

Question ID c6a26e14

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: c6a26e14

$$|x + 45| = 48$$

What is the positive solution to the given equation?

- A. 3
- B. 48
- C. 93
- D. 96

ID: c6a26e14 Answer

Correct Answer:

A

Rationale

Choice A is correct. The given absolute value equation can be rewritten as two linear equations: $x + 45 = 48$ and $-(x + 45) = 48$, or $x + 45 = -48$. Subtracting 45 from both sides of the equation $x + 45 = 48$ yields $x = 3$. Subtracting 45 from both sides of the equation $x + 45 = -48$ yields $x = -93$. Thus, the given equation has two possible solutions, 3 and -93 . Therefore, the positive solution to the given equation is 3.

Choice B 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

Question ID 07bcecac

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 30%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 07bcecac

$$P(t) = 24.8(1.036)^t$$

The function P gives the predicted population, in millions, of a certain country for the period from **1984** to **2018**, where t is the number of years after **1984**. According to the model, what is the best interpretation of the statement " $P(8)$ is approximately equal to **32.91**"?

- A. In **1984**, the predicted population of this country was approximately **8** million.
- B. In **1984**, the predicted population of this country was approximately **32.91** million.
- C. **8** years after **1984**, the predicted population of this country was approximately **32.91** million.
- D. **32.91** years after **1984**, the predicted population of this country was approximately **8** million.

ID: 07bcecac Answer

Correct Answer:

C

Rationale

Choice C is correct. The function P gives the predicted population, in millions, of a certain country for the period from **1984** to **2018**, where t is the number of years after **1984**. Since the value of $P(8)$ is the value of $P(t)$ when $t = 8$, it follows that " $P(8)$ is approximately equal to **32.91**" means that the value of $P(t)$ is approximately equal to **32.91** when $t = 8$. Therefore, the best interpretation of the statement " $P(8)$ is approximately equal to **32.91**" is that **8** years after **1984**, the predicted population of this country was approximately **32.91** million.

Choice A is incorrect. In **1984**, the predicted population of this country was **24.8** million, not approximately **8** million.

Choice B is incorrect. In **1984**, the predicted population of this country was **24.8** million, not approximately **32.91** million.

Choice D is incorrect. **32.91** years after **1984**, the predicted population of this country was $24.8(1.036)^{32.91}$ million, or approximately **79.42** million, not approximately **8** million.

Question Difficulty:

Easy

Question ID ad03127d

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #002B36; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> |

ID: ad03127d

$$6r = 7s + t$$

The given equation relates the variables r , s , and t . Which equation correctly expresses s in terms of r and t ?

- A. $s = 42r - t$
- B. $s = 7(6r - t)$
- C. $s = \frac{6}{7}r - t$
- D. $s = \frac{6r-t}{7}$

ID: ad03127d Answer

Correct Answer:

D

Rationale

Choice D is correct. Subtracting t from both sides of the given equation yields $6r - t = 7s$. Dividing both sides of this equation by 7 yields $\frac{6r-t}{7} = s$. Therefore, the equation $s = \frac{6r-t}{7}$ correctly expresses s in terms of r and t .

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:

Easy

Question ID 02add2d2

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 02add2d2

A company has a newsletter. In January **2018**, there were **1,300** customers subscribed to the newsletter. For the next **24** months after January **2018**, the total number of customers subscribed to the newsletter each month was **7%** greater than the total number subscribed the previous month. Which equation gives the total number of customers, c , subscribed to the company's newsletter m months after January **2018**, where $m \leq 24$?

- A. $c = 1,300(0.07)^m$
- B. $c = 1,300(1.07)^m$
- C. $c = 1,300(1.7)^m$
- D. $c = 1,300(7)^m$

ID: 02add2d2 Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that in January **2018**, there were **1,300** customers subscribed to a company's newsletter and for the next **24** months after January **2018**, the total number of customers subscribed to the newsletter each month was **7%** greater than the total number subscribed the previous month. It follows that this situation can be represented by the equation

$c = a(1 + \frac{r}{100})^m$, where c is the total number of customers subscribed to the company's newsletter m months after January **2018**, a is the number of customers subscribed to the newsletter in January **2018**, and the total number of customers subscribed to the newsletter each month was $r\%$ greater than the total number subscribed the previous month. Substituting **1,300** for a and **7** for r in this equation yields $c = 1,300(1 + \frac{7}{100})^m$, or $c = 1,300(1.07)^m$.

Choice A is incorrect. This equation represents a situation where the total number of customers subscribed each month was **93%** less, not **7%** greater, than the total number subscribed the previous month.

Choice C is incorrect. This equation represents a situation where the total number of customers subscribed each month was **70%**, not **7%**, greater than the total number subscribed the previous month.

Choice D is incorrect. This equation represents a situation where the total number of customers subscribed each month was **600%**, not **7%**, greater than the total number subscribed the previous month.

Question Difficulty:

Medium

Question ID f65288e8

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

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. $\frac{1}{2}$

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

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

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

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

Question ID 788bfd56

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 788bfd56

The function f is defined by $f(x) = 4 + \sqrt{x}$. What is the value of $f(144)$?

- A. 0
- B. 16
- C. 40
- D. 76

ID: 788bfd56 Answer

Correct Answer:

B

Rationale

Choice B is correct. The value of $f(144)$ is the value of $f(x)$ when $x = 144$. It's given that the function f is defined by $f(x) = 4 + \sqrt{x}$. Substituting 144 for x in this equation yields $f(144) = 4 + \sqrt{144}$. Since the positive square root of 144 is 12, it follows that this equation can be rewritten as $f(144) = 4 + 12$, or $f(144) = 16$. Therefore, the value of $f(144)$ is 16.

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

Choice C is incorrect. This is the value of $f(1,296)$, not $f(144)$.

Choice D is incorrect. This is the value of $f(5,184)$, not $f(144)$.

Question Difficulty:

Easy

Question ID 2c288148

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 2c288148

$$\sqrt{k-x} = 58-x$$

In the given equation, k is a constant. The equation has exactly one real solution. What is the minimum possible value of $4k$?

ID: 2c288148 Answer

Correct Answer:

231

Rationale

The correct answer is 231. It's given that $\sqrt{k-x} = 58-x$. Squaring both sides of this equation yields $k-x = (58-x)^2$, which is equivalent to the given equation if $58-x > 0$. It follows that if a solution to the equation $k-x = (58-x)^2$ satisfies $58-x > 0$, then it's also a solution to the given equation; if not, it's extraneous. The equation $k-x = (58-x)^2$ can be rewritten as $k-x = 3,364 - 116x + x^2$. Adding x to both sides of this equation yields $k = x^2 - 115x + 3,364$. Subtracting k from both sides of this equation yields $0 = x^2 - 115x + (3,364 - k)$. The number of solutions to a quadratic equation in the form $0 = ax^2 + bx + c$, where a , b , and c are constants, can be determined by the value of the discriminant, $b^2 - 4ac$. Substituting -115 for b , 1 for a , and $3,364 - k$ for c in $b^2 - 4ac$ yields $(-115)^2 - 4(1)(3,364 - k)$, or $4k - 231$. The equation $0 = x^2 - 115x + (3,364 - k)$ has exactly one real solution if the discriminant is equal to zero, or $4k - 231 = 0$. Subtracting 231 from both sides of this equation yields $4k = 231$. Dividing both sides of this equation by 4 yields $k = 57.75$. Therefore, if $k = 57.75$, then the equation $0 = x^2 - 115x + (3,364 - k)$ has exactly one real solution. Substituting 57.75 for k in this equation yields $0 = x^2 - 115x + (3,364 - 57.75)$, or $0 = x^2 - 115x + 3,306.25$, which is equivalent to $0 = (x - 57.5)^2$. Taking the square root of both sides of this equation yields $0 = x - 57.5$. Adding 57.5 to both sides of this equation yields $57.5 = x$. To check whether this solution satisfies $58-x > 0$, the solution, 57.5, can be substituted for x in $58-x > 0$, which yields $58 - 57.5 > 0$, or $0.5 > 0$. Since 0.5 is greater than 0, it follows that if $k = 57.75$, or $4k = 231$, then the given equation has exactly one real solution. If $4k < 231$, then the discriminant, $4k - 231$, is negative and the given equation has no solutions. Therefore, the minimum possible value of $4k$ is 231.

Question Difficulty:

Hard

Question ID 40491607

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 40491607

$$f(x) = (x - 1)(x + 3)(x - 2)$$

In the xy -plane, when the graph of the function f , where $y = f(x)$, is shifted up 6 units, the resulting graph is defined by the function g . If the graph of $y = g(x)$ crosses through the point $(4, b)$, where b is a constant, what is the value of b ?

ID: 40491607 Answer

Correct Answer:

48

Rationale

The correct answer is 48. It's given that in the xy -plane, when the graph of the function f , where $y = f(x)$, is shifted up 6 units, the resulting graph is defined by the function g . Therefore, function g can be defined by the equation $g(x) = f(x) + 6$. It's given that $f(x) = (x - 1)(x + 3)(x - 2)$. Substituting $(x - 1)(x + 3)(x - 2)$ for $f(x)$ in the equation $g(x) = f(x) + 6$ yields $g(x) = (x - 1)(x + 3)(x - 2) + 6$. For the point $(4, b)$, the value of x is 4. Substituting 4 for x in the equation $g(x) = (x - 1)(x + 3)(x - 2) + 6$ yields $g(4) = (4 - 1)(4 + 3)(4 - 2) + 6$, or $g(4) = 48$. It follows that the graph of $y = g(x)$ crosses through the point $(4, 48)$. Therefore, the value of b is 48.

Question Difficulty:

Hard

Question ID 369b7bb7

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 369b7bb7

The function g is defined by $g(x) = \sqrt{8x + 1}$. What is the value of $g(3)$?

- A. $\frac{5}{8}$
- B. $\frac{25}{8}$
- C. 5
- D. 25

ID: 369b7bb7 Answer

Correct Answer:

C

Rationale

Choice C is correct. It's given that the function g is defined by $g(x) = \sqrt{8x + 1}$. Substituting 3 for x in the given function yields $g(3) = \sqrt{8(3) + 1}$, which is equivalent to $g(3) = \sqrt{25}$, or $g(3) = 5$. Therefore, the value of $g(3)$ is 5.

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. This is the value of $8(3) + 1$, not $\sqrt{8(3) + 1}$.

Question Difficulty:

Easy

Question ID 3206b905

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 20%; background-color: #003366; height: 10px;"></div> <div style="width: 20%; background-color: #003366; height: 10px;"></div> <div style="width: 60%; background-color: #cccccc; height: 10px;"></div> |

ID: 3206b905

Which of the following expressions is equivalent to $8x^{10} - 8x^9 + 88x$?

- A. $x(7x^{10} - 7x^9 + 87x)$
- B. $x(8^{10} - 8^9 + 88)$
- C. $8x(x^{10} - x^9 + 11x)$
- D. $8x(x^9 - x^8 + 11)$

ID: 3206b905 Answer

Correct Answer:

D

Rationale

Choice D is correct. Since $8x$ is a common factor of each term in the given expression, the expression can be rewritten as $8x(x^9 - x^8 + 11)$.

Choice A is incorrect. This expression is equivalent to $7x^{11} - 7x^{10} + 87x^2$.

Choice B is incorrect. This expression is equivalent to $8^{10}x - 8^9x + 88x$.

Choice C is incorrect. This expression is equivalent to $8x^{11} - 8x^{10} + 88x^2$.

Question Difficulty:

Medium

Question ID f89af023

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: f89af023

A rectangular volleyball court has an area of 162 square meters. If the length of the court is twice the width, what is the width of the court, in meters?

- A. 9
- B. 18
- C. 27
- D. 54

ID: f89af023 Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that the volleyball court is rectangular and has an area of 162 square meters. The formula for the area of a rectangle is $A = \ell \cdot w$, where A is the area, ℓ is the length, and w is the width of the rectangle. It's also given that the length of the volleyball court is twice the width, thus $\ell = 2w$. Substituting the given value into the formula for the area of a rectangle and using the relationship between length and width for this rectangle yields $162 = (2w)(w)$. This equation can be rewritten as $162 = 2w^2$. Dividing both sides of this equation by 2 yields $81 = w^2$. Taking the square root of both sides of this equation yields $\pm 9 = w$. Since the width of a rectangle is a positive number, the width of the volleyball court is 9 meters.

Choice B is incorrect because this is the length of the rectangle. Choice C is incorrect because this is the result of using 162 as the perimeter rather than the area. Choice D is incorrect because this is the result of calculating w in the equation $162 = 2w + w$ instead of $162 = (2w)(w)$.

Question Difficulty:

Medium

Question ID 7902bed0

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 100px; height: 10px; background-color: #0056b3;"></div> <div style="width: 100px; height: 10px; background-color: #0056b3;"></div> <div style="width: 100px; height: 10px; background-color: #0056b3;"></div> |

ID: 7902bed0

A machine launches a softball from ground level. The softball reaches a maximum height of **51.84** meters above the ground at **1.8** seconds and hits the ground at **3.6** seconds. Which equation represents the height above ground h , in meters, of the softball t seconds after it is launched?

- A. $h = -t^2 + 3.6$
- B. $h = -t^2 + 51.84$
- C. $h = -16(t - 1.8)^2 - 3.6$
- D. $h = -16(t - 1.8)^2 + 51.84$

ID: 7902bed0 Answer

Correct Answer:

D

Rationale

Choice D is correct. An equation representing the height above ground h , in meters, of a softball t seconds after it is launched by a machine from ground level can be written in the form $h = -a(t - b)^2 + c$, where a , b , and c are positive constants. In this equation, b represents the time, in seconds, at which the softball reaches its maximum height of c meters above the ground. It's given that this softball reaches a maximum height of **51.84** meters above the ground at **1.8** seconds; therefore, $b = 1.8$ and $c = 51.84$. Substituting **1.8** for b and **51.84** for c in the equation $h = -a(t - b)^2 + c$ yields $h = -a(t - 1.8)^2 + 51.84$. It's also given that this softball hits the ground at **3.6** seconds; therefore, $h = 0$ when $t = 3.6$. Substituting **0** for h and **3.6** for t in the equation $h = -a(t - 1.8)^2 + 51.84$ yields $0 = -a(3.6 - 1.8)^2 + 51.84$, which is equivalent to $0 = -a(1.8)^2 + 51.84$, or $0 = -3.24a + 51.84$. Adding **3.24a** to both sides of this equation yields $3.24a = 51.84$. Dividing both sides of this equation by **3.24** yields $a = 16$. Substituting **16** for a in the equation $h = -a(t - 1.8)^2 + 51.84$ yields $h = -16(t - 1.8)^2 + 51.84$. Therefore, $h = -16(t - 1.8)^2 + 51.84$ represents the height above ground h , in meters, of this softball t seconds after it is launched.

Choice A is incorrect. This equation represents a situation where the maximum height is **3.6** meters above the ground at **0** seconds, not **51.84** meters above the ground at **1.8** seconds.

Choice B is incorrect. This equation represents a situation where the maximum height is **51.84** meters above the ground at **0** seconds, not **1.8** seconds.

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

Question Difficulty:

Hard

Question ID 4a0d0399

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 4a0d0399

The function f is defined by $f(x) = a^x + b$, where a and b are constants. In the xy -plane, the graph of $y = f(x)$ has an x -intercept at $(2, 0)$ and a y -intercept at $(0, -323)$. What is the value of b ?

