is 36 (last term in the expression) and $(5x \cdot (-6)) + (-6 \cdot x) = -30x + (-6x) = -36x$ (middle term in the expression). The two factors can be written as $(5x - 6)(x - 6)$. The student could have then set each of the factors equal to 0 and solved for x, resulting in $5x - 6 = 0 \rightarrow 5x = 6 \rightarrow x = \frac{6}{5} \rightarrow x = 1.2$ and $x - 6 = 0 \rightarrow x = 6$. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option F is incorrect	The student likely factored $5x^2 - 36x + 36$ as $(5x + 6)(x + 6)$ without verifying the middle term and set each of the factors equal to 0 to solve for x, resulting in $5x + 6 = 0 \rightarrow 5x = -6 \rightarrow x = -\frac{6}{5} \rightarrow x = -1.2$ and $x + 6 = 0 \rightarrow x = -6$. The student needs to focus on understanding how to find the solutions of a quadratic equation.
	Option G is incorrect	The student likely factored $5x^2 - 36x + 36$ as $(5x - 9)(x - 4)$ without verifying the middle term and set each of the factors equal to 0 to solve for x, resulting in $5x - 9 = 0 \rightarrow 5x = 9 \rightarrow x = \frac{9}{5} \rightarrow x = 1.8$ and $x - 4 = 0 \rightarrow x = 4$. The student needs to focus on understanding how to find the solutions of a quadratic equation.
	Option H is incorrect	The student likely factored $5x^2 - 36x + 36$ as $(5x + 9)(x + 4)$ without verifying the middle term and set each of the factors equal to 0 to solve for x, resulting in $5x + 9 = 0 \rightarrow 5x = -9 \rightarrow x = -\frac{9}{5} \rightarrow x = -1.8$ and $x + 4 = 0 \rightarrow x = -4$. The student needs to focus on understanding how to find the solutions of a quadratic equation.

Item#	Rationale	
41	Option A is correct	To determine the domain (all possible x-values) of the part of the exponential function graphed on the grid, the student could have identified all the values of x for which the graph has a y-value. The graph extends upward indefinitely from -2 on the left, making the domain $x \geq -2$.
	Option B is incorrect	The student likely interpreted "domain" to mean all possible y-values instead of all possible x-values. The student likely identified the graph as extending upward indefinitely from 4.5 on the bottom, making the domain $y \geq 4.5$. The student needs to focus on understanding how to represent the domain from a graph of an exponential function.
	Option C is incorrect	The student likely identified the variable (symbol used to represent an unknown number) representing the domain correctly but interpreted "domain" to mean all possible y-values instead of all possible x-values. The student likely identified the graph as extending upward indefinitely from 4.5 on the bottom, making the domain $x \geq 4.5$. The student needs to focus on understanding how to represent the domain from a graph of an exponential function.
	Option D is incorrect	The student likely determined the domain correctly but identified the variable (symbol used to represent an unknown number) y instead of x as representing the domain, making the domain $y \geq -2$. The student needs to focus on understanding how to represent the domain from a graph of an exponential function.
42	-38 and any equivalent values are correct	To determine the solution, the student could have solved the equation for m. To solve the equation, the student could have first distributed (multiplied) -1 to the terms inside the first set of parentheses and 4 to the terms inside the second set of parentheses, resulting in $-1(6m) + (-1)(8) = 4(17) + 4(-m) \rightarrow -6m - 8 = 68 - 4m$. The student could have then added 8 to both sides of the equation, resulting in $-6m = 76 - 4m$. The student could have then added $4m$ to both sides of the equation, resulting in $-2m = 76$. To solve for m, the student could have divided both sides of the equation by -2, resulting in $m = -38$. Therefore the solution to the equation is -38. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.

