Math question 1

If $f(x) = x + 7$ and $g(x) = 7x$, what is the value of $4f(2) - g(2)$?

A) −5

B) 1

C) 22

D) 28

Key	C
Domain	Algebra
Skill	*Linear functions* Evaluate a linear function given an input value

Key Explanation: Choice C is correct. The value of $f(2)$ can be found by substituting 2 for x in the given equation $f(x) = x + 7$, which yields $f(2) = 2 + 7$, or $f(2) = 9$. The value of $g(2)$ can be found by substituting 2 for x in the given equation $g(x) = 7x$, which yields $g(2) = 7(2)$, or $g(2) = 14$. The value of the expression $4f(2) - g(2)$ can be found by substituting the corresponding values into the expression, which gives $4(9) - 14$. This expression is equivalent to $36 - 14$, or 22.

Distractor Explanations: Choice A is incorrect. This is the value of $f(2) - g(2)$, not $4f(2) - g(2)$. **Choice B** is incorrect and may result from calculating $4f(2)$ as $4(2) + 7$, rather than $4(2 + 7)$. **Choice D** is incorrect and may result from conceptual or calculation errors.

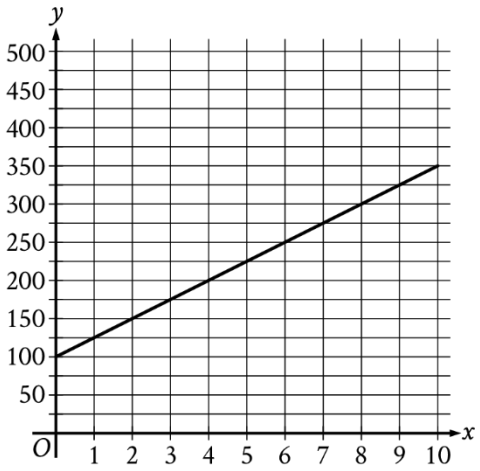
Math question 2

The y-intercept of the graph of $y = -6x - 32$ in the xy-plane is $(0, y)$. What is the value of y?

Key	−32
Domain	Algebra
Skill	*Linear equations in two variables* Make connections between an algebraic representation and a graph

Key Explanation: The correct answer is −32. It's given that the y-intercept of the graph of $y = -6x - 32$ is $(0, y)$. Substituting 0 for x in this equation yields $y = -6(0) - 32$ or $y = -32$. Therefore, the value of y that corresponds to the y-intercept of the graph of $y = -6x - 32$ in the xy-plane is −32.

Math question 3



The graph of the function f, where $y = f(x)$, models the total cost y, in dollars, for a certain video game system and x games. What is the best interpretation of the slope of the graph in this context?

A) Each game costs $25.

B) The video game system costs $100.

C) The video game system costs $25.

D) Each game costs $100.

Key	A
Domain	Algebra
Skill	*Linear functions* Interpret the graph of a linear function in terms of a context

Key Explanation: Choice A is correct. The given graph is a line, and the slope of a line is defined as the change in the value of y for each increase in the value of x by 1. It's given that y represents the total cost, in dollars, and that x represents the number of games. Therefore, the change in the value of y for each increase in the value of x by 1 represents the change in total cost, in dollars, for each increase in the number of games by 1. In other words, the slope represents the cost, in dollars, per game. The graph shows that when the value of x increases from 0 to 1, the value of y increases from 100 to 125. It follows that the slope is 25, or the cost per game is $25. Thus, the best interpretation of the slope of the graph is that each game costs $25.

Distractor Explanations: Choice B is incorrect. This is an interpretation of the y-intercept of the graph rather than the slope of the graph. **Choice C** is incorrect. The slope of the graph is the cost per game, not the cost of the video game system. **Choice D** is incorrect. Each game costs $25, not $100.

Math question 4

$$y < -4x + 4$$

Which point (x, y) is a solution to the given inequality in the xy-plane?

A) $(2, -1)$

B) $(2, 1)$

C) $(0, 5)$

D) $(-4, 0)$

Key	D
Domain	Algebra
Skill	*Linear inequalities in one or two variables* For a linear inequality, interpret a point in the xy-plane

Key Explanation: Choice D is correct. For a point (x, y) to be a solution to the given inequality in the xy-plane, the value of the point's y-coordinate must be less than the value of $-4x + 4$, where x is the value of the x-coordinate of the point. This is true of the point $(-4, 0)$ because $0 < -4(-4) + 4$, or $0 < 20$. Therefore, the point $(-4, 0)$ is a solution to the given inequality.