ID: 4a0d0399 Answer

Correct Answer:

-324

Rationale

The correct answer is -324 . It's given that the function f is defined by $f(x) = a^x + b$, where a and b are constants. It's also given that the graph of $y = f(x)$ has a y -intercept at $(0, -323)$. It follows that $f(0) = -323$. Substituting 0 for x and -323 for $f(x)$ in $f(x) = a^x + b$ yields $-323 = a^0 + b$, or $-323 = 1 + b$. Subtracting 1 from each side of this equation yields $-324 = b$. Therefore, the value of b is -324 .

Question Difficulty:

Hard

Question ID 768b60d2

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 768b60d2

For the exponential function f , the value of $f(0)$ is c , where c is a constant. Of the following equations that define the function f , which equation shows the value of c as the coefficient or the base?

- A. $f(x) = 22(1.5)^{x+1}$
- B. $f(x) = 33(1.5)^x$
- C. $f(x) = 49.5(1.5)^{x-1}$
- D. $f(x) = 74.25(1.5)^{x-2}$

ID: 768b60d2 Answer

Correct Answer:

B

Rationale

Choice B is correct. Each of the given choices is an equation of the form $f(x) = a(b)^{x-k}$, where a , b , and k are constants. For an equation of this form, the coefficient, a , is equal to the value of the function when the exponent is equal to 0, or when $x = k$. It follows that in the equation $f(x) = 33(1.5)^x$, the coefficient, 33, is equal to the value of $f(0)$. Substituting 0 for x in this equation yields $f(0) = 33(1.5)^0$, which is equivalent to $f(0) = 33(1)$, or $f(0) = 33$. Thus, the value of c is 33 and the equation $f(x) = 33(1.5)^x$ shows the value of c as the coefficient.

Choice A is incorrect. This equation shows the value of $f(-1)$, not $f(0)$, as the coefficient.

Choice C is incorrect. This equation shows the value of $f(1)$, not $f(0)$, as the coefficient.

Choice D is incorrect. This equation shows the value of $f(2)$, not $f(0)$, as the coefficient.

Question Difficulty:

Medium

Question ID e53add44

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 20%; background-color: #0056b3;"></div> <div style="width: 20%; background-color: #0056b3;"></div> <div style="width: 60%; background-color: #e0e0e0;"></div> |

ID: e53add44

$$S(n) = 38,000a^n$$

The function S above models the annual salary, in dollars, of an employee n years after starting a job, where a is a constant. If the employee's salary increases by 4% each year, what is the value of a ?

- A. 0.04
- B. 0.4
- C. 1.04
- D. 1.4

ID: e53add44 Answer

Correct Answer:

C

Rationale

Choice C is correct. A model for a quantity S that increases by a certain percentage per time period n is an exponential function in the form $S(n) = I\left(1 + \frac{r}{100}\right)^n$, where I is the initial value at time $n = 0$ for $r\%$ annual increase. It's given that the annual increase in an employee's salary is 4%, so $r = 4$. The initial value can be found by substituting 0 for n in the given function, which yields $S(0) = 38,000$. Therefore, $I = 38,000$. Substituting these values for r and I into the form of the exponential function $S(n) = I\left(1 + \frac{r}{100}\right)^n$ yields $S(n) = 38,000\left(1 + \frac{4}{100}\right)^n$, or $S(n) = 38,000(1.04)^n$. Therefore, the value of a in the given function is 1.04.

Choices A, B, and D are incorrect and may result from incorrectly representing the annual increase in the exponential function.

Question Difficulty:

Medium

Question ID f2f3fa00

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #005a99; height: 10px;"></div> |

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

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

Question ID b4a6ed81

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: b4a6ed81

The expression $90y^5 - 54y^4$ is equivalent to $ry^4(15y - 9)$, where r is a constant. What is the value of r ?

ID: b4a6ed81 Answer

Correct Answer:

6

Rationale

The correct answer is **6**. Applying the distributive property to the expression $ry^4(15y - 9)$ yields $15ry^5 - 9ry^4$. Since $90y^5 - 54y^4$ is equivalent to $ry^4(15y - 9)$, it follows that $90y^5 - 54y^4$ is also equivalent to $15ry^5 - 9ry^4$. Since these expressions are equivalent, it follows that corresponding coefficients are equivalent. Therefore, $90 = 15r$ and $-54 = -9r$. Solving either of these equations for r will yield the value of r . Dividing both sides of $90 = 15r$ by 15 yields $6 = r$. Therefore, the value of r is **6**.

Question Difficulty:

Medium

Question ID 9654add7

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 9654add7

$$f(x) = -500x^2 + 25,000x$$

The revenue $f(x)$, in dollars, that a company receives from sales of a product is given by the function f above, where x is the unit price, in dollars, of the product. The graph of $y = f(x)$ in the xy -plane intersects the x -axis at 0 and a . What does a represent?

- A. The revenue, in dollars, when the unit price of the product is \$0
- B. The unit price, in dollars, of the product that will result in maximum revenue
- C. The unit price, in dollars, of the product that will result in a revenue of \$0
- D. The maximum revenue, in dollars, that the company can make

ID: 9654add7 Answer

Correct Answer:

C

Rationale

Choice C is correct. By definition, the y -value when a function intersects the x -axis is 0. It's given that the graph of the function intersects the x -axis at 0 and a , that x is the unit price, in dollars, of a product, and that $f(x)$, where $y = f(x)$, is the revenue, in dollars, that a company receives from the sales of the product. Since the value of a occurs when $y = 0$, a is the unit price, in dollars, of the product that will result in a revenue of \$0.

Choice A is incorrect. The revenue, in dollars, when the unit price of the product is \$0 is represented by $f(x)$, when $x = 0$. Choice B is incorrect. The unit price, in dollars, of the product that will result in maximum revenue is represented by the x -coordinate of the maximum of f . Choice D is incorrect. The maximum revenue, in dollars, that the company can make is represented by the y -coordinate of the maximum of f .

Question Difficulty:

Hard

Question ID 4618501a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: 4618501a

$$f(x) = 3,000(0.75)^x$$

A conservation scientist implemented a program to reduce the population of a certain species in an area. The given function estimates this species' population x years after 2008, where $x \leq 8$. Which of the following is the best interpretation of 3,000 in this context?

- A. The estimated percent decrease in the population for this species and area every 8 years after 2008
- B. The estimated percent decrease in the population for this species and area each year after 2008
- C. The estimated population for this species and area 8 years after 2008
- D. The estimated initial population for this species and area in 2008

ID: 4618501a Answer

Correct Answer:

D

Rationale

Choice D is correct. Substituting 0 for x in the given equation yields $f(0) = 3,000(0.75)^0$, which is equivalent to $f(0) = 3,000(1)$, or $f(0) = 3,000$. It's given that the function estimates the species' population x years after 2008, so it follows that the estimated population of the species is 3,000 in 2008. Therefore, the best interpretation of 3,000 in this context is the estimated initial population for this species and area in 2008.

Choice A is incorrect and may result from conceptual errors.

Choice B is incorrect. The estimated percent decrease in the population for this species and area each year after 2008 is 25%, not 3,000.

Choice C is incorrect. The estimated population for this species and area 8 years after 2008 is $3,000(0.75)^8$, or approximately 300, not 3,000.

Question Difficulty:

Medium

Question ID 34847f8a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 34847f8a

$$\frac{2}{x-2} + \frac{3}{x+5} = \frac{rx+t}{(x-2)(x+5)}$$

The equation above is true for all $x > 2$, where r and t are positive constants. What is the value of rt ?

- A. -20
- B. 15
- C. 20
- D. 60

ID: 34847f8a Answer

Correct Answer:

C

Rationale

Choice C is correct. To express the sum of the two rational expressions on the left-hand side of the equation as the single rational expression on the right-hand side of the equation, the expressions on the left-hand side must have the same denominator.

Multiplying the first expression by $\frac{x+5}{x-5}$ results in $\frac{2(x+5)}{(x-2)(x+5)}$, and multiplying the second expression by $\frac{x-2}{x-2}$ results in $\frac{3(x-2)}{(x-2)(x+5)}$, so the given equation can be rewritten as $\frac{2(x+5)}{(x-2)(x+5)} + \frac{3(x-2)}{(x-2)(x+5)} = \frac{rx+t}{(x-2)(x+5)}$, or $\frac{2x+10}{(x-2)(x+5)} + \frac{3x-6}{(x-2)(x+5)} = \frac{rx+t}{(x-2)(x+5)}$. Since the two rational expressions on the left-hand side of the equation have the same denominator as the rational expression on the right-hand side of the equation, it follows that $(2x+10) + (3x-6) = rx+t$. Combining like terms on the left-hand side yields $5x+4 = rx+t$, so it follows that $r=5$ and $t=4$. Therefore, the value of rt is $(5)(4)=20$.

Choice A is incorrect and may result from an error when determining the sign of either r or t . Choice B is incorrect and may result from not distributing the 2 and 3 to their respective terms in $\frac{2(x+5)}{(x-2)(x+5)} + \frac{3(x-2)}{(x-2)(x+5)} = \frac{rx+t}{(x-2)(x+5)}$. Choice D is incorrect and may result from a calculation error.

Question Difficulty:

Hard

Question ID cc776a04

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: cc776a04

Which of the following is an equivalent form of

$$(1.5x - 2.4)^2 - (5.2x^2 - 6.4) ?$$

- A. $-2.2x^2 + 1.6$
- B. $-2.2x^2 + 11.2$
- C. $-2.95x^2 - 7.2x + 12.16$
- D. $-2.95x^2 - 7.2x + 0.64$

ID: cc776a04 Answer

Correct Answer:

C

Rationale

Choice C is correct. The first expression $(1.5x - 2.4)^2$ can be rewritten as $(1.5x - 2.4)(1.5x - 2.4)$. Applying the distributive property to this product yields $(2.25x^2 - 3.6x - 3.6x + 5.76) - (5.2x^2 - 6.4)$. This difference can be rewritten as $(2.25x^2 - 3.6x - 3.6x + 5.76) + (-1)(5.2x^2 - 6.4)$. Distributing the factor of -1 through the second expression yields $2.25x^2 - 3.6x - 3.6x + 5.76 - 5.2x^2 + 6.4$. Regrouping like terms, the expression becomes $(2.25x^2 - 5.2x^2) + (-3.6x - 3.6x) + (5.76 + 6.4)$. Combining like terms yields $-2.95x^2 - 7.2x + 12.16$.

Choices A, B, and D are incorrect and likely result from errors made when applying the distributive property or combining the resulting like terms.

Question Difficulty:

Medium

Question ID 263f9937

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 30%; background-color: #0056b3; height: 10px;"></div> <div style="width: 30%; background-color: #0056b3; height: 10px;"></div> <div style="width: 30%; background-color: #0056b3; height: 10px;"></div> |

ID: 263f9937

Growth of a Culture of Bacteria

| Day | Number of bacteria per milliliter at end of day |
|-----|---|
| 1 | 2.5×10^5 |
| 2 | 5.0×10^5 |
| 3 | 1.0×10^6 |

A culture of bacteria is growing at an exponential rate, as shown in the table above. At this rate, on which day would the number of bacteria per milliliter reach 5.12×10^8 ?

- A. Day 5
- B. Day 9
- C. Day 11
- D. Day 12

ID: 263f9937 Answer

Correct Answer:

D

Rationale

Choice D is correct. The number of bacteria per milliliter is doubling each day. For example, from day 1 to day 2, the number of bacteria increased from 2.5×10^5 to 5.0×10^5 . At the end of day 3 there are 10^6 bacteria per milliliter. At the end of day 4, there will be $10^6 \times 2$ bacteria per milliliter. At the end of day 5, there will be $(10^6 \times 2) \times 2$, or $10^6 \times (2^2)$ bacteria per milliliter, and so on. At the end of day d, the number of bacteria will be $10^6 \times (2^{d-3})$. If the number of bacteria per milliliter will reach 5.12×10^8 at the end of day d, then the equation $10^6 \times (2^{d-3}) = 5.12 \times 10^8$ must hold. Since 5.12×10^8 can be rewritten as 512×10^6 , the equation is equivalent to $2^{d-3} = 512$. Rewriting 512 as 2^9 gives $d - 3 = 9$, so $d = 12$. The number of bacteria per milliliter would reach 5.12×10^8 at the end of day 12.

Choices A, B, and C are incorrect. Given the growth rate of the bacteria, the number of bacteria will not reach 5.12×10^8 per milliliter by the end of any of these days.

Question Difficulty:

Hard

Question ID 4ac59df6

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 4ac59df6

Which expression is equivalent to $(8yz)(y)(7z)$?

- A. $56y^2z^2$
- B. $56y^2z$
- C. $56yz$
- D. $16yz$

ID: 4ac59df6 Answer

Correct Answer:

A

Rationale

Choice A is correct. The given expression can be rewritten as $(8 \cdot 7)(y \cdot y)(z \cdot z)$, which is equivalent to $(56)(y^2)(z^2)$, or $56y^2z^2$.

Choice B is incorrect. This expression is equivalent to $(8yz)(y)(7)$.

Choice C is incorrect. This expression is equivalent to $(8z)(y)(7)$.

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

Question Difficulty:

Easy

Question ID fada6b03

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: fada6b03

$$2x^2 - 8x - 7 = 0$$

One solution to the given equation can be written as $\frac{8-\sqrt{k}}{4}$, where k is a constant. What is the value of k ?

ID: fada6b03 Answer

Correct Answer:

120

Rationale

The correct answer is 120. The solutions to a quadratic equation of the form $ax^2 + bx + c = 0$ can be calculated using the quadratic formula and are given by $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. The given equation is in the form $ax^2 + bx + c = 0$, where $a = 2$, $b = -8$, and $c = -7$. It follows that the solutions to the given equation are $x = \frac{8 \pm \sqrt{(-8)^2 - 4(2)(-7)}}{2(2)}$, which is equivalent to $x = \frac{8 \pm \sqrt{64+56}}{4}$, or $x = \frac{8 \pm \sqrt{120}}{4}$. It's given that one solution to the equation $2x^2 - 8x - 7 = 0$ can be written as $\frac{8-\sqrt{k}}{4}$. The solution $\frac{8-\sqrt{120}}{4}$ is in this form. Therefore, the value of k is 120.

Question Difficulty:

Hard

Question ID 926c246b

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: 926c246b

$$D = 5,640(1.9)^t$$

The equation above estimates the global data traffic D , in terabytes, for the year that is t years after 2010. What is the best interpretation of the number 5,640 in this context?

- A. The estimated amount of increase of data traffic, in terabytes, each year
- B. The estimated percent increase in the data traffic, in terabytes, each year
- C. The estimated data traffic, in terabytes, for the year that is t years after 2010
- D. The estimated data traffic, in terabytes, in 2010

ID: 926c246b Answer

Correct Answer:

D

Rationale

Choice D is correct. Since t represents the number of years after 2010, the estimated data traffic, in terabytes, in 2010 can be calculated using the given equation when $t = 0$. Substituting 0 for t in the given equation yields $D = 5,640(1.9)^0$, or $5,640(1) = 5,640$. Thus, 5,640 represents the estimated data traffic, in terabytes, in 2010.

Choice A is incorrect. Since the equation is exponential, the amount of increase of data traffic each year isn't constant. Choice B is incorrect. According to the equation, the percent increase in data traffic each year is 90%. Choice C is incorrect. The estimated data traffic, in terabytes, for the year that is t years after 2010 is represented by D, not the number 5,640.

Question Difficulty:

Medium

Question ID 84e5e36c

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #002B36; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> |

ID: 84e5e36c

$$\begin{aligned}y &= 76 \\y &= x^2 - 5\end{aligned}$$

The graphs of the given equations in the xy -plane intersect at the point (x, y) . What is a possible value of x ?

