Question Bank
Math

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Nonlinear & Systems of Equations (key)

Question ID 3c95093c

1.1

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■□□

ID: 3c95093c

$$6x - 9y > 12$$

Which of the following inequalities is equivalent to the inequality above?

A. $x - y > 2$

B. $2x - 3y > 4$

C. $3x - 2y > 4$

D. $3y - 2x > 2$

ID: 3c95093c Answer

Correct Answer: B

Rationale

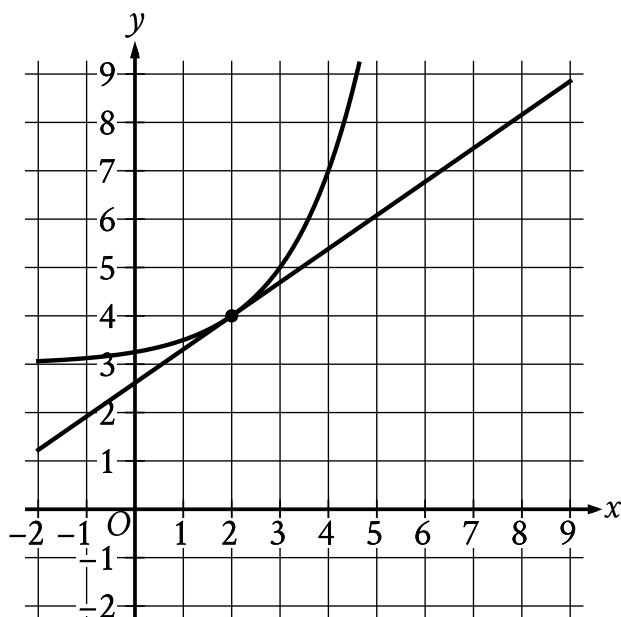Choice B is correct. Both sides of the given inequality can be divided by 3 to yield $2x - 3y > 4$.

Choices A, C, and D are incorrect because they are not equivalent to (do not have the same solution set as) the given inequality. For example, the ordered pair $(0, -1.5)$ is a solution to the given inequality, but it is not a solution to any of the inequalities in choices A, C, or D.

Question Difficulty: Easy

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Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■□□

ID: 4ca30186

The graph of a system of a linear equation and a nonlinear equation is shown. What is the solution (x, y) to this system?

A. $(0, 0)$

B. $(0, 2)$

C. $(2, 4)$

D. $(4, 0)$

ID: 4ca30186 Answer

Correct Answer: C

Rationale

Choice C is correct. The solution to the system of two equations corresponds to the point where the graphs of the equations intersect. The graphs of the linear equation and the nonlinear equation shown intersect at the point $(2, 4)$. Thus, the solution to the system is $(2, 4)$.

Choice A is incorrect and may result from conceptual or calculation errors.

Choice B is incorrect and may result from conceptual or calculation errors.

Choice D is incorrect and may result from conceptual or calculation errors.

Question Difficulty: Easy

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■☐☐

ID: 3de7a7d7

Which of the following is a solution to the equation $2x^2 - 4 = x^2$?

A. 1

B. 2

C. 3

D. 4

ID: 3de7a7d7 Answer

Correct Answer: B

Rationale

Choice B is correct. Subtracting x^2 from both sides of the given equation yields $x^2 - 4 = 0$. Adding 4 to both sides of the equation gives $x^2 = 4$. Taking the square root of both sides of the equation gives x = 2 or x = −2. Therefore, x = 2 is one solution to the original equation.

Alternative approach: Subtracting x^2 from both sides of the given equation yields $x^2 - 4 = 0$. Factoring this equation gives $x^2 - 4 = (x + 2)(x - 2) = 0$, such that x = 2 or x = −2. Therefore, x = 2 is one solution to the original equation.

Choices A, C, and D are incorrect and may be the result of computation errors.

Question Difficulty: Easy

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■□□

ID: 70f98ab4

$$q - 29r = s$$

The given equation relates the positive numbers q, r, and s. Which equation correctly expresses q in terms of r and s?

A. $q = s - 29r$

B. $q = s + 29r$

C. $q = 29rs$

D. $q = -\frac{s}{29r}$

ID: 70f98ab4 Answer

Correct Answer: B

Rationale

Choice B is correct. Adding $29r$ to each side of the given equation yields $q = s + 29r$. Therefore, the equation $q = s + 29r$ correctly expresses q in terms of r and s.

Choice A is incorrect and may result from conceptual or calculation errors.

Choice C is incorrect and may result from conceptual or calculation errors.

Choice D is incorrect and may result from conceptual or calculation errors.

Question Difficulty: Easy

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■□□

ID: 568aaf27

$$x + y = 12$$
$$y = x^2$$

If (x,y) is a solution to the system of equations above, which of the following is a possible value of x?

A. 0

B. 1

C. 2

D. 3

ID: 568aaf27 Answer

Correct Answer: D

Rationale

Choice D is correct. Substituting x^2 from the second equation for y in the first equation yields $x + x^2 = 12$. Subtracting 12 from both sides of this equation and rewriting the equation results in $x^2 + x - 12 = 0$. Factoring the left-hand side of this equation yields $(x-3)(x+4) = 0$. Using the zero product property to solve for x, it follows that $x - 3 = 0$ and $x + 4 = 0$. Solving each equation for x yields $x = 3$ and $x = -4$, respectively. Thus, two possible values of x are 3 and -4. Of the choices given, 3 is the only possible value of x.

Choices A, B, and C are incorrect. Substituting 0 for x in the first equation gives $0 + y = 12$, or $y = 12$; then, substituting 12 for y and 0 for x in the second equation gives $12 = 0^2$, or $12 = 0$, which is false. Similarly, substituting 1 or 2 for x in the first equation yields $y = 11$ or $y = 10$, respectively; then, substituting 11 or 10 for y in the second equation yields a false statement.

Question Difficulty: Easy

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■☐☐

ID: b76a2815

$$P = \frac{W}{t}$$

The power P produced by a machine is represented by the equation above, where W is the work performed during an amount of time t. Which of the following correctly expresses W in terms of P and t?

A. $W = Pt$

B. $W = \frac{P}{t}$

C. $W = \frac{t}{P}$

D. $W = P + t$

ID: b76a2815 Answer

Correct Answer: A

Rationale

Choice A is correct. Multiplying both sides of the equation by t yields $P \cdot t = (\frac{W}{t}) \cdot t$, or $Pt = W$, which expresses W in terms of P and t. This is equivalent to W = Pt.

Choices B, C, and D are incorrect. Each of the expressions given in these answer choices gives W in terms of P and t but doesn't maintain the given relationship between W, P, and t. These expressions may result from performing different operations with t on each side of the equation. In choice B, W has been multiplied by t, and P has been divided by t. In choice C, W has been multiplied by t, and the quotient of P divided by t has been reciprocated. In choice D, W has been multiplied by t, and P has been added to t. However, in order to maintain the relationship between the variables in the given equation, the same operation must be performed with t on each side of the equation.

Question Difficulty: Easy

Question ID c7789423

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■□□

ID: c7789423

$$|x - 2| = 9$$

What is one possible solution to the given equation?

ID: c7789423 Answer

Correct Answer: 11, -7

Rationale

The correct answer is 11 or -7. By the definition of absolute value, if $|x - 2| = 9$, then $x - 2 = 9$ or $x - 2 = -9$. Adding 2 to both sides of the equation $x - 2 = 9$ yields $x = 11$. Adding 2 to both sides of the equation $x - 2 = -9$ yields $x = -7$. Thus, the given equation, $|x - 2| = 9$, has two possible solutions, 11 and -7. Note that 11 and -7 are examples of ways to enter a correct answer.