Item#	Rationale	
43	Option B is correct	To determine which function is equivalent to $y = 3(x + 2)^2 + 7$, the student could have simplified the equation into the standard form of a quadratic equation, $y = ax^2 + bx + c$. First the student could have rewritten the equation as $y = 3(x + 2)(x + 2) + 7$. Then the student could have multiplied $(x + 2)$ by $(x + 2)$, resulting in $y = 3(x^2 + 4x + 4) + 7$. Then the student could have multiplied 3 by each term inside the parentheses, resulting in $y = 3x^2 + 12x + 12 + 7$. Lastly the student could have added the constants 12 and 7, resulting in $y = 3x^2 + 12x + 19$. The rationale for the correct answer 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 combined the constants before multiplying by 3, resulting in $y = 3(x^2 + 4x + 4) + 7 \rightarrow y = 3(x^2 + 4x + 11) \rightarrow y = 3x^2 + 12x + 33$. The student needs to focus on understanding how to convert quadratic equations from vertex form to standard form.
	Option C is incorrect	The student likely identified the exponent (2) as multiplying each term in the expression $(x + 2)$ times itself, resulting in $y = 3(x^2 + 4) + 7 \rightarrow y = 3x^2 + 12 + 7 \rightarrow y = 3x^2 + 19$. The student needs to focus on understanding how to convert quadratic equations from vertex form to standard form.
	Option D is incorrect	The student likely identified the exponent (2) as multiplying each term in the expression $(x + 2)$ times itself and combined the constants before multiplying by 3, resulting in $y = 3(x^2 + 4) + 7 \rightarrow y = 3(x^2 + 11) \rightarrow y = 3x^2 + 33$. The student needs to focus on understanding how to convert quadratic equations from vertex form to standard form.

Item#	Rationale	
44	Option H is correct	To determine which table shows y as a function of x, the student could have recalled that a function represents a relationship where each input, x, has a single output, y. Also, the student could have recalled that a function can have repeated output values as long as all the input values are different. A student could have analyzed the ordered pairs $(1, 4)$, $(3, 4)$, $(7, 4)$, and $(12, 4)$ to conclude that each x-value has a single y-value, representing a function. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option F is incorrect	The student identified that a function could have repeated input values as long as all the output values are different. The student needs to focus on understanding whether a relation (relationship between the x- and y-values of ordered pairs) represented in a table defines a function.
	Option G is incorrect	The student identified the inclusion of at least one ordered pair with equal corresponding values in the table, $(-1, -1)$, as a requirement of a function. The student needs to focus on understanding whether a relation (relationship between the x- and y-values of ordered pairs) represented in a table defines a function.
	Option J is incorrect	The student identified the inclusion of the origin (point where the x-axis (horizontal) and the y-axis (vertical) on a coordinate grid intersect and also the point represented by the ordered pair $(0, 0)$) as a requirement of a function. The student needs to focus on understanding whether a relation (relationship between the x- and y-values of ordered pairs) represented in a table defines a function.

Item#	Rationale	
45	Option A is correct	To determine the equation of a line parallel (lines that do not intersect and are always the same distance from each other) to another line, the student could have first identified $y = 1.2x + 3.8$ as being in slope-intercept form ($y = mx + b$, where m represents the slope (steepness of a straight line when graphed on a coordinate grid; $m = \frac{y_2 - y_1}{x_2 - x_1}$) and b represents the y-intercept (value where a line crosses the y-axis)). Since parallel lines have the same slope, the student could have substituted the slope, 1.2, into the slope-intercept form, resulting in $y = 1.2x + b$. To determine the y-intercept, the student could have substituted the point $(5, 0)$ for x and y in the slope-intercept form, resulting in $0 = 1.2(5) + b$. The student could have then multiplied 1.2 by 5, resulting in $0 = 6 + b$. To solve the equation for b, the student could have subtracted 6 from both sides of the equation, resulting in $-6 = b$. The equation $y = 1.2x - 6$ represents the line that passes through the point $(5, 0)$ and is parallel to the line represented by $y = 1.2x + 3.8$. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option B is incorrect	The student likely determined that if the slope of a line is m, the slope of the line parallel to it is $-m$ instead of m. The student needs to focus on understanding how to determine the slope of a line that is parallel to a given line represented by an equation.
	Option C is incorrect	The student identified the slope of the parallel line correctly but identified the value of 5 from the point $(5, 0)$ as the y-intercept, resulting in the equation $y = 1.2x + 5$. The student needs to focus on understanding how to determine the y-intercept of a line that is parallel to a given line represented by an equation.
	Option D is incorrect	The student likely determined that if the slope of a line is m, the slope of the line parallel to it is $-m$ instead of m and identified the opposite value of 5 from the point $(5, 0)$ as the y-intercept, resulting in the equation $y = -1.2x - 5$. The student needs to focus on understanding how to determine the slope and y-intercept of a line that is parallel to a given line represented by an equation.