Distractor Explanations: Choices A, **B**, and **C** are incorrect. None of these points is a solution to the given inequality because each point's y-coordinate is greater than the value of $-4x + 4$ for the point's x-coordinate.

Math question 5

Figure A and figure B are both regular polygons. The sum of the perimeter of figure A and the perimeter of figure B is 63 inches. The equation $3x + 6y = 63$ represents this situation, where x is the number of sides of figure A and y is the number of sides of figure B. Which statement is the best interpretation of 6 in this context?

A) Each side of figure B has a length of 6 inches.

B) The number of sides of figure B is 6.

C) Each side of figure A has a length of 6 inches.

D) The number of sides of figure A is 6.

Key	A
Domain	Algebra
Skill	*Linear equations in two variables* For a linear equation, interpret a solution, constant, variable, factor, or term based on the context

Key Explanation: Choice A is correct. It's given that figure A and figure B (not shown) are both regular polygons and the sum of the perimeters of the two figures is 63 inches. It's also given that x is the number of sides of figure A and y is the number of sides of figure B, and that the equation $3x + 6y = 63$ represents this situation. Thus, $3x$ and $6y$ represent the perimeters, in inches, of figure A and figure B, respectively. Since $6y$ represents the perimeter, in inches, of figure B and y is the number of sides of figure B, it follows that each side of figure B has a length of 6 inches.

Distractor Explanations: Choice B is incorrect. The number of sides of figure B is y, not 6. **Choice C** is incorrect. Since the perimeter, in inches, of figure A is represented by $3x$, each side of figure A has a length of 3 inches, not 6 inches. **Choice D** is incorrect. The number of sides of figure A is x, not 6.

Math question 6

Store A sells raspberries for $5.50 per pint and blackberries for $3.00 per pint. Store B sells raspberries for $6.50 per pint and blackberries for $8.00 per pint. A certain purchase of raspberries and blackberries would cost $37.00 at store A or $66.00 at store B. How many pints of blackberries are in this purchase?

A) 12

B) 8

C) 5

D) 4

Key	C
Domain	Algebra
Skill	*Systems of two linear equations in two variables* Create and use a system of two linear equations

Key Explanation: Choice C is correct. It's given that store A sells raspberries for $5.50 per pint and blackberries for $3.00 per pint, and a certain purchase of raspberries and blackberries at store A would cost $37.00. It's also given that store B sells raspberries for $6.50 per pint and blackberries for $8.00 per pint, and this purchase of raspberries and blackberries at store B would cost $66.00. Let r represent the number of pints of raspberries and b represent the number of pints of blackberries in this purchase. The equation $5.50r + 3.00b = 37.00$ represents this purchase of raspberries and blackberries from store A and the equation $6.50r + 8.00b = 66.00$ represents this purchase of raspberries and blackberries from store B. Solving the system of equations by elimination gives the value of r and the value of b that make the system of equations true. Multiplying both sides of the equation for store A by 6.5 yields $(5.50r)(6.5) + (3.00b)(6.5) = (37.00)(6.5)$, or $35.75r + 19.5b = 240.5$. Multiplying both sides of the equation for store B by 5.5 yields $(6.50r)(5.5) + (8.00b)(5.5) = (66.00)(5.5)$, or $35.75r + 44b = 363$. Subtracting both sides of the equation for store A, $35.75r + 19.5b = 240.5$, from the corresponding sides of the equation for store B, $35.75r + 44b = 363$, yields $(35.75r - 35.75r) + (44b - 19.5b) = (363 - 240.5)$, or $24.5b = 122.5$. Dividing both sides of this equation by 24.5 yields $b = 5$. Thus, 5 pints of blackberries are in this purchase.

Distractor Explanations: Choices A and **B** are incorrect and may result from conceptual or calculation errors. **Choice D** is incorrect. This is the number of pints of raspberries, not blackberries, in the purchase.

Math question 7

$$g(x) = x^2 + 55$$

What is the minimum value of the given function?