Question Difficulty: Easy

Question ID eb268057

1.8

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■ □ □

ID: eb268057

$$x^2 = 64$$

Which of the following values of x satisfies the given equation?

A. -8

B. 4

C. 32

D. 128

ID: eb268057 Answer

Correct Answer: A

Rationale

Choice A is correct. Solving for x by taking the square root of both sides of the given equation yields $x = 8$ or $x = -8$. Of the choices given, -8 satisfies the given equation.

Choice B is incorrect and may result from a calculation error when solving for x. Choice C is incorrect and may result from dividing 64 by 2 instead of taking the square root. Choice D is incorrect and may result from multiplying 64 by 2 instead of taking the square root.

Question Difficulty: Easy

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■□□

ID: 98f735f2

The total revenue from sales of a product can be calculated using the formula $T = PQ$, where T is the total revenue, P is the price of the product, and Q is the quantity of the product sold. Which of the following equations gives the quantity of product sold in terms of P and T ?

A. $Q = \dfrac{P}{T}$

B. $Q = \dfrac{T}{P}$

C. $Q = PT$

D. $Q = T - P$

ID: 98f735f2 Answer

Correct Answer: B

Rationale

Choice B is correct. Solving the given equation for Q gives the quantity of the product sold in terms of P and T. Dividing both sides of the given equation by P yields $\dfrac{T}{P} = Q$, or $Q = \dfrac{T}{P}$. Therefore, $Q = \dfrac{T}{P}$ gives the quantity of product sold in terms of P and T.

Choice A is incorrect and may result from an error when dividing both sides of the given equation by P. Choice C is incorrect and may result from multiplying, rather than dividing, both sides of the given equation by P. Choice D is incorrect and may result from subtracting P from both sides of the equation rather than dividing both sides by P.

Question Difficulty: Easy

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■☐☐

ID: fcb78856

$$b = 42cf$$

The given equation relates the positive numbers b, c, and f. Which equation correctly expresses c in terms of b and f?

A. $c = \frac{b}{42f}$

B. $c = \frac{b-42}{f}$

C. $c = 42bf$

D. $c = 42 - b - f$

ID: fcb78856 Answer

Correct Answer: A

Rationale

Choice A is correct. It's given that the equation $b = 42cf$ relates the positive numbers b, c, and f. Dividing each side of the given equation by $42f$ yields $\frac{b}{42f} = c$, or $c = \frac{b}{42f}$. Thus, the equation $c = \frac{b}{42f}$ correctly expresses c in terms of b and f.

Choice B is incorrect. This equation can be rewritten as $b = cf + 42$.

Choice C is incorrect. This equation can be rewritten as $b = \frac{c}{42f}$.

Choice D is incorrect. This equation can be rewritten as $b = 42 - c - f$.

Question Difficulty: Easy

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■□□

ID: 4236c5a3

If $(x+5)^2 = 4$, which of the following is a possible value of x ?

A. 1

B. -1

C. -2

D. -3

ID: 4236c5a3 Answer

Correct Answer: D

Rationale

Choice D is correct. If $(x+5)^2 = 4$, then taking the square root of each side of the equation gives $x+5=2$ or $x+5=-2$. Solving these equations for x gives $x=-3$ or $x=-7$. Of these, -3 is the only solution given as a choice.

Choice A is incorrect and may result from solving the equation $x+5=4$ and making a sign error. Choice B is incorrect and may result from solving the equation $x+5=4$. Choice C is incorrect and may result from finding a possible value of $x+5$.

Question Difficulty: Easy

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■□□

ID: f11ffa93

$$\sqrt{x+4} = 11$$

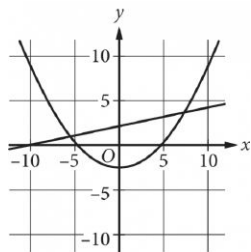What value of x satisfies the equation above?

ID: f11ffa93 Answer

Rationale

The correct answer is 117. Squaring both sides of the given equation gives $x+4=11^2$, or $x+4=121$. Subtracting 4 from both sides of this equation gives $x=117$.

Question Difficulty: Easy

Question ID a5663025

2.1

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■☐

ID: a5663025

A system of equations consists of a quadratic equation and a linear equation. The equations in this system are graphed in the *xy*-plane above. How many solutions does this system have?

A. 0

B. 1

C. 2

D. 3

ID: a5663025 Answer

Correct Answer: C

Rationale

Choice C is correct. The solutions to a system of two equations correspond to points where the graphs of the equations intersect. The given graphs intersect at 2 points; therefore, the system has 2 solutions.

Choice A is incorrect because the graphs intersect. Choice B is incorrect because the graphs intersect more than once. Choice D is incorrect. It's not possible for the graph of a quadratic equation and the graph of a linear equation to intersect more than twice.

Question Difficulty: Medium

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■☐

ID: d0a7871e

$$y = x + 1$$
$$y = x^2 + x$$

If (x, y) is a solution to the system of equations above, which of the following could be the value of x ?

A. −1

B. 0

C. 2

D. 3

ID: d0a7871e Answer

Correct Answer: A

Rationale

Choice A is correct. It is given that $y = x + 1$ and $y = x^2 + x$. Setting the values for y equal to each other yields $x + 1 = x^2 + x$. Subtracting x from each side of this equation yields $x^2 = 1$. Therefore, x can equal 1 or −1. Of these, only −1 is given as a choice.

Choice B is incorrect. If x = 0, then x + 1 = 1, but $x^2 + x = 0^2 + 0 = 0 \neq 1$. Choice C is incorrect. If x = 2, then x + 1 = 3, but $x^2 + x = 2^2 + 2 = 6 \neq 3$. Choice D is incorrect. If x = 3, then x + 1 = 4, but $x^2 + x = 3^2 + 3 = 12 \neq 4$.

Question Difficulty: Medium

Question ID 7f81d0c3

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■□

ID: 7f81d0c3

$$x^2 - x - 1 = 0$$

What values satisfy the equation above?

A. $x = 1$ and $x = 2$

B. $x = -\dfrac{1}{2}$ and $x = \dfrac{3}{2}$

C. $x = \dfrac{1+\sqrt{5}}{2}$ and $x = \dfrac{1-\sqrt{5}}{2}$

D. $x = \dfrac{-1+\sqrt{5}}{2}$ and $x = \dfrac{-1-\sqrt{5}}{2}$

ID: 7f81d0c3 Answer

Correct Answer: C

Rationale

Choice C is correct. Using the quadratic formula to solve the given expression yields $x = \dfrac{-(-1) \pm \sqrt{(-1)^2 - (4)(1)(-1)}}{(2)(1)} = \dfrac{1 \pm \sqrt{5}}{2}$. Therefore, $x = \dfrac{1+\sqrt{5}}{2}$ and $x = \dfrac{1-\sqrt{5}}{2}$ satisfy the given equation.

Choices A and B are incorrect and may result from incorrectly factoring or incorrectly applying the quadratic formula. Choice D is incorrect and may result from a sign error.

Question Difficulty: Medium

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■□

ID: 911383f2

$$(x-4)(x+2)(x-1)=0$$

What is the product of the solutions to the given equation?

A. 8

B. 3

C. -3

D. -8

ID: 911383f2 Answer

Correct Answer: D

Rationale

Choice D is correct. By the zero-product property, if $(x-4)(x+2)(x-1)=0$, then $x-4=0$, $x+2=0$, or $x-1=0$. Solving each of these equations for x yields $x=4$, $x=-2$, or $x=1$. The product of these solutions is $(4)(-2)(1)=-8$.