- A. $-\frac{76}{5}$
- B. -9
- C. 5
- D. 76

ID: 84e5e36c Answer

Correct Answer:

B

Rationale

Choice B is correct. Since the point (x, y) is an intersection point of the graphs of the given equations in the xy -plane, the pair (x, y) should satisfy both equations, and thus is a solution of the given system. According to the first equation, $y = 76$.

Substituting 76 in place of y in the second equation yields $x^2 - 5 = 76$. Adding 5 to both sides of this equation yields $x^2 = 81$. Taking the square root of both sides of this equation yields two solutions: $x = 9$ and $x = -9$. Of these two solutions, only -9 is given as a choice.

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. This is the value of coordinate y , rather than x , of the intersection point (x, y) .

Question Difficulty:

Easy

Question ID ff2c1431

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 25%; background-color: #005599; height: 10px;"></div> <div style="width: 50%; background-color: #cccccc; height: 10px;"></div> |

ID: ff2c1431

$$7m = 5(n + p)$$

The given equation relates the positive numbers m , n , and p . Which equation correctly gives n in terms of m and p ?

- A. $n = \frac{5p}{7m}$
- B. $n = \frac{7m}{5} - p$
- C. $n = 5(7m) + p$
- D. $n = 7m - 5 - p$

ID: ff2c1431 Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that the equation $7m = 5(n + p)$ relates the positive numbers m , n , and p . Dividing both sides of the given equation by 5 yields $\frac{7m}{5} = n + p$. Subtracting p from both sides of this equation yields $\frac{7m}{5} - p = n$, or $n = \frac{7m}{5} - p$. It follows that the equation $n = \frac{7m}{5} - p$ correctly gives n in terms of m and p .

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:

Medium

Question ID 137cc6fd

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 137cc6fd

$$\sqrt[5]{70n} \left(\sqrt[6]{70n} \right)^2$$

For what value of x is the given expression equivalent to $(70n)^{30x}$, where $n > 1$?

ID: 137cc6fd Answer

Correct Answer:

.0177, .0178, 4/225

Rationale

The correct answer is $\frac{4}{225}$. An expression of the form $\sqrt[k]{a}$, where k is an integer greater than 1 and $a \geq 0$, is equivalent to $a^{\frac{1}{k}}$. Therefore, the given expression, where $n > 1$, is equivalent to $(70n)^{\frac{1}{5}} \left((70n)^{\frac{1}{6}} \right)^2$. Applying properties of exponents, this expression can be rewritten as $(70n)^{\frac{1}{5}} (70n)^{\frac{1}{6} \cdot 2}$, or $(70n)^{\frac{1}{5}} (70n)^{\frac{1}{3}}$, which can be rewritten as $(70n)^{\frac{1}{5} + \frac{1}{3}}$, or $(70n)^{\frac{8}{15}}$. It's given that the expression $\sqrt[5]{70n} \left(\sqrt[6]{70n} \right)^2$ is equivalent to $(70n)^{30x}$, where $n > 1$. It follows that $(70n)^{\frac{8}{15}}$ is equivalent to $(70n)^{30x}$. Therefore, $\frac{8}{15} = 30x$. Dividing both sides of this equation by 30 yields $\frac{8}{450} = x$, or $\frac{4}{225} = x$. Thus, the value of x for which the given expression is equivalent to $(70n)^{30x}$, where $n > 1$, is $\frac{4}{225}$. Note that 4/225, .0177, .0178, 0.017, and 0.018 are examples of ways to enter a correct answer.

Question Difficulty:

Hard

Question ID 6ce95fc8

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

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. $\frac{1}{2} + \sqrt{11}$
- D. $\frac{1 + \sqrt{11}}{2}$

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

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

quadratic formula: . Subtracting $2x + 3$ from both sides of the given equation yields $2x^2 - 2x - 5 = 0$.

$$x = \frac{-(-2) \pm \sqrt{(-2)^2 - 4(2)(-5)}}{2(2)}$$

Applying the quadratic formula, where $a = 2$, $b = -2$, and $c = -5$, yields . This can be

rewritten as $x = \frac{2 \pm \sqrt{44}}{4}$. Since $\sqrt{44} = \sqrt{2^2(11)}$, or $2\sqrt{11}$, the equation can be rewritten as $x = \frac{2 \pm 2\sqrt{11}}{4}$. Dividing 2 from

$$\frac{1 + \sqrt{11}}{2} \text{ or } \frac{1 - \sqrt{11}}{2}$$

both the numerator and denominator yields $\frac{1 + \sqrt{11}}{2}$. Of these two solutions, only $\frac{1 + \sqrt{11}}{2}$ 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

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{a} \quad x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

instead of

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

Question ID 4dd4efcf

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 4dd4efcf

$$f(x) = ax^2 + 4x + c$$

In the given quadratic function, a and c are constants. The graph of $y = f(x)$ in the xy -plane is a parabola that opens upward and has a vertex at the point (h, k) , where h and k are constants. If $k < 0$ and $f(-9) = f(3)$, which of the following must be true?

- I. $c < 0$
- II. $a \geq 1$

- A. I only
- B. II only
- C. I and II
- D. Neither I nor II

ID: 4dd4efcf Answer

Correct Answer:

D

Rationale

Choice D is correct. It's given that the graph of $y = f(x)$ in the xy -plane is a parabola with vertex (h, k) . If $f(-9) = f(3)$, then for the graph of $y = f(x)$, the point with an x -coordinate of -9 and the point with an x -coordinate of 3 have the same y -coordinate. In the xy -plane, a parabola is a symmetric graph such that when two points have the same y -coordinate, these points are equidistant from the vertex, and the x -coordinate of the vertex is halfway between the x -coordinates of these two points.

Therefore, for the graph of $y = f(x)$, the points with x -coordinates -9 and 3 are equidistant from the vertex, (h, k) , and h is halfway between -9 and 3 . The value that is halfway between -9 and 3 is $\frac{-9+3}{2}$, or -3 . Therefore, $h = -3$. The equation defining f can also be written in vertex form, $f(x) = a(x - h)^2 + k$. Substituting -3 for h in this equation yields

$f(x) = a(x - (-3))^2 + k$, or $f(x) = a(x + 3)^2 + k$. This equation is equivalent to $f(x) = a(x^2 + 6x + 9) + k$, or $f(x) = ax^2 + 6ax + 9a + k$. Since $f(x) = ax^2 + 4x + c$, it follows that $6a = 4$ and $9a + k = c$. Dividing both sides of the equation $6a = 4$ by 6 yields $a = \frac{4}{6}$, or $a = \frac{2}{3}$. Since $\frac{2}{3} < 1$, it's not true that $a \geq 1$. Therefore, statement II isn't true.

Substituting $\frac{2}{3}$ for a in the equation $9a + k = c$ yields $9(\frac{2}{3}) + k = c$, or $6 + k = c$. Subtracting 6 from both sides of this equation yields $k = c - 6$. If $k < 0$, then $c - 6 < 0$, or $c < 6$. Since c could be any value less than 6 , it's not necessarily true that $c < 0$. Therefore, statement I isn't necessarily true. Thus, neither I nor II must be true.

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.

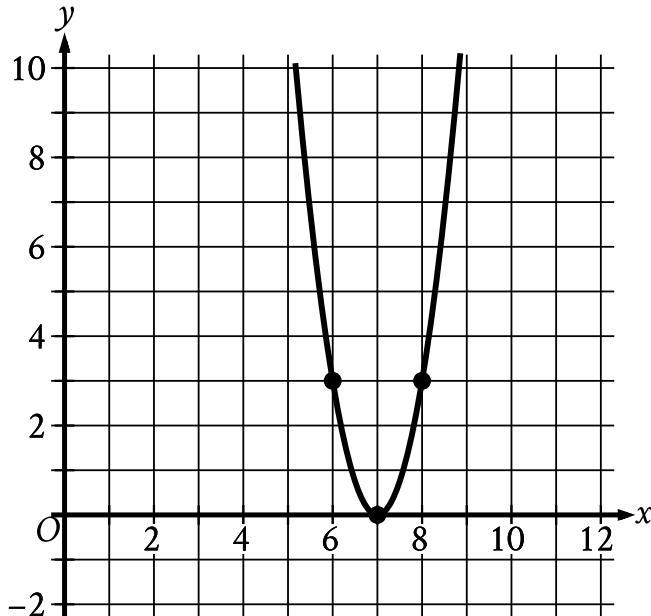
Question Difficulty:

Hard

Question ID cc2601cb

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 25%; background-color: #e0e0e0; height: 10px;"></div> |

ID: cc2601cb



The x -intercept of the graph shown is $(x, 0)$. What is the value of x ?

ID: cc2601cb Answer

Correct Answer:

7

Rationale

The correct answer is 7. It's given that the x -intercept of the graph shown is $(x, 0)$. The graph passes through the point $(7, 0)$. Therefore, the value of x is 7.

Question Difficulty:

Easy

Question ID 6bdcac03

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 20%; background-color: #003366; height: 10px;"></div> <div style="width: 20%; background-color: #003366; height: 10px;"></div> <div style="width: 60%; background-color: #cccccc; height: 10px;"></div> |

ID: 6bdcac03

$$x^2 = -841$$

How many distinct real solutions does the given equation have?

- A. Exactly one
- B. Exactly two
- C. Infinitely many
- D. Zero

ID: 6bdcac03 Answer

Correct Answer:

D

Rationale

Choice D is correct. Since the square of a real number is never negative, the given equation isn't true for any real value of x . Therefore, the given equation has zero distinct real solutions.

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:

Medium

Question ID f5aa5040

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: f5aa5040

In the xy -plane, a line with equation $2y = c$ for some constant c intersects a parabola at exactly one point. If the parabola has equation $y = -2x^2 + 9x$, what is the value of c ?

ID: f5aa5040 Answer

Correct Answer:

20.25, 81/4

Rationale

The correct answer is $\frac{81}{4}$. The given linear equation is $2y = c$. Dividing both sides of this equation by 2 yields $y = \frac{c}{2}$. Substituting $\frac{c}{2}$ for y in the equation of the parabola yields $\frac{c}{2} = -2x^2 + 9x$. Adding $2x^2$ and $-9x$ to both sides of this equation yields $2x^2 - 9x + \frac{c}{2} = 0$. Since it's given that the line and the parabola intersect at exactly one point, the equation $2x^2 - 9x + \frac{c}{2} = 0$ must have exactly one solution. An equation of the form $Ax^2 + Bx + C = 0$, where A , B , and C are constants, has exactly one solution when the discriminant, $B^2 - 4AC$, is equal to 0. In the equation $2x^2 - 9x + \frac{c}{2} = 0$, where $A = 2$, $B = -9$, and $C = \frac{c}{2}$, the discriminant is $(-9)^2 - 4(2)(\frac{c}{2})$. Setting the discriminant equal to 0 yields $(-9)^2 - 4(2)(\frac{c}{2}) = 0$, or $81 - 4c = 0$. Adding $4c$ to both sides of this equation yields $81 = 4c$. Dividing both sides of this equation by 4 yields $c = \frac{81}{4}$. Note that 81/4 and 20.25 are examples of ways to enter a correct answer.

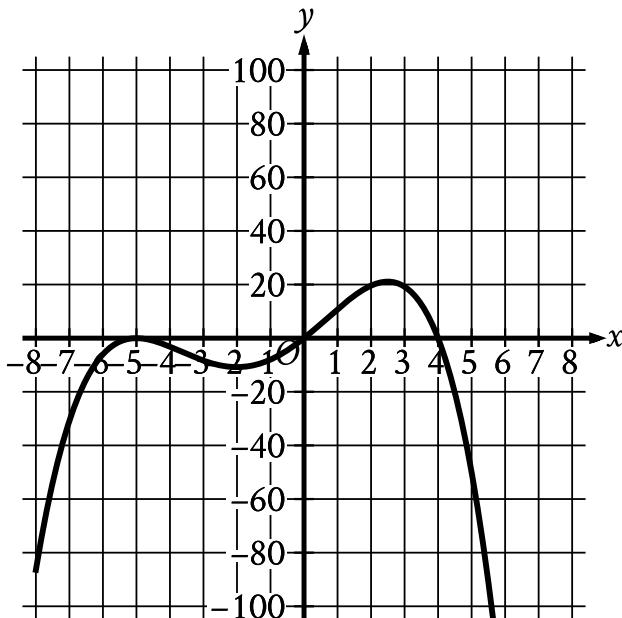
Question Difficulty:

Hard

Question ID 252a3b3a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 252a3b3a



Which of the following could be the equation of the graph shown in the xy -plane?

- A. $y = -\frac{1}{10}x(x - 4)(x + 5)$
- B. $y = -\frac{1}{10}x(x - 4)(x + 5)^2$
- C. $y = -\frac{1}{10}x(x - 5)(x + 4)$
- D. $y = -\frac{1}{10}x(x - 5)^2(x + 4)$

ID: 252a3b3a Answer

Correct Answer:

B

Rationale

Choice B is correct. Each of the given choices is an equation of the form $y = -\frac{1}{10}x(x - a)^m(x + b)^n$, where a , b , m , and n are positive constants. In the xy -plane, the graph of an equation of this form has x -intercepts at $x = 0$, $x = a$, and $x = -b$. The graph shown has x -intercepts at $x = 0$, $x = 4$, and $x = -5$. Therefore, $a = 4$ and $b = 5$. Of the given choices, only choices A and B have $a = 4$ and $b = 5$. For an equation in the form $y = -\frac{1}{10}x(x - a)^m(x + b)^n$, if all values of x that are less than $-b$ or greater than a correspond to negative y -values, then the sum of all the exponents of the factors on the right-hand side of the equation is even. In the graph shown, all values of x less than -5 or greater than 4 correspond to negative y -values. Therefore, the sum of all the exponents of the factors on the right-hand side of the equation $y = -\frac{1}{10}x(x - 4)^m(x + 5)^n$ must be even. For choice A, the sum of these exponents is $1 + 1 + 1$, or 3 , which is odd. For choice B, the sum of these exponents is $1 + 1 + 2$, or 4 , which is even. Therefore, $y = -\frac{1}{10}x(x - 4)(x + 5)^2$ could be the equation of the graph shown.

Choice A is incorrect. For the graph of this equation, all values of x less than -5 correspond to positive, not negative, y -values.

Choice C is incorrect. The graph of this equation has x -intercepts at $x = -4$, $x = 0$, and $x = 5$, rather than x -intercepts at $x = -5$, $x = 0$, and $x = 4$.

Choice D is incorrect. The graph of this equation has x -intercepts at $x = -4$, $x = 0$, and $x = 5$, rather than x -intercepts at $x = -5$, $x = 0$, and $x = 4$.

Question Difficulty:

Medium

Question ID 2992ac30

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 2992ac30

$$P(t) = 260(1.04)^{(\frac{6}{4})t}$$

The function P models the population, in thousands, of a certain city t years after 2003. According to the model, the population is predicted to increase by 4% every n months. What is the value of n ?

- A. 8
- B. 12
- C. 18
- D. 72

ID: 2992ac30 Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that the function P models the population, in thousands, of a certain city t years after 2003. The value of the base of the given exponential function, 1.04, corresponds to an increase of 4% for every increase of 1 in the exponent, $(\frac{6}{4})t$. If the exponent is equal to 0, then $(\frac{6}{4})t = 0$. Multiplying both sides of this equation by $(\frac{4}{6})$ yields $t = 0$. If the exponent is equal to 1, then $(\frac{6}{4})t = 1$. Multiplying both sides of this equation by $(\frac{4}{6})$ yields $t = \frac{4}{6}$, or $t = \frac{2}{3}$. Therefore, the population is predicted to increase by 4% every $\frac{2}{3}$ of a year. It's given that the population is predicted to increase by 4% every n months. Since there are 12 months in a year, $\frac{2}{3}$ of a year is equivalent to $(\frac{2}{3})(12)$, or 8, months. Therefore, the value of n is 8.