A) 3,025

B) 110

C) 55

D) 0

Key	C
Domain	Advanced Math
Skill	*Nonlinear functions* Determine the most suitable form of a function to display key features

Key Explanation: Choice C is correct. A quadratic function in the form $g(x) = a(x - h)^2 + k$, where a, h, and k are constants, has a minimum value of k at $x = h$ when $a > 0$. The given quadratic function can be rewritten as $g(x) = 1(x - 0)^2 + 55$, where $h = 0$ and $k = 55$. Therefore, the minimum value of the given function is 55.

Distractor Explanations: Choice A is incorrect and may result from squaring the minimum value. **Choice B** is incorrect and may result from multiplying the minimum value by 2. **Choice D** is incorrect. This is the x-value at which the minimum value of $g(x)$ occurs.

Math question 8

The function h is defined by $h(x) = a^x + b$, where a and b are positive constants. The graph of $y = h(x)$ in the xy-plane passes through the points $(0, 10)$ and $\left(-2, \frac{325}{36}\right)$. What is the value of ab?

A) $\frac{1}{4}$

B) $\frac{1}{2}$

C) 54

D) 60

Key	C
Domain	Advanced Math
Skill	*Nonlinear functions* Make connections between algebraic representations and a graph

Key Explanation: Choice C is correct. It's given that the function h is defined by $h(x) = a^x + b$ and that the graph of $y = h(x)$ in the xy-plane passes through the points $(0, 10)$ and $\left(-2, \frac{325}{36}\right)$. Substituting 0 for x and 10 for $h(x)$ in the equation $h(x) = a^x + b$ yields $10 = a^0 + b$, or $10 = 1 + b$. Subtracting 1 from both sides of this equation yields $9 = b$. Substituting -2 for x and $\frac{325}{36}$ for $h(x)$ in the equation $h(x) = a^x + 9$ yields $\frac{325}{36} = a^{-2} + 9$. Subtracting 9 from both sides of this equation yields $\frac{1}{36} = a^{-2}$, which can be rewritten as $\frac{1}{36} = \frac{1}{a^2}$, or $a^2 = 36$. Taking the square root of both sides of this equation yields $a = 6$ and $a = -6$, but because it's given that a is a positive constant, a must equal 6. Because the value of a is 6 and the value of b is 9, the value of ab is (6)(9), or 54.

Distractor Explanations: Choice A is incorrect and may result from finding the value of $a^{-2}b$ rather than the value of ab. **Choice B** is incorrect and may result from conceptual or calculation errors. **Choice D** is incorrect and may result from correctly finding the value of a as 6, but multiplying it by the y-value in the first ordered pair rather than by the value of b.

Math question 9

$$(x - 1)^2 = -4$$

How many distinct real solutions does the given equation have?

A) Exactly one

B) Exactly two

C) Infinitely many

D) Zero

Key	D
Domain	Advanced Math
Skill	*Nonlinear equations in one variable and systems of equations in two variables* Determine the conditions under which a quadratic equation has zero, one, two, or infinitely many real solutions

Key Explanation: Choice D is correct. Any quantity that is positive or negative in value has a positive value when squared. Therefore, the left-hand side of the given equation is either positive or zero for any value of x. Since the right-hand side of the given equation is negative, there is no value of x for which the given equation is true. Thus, the number of distinct real solutions for the given equation is zero.

Distractor Explanations: Choices A, **B**, and **C** are incorrect and may result from conceptual errors.

Math question 10

Which expression is equivalent to $\frac{4}{4x-5} - \frac{1}{x+1}$?

A) $\frac{9}{(x+1)(4x-5)}$

B) $\frac{3}{3x-6}$

C) $\frac{1}{(x+1)(4x-5)}$

D) $-\frac{1}{(x+1)(4x-5)}$

Key	A
Domain	Advanced Math
Skill	*Equivalent expressions* Rewrite a rational expression

Key Explanation: Choice A is correct. To subtract one rational expression from another, the denominators of the expressions must be the same. Since $4x - 5$ and $x + 1$ do not have any common factors, each rational expression should be rewritten with a denominator of $(x + 1)(4x - 5)$. Multiplying $\frac{4}{(4x-5)}$ by $\frac{x+1}{x+1}$ and multiplying $\frac{1}{(x+1)}$ by $\frac{4x-5}{4x-5}$ yields $\frac{4(x+1)}{(x+1)(4x-5)} - \frac{4x-5}{(x+1)(4x-5)}$. This expression can be rewritten using the distributive property, which yields $\frac{4x+4}{(x+1)(4x-5)} - \frac{4x-5}{(x+1)(4x-5)}$. Since the denominators are the same, this expression is equivalent to $\frac{4x+4-4x+5}{(x+1)(4x-5)}$, or $\frac{9}{(x+1)(4x-5)}$.