Choice A is incorrect and may result from sign errors made when solving the given equation. Choice B is incorrect and may result from finding the sum, not the product, of the solutions. Choice C is incorrect and may result from finding the sum, not the product, of the solutions in addition to making sign errors when solving the given equation.

Question Difficulty: Medium

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■ ■ ☐

ID: b80d10d7

$$\frac{2(x+1)}{x+5} = 1 - \frac{1}{x+5}$$

What is the solution to the equation above?

A. 0

B. 2

C. 3

D. 5

ID: b80d10d7 Answer

Correct Answer: B

Rationale

Choice B is correct. Since $\frac{x+5}{x+5}$ is equivalent to 1, the right-hand side of the given equation can be rewritten as $\frac{x+5}{x+5} - \frac{1}{x+5}$, or $\frac{x+4}{x+5}$. Since the left- and right-hand sides of the equation $\frac{2(x+1)}{x+5} = \frac{x+4}{x+5}$ have the same denominator, it follows that $2(x+1) = x+4$. Applying the distributive property of multiplication to the expression $2(x+1)$ yields $2(x) + 2(1)$, or $2x+2$. Therefore, $2x+2 = x+4$. Subtracting x and 2 from both sides of this equation yields $x = 2$.

Choices A, C, and D are incorrect. If $x = 0$, then $\frac{2(0+1)}{0+5} = 1 - \frac{1}{0+5}$. This can be rewritten as $\frac{2}{5} = \frac{4}{5}$, which is a false statement. Therefore, 0 isn't a solution to the given equation. Substituting 3 and 5 into the given equation yields similarly false statements.

Question Difficulty: Medium

Question ID fcdf87b7

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■☐

ID: fcdf87b7

$$y = x^2 - 4x + 4$$
$$y = 4 - x$$

If the ordered pair (x, y) satisfies the system of equations above, what is one possible value of x ?

ID: fcdf87b7 Answer

Rationale

The correct answer is either 0 or 3. For an ordered pair to satisfy a system of equations, both the x- and y-values of the ordered pair must satisfy each equation in the system. Both expressions on the right-hand side of the given equations are equal to y, therefore it follows that both expressions on the right-hand side of the equations are equal to each other: $x^2 - 4x + 4 = 4 - x$. This equation can be rewritten as $x^2 - 3x = 0$, and then through factoring, the equation becomes $x(x - 3) = 0$. Because the product of the two factors is equal to 0, it can be concluded that either $x = 0$ or $x - 3 = 0$, or rather, $x = 0$ or $x = 3$. Note that 0 and 3 are examples of ways to enter a correct answer.

Question Difficulty: Medium

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■☐

ID: 652054da

An oceanographer uses the equation $s = \dfrac{3}{2}p$ to model the speed s, in knots, of an ocean wave, where p represents the period of the wave, in seconds. Which of the following represents the period of the wave in terms of the speed of the wave?

A. $p = \dfrac{2}{3}s$

B. $p = \dfrac{3}{2}s$

C. $p = \dfrac{2}{3} + s$

D. $p = \dfrac{3}{2} + s$

ID: 652054da Answer

Correct Answer: A

Rationale

Choice A is correct. It's given that p represents the period of the ocean wave, so the equation $s = \dfrac{3}{2}p$ can be solved for p to represent the period of the wave in terms of the speed of the wave. Multiplying both sides of the equation by the reciprocal of $\dfrac{3}{2}$ will isolate p. This yields $\dfrac{2}{3}s = \dfrac{2}{3}\left(\dfrac{3}{2}p\right)$, which simplifies to $\dfrac{2}{3}s = p$. Therefore, $p = \dfrac{2}{3}s$.

Choices B, C, and D are incorrect and may result from errors made when rearranging the equation to solve for p.

Question Difficulty: Medium

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■□

ID: 6e02cd78

In the *xy*-plane, what is the *y*-coordinate of the point of intersection of the graphs of $y = (x-1)^2$ and $y = 2x-3$?

ID: 6e02cd78 Answer

Rationale

The correct answer is 1. The point of intersection of the graphs of the given equations is the solution to the system of the two equations. Since $y = (x-1)^2$ and $y = 2x-3$, it follows that $(x-1)^2 = 2x-3$, or $(x-1)(x-1) = 2x-3$. Applying the distributive property to the left-hand side of this equation yields $x^2 - 2x + 1 = 2x - 3$. Subtracting $2x$ from and adding 3 to both sides of this equation yields $x^2 - 4x + 4 = 0$. Factoring the left-hand side of this equation yields $(x-2)(x-2) = 0$. By the zero product property, if $(x-2)(x-2) = 0$, it follows that $x-2 = 0$. Adding 2 to both sides of $x-2 = 0$ yields $x = 2$. Substituting 2 for x in either of the given equations yields $y = 1$. For example, substituting 2 for x in the second given equation yields $y = 2(2) - 3$, or $y = 1$. Therefore, the point of intersection of the graphs of the given equations is $(2, 1)$. The y-coordinate of this point is 1.

Question Difficulty: Medium

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■□

ID: 802549ac

$$(x+2)(x+3)=(x-2)(x-3)+10$$

Which of the following is a solution to the given equation?

A. 1

B. 0

C. -2

D. -5

ID: 802549ac Answer

Correct Answer: A

Rationale

Choice A is correct. Applying the distributive property on the left- and right-hand sides of the given equation yields $x^2+2x+3x+6=x^2-2x-3x+6+10$, or $x^2+5x+6=x^2-5x+16$. Subtracting x^2 from and adding $5x$ to both sides of this equation yields $10x+6=16$. Subtracting 6 from both sides of this equation and then dividing both sides by 10 yields $x=1$.

Choices B, C, and D are incorrect. Substituting 0, -2, or -5 for x in the given equation will result in a false statement. If $x=0$, the given equation becomes $6=16$; if $x=-2$, the given equation becomes $0=30$; and if $x=-5$, the given equation becomes $6=66$. Therefore, the values 0, -2, and -5 aren't solutions to the given equation.

Question Difficulty: Medium

Question ID a4f61d75

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■ ■ ☐

ID: a4f61d75

$$x^2 - ax + 12 = 0$$

In the equation above, a is a constant and $a > 0$. If the equation has two integer solutions, what is a possible value of a ?

ID: a4f61d75 Answer

Rationale

The correct answer is either 7, 8, or 13. Since the given equation has two integer solutions, the expression on the left-hand side of this equation can be factored as $(x + c)(x + d)$, where c and d are also integers. The product of c and d must equal the constant term of the original quadratic expression, which is 12. Additionally, the sum of c and d must be a negative number since it's given that $a > 0$, but the sign preceding a in the given equation is negative. The possible pairs of values for c and d that satisfy both of these conditions are -4 and -3, -6 and -2, and -12 and -1. Since the value of $-a$ is the sum of c and d, the possible values of $-a$ are $-4 + (-3) = -7$, $-6 + (-2) = -8$, and $-12 + (-1) = -13$. It follows that the possible values of a are 7, 8, and 13. Note that 7, 8, and 13 are examples of ways to enter a correct answer.

Question Difficulty: Medium

Question ID 630897df

2.11

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■☐

ID: 630897df

The speed of sound in dry air, v, can be modeled by the formula $v = 331.3 + 0.606T$, where T is the temperature in degrees Celsius and v is measured in meters per second. Which of the following correctly expresses T in terms of v ?