Item#	Rationale	
46	Option J is correct	To determine which statements are best supported by the graph of k, the student could have identified the ordered pair for the x-intercept (value where a graph crosses the x-axis), ordered pair for the y-intercept (value where a line crosses the y-axis), and equation for the axis of symmetry (line through a graph so that each side is a mirror image) of the graph. The ordered pair for the x-intercept is $(-3, 0)$, the ordered pair for the y-intercept is $(0, 9)$, and the equation for the axis of symmetry is $x = -3$. The student could have then reviewed the statements with the ordered pairs and equation identified and concluded that all three statements are supported by the graph of k. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option F is incorrect	The student identified the axis of symmetry as $x = 3$ instead of $x = -3$. The student needs to focus on understanding how to identify the axis of symmetry from the graph of a quadratic function.
	Option G is incorrect	The student identified the ordered pair for the y-intercept as $(9, 0)$ instead of $(0, 9)$. The student needs to focus on understanding how to identify the y-intercept from the graph of a quadratic function.
	Option H is incorrect	The student identified the ordered pair for the x-intercept as $(0, -3)$ instead of $(-3, 0)$. The student needs to focus on understanding how to identify the x-intercept from the graph of a quadratic function.

Item#	Rationale	
47	Option A is correct	To determine which graph best represents the solution set (set of all numbers that satisfy an equation or inequality) for the given situation, the student could have determined that the phrase “no more than” can be represented by all the ordered pairs where the sum of the *x*- and *y*-coordinates is less than or equal to 48 but greater than or equal to 0. Since the situation states that the student’s combined work schedules consist of “no more than 48 hours in one week,” the student could have represented an *x*-intercept (value where a line crosses the *x*-axis) of 48 as the maximum (greatest) number of hours worked at the first job and a *y*-intercept (value where a line crosses the *y*-axis) of 48 as the maximum number of hours worked at the second job. The student could have then drawn a line segment (the part of a line connecting two endpoints (points that mark the ends of a line segment or interval)) connecting the *x*- and *y*-intercepts and shaded the graph where the sum of the *x*- and *y*-coordinates is less than or equal to 48 but greater than or equal to 0. The rationale for the correct answer 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 correctly identified the line segment but interpreted the phrase “no more than” to mean that the solution set is represented by all the ordered pairs where the sum of the *x*- and *y*-coordinates is greater than or equal to 48. The student needs to focus on understanding how to graph the solution set of a linear inequality represented by a verbal description of a real-world situation.
	Option C is incorrect	The student interpreted the phrase “no more than” to mean that the solution set is represented by all the ordered pairs where the value of the *x*-coordinate is greater than or equal to the value of the *y*-coordinate when *x* is greater than or equal to 0. The student needs to focus on understanding how to graph the solution set of a linear inequality represented by a verbal description of a real-world situation.
	Option D is incorrect	The student interpreted the phrase “no more than” to mean that the solution set is all the ordered pairs where the value of the *x*-coordinate is less than or equal to the value of the *y*-coordinate when *x* is greater than or equal to 0. The student needs to focus on understanding how to graph the solution set of a linear inequality represented by a verbal description of a real-world situation.