Choice B is incorrect. This is the number of months in which the population is predicted to increase by 4% according to the model $P(t) = 260(1.04)^t$, not $P(t) = 260(1.04)^{(\frac{6}{4})t}$.

Choice C is incorrect. This is the number of months in which the population is predicted to increase by 4% according to the model $P(t) = 260(1.04)^{(\frac{4}{6})t}$, not $P(t) = 260(1.04)^{(\frac{6}{4})t}$.

Choice D is incorrect. This is the number of months in which the population is predicted to increase by 4% according to the model $P(t) = 260(1.04)^{(\frac{1}{6})t}$, not $P(t) = 260(1.04)^{(\frac{6}{4})t}$.

Question Difficulty:

Hard

Question ID 58443765

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #002B36; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> |

ID: 58443765

$$y = 5x + 4$$

$$y = 5x^2 + 4$$

Which ordered pair (x, y) is a solution to the given system of equations?

- A. $(0, 0)$
- B. $(0, 4)$
- C. $(8, 44)$
- D. $(8, 84)$

ID: 58443765 Answer

Correct Answer:

B

Rationale

Choice B is correct. The second equation in the given system is $y = 5x^2 + 4$. Substituting $5x^2 + 4$ for y in the first equation of the given system yields $5x^2 + 4 = 5x + 4$. Subtracting 4 from both sides of this equation yields $5x^2 = 5x$. Subtracting $5x$ from both sides of this equation yields $5x^2 - 5x = 0$. Factoring out a common factor of $5x$ from the left-hand side of this equation yields $5x(x - 1) = 0$. It follows that $5x = 0$ or $x - 1 = 0$. Dividing both sides of the equation $5x = 0$ by 5 yields $x = 0$. Substituting 0 for x in the equation $y = 5x + 4$ yields $y = 5(0) + 4$, or $y = 4$. Therefore, a solution to the given system of equations is the ordered pair $(0, 4)$.

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

Question ID 3d7d7534

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 3d7d7534

$$(d - 30)(d + 30) - 7 = -7$$

What is a solution to the given equation?

ID: 3d7d7534 Answer

Correct Answer:

30, -30

Rationale

The correct answer is either **-30** or **30**. Adding **7** to each side of the given equation yields $(d - 30)(d + 30) = 0$. Since a product of two factors is equal to **0** if and only if at least one of the factors is **0**, either $d - 30 = 0$ or $d + 30 = 0$. Adding **30** to each side of the equation $d - 30 = 0$ yields $d = 30$. Subtracting **30** from each side of the equation $d + 30 = 0$ yields $d = -30$. Therefore, the solutions to the given equation are **-30** and **30**. Note that -30 and 30 are examples of ways to enter a correct answer.

Question Difficulty:

Medium

Question ID 841ef26c

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 841ef26c

$$f(x) = 4x^2 + 64x + 262$$

The function g is defined by $g(x) = f(x + 5)$. For what value of x does $g(x)$ reach its minimum?

- A. -13
- B. -8
- C. -5
- D. -3

ID: 841ef26c Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that $g(x) = f(x + 5)$. Since $f(x) = 4x^2 + 64x + 262$, it follows that $f(x + 5) = 4(x + 5)^2 + 64(x + 5) + 262$. Expanding the quantity $(x + 5)^2$ in this equation yields $f(x + 5) = 4(x^2 + 10x + 25) + 64(x + 5) + 262$. Distributing the 4 and the 64 yields $f(x + 5) = 4x^2 + 40x + 100 + 64x + 320 + 262$. Combining like terms yields $f(x + 5) = 4x^2 + 104x + 682$. Therefore, $g(x) = 4x^2 + 104x + 682$. For a quadratic function defined by an equation of the form $g(x) = a(x - h)^2 + k$, where a , h , and k are constants and a is positive, $g(x)$ reaches its minimum, k , when the value of x is h . The equation $g(x) = 4x^2 + 104x + 682$ can be rewritten in this form by completing the square. This equation is equivalent to $g(x) = 4(x^2 + 26) + 682$, or $g(x) = 4(x^2 + 26x + 169 - 169) + 682$. This equation can be rewritten as $g(x) = 4((x + 13)^2 - 169) + 682$, or $g(x) = 4(x + 13)^2 - 4(169) + 682$, which is equivalent to $g(x) = 4(x + 13)^2 + 6$. This equation is in the form $g(x) = a(x - h)^2 + k$, where $a = 4$, $h = -13$, and $k = 6$. Therefore, $g(x)$ reaches its minimum when the value of x is -13 .

Choice B is incorrect. This is the value of x for which $f(x)$, rather than $g(x)$, reaches its minimum.

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

Choice D is incorrect. This is the value of x for which $f(x - 5)$, rather than $f(x + 5)$, reaches its minimum.

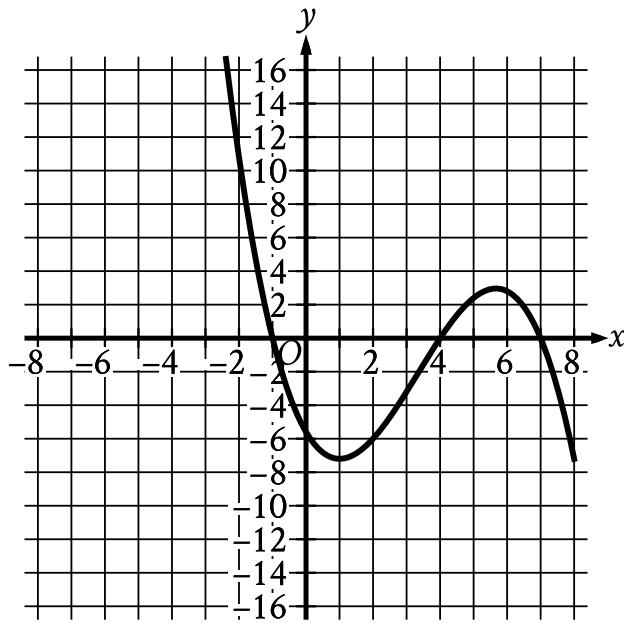
Question Difficulty:

Hard

Question ID cc6ccd71

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: cc6ccd71



The graph of $y = f(x)$ is shown, where the function f is defined by $f(x) = ax^3 + bx^2 + cx + d$ and a, b, c , and d are constants. For how many values of x does $f(x) = 0$?

- A. One
- B. Two
- C. Three
- D. Four

ID: cc6ccd71 Answer

Correct Answer:

C

Rationale

Choice C is correct. If a value of x satisfies $f(x) = 0$, the graph of $y = f(x)$ will contain a point $(x, 0)$ and thus touch the x-axis. Since there are 3 points at which this graph touches the x-axis, there are 3 values of x for which $f(x) = 0$.

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:

Medium

Question ID 70482e20

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 70482e20

Which expression is equivalent to $11x^3 - 5x^3$?

- A. $16x^3$
- B. $6x^3$
- C. $6x^6$
- D. $16x^6$

ID: 70482e20 Answer

Correct Answer:

B

Rationale

Choice B is correct. The given expression can be rewritten as $11x^3 + (-5)x^3$. Since the two terms of this expression are both constant multiples of x^3 , they are like terms and can, therefore, be combined through addition. Adding like terms in the expression $11x^3 + (-5)x^3$ yields $6x^3$.

Choice A is incorrect. This is equivalent to $11x^3 + 5x^3$, not $11x^3 - 5x^3$.

Choice C is incorrect. This is equivalent to $11x^6 - 5x^6$, not $11x^3 - 5x^3$.

Choice D is incorrect. This is equivalent to $11x^6 + 5x^6$, not $11x^3 - 5x^3$.

Question Difficulty:

Easy

Question ID 8452c42b

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 8452c42b

Which expression is equivalent to $50x^2 + 5x^2$?

- A. $250x^2$
- B. $10x^2$
- C. $45x^2$
- D. $55x^2$

ID: 8452c42b Answer

Correct Answer:

D

Rationale

Choice D is correct. The given expression shows addition of two like terms. Therefore, the given expression is equivalent to $(50 + 5)x^2$, or $55x^2$.

Choice A is incorrect. This expression is equivalent to $(50)(5)x^2$, not $(50 + 5)x^2$.

Choice B is incorrect. This expression is equivalent to $(\frac{50}{5})x^2$, not $(50 + 5)x^2$.

Choice C is incorrect. This expression is equivalent to $(50 - 5)x^2$, not $(50 + 5)x^2$.

Question Difficulty:

Easy

Question ID b39d74a0

Assessment

Test

Domain

Skill

Difficulty

SAT

Math

Advanced Math

Nonlinear functions

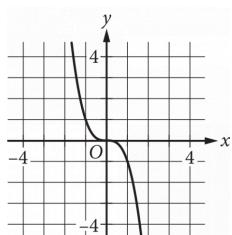


ID: b39d74a0

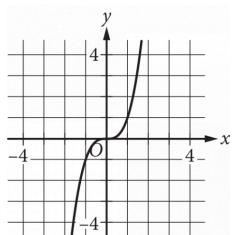
| x | y |
|---|----|
| 0 | 0 |
| 1 | 1 |
| 2 | 8 |
| 3 | 27 |

The table shown includes some values of x and their corresponding values of y . Which of the following graphs in the xy -plane could represent the relationship between x and y ?

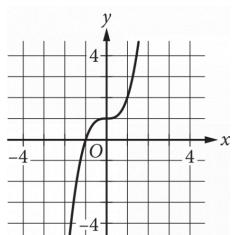
A.



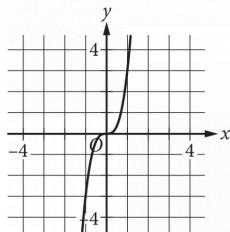
B.



C.



D.



ID: b39d74a0 Answer

Correct Answer:

B

Rationale

Choice B is correct. Each pair of values shown in the table gives the ordered pair of coordinates for a point that lies on the graph that represents the relationship between x and y in the xy -plane: $(0,0)$, $(1,1)$, $(2,8)$, and $(3,27)$. Only the graph in choice B passes through the points listed in the table that are visible in the given choices.

Choices A, C, and D are incorrect. None of these graphs passes through the point $(1,1)$.

Question Difficulty:

Easy

Question ID ea6d05bb

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: ea6d05bb

The expression $(3x - 23)(19x + 6)$ is equivalent to the expression $ax^2 + bx + c$, where a , b , and c are constants. What is the value of b ?

ID: ea6d05bb Answer

Correct Answer:

-419

Rationale

The correct answer is **-419**. It's given that the expression $(3x - 23)(19x + 6)$ is equivalent to the expression $ax^2 + bx + c$, where a , b , and c are constants. Applying the distributive property to the given expression, $(3x - 23)(19x + 6)$, yields $(3x)(19x) + (3x)(6) - (23)(19x) - (23)(6)$, which can be rewritten as $57x^2 + 18x - 437x - 138$. Combining like terms yields $57x^2 - 419x - 138$. Since this expression is equivalent to $ax^2 + bx + c$, it follows that the value of b is **-419**.

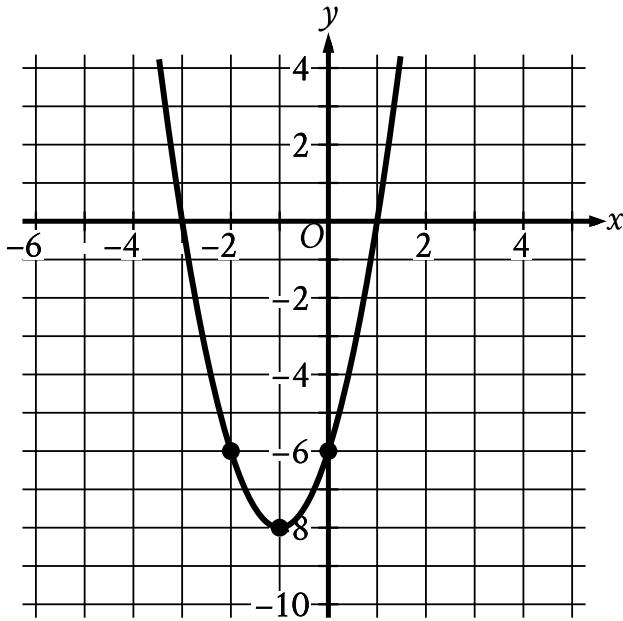
Question Difficulty:

Hard

Question ID 09d21d79

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 30%; height: 10px; background-color: #0056b3;"></div> <div style="width: 30%; height: 10px; background-color: #0056b3;"></div> <div style="width: 30%; height: 10px; background-color: #0056b3;"></div> |

ID: 09d21d79



The graph of $y = 2x^2 + bx + c$ is shown, where b and c are constants. What is the value of bc ?

ID: 09d21d79 Answer

Correct Answer:

-24

Rationale

The correct answer is -24 . Since the graph passes through the point $(0, -6)$, it follows that when the value of x is 0 , the value of y is -6 . Substituting 0 for x and -6 for y in the given equation yields $-6 = 2(0)^2 + b(0) + c$, or $-6 = c$. Therefore, the value of c is -6 . Substituting -6 for c in the given equation yields $y = 2x^2 + bx - 6$. Since the graph passes through the point $(-1, -8)$, it follows that when the value of x is -1 , the value of y is -8 . Substituting -1 for x and -8 for y in the equation $y = 2x^2 + bx - 6$ yields $-8 = 2(-1)^2 + b(-1) - 6$, or $-8 = 2 - b - 6$, which is equivalent to $-8 = -4 - b$. Adding 4 to each side of this equation yields $-4 = -b$. Dividing each side of this equation by -1 yields $4 = b$. Since the value of b is 4 and the value of c is -6 , it follows that the value of bc is $(4)(-6)$, or -24 .

Alternate approach: The given equation represents a parabola in the xy -plane with a vertex at $(-1, -8)$. Therefore, the given equation, $y = 2x^2 + bx + c$, which is written in standard form, can be written in vertex form, $y = a(x - h)^2 + k$, where (h, k) is the vertex of the parabola and a is the value of the coefficient on the x^2 term when the equation is written in standard form. It follows that $a = 2$. Substituting 2 for a , -1 for h , and -8 for k in this equation yields $y = 2(x - (-1))^2 + (-8)$, or $y = 2(x + 1)^2 - 8$. Squaring the binomial on the right-hand side of this equation yields $y = 2(x^2 + 2x + 1) - 8$. Multiplying each term inside the parentheses on the right-hand side of this equation by 2 yields $y = 2x^2 + 4x + 2 - 8$, which is equivalent to $y = 2x^2 + 4x - 6$. From the given equation $y = 2x^2 + bx + c$, it follows that the value of b is 4 and the value of c is -6 . Therefore, the value of bc is $(4)(-6)$, or -24 .

Question Difficulty:
Hard

Question ID 722de804

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #005a9f; height: 10px;"></div> |

ID: 722de804

$$(x - 47)^2 = 1$$

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

ID: 722de804 Answer

Correct Answer:

94

Rationale

The correct answer is 94. Taking the square root of each side of the given equation yields $x - 47 = 1$ or $x - 47 = -1$. Adding 47 to both sides of the equation $x - 47 = 1$ yields $x = 48$. Adding 47 to both sides of the equation $x - 47 = -1$ yields $x = 46$. Therefore, the sum of the solutions to the given equation is $48 + 46$, or 94.