A. $T = \dfrac{v + 0.606}{331.3}$

B. $T = \dfrac{v - 0.606}{331.3}$

C. $T = \dfrac{v + 331.3}{0.606}$

D. $T = \dfrac{v - 331.3}{0.606}$

ID: 630897df Answer

Correct Answer: D

Rationale

Choice D is correct. To express T in terms of v, subtract 331.3 from both sides of the equation, which gives v – 331.3 = 0.606T. Dividing both sides of the equation by 0.606 gives $\dfrac{v - 331.3}{0.606} = T$.

Choices A, B, and C are incorrect and are the result of incorrect steps while solving for T.

Question Difficulty: Medium

Question ID c77ef2fb

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■☐

ID: c77ef2fb

Blood volume, V_B, in a human can be determined using the equation

$V_B = \dfrac{V_P}{1-H}$, where V_P is the plasma volume and H is the hematocrit (the

fraction of blood volume that is red blood cells). Which of the following correctly expresses the hematocrit in terms of the blood volume and the plasma volume?

A. $H = 1 - \dfrac{V_P}{V_B}$

B. $H = \dfrac{V_B}{V_P}$

C. $H = 1 + \dfrac{V_B}{V_P}$

D. $H = V_B - V_P$

ID: c77ef2fb Answer

Correct Answer: A

Rationale

Choice A is correct. The hematocrit can be expressed in terms of the blood volume and the plasma volume by

solving the given equation $V_B = \dfrac{V_P}{1-H}$ for H. Multiplying both sides of this equation by $(1-H)$ yields

$V_B(1-H) = V_p$. Dividing both sides by V_B yields $1 - H = \dfrac{V_P}{V_B}$. Subtracting 1 from both sides yields

$-H = -1 + \dfrac{V_p}{V_B}$. Dividing both sides by -1 yields $H = 1 - \dfrac{V_P}{V_B}$.

Choices B, C, and D are incorrect and may result from errors made when manipulating the equation.

Question Difficulty: Medium

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■☐

ID: 364a2d25

$x + y = 17$
$xy = 72$

If one solution to the system of equations above is (x, y), what is one possible value of x ?

ID: 364a2d25 Answer

Rationale

The correct answer is either 8 or 9. The first equation can be rewritten as $y = 17 - x$. Substituting $17 - x$ for y in the second equation gives $x(17 - x) = 72$. By applying the distributive property, this can be rewritten as $17x - x^2 = 72$. Subtracting 72 from both sides of the equation yields $x^2 - 17x + 72 = 0$. Factoring the left-hand side of this equation yields $(x - 8)(x - 9) = 0$. Applying the Zero Product Property, it follows that $x - 8 = 0$ and $x - 9 = 0$. Solving each equation for x yields $x = 8$ and $x = 9$ respectively. Note that 8 and 9 are examples of ways to enter a correct answer.

Question Difficulty: Medium

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■☐

ID: 0980fcdd

$$x^2 = 6x + y$$
$$y = -6x + 36$$

A solution to the given system of equations is (x,y). Which of the following is a possible value of xy ?

A. 0

B. 6

C. 12

D. 36

ID: 0980fcdd Answer

Correct Answer: A

Rationale

Choice A is correct. Solutions to the given system of equations are ordered pairs (x,y) that satisfy both equations in the system. Adding the left-hand and right-hand sides of the equations in the system yields $x^2 + y = 6x + -6x + y + 36$, or $x^2 + y = y + 36$. Subtracting y from both sides of this equation yields $x^2 = 36$. Taking the square root of both sides of this equation yields $x = 6$ and $x = -6$. Therefore, there are two solutions to this system of equations, one with an x-coordinate of 6 and the other with an x-coordinate of -6. Substituting 6 for x in the second equation yields $y = -6(6) + 36$, or $y = 0$; therefore, one solution is $(6,0)$. Similarly, substituting -6 for x in the second equation yields $y = -6(-6) + 36$, or $y = 72$; therefore, the other solution is $(-6,72)$. It follows then that if (x,y) is a solution to the system, then possible values of xy are $(6)(0) = 0$ and $(-6)(72) = -432$. Only 0 is among the given choices.

Choice B is incorrect. This is the x-coordinate of one of the solutions, $(6,0)$. Choice C is incorrect and may result from conceptual or computational errors. Choice D is incorrect. This is the square of the x-coordinate of one of the solutions, $(6,0)$.

Question Difficulty: Medium

Question ID 87a3de81

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■☐

$$x^2 + x - 12 = 0$$

If a is a solution of the equation above and $a > 0$, what is the value of a ?

Rationale

The correct answer is 3. The solution to the given equation can be found by factoring the quadratic expression. The factors can be determined by finding two numbers with a sum of 1 and a product of -12. The two numbers that meet these constraints are 4 and -3. Therefore, the given equation can be rewritten as $(x+4)(x-3)=0$. It follows that the solutions to the equation are $x = -4$ or $x = 3$. Since it is given that $a > 0$, a must equal 3.

Question Difficulty: Medium

Question ID 2683b5db

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■☐

ID: 2683b5db

$$T = 0.01(P - 40{,}000)$$

In a city, the property tax T, in dollars, is calculated using the formula above, where P is the value of the property, in dollars. Which of the following expresses the value of the property in terms of the property tax?

A. $P = 100T - 400$

B. $P = 100T + 400$

C. $P = 100T - 40{,}000$

D. $P = 100T + 40{,}000$

ID: 2683b5db Answer

Correct Answer: D

Rationale

Choice D is correct. To express the value of the property in terms of the property tax, the given equation must be solved for P. Multiplying both sides of the equation by 100 gives $100T = P - 40{,}000$. Adding 40,000 to both sides of the equation gives $100T + 40{,}000 = P$. Therefore, $P = 100T + 40{,}000$.

Choice A is incorrect and may result from multiplying 40,000 by 0.01, then subtracting 400 from, instead of adding 400 to, the left-hand side of the equation. Choice B is incorrect and may result from multiplying 40,000 by 0.01. Choice C is incorrect and may result from subtracting instead of adding 40,000 from the left-hand side of the equation.

Question Difficulty: Medium

Question ID 2f958af9

2.17

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■☐

ID: 2f958af9

$$v^2 = \frac{LT}{m}$$

The formula above expresses the square of the speed v of a wave moving along a string in terms of tension T, mass m, and length L of the string. What is T in terms of m, v, and L ?

A. $T = \frac{mv^2}{L}$

B. $T = \frac{m}{v^2L}$

C. $T = \frac{mL}{v^2}$

D. $T = \frac{L}{mv^2}$

ID: 2f958af9 Answer

Correct Answer: A

Rationale

Choice A is correct. To write the formula as T in terms of m, v, and L means to isolate T on one side of the equation. First, multiply both sides of the equation by m, which gives $mv^2 = \frac{mLT}{m}$, which simplifies to $mv^2 =$ LT. Next, divide both sides of the equation by L, which gives $\frac{mv^2}{L} = \frac{LT}{L}$, which simplifies to $T = \frac{mv^2}{L}$.

Choices B, C, and D are incorrect and may be the result of incorrectly applying operations to each side of the equation.

Question Difficulty: Medium

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Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■□

ID: 876a731c

$$y = x^2$$
$$2y + 6 = 2(x + 3)$$

If (x, y) is a solution of the system of equations above and $x > 0$, what is the value of xy ?

A. 1

B. 2

C. 3

D. 9

ID: 876a731c Answer

Correct Answer: A

Rationale

Choice A is correct. Substituting x^2 for y in the second equation gives $2(x^2) + 6 = 2(x + 3)$. This equation can be solved as follows:

$2x^2 + 6 = 2x + 6$	Apply the distributive property.
$2x^2 + 6 - 2x - 6 = 0$	Subtract 2x and 6 from both sides of the equation.
$2x^2 - 2x = 0$	Combine like terms.
$2x(x - 1) = 0$	Factor both terms on the left side of the equation by 2x.