Item#	Rationale	
48	Option J is correct	To determine the equivalent function, the student could have found the factors (numbers or expressions that can be multiplied to get another number or expression) of $9x^2 - 24x + 16$. The student could have identified two factors in the form, $(Ax + B)$ and $(Cx + D)$, for which $A \cdot C = 9$, $(A \cdot D) + (B \cdot C) = -24$, and $B \cdot D = 16$. The student could have identified the two factors as $(3x - 4)$ and $(3x - 4)$, because $3x \cdot 3x = 9x^2$, $(3x \cdot (-4)) + (-4 \cdot 3x) = -24x$, and $-4 \cdot (-4) = 16$. The function $q(x) = (3x - 4)(3x - 4)$, so $q(x) = (3x - 4)^2$. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option F is incorrect	The student likely identified the factors as $(9x - 4)$ and $(x - 4)$ and verified that $9x \cdot x = 9x^2$ and $-4 \cdot (-4) = 16$ but did not verify the middle term was $-24x$ when $(9x \cdot (-4)) + (-4 \cdot x) = -40x$. The student needs to focus on understanding how to find the factors of an expression in the form $ax^2 + bx + c$.
	Option G is incorrect	The student likely identified the factors as $(3x + 4)$ and $(3x + 4)$ and verified that $3x \cdot 3x = 9x^2$ and $4 \cdot 4 = 16$ but did not verify the middle term was $-24x$ when $(3x \cdot 4) + (4 \cdot 3x) = 24x$. The student needs to focus on understanding how to find the factors of an expression in the form $ax^2 + bx + c$.
	Option H is incorrect	The student likely identified the factors as $(9x + 4)$ and $(x + 4)$ and verified that $9x \cdot x = 9x^2$ and $4 \cdot 4 = 16$ but did not verify the middle term was $-24x$ when $(9x \cdot 4) + (4 \cdot x) = 40x$. The student needs to focus on understanding how to find the factors of an expression in the form $ax^2 + bx + c$.

Item#	Rationale	
49	Option B is correct	To determine which graph best represents the system of equations and its solution, the student could have graphed both equations on the coordinate grid. The student could have changed the first equation to slope-intercept form, $y = mx + b$, by subtracting $8x$ from both sides of the equation and then dividing both sides of the equation by -4, resulting in $y = 2x + 4$. The graph of this first equation has a slope (steepness of a straight line when graphed on a coordinate grid; $m = \frac{y_2 - y_1}{x_2 - x_1}$) of 2 and a y-intercept (value where a line crosses the y-axis) of 4. The student could have then changed the second equation to slope-intercept form, $y = mx + b$, by subtracting $3x$ from both sides of the equation and then dividing both sides of the equation by 15, resulting in $y = -\frac{3}{15}x - \frac{6}{15} \rightarrow y = -\frac{1}{5}x - \frac{2}{5}$. The graph of this second equation has a slope of $-\frac{1}{5}$ and a y-intercept of $-\frac{2}{5}$. These two lines and the solution to the system of equations are best represented on this graph. The rationale for the correct answer 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 sign errors when calculating the y-intercepts of the lines representing the system of equations, identifying the first equation as $y = 2x - 4$ and the second equation as $y = -\frac{1}{5}x + \frac{2}{5}$. The student needs to focus on understanding how to divide negative numbers and graph a system of two linear equations on a coordinate grid.
	Option C is incorrect	The student likely identified the reciprocal (a pair of numbers that, when multiplied together, equal 1) of both slopes of the lines and solved $8x = -16$ for the y-intercept of the line representing the first equation and $3x = -6$ for the y-intercept of the line representing the second equation. The line of the first equation has a slope of $\frac{1}{2}$ and a y-intercept of -2, and the line of the second equation has a slope of -5 and a y-intercept of -2, resulting in the equations $y = \frac{1}{2}x - 2$ and $y = -5x - 2$. The student needs to focus on understanding how to set up linear equations and graph a system of two linear equations on a coordinate grid.

Item#	Rationale	
	Option D is incorrect	The student likely identified the reciprocal (a pair of numbers that, when multiplied together, equal 1) of both slopes of the lines and solved $8x = 16$ for the y-intercept of the line representing the first equation and $3x = 6$ for the y-intercept of the line representing the second equation. The line of the first equation has a slope of $\frac{1}{2}$ and a y-intercept of 2, and the line of the second equation has a slope of -5 and a y-intercept of 2, resulting in the equations $y = \frac{1}{2}x + 2$ and $y = -5x + 2$. The student needs to focus on understanding how to set up linear equations and graph a system of two linear equations on a coordinate grid.