Distractor Explanations: Choices B, **C**, and **D** are incorrect and may result from conceptual or calculation errors.

Math question 11

For the function f, $f(0) = 86$, and for each increase in x by 1, the value of $f(x)$ decreases by 80%. What is the value of $f(2)$?

Keys	3.44, 86/25
Domain	Advanced Math
Skill	*Nonlinear functions* Create and use quadratic or exponential functions

Key Explanation: The correct answer is 3.44. It's given that $f(0) = 86$ and that for each increase in x by 1, the value of $f(x)$ decreases by 80%. Because the output of the function decreases by a constant percentage for each 1-unit increase in the value of x, this relationship can be represented by an exponential function of the form $f(x) = a(b)^x$, where a represents the initial value of the function and b represents the rate of decay, expressed as a decimal. Because $f(0) = 86$, the value of a must be 86. Because the value of $f(x)$ decreases by 80% for each 1-unit increase in x, the value of b must be (1 − 0.80), or 0.2. Therefore, the function f can be defined by

$f(x) = 86(0.2)^x$. Substituting 2 for x in this function yields $f(2) = 86(0.2)^2$, which is equivalent to $f(2) = 86(0.04)$, or $f(2) = 3.44$. Either 3.44 or 86/25 may be entered as the correct answer.

Alternate approach: It's given that $f(0) = 86$ and that for each increase in x by 1, the value of $f(x)$ decreases by 80%. Therefore, when $x = 1$, the value of $f(x)$ is (100 − 80)%, or 20%, of 86, which can be expressed as (0.20)(86). Since (0.20)(86) = 17.2, the value of $f(1)$ is 17.2. Similarly, when $x = 2$, the value of $f(x)$ is 20% of 17.2, which can be expressed as (0.20)(17.2). Since (0.20)(17.2) = 3.44, the value of $f(2)$ is 3.44. Either 3.44 or 86/25 may be entered as the correct answer.

Math question 12

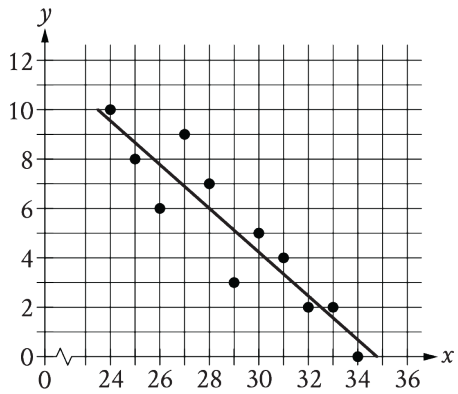
In the xy-plane, a line with equation $2y = 4.5$ intersects a parabola at exactly one point. If the parabola has equation $y = -4x^2 + bx$, where b is a positive constant, what is the value of b?

Key	6
Domain	Advanced Math
Skill	*Nonlinear equations in one variable and systems of equations in two variables* Solve systems of linear and nonlinear equations in two variables

Key Explanation: The correct answer is 6. It's given that a line with equation $2y = 4.5$ intersects a parabola with equation $y = -4x^2 + bx$, where b is a positive constant, at exactly one point in the xy-plane. It follows that the system of equations consisting of $2y = 4.5$ and $y = -4x^2 + bx$ has exactly one solution. Dividing both sides of the equation of the line by 2 yields $y = 2.25$. Substituting 2.25 for y in the equation of the parabola yields $2.25 = -4x^2 + bx$. Adding $4x^2$ and subtracting bx from both sides of this equation yields $4x^2 - bx + 2.25 = 0$. A quadratic equation in the form of $ax^2 + bx + c = 0$, where a, b, and c are constants, has exactly one solution when the discriminant, $b^2 - 4ac$, is equal to zero. Substituting 4 for a and 2.25 for c in the expression $b^2 - 4ac$ and setting this expression equal to 0 yields $b^2 - 4(4)(2.25) = 0$, or $b^2 - 36 = 0$. Adding 36 to each side of this equation yields $b^2 = 36$. Taking the square root of each side of this equation yields $b = \pm 6$. It's given that b is positive, so the value of b is 6.