Thus, $x = 0$ and $x = 1$ are the solutions to the system. Since $x > 0$, only $x = 1$ needs to be considered. The value of y when $x = 1$ is $y = x^2 = 1^2 = 1$. Therefore, the value of xy is $(1)(1) = 1$.

Choices B, C, and D are incorrect and likely result from a computational or conceptual error when solving this system of equations.

2.19

Question ID 928498f3

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■□

ID: 928498f3

$$6x^2 + 5x - 7 = 0$$

What are the solutions to the given equation?

A. $\dfrac{-5 \pm \sqrt{25+168}}{12}$

B. $\dfrac{-6 \pm \sqrt{25+168}}{12}$

C. $\dfrac{-5 \pm \sqrt{36-168}}{12}$

D. $\dfrac{-6 \pm \sqrt{36-168}}{12}$

ID: 928498f3 Answer

Correct Answer: A

Rationale

Choice A is correct. The quadratic formula, $x = \dfrac{-b \pm \sqrt{b^2-4ac}}{2a}$, can be used to find the solutions to an equation in the form $ax^2 + bx + c = 0$. In the given equation, $a = 6$, $b = 5$, and $c = -7$. Substituting these values into the quadratic formula gives $\dfrac{-5 \pm \sqrt{5^2-4(6)(-7)}}{2(6)}$, or $\dfrac{-5 \pm \sqrt{25+168}}{12}$.

Choice B is incorrect and may result from using $\dfrac{-a \pm \sqrt{b^2-4ac}}{2a}$ as the quadratic formula. Choice C is incorrect and may result from using $\dfrac{-b \pm \sqrt{a^2+4ac}}{2a}$ as the quadratic formula. Choice D is incorrect and may

result from using $\dfrac{-a \pm \sqrt{a^2 + 4ac}}{2a}$ as the quadratic formula.

Question Difficulty: Medium

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■☐

ID: 2d2ab76b

$$y = x^2 - 1$$
$$y = 3$$

When the equations above are graphed in the *xy*-plane, what are the coordinates (*x*, *y*) of the points of intersection of the two graphs?

A. $(2,3)$
  and $(-2,3)$

B. $(2,4)$
  and $(-2,4)$

C. $(3,8)$
  and $(-3,8)$

D. $(\sqrt{2},3)$
  and $(-\sqrt{2},3)$

ID: 2d2ab76b Answer

Correct Answer: A

Rationale

Choice A is correct. The two equations form a system of equations, and the solutions to the system correspond to the points of intersection of the graphs. The solutions to the system can be found by substitution. Since the second equation gives y = 3, substituting 3 for y in the first equation gives $3 = x^2 - 1$. Adding 1 to both sides of the equation gives $4 = x^2$. Solving by taking the square root of both sides of the equation gives x = ±2. Since y = 3 for all values of x for the second equation, the solutions are (2, 3) and (−2, 3). Therefore, the points of intersection of the two graphs are (2, 3) and (−2, 3).

Choices B, C, and D are incorrect and may be the result of calculation errors.

Question Difficulty: Medium

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■☐

ID: 3b4b8831

$$38x^2 = 38(9)$$

What is the negative solution to the given equation?

ID: 3b4b8831 Answer

Correct Answer: -3

Rationale

The correct answer is -3. Dividing both sides of the given equation by 38 yields $x^2 = 9$. Taking the square root of both sides of this equation yields the solutions $x = 3$ and $x = -3$. Therefore, the negative solution to the given equation is -3.

Question Difficulty: Medium

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■☐

ID: f5247e52

$$y = ax^2 - c$$

In the equation above, *a* and *c* are positive constants. How many times does the graph of the equation above intersect the graph of the equation $y = a + c$ in the *xy*-plane?

A. Zero

B. One

C. Two

D. More than two

ID: f5247e52 Answer

Correct Answer: C

Rationale

Choice C is correct. It is given that the constants a and c are both positive; therefore, the graph of the given quadratic equation is a parabola that opens up with a vertex on the y-axis at a point below the x-axis. The graph of the second equation provided is a horizontal line that lies above the x-axis. A horizontal line above the x-axis will intersect a parabola that opens up and has a vertex below the x-axis in exactly two points.

Choices A, B, and D are incorrect and are the result of not understanding the relationships of the graphs of the two equations given. Choice A is incorrect because the two graphs intersect. Choice B is incorrect because in order for there to be only one intersection point, the horizontal line would have to intersect the parabola at the vertex, but the vertex is below the x-axis and the line is above the x-axis. Choice D is incorrect because a line cannot intersect a parabola in more than two points.

Question Difficulty: Medium

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■■

ID: fc3d783a

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?

ID: fc3d783a Answer

Correct Answer: 6

Rationale

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.

Question Difficulty: Hard

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■■

ID: 4661e2a9

$$x - y = 1$$
$$x + y = x^2 - 3$$

Which ordered pair is a solution to the system of equations above?

A. $(1 + \sqrt{3}, \sqrt{3})$

B. $(\sqrt{3}, -\sqrt{3})$

C. $(1 + \sqrt{5}, \sqrt{5})$

D. $(\sqrt{5}, -1 + \sqrt{5})$

ID: 4661e2a9 Answer

Correct Answer: A

Rationale

Choice A is correct. The solution to the given system of equations can be found by solving the first equation for x, which gives $x = y + 1$, and substituting that value of x into the second equation which gives $y + 1 + y = (y + 1)^2 - 3$. Rewriting this equation by adding like terms and expanding $(y + 1)^2$ gives $2y + 1 = y^2 + 2y - 2$. Subtracting $2y$ from both sides of this equation gives $1 = y^2 - 2$. Adding to 2 to both sides of this equation gives $3 = y^2$. Therefore, it follows that $y = \pm\sqrt{3}$. Substituting $\sqrt{3}$ for y in the first equation yields $x - \sqrt{3} = 1$. Adding $\sqrt{3}$ to both sides of this equation yields $x = 1 + \sqrt{3}$. Therefore, the ordered pair $(1 + \sqrt{3}, \sqrt{3})$ is a solution to the given system of equations.

Choice B is incorrect. Substituting $\sqrt{3}$ for x and $-\sqrt{3}$ for y in the first equation yields $\sqrt{3} - (-\sqrt{3}) = 1$, or $2\sqrt{3} = 1$, which isn't a true statement. Choice C is incorrect. Substituting $1 + \sqrt{5}$ for x and $\sqrt{5}$ for y in the second equation yields $(1 + \sqrt{5}) + \sqrt{5} = (1 + \sqrt{5})^2 - 3$, or $1 + 2\sqrt{5} = 2\sqrt{5} + 3$, which isn't a true statement. Choice D is incorrect. Substituting $\sqrt{5}$ for x and $(-1 + \sqrt{5})$ for y in the second equation yields $\sqrt{5} + (-1 + \sqrt{5}) = (\sqrt{5})^2 - 3$, or $2\sqrt{5} - 1 = 2$, which isn't a true statement.

Question Difficulty: Hard

Question ID f65288e8

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■■

ID: f65288e8

$$\frac{1}{x^2+10x+25}=4$$

If x is a solution to the given equation, which of the following is a possible value of $x+5$?