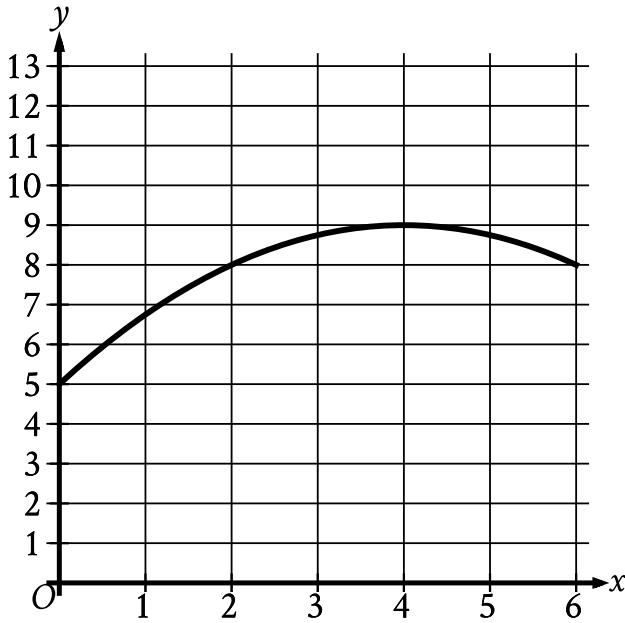
Question Difficulty:

Hard

Question ID 95d1c344

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 60%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 95d1c344



The graph models the number of active projects a company was working on x months after the end of November 2012, where $0 \leq x \leq 6$. According to the model, what is the predicted number of active projects the company was working on at the end of November 2012?

- A. 0
- B. 5
- C. 8
- D. 9

ID: 95d1c344 Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that the graph models the number of active projects a company was working on x months after the end of November 2012. Therefore, the value of x that corresponds to the end of November 2012 is 0. The point at which $x = 0$ is the y-intercept of the graph. It follows that the y-intercept of the graph shown is the point $(0, 5)$. Therefore, according to the model, the predicted number of active projects the company was working on at the end of November 2012 is 5.

Choice A is incorrect. This is the value of x that corresponds to the end of November 2012, not the predicted number of active projects the company was working on at the end of November 2012.

Choice C is incorrect. This is the predicted number of active projects the company was working on **2** months after the end of November **2012**.

Choice D is incorrect. This is the predicted number of active projects the company was working on **4** months after the end of November **2012**.

Question Difficulty:

Medium

Question ID 0536ad4f

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 75%; background-color: #cccccc; height: 10px;"></div> <div style="width: 75%; background-color: #cccccc; height: 10px;"></div> |

ID: 0536ad4f

Which expression is equivalent to $20w - (4w + 3w)$?

- A. $10w$
- B. $13w$
- C. $19w$
- D. $21w$

ID: 0536ad4f Answer

Correct Answer:

B

Rationale

Choice B is correct. Combining like terms inside the parentheses of the given expression, $20w - (4w + 3w)$, yields $20w - (7w)$. Combining like terms in this resulting expression yields $13w$.

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

Question ID 433184f1

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #005a99; height: 10px;"></div> |

ID: 433184f1

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

- A. $\frac{1}{(x+1)(4x-5)}$
- B. $\frac{3}{3x-6}$
- C. $-\frac{1}{(x+1)(4x-5)}$
- D. $\frac{9}{(x+1)(4x-5)}$

ID: 433184f1 Answer

Correct Answer:

D

Rationale

Choice D is correct. The expression $\frac{4}{4x-5} - \frac{1}{x+1}$ can be rewritten as $\frac{4}{4x-5} + \frac{(-1)}{x+1}$. To add the two terms of this expression, the terms can be rewritten with a common denominator. Since $\frac{x+1}{x+1} = 1$, the expression $\frac{4}{4x-5}$ can be rewritten as $\frac{(x+1)(4)}{(x+1)(4x-5)}$. Since $\frac{4x-5}{4x-5} = 1$, the expression $\frac{-1}{x+1}$ can be rewritten as $\frac{(4x-5)(-1)}{(4x-5)(x+1)}$. Therefore, the expression $\frac{4}{4x-5} + \frac{(-1)}{x+1}$ can be rewritten as $\frac{(x+1)(4)}{(x+1)(4x-5)} + \frac{(4x-5)(-1)}{(4x-5)(x+1)}$, which is equivalent to $\frac{(x+1)(4)+(4x-5)(-1)}{(x+1)(4x-5)}$. Applying the distributive property to each term of the numerator yields $\frac{(4x+4)+(-4x+5)}{(x+1)(4x-5)}$, or $\frac{(4x+(-4x))+(4+5)}{(x+1)(4x-5)}$. Adding like terms in the numerator yields $\frac{9}{(x+1)(4x-5)}$.

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

Question ID d135f4bf

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: d135f4bf

The function f is defined by $f(x) = (x - 6)(x - 2)(x + 6)$. In the xy -plane, the graph of $y = g(x)$ is the result of translating the graph of $y = f(x)$ up 4 units. What is the value of $g(0)$?

ID: d135f4bf Answer

Correct Answer:

76

Rationale

The correct answer is 76. It's given that the graph of $y = g(x)$ is the result of translating the graph of $y = f(x)$ up 4 units in the xy -plane. It follows that the graph of $y = g(x)$ is the same as the graph of $y = f(x) + 4$. Substituting $g(x)$ for y in the equation $y = f(x) + 4$ yields $g(x) = f(x) + 4$. It's given that $f(x) = (x - 6)(x - 2)(x + 6)$. Substituting $(x - 6)(x - 2)(x + 6)$ for $f(x)$ in the equation $g(x) = f(x) + 4$ yields $g(x) = (x - 6)(x - 2)(x + 6) + 4$. Substituting 0 for x in this equation yields $g(0) = (0 - 6)(0 - 2)(0 + 6) + 4$, or $g(0) = 76$. Thus, the value of $g(0)$ is 76.

Question Difficulty:

Hard

Question ID 1d3fee25

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #002B36; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> |

ID: 1d3fee25

Which of the following is equivalent to $3(x + 5) - 6$?

- A. $3x - 3$
- B. $3x - 1$
- C. $3x + 9$
- D. $15x - 6$

ID: 1d3fee25 Answer

Correct Answer:

C

Rationale

Choice C is correct. Using the distributive property to multiply 3 and $(x + 5)$ gives $3x + 15 - 6$, which can be rewritten as $3x + 9$.

Choice A is incorrect and may result from rewriting the given expression as $3(x + 5 - 6)$. Choice B is incorrect and may result from incorrectly rewriting the expression as $(3x + 5) - 6$. Choice D is incorrect and may result from incorrectly rewriting the expression as $3(5x) - 6$.

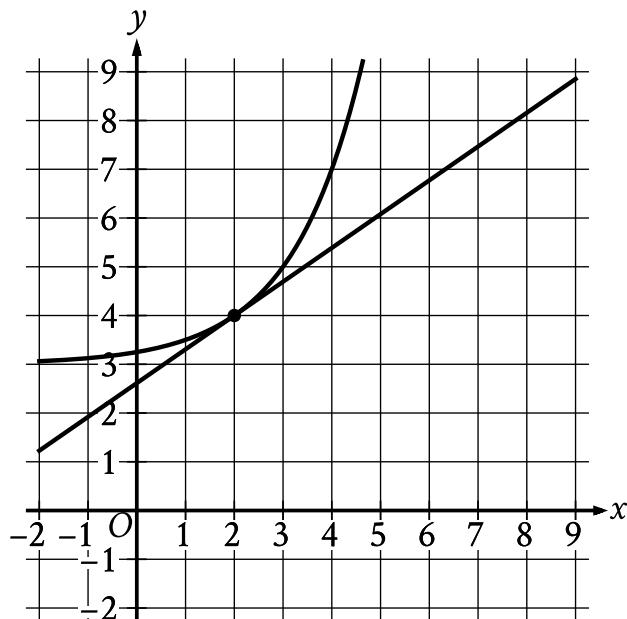
Question Difficulty:

Easy

Question ID 4ca30186

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #002B36; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> |

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

Question ID 911383f2

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

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

Question ID d8789a4c

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: d8789a4c

$$\frac{x^2 - c}{x - b}$$

In the expression above, b and c are positive integers. If the expression is equivalent to $x + b$ and $x \neq b$, which of the following could be the value of c ?

- A. 4
- B. 6
- C. 8
- D. 10

ID: d8789a4c Answer

Correct Answer:

A

Rationale

Choice A is correct. If the given expression is equivalent to $x + b$, then $\frac{x^2 - c}{x - b} = x + b$, where x isn't equal to b . Multiplying both sides of this equation by $x - b$ yields $x^2 - c = (x + b)(x - b)$. Since the right-hand side of this equation is in factored form for the difference of squares, the value of c must be a perfect square. Only choice A gives a perfect square for the value of c .

Choices B, C, and D are incorrect. None of these values of c produces a difference of squares. For example, when 6 is substituted

for c in the given expression, the result is $\frac{x^2 - 6}{x - b}$. The expression $x^2 - 6$ can't be factored with integer values, and therefore $\frac{x^2 - 6}{x - b}$ isn't equivalent to $x + b$.

Question Difficulty:

Hard

Question ID b80d10d7

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 20%; background-color: #003366; height: 10px;"></div> <div style="width: 20%; background-color: #006699; height: 10px;"></div> <div style="width: 60%; background-color: #cccccc; height: 10px;"></div> |

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 fde6f3bb

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a99; height: 10px;"></div> <div style="width: 25%; background-color: #005a99; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: fde6f3bb

$$\begin{aligned}g(x) &= \frac{3}{5}x + \frac{7}{6} \\h(x) &= 6x - 5\end{aligned}$$

The functions g and h are defined by the equations shown. Which expression is equivalent to $g(x) \cdot h(x)$?

- A. $\frac{18x^2}{5} - \frac{35}{6}$
- B. $\frac{18x^2}{5} + \frac{27x}{11} - \frac{35}{6}$
- C. $\frac{18x^2}{5} - 4x - \frac{35}{6}$
- D. $\frac{18x^2}{5} + 4x - \frac{35}{6}$

ID: fde6f3bb Answer

Correct Answer:

D

Rationale

Choice D is correct. It's given that $g(x) = \frac{3}{5}x + \frac{7}{6}$ and $h(x) = 6x - 5$. Substituting $\frac{3}{5}x + \frac{7}{6}$ for $g(x)$ and $6x - 5$ for $h(x)$ in the expression $g(x) \cdot h(x)$ yields $(\frac{3}{5}x + \frac{7}{6})(6x - 5)$. This expression can be rewritten as $\frac{3}{5}x(6x - 5) + \frac{7}{6}(6x - 5)$, or $\frac{18x^2}{5} - 3x + 7x - \frac{35}{6}$, which is equivalent to $\frac{18x^2}{5} + 4x - \frac{35}{6}$.

Choice A is incorrect. This expression is equivalent to $\frac{3}{5}x(6x) + \frac{7}{6}(-5)$, not $(\frac{3}{5}x + \frac{7}{6})(6x - 5)$.

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

Choice C is incorrect. This expression is equivalent to $(\frac{3}{5}x - \frac{7}{6})(6x + 5)$, not $(\frac{3}{5}x + \frac{7}{6})(6x - 5)$.

Question Difficulty:

Medium

Question ID d4950429

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: d4950429

A rectangle has a length of x units and a width of $(x - 15)$ units. If the rectangle has an area of 76 square units, what is the value of x ?

- A. 4
- B. 19
- C. 23
- D. 76

ID: d4950429 Answer

Correct Answer:

B

Rationale

Choice B is correct. The area of a rectangle is equal to its length multiplied by its width. Multiplying the given length, x units, by the given width, $(x - 15)$ units, yields $x(x - 15)$ square units. If the rectangle has an area of 76 square units, it follows that $x(x - 15) = 76$, or $x^2 - 15x = 76$. Subtracting 76 from both sides of this equation yields $x^2 - 15x - 76 = 0$. Factoring the left-hand side of this equation yields $(x - 19)(x + 4) = 0$. Applying the zero product property to this equation yields two solutions: $x = 19$ and $x = -4$. Since x is the rectangle's length, in units, which must be positive, the value of x is 19.

Choice A is incorrect. This is the width, in units, of the rectangle, not the value of x .

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

Choice D is incorrect. This is the area, in square units, of the rectangle, not the value of x .

Question Difficulty:

Medium

Question ID 752055d1

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 752055d1

A scientist initially measures **12,000** bacteria in a growth medium. **4** hours later, the scientist measures **24,000** bacteria. Assuming exponential growth, the formula $P = C(2)^{rt}$ gives the number of bacteria in the growth medium, where r and C are constants and P is the number of bacteria t hours after the initial measurement. What is the value of r ?

- A. $\frac{1}{12,000}$
- B. $\frac{1}{4}$
- C. 4
- D. 12,000

ID: 752055d1 Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that the formula $P = C(2)^{rt}$ gives the number of bacteria in a growth medium, where r and C are constants and P is the number of bacteria t hours after the initial measurement. It's also given that a scientist initially measures **12,000** bacteria in the growth medium. Since the initial measurement is **0** hours after the initial measurement, it follows that when $t = 0$, $P = 12,000$. Substituting **0** for t and **12,000** for P in the given equation yields $12,000 = C(2)^{r(0)}$, or $12,000 = C(2)^0$, which is equivalent to $12,000 = C$. It's given that **4** hours later, the scientist measures **24,000** bacteria, or when $t = 4$, $P = 24,000$. Substituting **4** for t , **24,000** for P , and **12,000** for C in the given equation yields $24,000 = 12,000(2)^{4r}$. Dividing each side of this equation by **12,000** yields $2 = 2^{4r}$, or $2^1 = 2^{4r}$, which is equivalent to $1 = 4r$. Dividing both sides of this equation by **4** yields $\frac{1}{4} = r$. Therefore, the value of r is $\frac{1}{4}$.

Choice A is incorrect. This is the value of the reciprocal of C .

Choice C is incorrect. This is the value of the reciprocal of r .

Choice D is incorrect. This is the value of C .

Question Difficulty:

Medium

Question ID d0a53ef5

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: d0a53ef5

$$\sqrt{(x - 2)^2} = \sqrt{3x + 34}$$

What is the smallest solution to the given equation?

ID: d0a53ef5 Answer

Correct Answer:

-3

Rationale

The correct answer is **-3**. Squaring both sides of the given equation yields $(x - 2)^2 = 3x + 34$, which can be rewritten as $x^2 - 4x + 4 = 3x + 34$. Subtracting $3x$ and 34 from both sides of this equation yields $x^2 - 7x - 30 = 0$. This quadratic equation can be rewritten as $(x - 10)(x + 3) = 0$. According to the zero product property, $(x - 10)(x + 3)$ equals zero when either $x - 10 = 0$ or $x + 3 = 0$. Solving each of these equations for x yields $x = 10$ or $x = -3$. Therefore, the given equation has two solutions, **10** and **-3**. Of these two solutions, **-3** is the smallest solution to the given equation.

Question Difficulty:

Hard

Question ID fcdf87b7

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 50%; background-color: #cccccc; height: 10px;"></div> |

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

Question ID 3148fe3e

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 50%; background-color: #cccccc; height: 10px;"></div> |

ID: 3148fe3e

$$x^2 + y + 10 = 10$$

$$8x + 16 - y = 0$$

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

- A. -16
- B. -4
- C. 2
- D. 8

ID: 3148fe3e Answer

Correct Answer:

B

Rationale

Choice A is correct. Adding y to each side of the second equation in the given system of equations yields $8x + 16 = y$. Substituting $8x + 16$ for y in the first equation yields $x^2 + 8x + 16 + 10 = 10$. Subtracting 10 from each side of this equation yields $x^2 + 8x + 16 = 0$. This equation can be rewritten as $(x + 4)^2 = 0$. Taking the square root of each side of this equation yields $x + 4 = 0$. Subtracting 4 from each side of this equation yields $x = -4$. Therefore, the value of x is -4 .