Math question 13

The scatterplot shows the relationship between two variables, x and y. A line of best fit for the data is also shown.



At $x = 32$, which of the following is closest to the y-value predicted by the line of best fit?

A) 0.4

B) 1.5

C) 2.4

D) 3.3

Key	C
Domain	Problem-Solving and Data Analysis
Skill	*Two-variable data: Models and scatterplots* Analyze and interpret data in a scatterplot

Key Explanation: Choice C is correct. At $x = 32$, the line of best fit has a y-value between 2 and 3. The only choice with a value between 2 and 3 is choice C.

Distractor Explanations: Choice A is incorrect. This is the difference between the y-value predicted by the line of best fit and the actual y-value at $x = 32$ rather than the y-value predicted by the line of best fit at $x = 32$.

Choice B is incorrect. This is the *y*-value predicted by the line of best fit at $x = 31$ rather than at $x = 32$. **Choice D** is incorrect. This is the *y*-value predicted by the line of best fit at $x = 33$ rather than at $x = 32$.

Math question 14

In a group, 40% of the items are red. Of all the red items in the group, 30% also have stripes. What percentage of the items in the group are red and have stripes?

A) 10%

B) 12%

C) 70%

D) 75%

Key	B
Domain	Problem-Solving and Data Analysis
Skill	*Percentages* Use percentages to solve problems

Key Explanation: Choice B is correct. It's given that in a group, 40% of the items are red. It follows that the number of red items in the group can be represented by $0.4x$, where x represents the total number of items in the group. It's also given that of all the red items in the group, 30% also have stripes. It follows that the number of items in the group that are red and have stripes can be represented by $0.3(0.4x)$, or $0.12x$. The expression $0.12x$ represents 12% of x. Since x represents the total number of items in the group, it follows that 12% of the items in the group are red and have stripes.

Distractor Explanations: Choice A is incorrect and may result from subtracting 30% from 40% rather than calculating 30% of 40%. **Choice C** is incorrect and may result from adding 30% and 40% rather than calculating 30% of 40%. **Choice D** is incorrect and may result from calculating the percentage that 30% is of 40% rather than calculating 30% of 40%.

Math question 15

The density of a certain type of wood is 353 kilograms per cubic meter. A sample of this type of wood is in the shape of a cube and has a mass of 345 kilograms. To the nearest hundredth of a meter, what is the length of one edge of this sample?

A) 0.98

B) 0.99

C) 1.01

D) 1.02

Key	B
Domain	Problem-Solving and Data Analysis
Skill	*Ratios, rates, proportional relationships, and units* Solve problems involving derived units

Key Explanation: Choice B is correct. It's given that the density of a certain type of wood is 353 kilograms per cubic meter (kg/m^3), and a sample of this type of wood has a mass of 345 kg. Let x represent the volume, in m^3, of the sample. It follows that the relationship between the density, mass, and volume of this sample can be written as $\frac{353\text{kg}}{1\ \text{m}^3} = \frac{345\text{kg}}{x\ \text{m}^3}$, or $353 = \frac{345}{x}$. Multiplying both sides of this equation by x yields $353x = 345$. Dividing both sides of this equation by 353 yields $x = \frac{345}{353}$. Therefore, the volume of this sample is $\frac{345}{353}\ \text{m}^3$. Since it's given that the sample of this type of wood is a cube, it follows that the length of one edge of this sample can be found using the volume formula for a cube, $V = s^3$, where V represents the volume, in m^3, and s represents the length, in m, of one edge of the cube. Substituting $\frac{345}{353}$ for V in this formula yields $\frac{345}{353} = s^3$. Taking the cube root

of both sides of this equation yields $\sqrt[3]{\frac{345}{353}} = s$, or $s \approx 0.99$. Therefore, the length of one edge of this sample to the nearest hundredth of a meter is 0.99.

Distractor Explanations: Choices A, **C**, and **D** are incorrect and may result from conceptual or calculation errors.

Math question 16

Two nearby trees are perpendicular to the ground, which is flat. One of these trees is 10 feet tall and has a shadow that is 5 feet long. At the same time, the shadow of the other tree is 2 feet long. How tall, in feet, is the other tree?