A. $\dfrac{1}{2}$

B. $\dfrac{5}{2}$

C. $\dfrac{9}{2}$

D. $\dfrac{11}{2}$

ID: f65288e8 Answer

Correct Answer: A

Rationale

Choice A is correct. The given equation can be rewritten as $\frac{1}{(x+5)^2}=4$. Multiplying both sides of this equation by $(x+5)^2$ yields $1=4(x+5)^2$. Dividing both sides of this equation by 4 yields $\frac{1}{4}=(x+5)^2$. Taking the square root of both sides of this equation yields $\frac{1}{2}=x+5$ or $-\frac{1}{2}=x+5$. Therefore, a possible value of $x+5$ is $\frac{1}{2}$.

Choices B, C, and D are incorrect and may result from computational or conceptual errors.

Question Difficulty: Hard

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■ ■ ■

ID: f2f3fa00

During a 5-second time interval, the average acceleration a, in meters per second squared, of an object with an initial velocity of 12 meters per second is defined by the equation $a = \dfrac{v_f - 12}{5}$, where v_f is the final velocity of the object in meters per second. If the equation is rewritten in the form $v_f = xa + y$, where x and y are constants, what is the value of x ?

ID: f2f3fa00 Answer

Rationale

The correct answer is 5. The given equation can be rewritten in the form $v_f = xa + y$, like so:

$$a = \frac{v_f - 12}{5}$$

$$v_f - 12 = 5a$$

$$v_f = 5a + 12$$

It follows that the value of x is 5 and the value of y is 12.

Question Difficulty: Hard

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■ ■ ■

ID: 6ce95fc8

$$2x^2 - 2 = 2x + 3$$

Which of the following is a solution to the equation above?

A. 2

B. $1 - \sqrt{11}$

C. $\dfrac{1}{2} + \sqrt{11}$

D. $\dfrac{1 + \sqrt{11}}{2}$

ID: 6ce95fc8 Answer

Correct Answer: D

Rationale

Choice D is correct. A quadratic equation in the form $ax^2 + bx + c = 0$, where a, b, and c are constants, can be solved using the quadratic formula: $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. Subtracting $2x + 3$ from both sides of the given equation yields $2x^2 - 2x - 5 = 0$. Applying the quadratic formula, where $a = 2$, $b = -2$, and $c = -5$, yields $x = \dfrac{-(-2) \pm \sqrt{(-2)^2 - 4(2)(-5)}}{2(2)}$. This can be rewritten as $x = \dfrac{2 \pm \sqrt{44}}{4}$. Since $\sqrt{44} = \sqrt{2^2(11)}$, or $2\sqrt{11}$, the equation can be rewritten as $x = \dfrac{2 \pm 2\sqrt{11}}{4}$. Dividing 2 from both the numerator and denominator yields $\dfrac{1 + \sqrt{11}}{2}$ or $\dfrac{1 - \sqrt{11}}{2}$. Of these two solutions, only $\dfrac{1 + \sqrt{11}}{2}$ is present among the choices. Thus, the correct choice is D.

Choice A is incorrect and may result from a computational or conceptual error. Choice B is incorrect and may result from using $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{a}$ instead of $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ as the quadratic formula. Choice C is incorrect and may result from rewriting $\sqrt{44}$ as $4\sqrt{11}$ instead of $2\sqrt{11}$.

Question Difficulty: Hard

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■ ■ ■

ID: c303ad23

If $3x^2 - 18x - 15 = 0$, what is the value of $x^2 - 6x$?

ID: c303ad23 Answer

Correct Answer: 5

Rationale

The correct answer is 5. Dividing each side of the given equation by 3 yields $x^2 - 6x - 5 = 0$. Adding 5 to each side of this equation yields $x^2 - 6x = 5$. Therefore, if $3x^2 - 18x - 15 = 0$, the value of $x^2 - 6x$ is 5.

Question Difficulty: Hard

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■ ■ ■

ID: 7bd10ef3

$$2x^2 - 4x = t$$

In the equation above, t is a constant. If the equation has no real solutions, which of the following could be the value of t ?

A. -3

B. -1

C. 1

D. 3

ID: 7bd10ef3 Answer

Correct Answer: A

Rationale

Choice A is correct. The number of solutions to any quadratic equation in the form $ax^2 + bx + c = 0$, where a, b, and c are constants, can be found by evaluating the expression $b^2 - 4ac$, which is called the discriminant. If the value of $b^2 - 4ac$ is a positive number, then there will be exactly two real solutions to the equation. If the value of $b^2 - 4ac$ is zero, then there will be exactly one real solution to the equation. Finally, if the value of $b^2 - 4ac$ is negative, then there will be no real solutions to the equation.

The given equation $2x^2 - 4x = t$ is a quadratic equation in one variable, where t is a constant. Subtracting t from both sides of the equation gives $2x^2 - 4x - t = 0$. In this form, $a = 2$, $b = -4$, and $c = -t$. The values of t for which the equation has no real solutions are the same values of t for which the discriminant of this equation is a negative value. The discriminant is equal to $(-4)^2 - 4(2)(-t)$; therefore, $(-4)^2 - 4(2)(-t) < 0$. Simplifying the left side of the inequality gives $16 + 8t < 0$. Subtracting 16 from both sides of the inequality and then dividing both sides by 8 gives $t < -2$. Of the values given in the options, -3 is the only value that is less than -2. Therefore, choice A must be the correct answer.

Choices B, C, and D are incorrect and may result from a misconception about how to use the discriminant to determine the number of solutions of a quadratic equation in one variable.

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■■

ID: 66bce0c1

$$\sqrt{2x+6}+4=x+3$$

What is the solution set of the equation above?

A. $\{-1\}$

B. $\{5\}$

C. $\{-1, 5\}$

D. $\{0, -1, 5\}$

ID: 66bce0c1 Answer

Correct Answer: B

Rationale

Choice B is correct. Subtracting 4 from both sides of $\sqrt{2x+6}+4=x+3$ isolates the radical expression on the left side of the equation as follows: $\sqrt{2x+6}=x-1$. Squaring both sides of $\sqrt{2x+6}=x-1$ yields $2x+6=x^2-2x+1$. This equation can be rewritten as a quadratic equation in standard form: $x^2-4x-5=0$. One way to solve this quadratic equation is to factor the expression x^2-4x-5 by identifying two numbers with a sum of -4 and a product of -5. These numbers are -5 and 1. So the quadratic equation can be factored as $(x-5)(x+1)=0$. It follows that 5 and -1 are the solutions to the quadratic equation. However, the solutions must be verified by checking whether 5 and -1 satisfy the original equation, $\sqrt{2x+6}+4=x+3$. When $x=-1$, the original equation gives $\sqrt{2(-1)+6}+4=(-1)+3$, or $6=2$, which is false. Therefore, -1 does not satisfy the original equation. When $x=5$, the original equation gives $\sqrt{2(5)+6}+4=5+3$, or $8=8$, which is true. Therefore, $x=5$ is the only solution to the original equation, and so the solution set is $\{5\}$.

Choices A, C, and D are incorrect because each of these sets contains at least one value that results in a false statement when substituted into the given equation. For instance, in choice D, when 0 is substituted for x into the given equation, the result is $\sqrt{2(0)+6}+4=(0)+3$, or $\sqrt{6}+4=3$. This is not a true statement, so 0 is not a solution to the given equation.

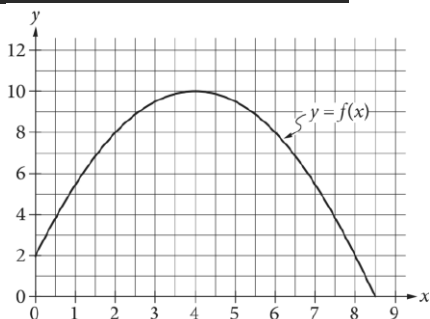# Question ID 97e50fa2

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■ ■ ■

ID: 97e50fa2

The graph of the function f, defined by $f(x) = -\frac{1}{2}(x-4)^2 + 10$, is shown in the xy-plane above. If the function g (not shown) is defined by $g(x) = -x + 10$, what is one possible value of a such that $f(a) = g(a)$?