Choice A is incorrect. This is the value of y , not x .

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:

Medium

Question ID 271ffad7

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 100px; height: 10px; background-color: #0056b3;"></div> <div style="width: 100px; height: 10px; background-color: #0056b3;"></div> <div style="width: 100px; height: 10px; background-color: #0056b3;"></div> |

ID: 271ffad7

A quadratic function models a projectile's height, in meters, above the ground in terms of the time, in seconds, after it was launched. The model estimates that the projectile was launched from an initial height of 7 meters above the ground and reached a maximum height of 51.1 meters above the ground 3 seconds after the launch. How many seconds after the launch does the model estimate that the projectile will return to a height of 7 meters?

- A. 3
- B. 6
- C. 7
- D. 9

ID: 271ffad7 Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that a quadratic function models the projectile's height, in meters, above the ground in terms of the time, in seconds, after it was launched. It follows that an equation representing the model can be written in the form

$f(x) = a(x - h)^2 + k$, where $f(x)$ is the projectile's estimated height above the ground, in meters, x seconds after the launch, a is a constant, and k is the maximum height above the ground, in meters, the model estimates the projectile reached h seconds after the launch. It's given that the model estimates the projectile reached a maximum height of 51.1 meters above the ground 3 seconds after the launch. Therefore, $k = 51.1$ and $h = 3$. Substituting 51.1 for k and 3 for h in the equation

$f(x) = a(x - h)^2 + k$ yields $f(x) = a(x - 3)^2 + 51.1$. It's also given that the model estimates that the projectile was launched from an initial height of 7 meters above the ground. Therefore, when $x = 0$, $f(x) = 7$. Substituting 0 for x and 7 for $f(x)$ in the equation $f(x) = a(x - 3)^2 + 51.1$ yields $7 = a(0 - 3)^2 + 51.1$, or $7 = 9a + 51.1$. Subtracting 51.1 from both sides of this equation yields $-44.1 = 9a$. Dividing both sides of this equation by 9 yields $-4.9 = a$. Substituting -4.9 for a in the equation $f(x) = a(x - 3)^2 + 51.1$ yields $f(x) = -4.9(x - 3)^2 + 51.1$. Therefore, the equation

$f(x) = -4.9(x - 3)^2 + 51.1$ models the projectile's height, in meters, above the ground x seconds after it was launched. The number of seconds after the launch that the model estimates that the projectile will return to a height of 7 meters is the value of x when $f(x) = 7$. Substituting 7 for $f(x)$ in $f(x) = -4.9(x - 3)^2 + 51.1$ yields $7 = -4.9(x - 3)^2 + 51.1$. Subtracting 51.1 from both sides of this equation yields $-44.1 = -4.9(x - 3)^2$. Dividing both sides of this equation by -4.9 yields

$9 = (x - 3)^2$. Taking the square root of both sides of this equation yields two equations: $3 = x - 3$ and $-3 = x - 3$. Adding 3 to both sides of the equation $3 = x - 3$ yields $6 = x$. Adding 3 to both sides of the equation $-3 = x - 3$ yields $0 = x$. Since 0 seconds after the launch represents the time at which the projectile was launched, 6 must be the number of seconds the model estimates that the projectile will return to a height of 7 meters.

Alternate approach: It's given that a quadratic function models the projectile's height, in meters, above the ground in terms of the time, in seconds, after it was launched. It's also given that the model estimates that the projectile was launched from an initial height of 7 meters above the ground and reached a maximum height of 51.1 meters above the ground 3 seconds after the launch. Since the model is quadratic, and quadratic functions are symmetric, the model estimates that for any given height less than the maximum height, the time the projectile takes to travel from the given height to the maximum height is the same as the time the

projectile takes to travel from the maximum height back to the given height. Thus, since the model estimates the projectile took **3** seconds to travel from **7** meters above the ground to its maximum height of **51.1** meters above the ground, the model also estimates the projectile will take **3** more seconds to travel from its maximum height of **51.1** meters above the ground back to **7** meters above the ground. Thus, the model estimates that the projectile will return to a height of **7** meters **3** seconds after it reaches its maximum height, which is **6** seconds after the launch.

Choice A is incorrect. The model estimates that **3** seconds after the launch, the projectile reached a height of **51.1** meters, not **7** meters.

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:

Hard

Question ID ee857afb

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: ee857afb

$$y = x^2 - 14x + 22$$

The given equation relates the variables x and y . For what value of x does the value of y reach its minimum?

ID: ee857afb Answer

Correct Answer:

7

Rationale

The correct answer is 7. When an equation is of the form $y = ax^2 + bx + c$, where a , b , and c are constants, the value of y reaches its minimum when $x = -\frac{b}{2a}$. Since the given equation is of the form $y = ax^2 + bx + c$, it follows that $a = 1$, $b = -14$, and $c = 22$. Therefore, the value of y reaches its minimum when $x = -\frac{(-14)}{2(1)}$, or $x = 7$.

Question Difficulty:

Hard

Question ID a520ba07

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: a520ba07

$$\sqrt[3]{x^3y^6}$$

Which of the following expressions is equivalent to the expression above?

- A. y^2
- B. xy^2
- C. y^3
- D. xy^3

ID: a520ba07 Answer

Correct Answer:

B

Rationale

Choice B is correct. One of the properties of radicals is $\sqrt[n]{ab} = \sqrt[n]{a} \cdot \sqrt[n]{b}$. Thus, the given expression can be rewritten as $\sqrt[3]{x^3} \cdot \sqrt[3]{y^6}$. Simplifying by taking the cube root of each part gives $x^1 \cdot y^2$, or xy^2 .

Choices A, C, and D are incorrect and may be the result of incorrect application of the properties of exponents and radicals.

Question Difficulty:

Medium

Question ID 5b6af6b1

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: 5b6af6b1

Which expression is equivalent to $(d - 6)(8d^2 - 3)$?

- A. $8d^3 - 14d^2 - 3d + 18$
- B. $8d^3 - 17d^2 + 48$
- C. $8d^3 - 48d^2 - 3d + 18$
- D. $8d^3 - 51d^2 + 48$

ID: 5b6af6b1 Answer

Correct Answer:

C

Rationale

Choice C is correct. Applying the distributive property to the given expression yields $d(8d^2 - 3) - 6(8d^2 - 3)$. Applying the distributive property once again to this expression yields $(d)(8d^2) + (d)(-3) + (-6)(8d^2) + (-6)(-3)$, or $8d^3 + (-3d) + (-48d^2) + 18$. This expression can be rewritten as $8d^3 - 48d^2 - 3d + 18$. Thus, $(d - 6)(8d^2 - 3)$ is equivalent to $8d^3 - 48d^2 - 3d + 18$.

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:

Medium

Question ID 652054da

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 20%; background-color: #003366; height: 10px;"></div> <div style="width: 20%; background-color: #003366; height: 10px;"></div> <div style="width: 60%; background-color: #cccccc; height: 10px;"></div> |

ID: 652054da

An oceanographer uses the equation $s = \frac{3}{2}p$ 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. $p = \frac{2}{3}s$
- B. $p = \frac{3}{2}s$
- C. $p = \frac{2}{3} + s$
- D. $p = \frac{3}{2} + s$

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 $s = \frac{3}{2}p$ 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 $\frac{3}{2}$

will isolate p . This yields $\frac{2}{3}s = \frac{2}{3}\left(\frac{3}{2}p\right)$, which simplifies to $\frac{2}{3}s = p$. Therefore, $p = \frac{2}{3}s$.

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

Question Difficulty:

Medium

Question ID 0380bbdc

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 0380bbdc

If $4\sqrt{2x} = 16$, what is the value of $6x$?

- A. 24
- B. 48
- C. 72
- D. 96

ID: 0380bbdc Answer

Correct Answer:

B

Rationale

Choice B is correct. Dividing each side of the given equation by 4 yields $\sqrt{2x} = 4$. Squaring both sides of this equation yields $2x = 16$. Multiplying each side of this equation by 3 yields $6x = 48$. Therefore, the value of $6x$ is 48.

Choice A is incorrect. This is the value of $3x$, not $6x$.

Choice C is incorrect. This is the value of $9x$, not $6x$.

Choice D is incorrect. This is the value of $12x$, not $6x$.

Question Difficulty:

Medium

Question ID 837e9da7

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 837e9da7

The function f is defined by $f(x) = \frac{1}{6x}$. What is the value of $f(x)$ when $x = 3$?

- A. $\frac{1}{3}$
- B. $\frac{1}{6}$
- C. $\frac{1}{9}$
- D. $\frac{1}{18}$

ID: 837e9da7 Answer

Correct Answer:

D

Rationale

Choice D is correct. It's given that $f(x) = \frac{1}{6x}$. Substituting 3 for x in this equation yields $f(3) = \frac{1}{6(3)}$, or $f(3) = \frac{1}{18}$. Therefore, when $x = 3$, the value of $f(x)$ is $\frac{1}{18}$.

Choice A is incorrect. This is the value of $f(x)$ when $x = 0.5$.

Choice B is incorrect. This is the value of $f(x)$ when $x = 1$.

Choice C is incorrect. This is the value of $f(x)$ when $x = 1.5$.

Question Difficulty:

Easy

Question ID a255ae72

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: a255ae72

If $x^2 = a + b$ and $y^2 = a + c$, which of the

following is equal to $(x^2 - y^2)^2$?

- A. $a^2 - 2ac + c^2$
- B. $b^2 - 2bc + c^2$
- C. $4a^2 - 4abc + c^2$
- D. $4a^2 - 2abc + b^2c^2$

ID: a255ae72 Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that $x^2 = a + b$ and $y^2 = a + c$. Using the distributive property, the expression $(x^2 - y^2)^2$ can be rewritten as $(x^2)^2 - 2x^2y^2 + (y^2)^2$. Substituting $a + b$ and $a + c$ for x^2 and y^2 , respectively, in this expression yields $(a+b)^2 - 2((a+b)(a+c)) + (a+c)^2$. Expanding this expression yields $(a^2 + 2ab + b^2) - (2a^2 + 2bc + 2ac + 2ab) + (a^2 + 2ac + c^2)$. Combining like terms, this expression can be rewritten as $b^2 - 2bc + c^2$.

Choices A, C, and D are incorrect and may result from an error in using the distributive property, substituting, or combining like terms.

Question Difficulty:

Medium

Question ID dd3b1e1a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: dd3b1e1a

$$f(x) = x^5 + 9x + 17$$

For the given function f , the graph of $y = f(x)$ in the xy -plane passes through the point $(0, b)$, where b is a constant. What is the value of b ?

ID: dd3b1e1a Answer

Correct Answer:

17

Rationale

The correct answer is 17. It's given that the graph of $y = f(x)$ in the xy -plane passes through the point $(0, b)$, where b is a constant. It follows that $f(0)$ equals b . Substituting 0 for x in the given function yields $f(0) = 0^5 + 9(0) + 17$, or $f(0) = 17$. Therefore, the value of b is 17.

Question Difficulty:

Medium

Question ID 3de7a7d7

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|---|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 75%; background-color: #cccccc; height: 10px;"></div> |

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

Question ID 70f98ab4

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

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

Question ID 35e05e19

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 35e05e19

A park ranger hung squirrel houses each in the shape of a right rectangular prism for fox squirrels. Each house has a height of **11** inches. The length of each house's base is x inches, which is **1** inch more than the width of the house's base. Which function V gives the volume of each house, in cubic inches, in terms of the length of the house's base?

- A. $V(x) = 11x(x - 1)$
- B. $V(x) = 11x(x + 1)$
- C. $V(x) = x(x + 11)(x - 1)$
- D. $V(x) = x(x + 11)(x + 1)$

ID: 35e05e19 Answer

Correct Answer:

A

Rationale

Choice A is correct. The volume of a prism is equal to the area of its base times its height. It's given that the length of each house's base is x inches and that this length is **1** inch more than the width, in inches, of the house's base. It follows that the width, in inches, of the house's base is $x - 1$. The area of a rectangle is the product of its length and its width. Therefore, the area of the base of the house is $x(x - 1)$ square inches. It's given that the height of each house is **11** inches. Therefore, the function V that gives the volume of each house, in cubic inches, in terms of the length of the house's base x is $V(x) = x(x - 1)11$, or $V(x) = 11x(x - 1)$.

Choice B 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:

Hard

Question ID 2c05d312

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 2c05d312

$$57x^2 + (57b + a)x + ab = 0$$

In the given equation, a and b are positive constants. The product of the solutions to the given equation is kab , where k is a constant. What is the value of k ?

- A. $\frac{1}{57}$
- B. $\frac{1}{19}$
- C. 1
- D. 57

ID: 2c05d312 Answer

Correct Answer:

A

Rationale

Choice A is correct. The left-hand side of the given equation is the expression $57x^2 + (57b + a)x + ab$. Applying the distributive property to this expression yields $57x^2 + 57bx + ax + ab$. Since the first two terms of this expression have a common factor of $57x$ and the last two terms of this expression have a common factor of a , this expression can be rewritten as $57x(x + b) + a(x + b)$. Since the two terms of this expression have a common factor of $(x + b)$, it can be rewritten as $(x + b)(57x + a)$. Therefore, the given equation can be rewritten as $(x + b)(57x + a) = 0$. By the zero product property, it follows that $x + b = 0$ or $57x + a = 0$. Subtracting b from both sides of the equation $x + b = 0$ yields $x = -b$. Subtracting a from both sides of the equation $57x + a = 0$ yields $57x = -a$. Dividing both sides of this equation by 57 yields $x = \frac{-a}{57}$. Therefore, the solutions to the given equation are $-b$ and $\frac{-a}{57}$. It follows that the product of the solutions of the given equation is $(-b)\left(\frac{-a}{57}\right)$, or $\frac{ab}{57}$. It's given that the product of the solutions of the given equation is kab . It follows that $\frac{ab}{57} = kab$, which can also be written as $ab\left(\frac{1}{57}\right) = ab(k)$. It's given that a and b are positive constants. Therefore, dividing both sides of the equation $ab\left(\frac{1}{57}\right) = ab(k)$ by ab yields $\frac{1}{57} = k$. Thus, the value of k is $\frac{1}{57}$.

Choice B 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:

Hard

Question ID 1fe32f7d

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 1fe32f7d

$$-x^2 + bx - 676 = 0$$

In the given equation, b is a positive integer. The equation has no real solution. What is the greatest possible value of b ?

ID: 1fe32f7d Answer

Correct Answer:

51

Rationale

The correct answer is 51. A quadratic equation of the form $ax^2 + bx + c = 0$, where a , b , and c are constants, has no real solution if and only if its discriminant, $-4ac + b^2$, is negative. In the given equation, $a = -1$ and $c = -676$. Substituting -1 for a and -676 for c in this expression yields a discriminant of $b^2 - 4(-1)(-676)$, or $b^2 - 2,704$. Since this value must be negative, $b^2 - 2,704 < 0$, or $b^2 < 2,704$. Taking the positive square root of each side of this inequality yields $b < 52$. Since b is a positive integer, and the greatest integer less than 52 is 51, the greatest possible value of b is 51.

Question Difficulty:

Hard

Question ID a45ffacb

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 60%; background-color: #0056b3; height: 10px;"></div> |

ID: a45ffacb

Function f is defined by $f(x) = -a^x + b$, where a and b are constants. In the xy -plane, the graph of $y = f(x) - 15$ has a y -intercept at $(0, -\frac{99}{7})$. The product of a and b is $\frac{65}{7}$. What is the value of a ?