Item#	Rationale	
50	Option F is correct	To determine the domain (all possible x-values) and range (all possible y-values) of $g(x)$, the student could have graphed the quadratic function on a coordinate grid and analyzed the parabola (U-shaped graph). The student could have determined that the graph continues to extend downward and outward indefinitely, making the domain all real numbers. As the graph of this function opens downward, it is bound above by $y = 61$, making the range all values of y less than or equal to 61 ($y \leq 61$), or $g(x) \leq 61$. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option G is incorrect	The student identified the range correctly but used the x-value of the vertex (high or low point of the curve) as the upper bound of the domain, $x \leq 17$. The student needs to focus on understanding how to identify the domain of a quadratic function.
	Option H is incorrect	The student identified the domain correctly but identified the range as all possible x-values with an upper bound represented by the x-value of the vertex (high or low point of the curve), $x \leq 17$. The student needs to focus on understanding how to identify the range of a quadratic function.
	Option J is incorrect	The student likely used the x-value of the vertex (high or low point of the curve) as the upper bound of the domain, $x \leq 17$, and the y-value of the vertex as the lower bound of the range, $g(x) \geq 61$. The student likely then reversed the relationship between domain and range. The student needs to focus on understanding how to identify the domain and range of a quadratic function.

Item#	Rationale	
51	Option C is correct	To determine which system of equations can be used to find the prices in dollars of each large candle and each small candle at the store, the student could have written one equation to represent the total amount paid by a first customer for large and small candles and one equation to represent the total amount paid by a second customer for large and small candles. The total amount of 64 dollars paid by the first customer is equal to 3 times the price in dollars of each large candle, x, and 4 times the price in dollars of each small candle, y, which can be represented by the equation $3x + 4y = 64$. The total amount of 68 dollars (4 dollars more than the total amount paid by the first customer) paid by the second customer is equal to 1 times the price in dollars of each large candle, x, and 8 times the price in dollars of each small candle, y, which can be represented by the equation $x + 8y = 68$. Therefore the system of equations $3x + 4y = 64$ and $x + 8y = 68$ represent this situation.
	Option A is incorrect	The student likely identified the system of two linear equations correctly in standard form ($Ax + By = C$) but made sign errors on the y-terms when attempting to rewrite the equations in slope-intercept form ($y = mx + b$), resulting in the equations $4y = 3x + 64$ and $8y = x + 68$. The student needs to focus on understanding how to rewrite linear equations from standard form to slope-intercept form.
	Option B is incorrect	The student likely interpreted the phrase "$4 more" as subtracting instead of adding 4 dollars to the total amount paid by the first customer, calculating $64 - 4 = 60$. The student likely then identified the system of two linear equations in standard form ($Ax + By = C$) but made sign errors on the y-terms when attempting to rewrite the equations in slope-intercept form ($y = mx + b$), resulting in the equations $4y = 3x + 64$ and $8y = x + 60$. The student needs to focus on understanding how to interpret the verbal description of a system of equations and rewrite linear equations from standard form to slope-intercept form.
	Option D is incorrect	The student likely interpreted the phrase "$4 more" as subtracting instead of adding 4 dollars to the total amount paid by the first customer, calculating $64 - 4 = 60$ and identifying the system of two linear equations as $3x + 4y = 64$ and $x + 8y = 60$. The student needs to focus on understanding how to interpret the verbal description of a system of linear equations.