ID: 97e50fa2 Answer

Rationale

The correct answer is either 2 or 8. Substituting $x = a$ in the definitions for f and g gives $f(a) = -\frac{1}{2}(a-4)^2 + 10$ and $g(a) = -a + 10$, respectively. If $f(a) = g(a)$, then $-\frac{1}{2}(a-4)^2 + 10 = -a + 10$.

Subtracting 10 from both sides of this equation gives $-\frac{1}{2}(a-4)^2 = -a$. Multiplying both sides by -2 gives $(a-4)^2 = 2a$. Expanding $(a-4)^2$ gives $a^2 - 8a + 16 = 2a$. Combining the like terms on one side of the equation gives $a^2 - 10a + 16 = 0$. One way to solve this equation is to factor $a^2 - 10a + 16$ by identifying two numbers with a sum of -10 and a product of 16. These numbers are -2 and -8, so the quadratic equation can be factored as $(a-2)(a-8) = 0$. Therefore, the possible values of a are either 2 or 8. Note that 2 and 8 are examples of ways to enter a correct answer.

Alternate approach: Graphically, the condition $f(a) = g(a)$ implies the graphs of the functions $y = f(x)$ and $y = g(x)$ intersect at $x = a$. The graph $y = f(x)$ is given, and the graph of $y = g(x)$ may be sketched as a line with y-intercept 10 and a slope of -1 (taking care to note the different scales on each axis). These two graphs intersect at $x = 2$ and $x = 8$.

Question Difficulty: Hard

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Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■■

ID: 3d12b1e0

$$-16x^2 - 8x + c = 0$$

In the given equation, c is a constant. The equation has exactly one solution. What is the value of c?

ID: 3d12b1e0 Answer

Correct Answer: -1

Rationale

The correct answer is -1. A quadratic equation in the form $ax^2 + bx + c = 0$, where a, b, and c are constants, has exactly one solution when its discriminant, $b^2 - 4ac$, is equal to 0. In the given equation, $-16x^2 - 8x + c = 0$, $a = -16$ and $b = -8$. Substituting -16 for a and -8 for b in $b^2 - 4ac$ yields $(-8)^2 - 4(-16)(c)$, or $64 + 64c$. Since the given equation has exactly one solution, $64 + 64c = 0$. Subtracting 64 from both sides of this equation yields $64c = -64$. Dividing both sides of this equation by 64 yields $c = -1$. Therefore, the value of c is -1.

Question Difficulty: Hard

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■ ■ ■

ID: 71014fb1

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

How many distinct real solutions does the given equation have?

A. Exactly one

B. Exactly two

C. Infinitely many

D. Zero

ID: 71014fb1 Answer

Correct Answer: D

Rationale

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.

Choices A, B, and C are incorrect and may result from conceptual errors.

Question Difficulty: Hard

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■ ■ ■

ID: e9349667

$$y = x^2 + 2x + 1$$
$$x + y + 1 = 0$$

If (x_1, y_1) and (x_2, y_2) are the two solutions to the system of equations above, what is the value of $y_1 + y_2$?

A. -3

B. -2

C. -1

D. 1

ID: e9349667 Answer

Correct Answer: D

Rationale

Choice D is correct. The system of equations can be solved using the substitution method. Solving the second equation for y gives y = −x − 1. Substituting the expression −x − 1 for y into the first equation gives −x − 1 = x^2 + 2x + 1. Adding x + 1 to both sides of the equation yields x^2 + 3x + 2 = 0. The left-hand side of the equation can be factored by finding two numbers whose sum is 3 and whose product is 2, which gives (x + 2)(x + 1) = 0. Setting each factor equal to 0 yields x + 2 = 0 and x + 1 = 0, and solving for x yields x = −2 or x = −1. These values of x can be substituted for x in the equation y = −x − 1 to find the corresponding y-values: y = −(−2) − 1 = 2 − 1 = 1 and y = −(−1) − 1 = 1 − 1 = 0. It follows that (−2, 1) and (−1, 0) are the solutions to the given system of equations. Therefore, (x_1, y_1) = (−2, 1), (x_2, y_2) = (−1, 0), and $y_1 + y_2$ = 1 + 0 = 1.

Choice A is incorrect. The solutions to the system of equations are (x_1, y_1) = (−2, 1) and (x_2, y_2) = (−1, 0). Therefore, −3 is the sum of the x-coordinates of the solutions, not the sum of the y-coordinates of the solutions. Choices B and C are incorrect and may be the result of computation or substitution errors.

Question Difficulty: Hard

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■ ■ ■

ID: b03adde3

If $u-3=\dfrac{6}{t-2}$, what is t in terms of u ?

A. $t=\dfrac{1}{u}$

B. $t=\dfrac{2u+9}{u}$

C. $t=\dfrac{1}{u-3}$

D. $t=\dfrac{2u}{u-3}$

ID: b03adde3 Answer

Correct Answer: D

Rationale

Choice D is correct. Multiplying both sides of the given equation by $t-2$ yields $(t-2)(u-3)=6$. Dividing both sides of this equation by $u-3$ yields $t-2=\dfrac{6}{u-3}$. Adding 2 to both sides of this equation yields $t=\dfrac{6}{u-3}+2$, which can be rewritten as $t=\dfrac{6}{u-3}+\dfrac{2(u-3)}{u-3}$. Since the fractions on the right-hand side of this equation have a common denominator, adding the fractions yields $t=\dfrac{6+2(u-3)}{u-3}$. Applying the distributive property to the numerator on the right-hand side of this equation yields $t=\dfrac{6+2u-6}{u-3}$, which is equivalent to $t=\dfrac{2u}{u-3}$.

Choices A, B, and C are incorrect and may result from various misconceptions or miscalculations.

Question Difficulty: Hard

Question ID 30281058

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■ ■ ■

ID: 30281058

In the *xy*-plane, the graph of $y = x^2 - 9$ intersects line *p* at $(1, a)$ and $(5, b)$, where *a* and *b* are constants. What is the slope of line *p* ?

A. 6

B. 2

C. −2

D. −6

ID: 30281058 Answer

Correct Answer: A

Rationale

Choice A is correct. It's given that the graph of $y = x^2 - 9$ and line p intersect at $(1, a)$ and $(5, b)$. Therefore, the value of y when $x = 1$ is the value of a, and the value of y when $x = 5$ is the value of b. Substituting 1 for x in the given equation yields $y = (1)^2 - 9$, or $y = -8$. Similarly, substituting 5 for x in the given equation yields $y = (5)^2 - 9$, or $y = 16$. Therefore, the intersection points are $(1, -8)$ and $(5, 16)$. The slope of line p is the ratio of the change in y to the change in x between these two points: $\dfrac{16 - (-8)}{5 - 1} = \dfrac{24}{4}$, or 6.

Choices B, C, and D are incorrect and may result from conceptual or calculation errors in determining the values of a, b, or the slope of line p.

Question Difficulty: Hard

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■ ■ ■

ID: 5910bfff

$$D = T - \frac{9}{25}(100 - H)$$

The formula above can be used to approximate the dew point D, in degrees Fahrenheit, given the temperature T, in degrees Fahrenheit, and the relative humidity of H percent, where $H > 50$. Which of the following expresses the relative humidity in terms of the temperature and the dew point?