ID: a45ffacb Answer

Correct Answer:

5

Rationale

The correct answer is 5. It's given that $f(x) = -a^x + b$. Substituting $-a^x + b$ for $f(x)$ in the equation $y = f(x) - 15$ yields $y = -a^x + b - 15$. It's given that the y -intercept of the graph of $y = f(x) - 15$ is $(0, -\frac{99}{7})$. Substituting 0 for x and $-\frac{99}{7}$ for y in the equation $y = -a^x + b - 15$ yields $-\frac{99}{7} = -a^0 + b - 15$, which is equivalent to $-\frac{99}{7} = -1 + b - 15$, or $-\frac{99}{7} = b - 16$. Adding 16 to both sides of this equation yields $\frac{13}{7} = b$. It's given that the product of a and b is $\frac{65}{7}$, or $ab = \frac{65}{7}$. Substituting $\frac{13}{7}$ for b in this equation yields $(a)(\frac{13}{7}) = \frac{65}{7}$. Dividing both sides of this equation by $\frac{13}{7}$ yields $a = 5$.

Question Difficulty:

Hard

Question ID 95ed0b69

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 95ed0b69

$$p = \frac{k}{4j+9}$$

The given equation relates the distinct positive numbers p , k , and j . Which equation correctly expresses $4j + 9$ in terms of p and k ?

- A. $4j + 9 = \frac{k}{p}$
- B. $4j + 9 = kp$
- C. $4j + 9 = k - p$
- D. $4j + 9 = \frac{p}{k}$

ID: 95ed0b69 Answer

Correct Answer:

A

Rationale

Choice A is correct. To express $4j + 9$ in terms of p and k , the given equation must be solved for $4j + 9$. Since it's given that j is a positive number, $4j + 9$ is not equal to zero. Therefore, multiplying both sides of the given equation by $4j + 9$ yields the equivalent equation $p(4j + 9) = k$. Since it's given that p is a positive number, p is not equal to zero. Therefore, dividing each side of the equation $p(4j + 9) = k$ by p yields the equivalent equation $4j + 9 = \frac{k}{p}$.

Choice B is incorrect. This equation is equivalent to $p = \frac{4j+9}{k}$.

Choice C is incorrect. This equation is equivalent to $p = k - 4j - 9$.

Choice D is incorrect. This equation is equivalent to $p = k(4j + 9)$.

Question Difficulty:

Medium

Question ID 463eec13

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 463eec13

If $x \neq 0$, which of the following expressions is

$$\frac{\sqrt{16x^4y^8}}{x^3} \quad ?$$

- A. $8x^2y^4$
- B. $4xy^4$
- C. $4x^{-2}y^2$
- D. $4x^{-1}y^4$

ID: 463eec13 Answer

Correct Answer:

D

Rationale

$$\frac{\sqrt{16x^4y^8}}{x^3} = \frac{4x^2y^4}{x^3}$$

Choice D is correct. Taking the square root of an exponential expression halves the exponent, so

$$\frac{4y^4}{x} \quad \text{further reduces to} \quad 4x^{-1}y^4.$$

Choice A is incorrect and may result from neglecting the denominator of the given expression and from incorrectly calculating the square root of 16. Choice B is incorrect and may result from rewriting $\frac{1}{x}$ as x^1 rather than x^{-1} . Choice C is incorrect and may result from taking the square root of the variables in the numerator twice instead of once.

Question Difficulty:

Medium

Question ID 821e724e

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 821e724e

The function g is defined by $g(x) = (x + 14)(t - x)$, where t is a constant. In the xy -plane, the graph of $y = g(x)$ passes through the point $(24, 0)$. What is the value of $g(0)$?

ID: 821e724e Answer

Correct Answer:

336

Rationale

The correct answer is 336. By the zero product property, if $(x + 14)(t - x) = 0$, then $x + 14 = 0$, which gives $x = -14$, or $(t - x) = 0$, which gives $x = t$. Therefore, $g(x) = 0$ when $x = -14$ and when $x = t$. Since the graph of $y = g(x)$ passes through the point $(24, 0)$, it follows that $g(24) = 0$, so $t = 24$. Substituting 24 for t in the equation $g(x) = (x + 14)(t - x)$ yields $g(x) = (x + 14)(24 - x)$. The value of $g(0)$ can be calculated by substituting 0 for x in this equation, which yields $g(0) = (0 + 14)(24 - 0)$, or $g(0) = 336$.

Question Difficulty:

Hard

Question ID 341ba5db

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 341ba5db

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

What is the minimum value of the given function?

- A. 0
- B. 55
- C. 110
- D. 3,025

ID: 341ba5db Answer

Correct Answer:

B

Rationale

Choice B is correct. For a quadratic function defined by an equation of the form $g(x) = a(x - h)^2 + k$, where a , h , and k are constants and $a > 0$, the minimum value of the function is k . In the given function, $a = 1$, $h = 0$, and $k = 55$. Therefore, the minimum value of the given function is 55.

Choice A is incorrect. This is the value of x for which the given function reaches its minimum value, not the minimum value of the function.

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:

Medium

Question ID d8e84431

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: d8e84431

The area of a rectangular banner is **2,661** square inches. The banner's length x , in inches, is **24** inches longer than its width, in inches. Which equation represents this situation?

- A. $0 = x^2 - 24x - 2,661$
- B. $0 = x^2 - 24x + 2,661$
- C. $0 = x^2 + 24x - 2,661$
- D. $0 = x^2 + 24x + 2,661$

ID: d8e84431 Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that the banner's length x , in inches, is **24** inches longer than its width, in inches. It follows that the banner's width, in inches, can be represented by the expression $x - 24$. The area of a rectangle is the product of its length and its width. It's given that the area of the banner is **2,661** square inches, so it follows that $2,661 = x(x - 24)$, or $2,661 = x^2 - 24x$. Subtracting **2,661** from each side of this equation yields $0 = x^2 - 24x - 2,661$. Therefore, the equation that represents this situation is $0 = x^2 - 24x - 2,661$.

Choice B is incorrect and may result from representing the width, in inches, of the banner as $24 - x$, rather than $x - 24$.

Choice C is incorrect and may result from representing the width, in inches, of the banner as $x + 24$, rather than $x - 24$.

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

Question Difficulty:

Hard

Question ID 18e35375

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 18e35375

$$f(x) = (x - 14)(x + 19)$$

The function f is defined by the given equation. For what value of x does $f(x)$ reach its minimum?

- A. -266
- B. -19
- C. $-\frac{33}{2}$
- D. $-\frac{5}{2}$

ID: 18e35375 Answer

Correct Answer:

D

Rationale

Choice D is correct. It's given that $f(x) = (x - 14)(x + 19)$, which can be rewritten as $f(x) = x^2 + 5x - 266$. Since the coefficient of the x^2 -term is positive, the graph of $y = f(x)$ in the xy -plane opens upward and reaches its minimum value at its vertex. The x -coordinate of the vertex is the value of x such that $f(x)$ reaches its minimum. For an equation in the form $f(x) = ax^2 + bx + c$, where a , b , and c are constants, the x -coordinate of the vertex is $-\frac{b}{2a}$. For the equation $f(x) = x^2 + 5x - 266$, $a = 1$, $b = 5$, and $c = -266$. It follows that the x -coordinate of the vertex is $-\frac{5}{2(1)}$, or $-\frac{5}{2}$. Therefore, $f(x)$ reaches its minimum when the value of x is $-\frac{5}{2}$.

Alternate approach: The value of x for the vertex of a parabola is the x -value of the midpoint between the two x -intercepts of the parabola. Since it's given that $f(x) = (x - 14)(x + 19)$, it follows that the two x -intercepts of the graph of $y = f(x)$ in the xy -plane occur when $x = 14$ and $x = -19$, or at the points $(14, 0)$ and $(-19, 0)$. The midpoint between two points, (x_1, y_1) and (x_2, y_2) , is $(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2})$. Therefore, the midpoint between $(14, 0)$ and $(-19, 0)$ is $(\frac{14+(-19)}{2}, \frac{0+0}{2})$, or $(-\frac{5}{2}, 0)$. It follows that $f(x)$ reaches its minimum when the value of x is $-\frac{5}{2}$.

Choice A is incorrect. This is the y -coordinate of the y -intercept of the graph of $y = f(x)$ in the xy -plane.

Choice B is incorrect. This is one of the x -coordinates of the x -intercepts of the graph of $y = f(x)$ in the xy -plane.

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

Question Difficulty:

Hard

Question ID c303ad23

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #005a9f; height: 10px;"></div> |

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

Question ID 6e02cd78

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 25%; background-color: #005599; height: 10px;"></div> <div style="width: 50%; background-color: #cccccc; height: 10px;"></div> |

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

Question ID 15c364bf

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: 15c364bf

A sample of a certain isotope takes **29** years to decay to half its original mass. The function $s(t) = 184(0.5)^{\frac{t}{29}}$ gives the approximate mass of this isotope, in grams, that remains t years after a **184**-gram sample starts to decay. Which statement is the best interpretation of $s(87) = 23$ in this context?

- A. Approximately **23** grams of the sample remains **87** years after the sample starts to decay.
- B. The mass of the sample has decreased by approximately **23** grams **87** years after the sample starts to decay.
- C. The mass of the sample has decreased by approximately **87** grams **23** years after the sample starts to decay.
- D. Approximately **87** grams of the sample remains **23** years after the sample starts to decay.

ID: 15c364bf Answer

Correct Answer:

A

Rationale

Choice A is correct. In the given function, $s(t)$ represents the approximate mass, in grams, of the sample that remains t years after the sample starts to decay. It follows that the best interpretation of $s(87) = 23$ is that approximately **23** grams of the sample remains **87** years after the sample starts to decay.

Choice B is incorrect. The mass of the sample has decreased by approximately **184 – 23**, or **161**, grams, not **23** grams, **87** years after the sample starts to decay.

Choice C is incorrect. The mass of the sample has decreased by approximately **78** grams, not **87** grams, **23** years after the sample starts to decay.

Choice D is incorrect. This would be the best interpretation of $s(23) = 87$, not $s(87) = 23$.

Question Difficulty:

Medium

Question ID 2cb17792

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 2cb17792

$$\begin{aligned}y + k &= x + 26 \\y - k &= x^2 - 5x\end{aligned}$$

In the given system of equations, k is a constant. The system has exactly one distinct real solution. What is the value of k ?

ID: 2cb17792 Answer

Correct Answer:

17.5, 35/2

Rationale

The correct answer is $\frac{35}{2}$. Subtracting the second equation from the first equation yields $(y + k) - (y - k) = x + 26 - (x^2 - 5x)$, or $2k = -x^2 + 6x + 26$. This is equivalent to $x^2 - 6x + (2k - 26) = 0$. It's given that the system has exactly one distinct real solution; therefore, this equation has exactly one distinct real solution. An equation of the form $ax^2 + bx + c = 0$, where a , b , and c are constants, has exactly one distinct real solution when the discriminant, $b^2 - 4ac$, is equal to 0. The equation $x^2 - 6x + (2k - 26) = 0$ is of this form, where $a = 1$, $b = -6$, and $c = 2k - 26$. Substituting these values into the discriminant, $b^2 - 4ac$, yields $(-6)^2 - 4(1)(2k - 26)$. Setting the discriminant equal to 0 yields $(-6)^2 - 4(1)(2k - 26) = 0$, or $-8k + 140 = 0$. Subtracting 140 from both sides of this equation yields $-8k = -140$. Dividing both sides of this equation by -8 yields $k = \frac{35}{2}$. Note that $35/2$ and 17.5 are examples of ways to enter a correct answer.

Question Difficulty:

Hard

Question ID ce508fb0

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: ce508fb0

The functions f and g are defined by the given equations.

$$f(x) = 3 + |-2x - x^2|$$

$$g(w) = \left| \frac{-w}{w-1} \right| - w + 5$$

If $f(-4) = c$, where c is a constant, what is the value of $g(c)$?

ID: ce508fb0 Answer

Correct Answer:

-4.9, -49/10

Rationale

The correct answer is **-4.9**. The value of $f(-4)$ is the value of $f(x)$ when $x = -4$. Substituting -4 for x in the equation $f(x) = 3 + |-2x - x^2|$ yields $f(-4) = 3 + |-2(-4) - (-4)^2|$, or $f(-4) = 3 + |-8|$, which is equivalent to $f(-4) = 3 + 8$, or $f(-4) = 11$. Since it's given that $f(-4) = c$, it follows that $c = 11$ and the value of $g(c)$ is the value of $g(11)$. Substituting 11 for w in the equation $g(w) = \left| \frac{-w}{w-1} \right| - w + 5$ yields $g(11) = \left| \frac{-11}{11-1} \right| - 11 + 5$, or $g(11) = |-1.1| - 6$, which is equivalent to $g(11) = 1.1 - 6$, or $g(11) = -4.9$. Note that -4.9 and -49/10 are examples of ways to enter a correct answer.

Question Difficulty:

Hard

Question ID 74473be4

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #005a9f; height: 10px;"></div> |

ID: 74473be4

Which quadratic equation has no real solutions?

- A. $x^2 + 14x - 49 = 0$
- B. $x^2 - 14x + 49 = 0$
- C. $5x^2 - 14x - 49 = 0$
- D. $5x^2 - 14x + 49 = 0$

ID: 74473be4 Answer

Correct Answer:

D

Rationale

Choice D is correct. The number of solutions to a quadratic equation in the form $ax^2 + bx + c = 0$, where a , b , and c are constants, can be determined by the value of the discriminant, $b^2 - 4ac$. If the value of the discriminant is greater than zero, then the quadratic equation has two distinct real solutions. If the value of the discriminant is equal to zero, then the quadratic equation has exactly one real solution. If the value of the discriminant is less than zero, then the quadratic equation has no real solutions. For the quadratic equation in choice D, $5x^2 - 14x + 49 = 0$, $a = 5$, $b = -14$, and $c = 49$. Substituting 5 for a , -14 for b , and 49 for c in $b^2 - 4ac$ yields $(-14)^2 - 4(5)(49)$, or -784. Since -784 is less than zero, it follows that the quadratic equation $5x^2 - 14x + 49 = 0$ has no real solutions.

Choice A is incorrect. The value of the discriminant for this quadratic equation is 392. Since 392 is greater than zero, it follows that this quadratic equation has two real solutions.

Choice B is incorrect. The value of the discriminant for this quadratic equation is 0. Since zero is equal to zero, it follows that this quadratic equation has exactly one real solution.

Choice C is incorrect. The value of the discriminant for this quadratic equation is 1,176. Since 1,176 is greater than zero, it follows that this quadratic equation has two real solutions.

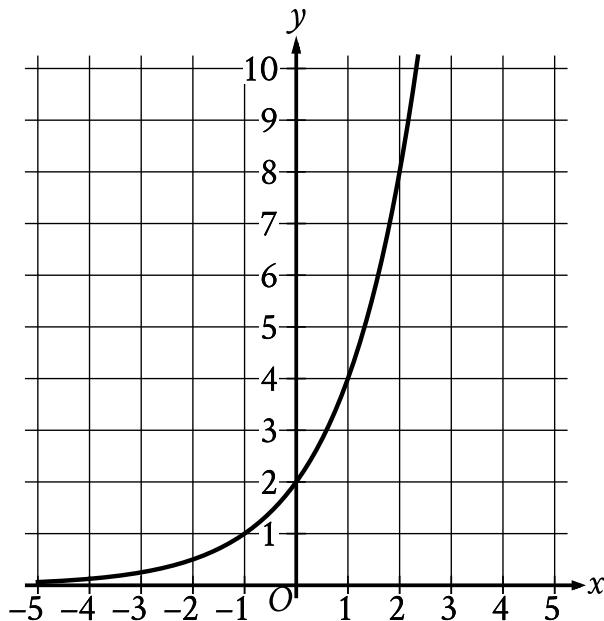
Question Difficulty:

Hard

Question ID b5c43226

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #e0e0e0;"></div> <div style="width: 25%; background-color: #e0e0e0;"></div> |

ID: b5c43226



What is the y -intercept of the graph shown?