Item#	Rationale	
52	Option G is correct	To determine which graph bests represents the function $h(x)$, the student could have first identified the linear parent function as $f(x) = x$. The student could have then realized that multiplying x by -1 means that the slope (steepness of a straight line when graphed on a coordinate grid; $m = \frac{y_2 - y_1}{x_2 - x_1}$) of the linear parent function, 1, is multiplied by -1, resulting in $-1x$, or $-x$. The student could have then realized the "$+3$" means that the graph of linear parent function f is shifted up 3 units on the coordinate grid. The y-intercept (value where a line crosses the y-axis) of the graph of f, point $(0, 0)$, is shifted up to point $(0, 3)$, the y-intercept of the graph of h. The graph of $h(x)$ will go through the point $(0, 3)$ and have a slope of -1, which is best represented on this graph. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option F is incorrect	The student identified the graph of a function that has the correct y-intercept but a slope of 1 instead of -1. The student needs to focus on understanding how transformations affect the slope of the graph of a line.
	Option H is incorrect	The student identified the graph of a function that has the correct slope but a y-intercept of -3 instead of 3. The student needs to focus on understanding how transformations affect the y-intercept of the graph of a line.
	Option J is incorrect	The student identified the graph of a function that has a slope of 1 instead of -1 and a y-intercept of -3 instead of 3. The student needs to focus on understanding how transformations affect the slope and y-intercept of the graph of a line.

Item#	Rationale	
53	Option D is correct	To determine the equivalent expression, the student could have rewritten $4\sqrt{147}$ as $4 \cdot \sqrt{49} \cdot \sqrt{3}$ and then calculated the square root (a value that, when multiplied by itself, is equal to the number under the $\sqrt{}$) of 49 to get $4 \cdot 7 \cdot \sqrt{3}$. The student could have then multiplied 4 and 7, resulting in $28 \cdot \sqrt{3}$, or $28\sqrt{3}$. The rationale for the correct answer 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 simplified $4\sqrt{147}$ as $4 \cdot 49 \cdot \sqrt{3}$, resulting in $196 \cdot \sqrt{3}$, or $196\sqrt{3}$. The student needs to focus on understanding how to simplify square roots.
	Option B is incorrect	The student likely simplified $4\sqrt{147}$ as $4 \cdot 3 \cdot \sqrt{49}$ and did not remove the $\sqrt{}$ after taking the square root of 49, resulting in $12 \cdot \sqrt{7}$, or $12\sqrt{7}$. The student needs to focus on understanding how to simplify square roots.
	Option C is incorrect	The student likely simplified only the $\sqrt{147}$ as $3 \cdot \sqrt{49}$ and did not remove the $\sqrt{}$ after taking the square root of 49, resulting in $3 \cdot \sqrt{7}$, or $3\sqrt{7}$. The student needs to focus on understanding how to simplify square roots.

Item#	Rationale	
54	Option G is correct	To determine the time in seconds the toy robot moves when the total distance is 408 centimeters, the student could have realized that when two variables (symbols used to represent unknown numbers), x (representing the time in seconds) and y (representing the total distance in centimeters), vary directly with each other, their relation can be represented by the equation $y = kx$. This equation represents the value of y, which can be determined by multiplying the value of x by the value of k (known as the constant of proportionality). The student could have calculated what number k, when multiplied by 11, equals 264, resulting in $264 = k \cdot 11 \rightarrow \frac{264}{11} = k \rightarrow 24 = k$. The student could have then substituted 24 for k and 408 for y in the equation $y = kx$, resulting in $408 = 24x$. To solve for x, the student could have divided both sides of the equation by 24, resulting in $17 = x$, which represents 17 seconds. The rationale for the correct answer is an efficient way to solve the problem. However, other methods could be used to solve the problem correctly.
	Option F is incorrect	The student likely identified the value of k (known as the constant of proportionality in the equation $y = kx$) as time in seconds, meaning 24 seconds. The student needs to focus on understanding how to set up and solve direct variation problems.
	Option H is incorrect	The student likely determined the time in seconds by calculating $\frac{408 - 264}{11}$ and rounding to the nearest second, resulting in a time of 13 seconds. The student needs to focus on understanding how to set up and solve direct variation problems.
	Option J is incorrect	The student likely determined the time in seconds by calculating $\frac{408}{11}$ and rounding to the nearest second, resulting in a time of 37 seconds. The student needs to focus on understanding how to set up and solve direct variation problems.