A. $H = \frac{25}{9}(D - T) + 100$

B. $H = \frac{25}{9}(D - T) - 100$

C. $H = \frac{25}{9}(D + T) + 100$

D. $H = \frac{25}{9}(D + T) - 100$

ID: 5910bfff Answer

Correct Answer: A

Rationale

Choice A is correct. It's given that $D = T - \frac{9}{25}(100 - H)$. Solving this formula for H expresses the relative humidity in terms of the temperature and the dew point. Subtracting T from both sides of this equation yields $D - T = -\frac{9}{25}(100 - H)$. Multiplying both sides by $-\frac{25}{9}$ yields $-\frac{25}{9}(D - T) = 100 - H$. Subtracting 100 from both sides yields $-\frac{25}{9}(D - T) - 100 = -H$. Multiplying both sides by -1 results in the formula $\frac{25}{9}(D - T) + 100 = H$.

Choices B, C, and D are incorrect and may result from errors made when rewriting the given formula.

Question Difficulty: Hard

Question ID 1697ffcf

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■ ■ ■

ID: 1697ffcf

In the *xy*-plane, the graph of $y = 3x^2 - 14x$ intersects the graph of $y = x$ at the points $(0, 0)$ and (a, a). What is the value of *a* ?

ID: 1697ffcf Answer

Rationale

The correct answer is 5. The intersection points of the graphs of $y = 3x^2 - 14x$ and $y = x$ can be found by solving the system consisting of these two equations. To solve the system, substitute x for y in the first equation. This gives $x = 3x^2 - 14x$. Subtracting x from both sides of the equation gives $0 = 3x^2 - 15x$. Factoring $3x$ out of each term on the left-hand side of the equation gives $0 = 3x(x - 5)$. Therefore, the possible values for x are 0 and 5. Since $y = x$, the two intersection points are $(0,0)$ and $(5,5)$. Therefore, $a = 5$.

Question Difficulty: Hard

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■ ■ ■

ID: ff2e5c76

$$x^2 - 40x - 10 = 0$$

What is the sum of the solutions to the given equation?

A. 0

B. 5

C. 10

D. 40

ID: ff2e5c76 Answer

Correct Answer: D

Rationale

Choice D is correct. Adding 10 to each side of the given equation yields $x^2 - 40x = 10$. To complete the square, adding $\left(\frac{40}{2}\right)^2$, or 20^2, to each side of this equation yields $x^2 - 40x + 20^2 = 10 + 20^2$, or $(x - 20)^2 = 410$. Taking the square root of each side of this equation yields $x - 20 = \pm\sqrt{410}$. Adding 20 to each side of this equation yields $x = 20 \pm \sqrt{410}$. Therefore, the solutions to the given equation are $x = 20 + \sqrt{410}$ and $x = 20 - \sqrt{410}$. The sum of these solutions is $\left(20 + \sqrt{410}\right) + \left(20 - \sqrt{410}\right)$, or 40.

Choice A is incorrect and may result from conceptual or calculation errors.

Choice B is incorrect and may result from conceptual or calculation errors.

Choice C is incorrect and may result from conceptual or calculation errors.

Question Difficulty: Hard

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■ ■ ■

ID: 2c5c22d0

$$y = x^2 + 3x - 7$$
$$y - 5x + 8 = 0$$

How many solutions are there to the system of equations above?

A. There are exactly 4 solutions.

B. There are exactly 2 solutions.

C. There is exactly 1 solution.

D. There are no solutions.

ID: 2c5c22d0 Answer

Correct Answer: C

Rationale

Choice C is correct. The second equation of the system can be rewritten as $y = 5x - 8$. Substituting $5x - 8$ for y in the first equation gives $5x - 8 = x^2 + 3x - 7$. This equation can be solved as shown below:

$$x^2 + 3x - 7 - 5x + 8 = 0$$

$$x^2 - 2x + 1 = 0$$

$$(x - 1)^2 = 0$$

$$x = 1$$

Substituting 1 for x in the equation $y = 5x - 8$ gives $y = -3$. Therefore, $(1, -3)$ is the only solution to the system of equations.

Choice A is incorrect. In the xy-plane, a parabola and a line can intersect at no more than two points. Since the graph of the first equation is a parabola and the graph of the second equation is a line, the system cannot have more than 2 solutions. Choice B is incorrect. There is a single ordered pair (x, y) that satisfies both equations of the system. Choice D is incorrect because the ordered pair $(1, -3)$ satisfies both equations of the system.

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■ ■ ■

ID: fc3dfa26

$$\frac{4x^2}{x^2-9} - \frac{2x}{x+3} = \frac{1}{x-3}$$

What value of x satisfies the equation above?

A. -3

B. $-\dfrac{1}{2}$

C. $\dfrac{1}{2}$

D. 3

ID: fc3dfa26 Answer

Correct Answer: C

Rationale

Choice C is correct. Each fraction in the given equation can be expressed with the common denominator x^2-9. Multiplying $\frac{2x}{x+3}$ by $\frac{x-3}{x-3}$ yields $\frac{2x^2-6x}{x^2-9}$, and multiplying $\frac{1}{x-3}$ by $\frac{x+3}{x+3}$ yields $\frac{x+3}{x^2-9}$.

Therefore, the given equation can be written as $\frac{4x^2}{x^2-9} - \frac{2x^2-6x}{x^2-9} = \frac{x+3}{x^2-9}$. Multiplying each fraction by the denominator results in the equation $4x^2-(2x^2-6x)=x+3$, or $2x^2+6x=x+3$. This equation can be solved by setting a quadratic expression equal to 0, then solving for x. Subtracting $x+3$ from both sides of this equation yields $2x^2+5x-3=0$. The expression $2x^2+5x-3$ can be factored, resulting in the equation $(2x-1)(x+3)=0$. By the zero product property, $2x-1=0$ or $x+3=0$. To solve for x in $2x-1=0$, 1 can be added to both sides of the equation, resulting in $2x=1$. Dividing both sides of this equation by 2 results in $x=\frac{1}{2}$. Solving for x in $x+3=0$ yields $x=-3$. However, this value of x would result in the second fraction of

the original equation having a denominator of 0. Therefore, $x = -3$ is an extraneous solution. Thus, the only

value of x that satisfies the given equation is $x = \dfrac{1}{2}$.

Choice A is incorrect and may result from solving $x + 3 = 0$ but not realizing that this solution is extraneous because it would result in a denominator of 0 in the second fraction. Choice B is incorrect and may result from a sign error when solving $2x - 1 = 0$ for x. Choice D is incorrect and may result from a calculation error.

Question Difficulty: Hard

Assessment	Test	Domain	Skill	Difficulty
SAT	Math	Advanced Math	Nonlinear equations in one variable and systems of equations in two variables	■■■

ID: 58b109d4

$$x^2 + y + 7 = 7$$
$$20x + 100 - y = 0$$

The solution to the given system of equations is (x, y). What is the value of x?

ID: 58b109d4 Answer

Correct Answer: -10

Rationale

The correct answer is -10. Adding y to both sides of the second equation in the given system yields $20x + 100 = y$. Substituting $20x + 100$ for y in the first equation in the given system yields $x^2 + 20x + 100 + 7 = 7$. Subtracting 7 from both sides of this equation yields $x^2 + 20x + 100 = 0$. Factoring the left-hand side of this equation yields $(x + 10)(x + 10) = 0$, or $(x + 10)^2 = 0$. Taking the square root of both sides of this equation yields $x + 10 = 0$. Subtracting 10 from both sides of this equation yields $x = -10$. Therefore, the value of x is -10.

Question Difficulty: Hard