A) 3

B) 4

C) 8

D) 27

Key	B
Domain	Geometry and Trigonometry
Skill	*Lines, angles, and triangles* Use concepts of congruence and similarity of triangles to solve problems

Key Explanation: Choice B is correct. Each tree and its shadow can be modeled using a right triangle, where the height of the tree and the length of its shadow are the legs of the triangle. At a given point in time, the right triangles formed by two nearby trees and their respective shadows will be similar. Therefore, if the height of the other tree is x, in feet, the value of x can be calculated by solving the proportional relationship $\frac{10 \text{ feet tall}}{5 \text{ feet long}} = \frac{x \text{ feet tall}}{2 \text{ feet long}}$. This equation is equivalent to $\frac{10}{5} = \frac{x}{2}$, or $2 = \frac{x}{2}$. Multiplying each side of the equation $2 = \frac{x}{2}$ by 2 yields $4 = x$. Therefore, the other tree is 4 feet tall.

Distractor Explanations: Choice A is incorrect and may result from calculating the difference between the lengths of the shadows, rather than the height of the other tree. **Choice C** is incorrect and may result from calculating the difference between the height of the 10-foot-tall tree and the length of the shadow of the other tree, rather than calculating the height of the other tree. **Choice D** is incorrect and may result from a conceptual or calculation error.

Math question 17

The length of a rectangle's diagonal is $5\sqrt{17}$, and the length of the rectangle's shorter side is 5. What is the length of the rectangle's longer side?

A) $\sqrt{17}$

B) 20

C) $15\sqrt{2}$

D) 400

Key	B
Domain	Geometry and Trigonometry
Skill	*Right triangles and trigonometry* Use the Pythagorean theorem to solve problems

Key Explanation: Choice B is correct. A rectangle's diagonal divides a rectangle into two congruent right triangles, where the diagonal is the hypotenuse of both triangles. It's given that the length of the diagonal is $5\sqrt{17}$ and the length of the rectangle's shorter side is 5. Therefore, each of the two right triangles formed by the rectangle's diagonal has a hypotenuse with length $5\sqrt{17}$, and a shorter leg with length 5. To calculate the length of the longer leg of each right triangle, the Pythagorean

theorem, $a^2 + b^2 = c^2$, can be used, where a and b are the lengths of the legs and c is the length of the hypotenuse of the triangle. Substituting 5 for a and $5\sqrt{17}$ for c in the equation $a^2 + b^2 = c^2$ yields $5^2 + b^2 = \left(5\sqrt{17}\right)^2$, which is equivalent to $25 + b^2 = 25(17)$, or $25 + b^2 = 425$. Subtracting 25 from each side of this equation yields $b^2 = 400$. Taking the positive square root of each side of this equation yields $b = 20$. Therefore, the length of the longer leg of each right triangle formed by the diagonal of the rectangle is 20. It follows that the length of the rectangle's longer side is 20.

Distractor Explanations: Choice A is incorrect and may result from dividing the length of the rectangle's diagonal by the length of the rectangle's shorter side, rather than substituting these values into the Pythagorean theorem. **Choice C** is incorrect and may result from using the length of the rectangle's diagonal as the length of a leg of the right triangle, rather than the length of the hypotenuse. **Choice D** is incorrect. This is the square of the length of the rectangle's longer side.

Math question 18

A circle has center O, and points A and B lie on the circle. The measure of arc AB is 45° and the length of arc AB is 3 inches. What is the circumference, in inches, of the circle?

A) 3

B) 6

C) 9

D) 24

Key	D
Domain	Geometry and Trigonometry
Skill	*Circles* Use definitions, properties, and theorems relating to circles to solve problems

Key Explanation: Choice D is correct. It's given that the measure of arc AB is 45° and the length of arc AB is 3 inches. The arc measure of the full circle is 360°. If x represents the circumference, in inches, of the circle, it follows that $\frac{45^\circ}{360^\circ} = \frac{3 \text{ inches}}{x \text{ inches}}$. This equation is equivalent to $\frac{45}{360} = \frac{3}{x}$, or $\frac{1}{8} = \frac{3}{x}$. Multiplying both sides of this equation by $8x$ yields $1(x) = 3(8)$, or $x = 24$. Therefore, the circumference of the circle is 24 inches.

Distractor Explanations: Choice A is incorrect. This is the length of arc AB. **Choice B** is incorrect and may result from multiplying the length of arc AB by 2. **Choice C** is incorrect and may result from squaring the length of arc AB.