- A. $(0, 0)$
- B. $(0, 2)$
- C. $(2, 0)$
- D. $(2, 2)$

ID: b5c43226 Answer

Correct Answer:

B

Rationale

Choice B is correct. The y -intercept of a graph in the xy -plane is the point at which the graph crosses the y -axis. The graph shown crosses the y -axis at the point $(0, 2)$. Therefore, the y -intercept of the graph shown is $(0, 2)$.

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

Question ID 13e5a5d5

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #002B36; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> |

ID: 13e5a5d5

$$5|x| = 45$$

What is the positive solution to the given equation?

ID: 13e5a5d5 Answer

Correct Answer:

9

Rationale

The correct answer is 9. Dividing both sides of the given equation by 5 yields $|x| = 9$. By the definition of absolute value, if $|x| = 9$, then $x = 9$ or $x = -9$. Therefore, the two solutions to the equation $5|x| = 45$ are 9 and -9 . It follows that the positive solution to the given equation is 9.

Question Difficulty:

Easy

Question ID 7bd10ef3

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

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.

Question Difficulty:
Hard

Question ID 2fec8bf4

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 2fec8bf4

$$P(t) = 1,800(1.02)^t$$

The function P gives the estimated number of marine mammals in a certain area, where t is the number of years since a study began. What is the best interpretation of $P(0) = 1,800$ in this context?

- A. The estimated number of marine mammals in the area was **102** when the study began.
- B. The estimated number of marine mammals in the area was **1,800** when the study began.
- C. The estimated number of marine mammals in the area increased by **102** each year during the study.
- D. The estimated number of marine mammals in the area increased by **1,800** each year during the study.

ID: 2fec8bf4 Answer

Correct Answer:

B

Rationale

Choice B is correct. The function P gives the estimated number of marine mammals in a certain area, where t is the number of years since a study began. Since the value of $P(0)$ is the value of $P(t)$ when $t = 0$, it follows that $P(0) = 1,800$ means that the value of $P(t)$ is **1,800** when $t = 0$. Since t is the number of years since the study began, it follows that $t = 0$ is 0 years since the study began, or when the study began. Therefore, the best interpretation of $P(0) = 1,800$ in this context is the estimated number of marine mammals in the area was **1,800** when the study began.

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.

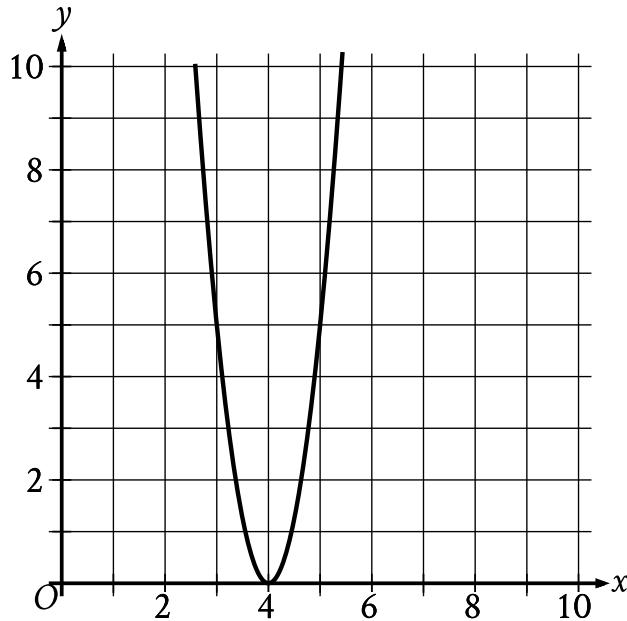
Question Difficulty:

Easy

Question ID e166aca6

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #e0e0e0;"></div> <div style="width: 25%; background-color: #e0e0e0;"></div> |

ID: e166aca6



What is the x -intercept of the graph shown?

- A. $(-5, 0)$
- B. $(5, 0)$
- C. $(-4, 0)$
- D. $(4, 0)$

ID: e166aca6 Answer

Correct Answer:

D

Rationale

Choice D is correct. The x -intercept of the graph shown is the point (x, y) on the graph where $y = 0$. At $y = 0$, the corresponding value of x is 4. Therefore, the x -intercept of the graph shown is $(4, 0)$.

Choice A is incorrect. This is the x -intercept of a graph in the xy -plane that intersects the x -axis at $x = -5$, not $x = 4$.

Choice B is incorrect. This is the x -intercept of a graph in the xy -plane that intersects the x -axis at $x = 5$, not $x = 4$.

Choice C is incorrect. This is the x -intercept of a graph in the xy -plane that intersects the x -axis at $x = -4$, not $x = 4$.

Question Difficulty:

Easy

Question ID f28944ff

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: f28944ff

$$q(x) = 32(2^x)$$

Which table gives three values of x and their corresponding values of $q(x)$ for function q ?

- A.

| | | | |
|--------|-----|---|----|
| x | -1 | 0 | 1 |
| $q(x)$ | -64 | 0 | 64 |
- B.

| | | | |
|--------|----------------|---|----|
| x | -1 | 0 | 1 |
| $q(x)$ | $\frac{1}{16}$ | 2 | 64 |
- C.

| | | | |
|--------|----------------|----|----|
| x | -1 | 0 | 1 |
| $q(x)$ | $\frac{1}{16}$ | 32 | 64 |
- D.

| | | | |
|--------|----|----|----|
| x | -1 | 0 | 1 |
| $q(x)$ | 16 | 32 | 64 |

ID: f28944ff Answer

Correct Answer:

D

Rationale

Choice D is correct. Substituting -1 for x in the given function yields $q(-1) = 32(2)^{-1}$, which is equivalent to $q(-1) = 32(\frac{1}{2})$, or $q(-1) = 16$. Therefore, when $x = -1$, the corresponding value of $q(x)$ for function q is 16 . Substituting 0 for x in the given function yields $q(0) = 32(2)^0$, which is equivalent to $q(0) = 32(1)$, or $q(0) = 32$. Therefore, when $x = 0$, the corresponding value of $q(x)$ for function q is 32 . Substituting 1 for x in the given function yields $q(1) = 32(2)^1$, which is equivalent to $q(1) = 32(2)$, or $q(1) = 64$. Therefore, when $x = 1$, the corresponding value of $q(x)$ for function q is 64 . Of the choices given, only the table in choice D gives these three values of x and their corresponding values of $q(x)$ for function q .

Choice A is incorrect. This table gives three values of x and their corresponding values of $q(x)$ for the function $q(x) = 32(2x)$.

Choice B is incorrect. This table gives three values of x and their corresponding values of $q(x)$ for the function $q(x) = 2(32)^x$.

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

Question Difficulty:

Medium

Question ID 11ccf3e1

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 50%; background-color: #cccccc; height: 10px;"></div> |

ID: 11ccf3e1

$$14j + 5k = m$$

The given equation relates the numbers j , k , and m . Which equation correctly expresses k in terms of j and m ?

- A. $k = \frac{m-14j}{5}$
- B. $k = \frac{1}{5}m - 14j$
- C. $k = \frac{14j-m}{5}$
- D. $k = 5m - 14j$

ID: 11ccf3e1 Answer

Correct Answer:

A

Rationale

Choice A is correct. Subtracting $14j$ from each side of the given equation results in $5k = m - 14j$. Dividing each side of this equation by 5 results in $k = \frac{m-14j}{5}$.

Choice B 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:

Medium

Question ID 50e40f08

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 60%; background-color: #0056b3; height: 10px;"></div> <div style="width: 60%; background-color: #0056b3; height: 10px;"></div> <div style="width: 40%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 50e40f08

$$f(x) = (x + 6)(x - 4)$$

If the given function f is graphed in the xy -plane, where $y = f(x)$, what is the x -coordinate of an x -intercept of the graph?

ID: 50e40f08 Answer

Correct Answer:

-6, 4

Rationale

The correct answer is either **-6** or **4**. The x -intercepts of a graph in the xy -plane are the points where $y = 0$. Thus, for an x -intercept of the graph of $y = f(x)$, $0 = f(x)$. Substituting 0 for $f(x)$ in the equation $f(x) = (x + 6)(x - 4)$ yields $0 = (x + 6)(x - 4)$. By the zero product property, $x + 6 = 0$ and $x - 4 = 0$. Subtracting **6** from both sides of the equation $x + 6 = 0$ yields $x = -6$. Adding **4** to both sides of the equation $x - 4 = 0$ yields $x = 4$. Therefore, the x -coordinates of the x -intercepts of the graph of $y = f(x)$ are **-6** and **4**. Note that -6 and 4 are examples of ways to enter a correct answer.

Question Difficulty:

Medium

Question ID e11294f9

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: e11294f9

The solutions to $x^2 + 6x + 7 = 0$ are r and s , where $r < s$. The solutions to $x^2 + 8x + 8 = 0$ are t and u , where $t < u$. The solutions to $x^2 + 14x + c = 0$, where c is a constant, are $r + t$ and $s + u$. What is the value of c ?

ID: e11294f9 Answer

Correct Answer:

31

Rationale

The correct answer is 31. Subtracting 7 from both sides of the equation $x^2 + 6x + 7 = 0$ yields $x^2 + 6x = -7$. To complete the square, adding $(\frac{6}{2})^2$, or 3^2 , to both sides of this equation yields $x^2 + 6x + 3^2 = -7 + 3^2$, or $(x + 3)^2 = 2$. Taking the square root of both sides of this equation yields $x + 3 = \pm\sqrt{2}$. Subtracting 3 from both sides of this equation yields $x = -3 \pm \sqrt{2}$. Therefore, the solutions r and s to the equation $x^2 + 6x + 7 = 0$ are $-3 - \sqrt{2}$ and $-3 + \sqrt{2}$. Since $r < s$, it follows that $r = -3 - \sqrt{2}$ and $s = -3 + \sqrt{2}$. Subtracting 8 from both sides of the equation $x^2 + 8x + 8 = 0$ yields $x^2 + 8x = -8$. To complete the square, adding $(\frac{8}{2})^2$, or 4^2 , to both sides of this equation yields $x^2 + 8x + 4^2 = -8 + 4^2$, or $(x + 4)^2 = 8$. Taking the square root of both sides of this equation yields $x + 4 = \pm\sqrt{8}$, or $x + 4 = \pm 2\sqrt{2}$. Subtracting 4 from both sides of this equation yields $x = -4 \pm 2\sqrt{2}$. Therefore, the solutions t and u to the equation $x^2 + 8x + 8 = 0$ are $-4 - 2\sqrt{2}$ and $-4 + 2\sqrt{2}$. Since $t < u$, it follows that $t = -4 - 2\sqrt{2}$ and $u = -4 + 2\sqrt{2}$. It's given that the solutions to $x^2 + 14x + c = 0$, where c is a constant, are $r + t$ and $s + u$. It follows that this equation can be written as $(x - (r + t))(x - (s + u)) = 0$, which is equivalent to $x^2 - (r + t + s + u)x + (r + t)(s + u) = 0$. Therefore, the value of c is $(r + t)(s + u)$. Substituting $-3 - \sqrt{2}$ for r , $-4 - 2\sqrt{2}$ for t , $-3 + \sqrt{2}$ for s , and $-4 + 2\sqrt{2}$ for u in this equation yields $((-3 - \sqrt{2}) + (-4 - 2\sqrt{2}))((-3 + \sqrt{2}) + (-4 + 2\sqrt{2}))$, which is equivalent to $(-7 - 3\sqrt{2})(-7 + 3\sqrt{2})$, or $(-7)(-7) - (3\sqrt{2})(3\sqrt{2})$, which is equivalent to $49 - 18$, or 31. Therefore, the value of c is 31.

Question Difficulty:

Hard

Question ID 772de699

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 772de699

Which expression is equivalent to $23x^3 + 2x^2 + 9x$?

- A. $23x(x^2 + 2x + 9)$
- B. $9x(23x^3 + 2x^2 + 1)$
- C. $x(23x^2 + 2x + 9)$
- D. $34(x^3 + x^2 + x)$

ID: 772de699 Answer

Correct Answer:

C

Rationale

Choice C is correct. Since x is a common factor of each term in the given expression, the given expression can be rewritten as $x(23x^2 + 2x + 9)$.

Choice A is incorrect. This expression is equivalent to $23x^3 + 46x^2 + 207x$.

Choice B is incorrect. This expression is equivalent to $207x^4 + 18x^3 + 9x$.

Choice D is incorrect. This expression is equivalent to $34x^3 + 34x^2 + 34x$.

Question Difficulty:

Easy

Question ID 03ff48d2

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #005a9f; height: 10px;"></div> |

ID: 03ff48d2

$$x(kx - 56) = -16$$

In the given equation, k is an integer constant. If the equation has no real solution, what is the least possible value of k ?

ID: 03ff48d2 Answer

Correct Answer:

50

Rationale

The correct answer is 50. An equation of the form $ax^2 + bx + c = 0$, where a , b , and c are constants, has no real solutions if and only if its discriminant, $b^2 - 4ac$, is negative. Applying the distributive property to the left-hand side of the equation

$x(kx - 56) = -16$ yields $kx^2 - 56x = -16$. Adding 16 to each side of this equation yields $kx^2 - 56x + 16 = 0$.

Substituting k for a , -56 for b , and 16 for c in $b^2 - 4ac$ yields a discriminant of $(-56)^2 - 4(k)(16)$, or $3,136 - 64k$. If the given equation has no real solution, it follows that the value of $3,136 - 64k$ must be negative. Therefore, $3,136 - 64k < 0$. Adding $64k$ to both sides of this inequality yields $3,136 < 64k$. Dividing both sides of this inequality by 64 yields $49 < k$, or $k > 49$. Since it's given that k is an integer, the least possible value of k is 50.

Question Difficulty:

Hard

Question ID 7028c74f

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 7028c74f

$$5(x + 7) = 15(x - 17)(x + 7)$$

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

ID: 7028c74f Answer

Correct Answer:

10.33, 31/3

Rationale

The correct answer is $\frac{31}{3}$. Subtracting $5(x + 7)$ from each side of the given equation yields $0 = 15(x - 17)(x + 7) - 5(x + 7)$. Since $5(x + 7)$ is a common factor of each of the terms on the right-hand side of this equation, it can be rewritten as $0 = 5(x + 7)(3(x - 17) - 1)$. This is equivalent to $0 = 5(x + 7)(3x - 51 - 1)$, or $0 = 5(x + 7)(3x - 52)$. Dividing both sides of this equation by 5 yields $0 = (x + 7)(3x - 52)$. Since a product of two factors is equal to 0 if and only if at least one of the factors is 0, either $x + 7 = 0$ or $3x - 52 = 0$. Subtracting 7 from both sides of the equation $x + 7 = 0$ yields $x = -7$. Adding 52 to both sides of the equation $3x - 52 = 0$ yields $3x = 52$. Dividing both sides of this equation by 3 yields $x = \frac{52}{3}$. Therefore, the solutions to the given equation are -7 and $\frac{52}{3}$. It follows that the sum of the solutions to the given equation is $-7 + \frac{52}{3}$, which is equivalent to $-\frac{21}{3} + \frac{52}{3}$, or $\frac{31}{3}$. Note that 31/3 and 10.33 are examples of ways to enter a correct answer.

Question Difficulty:

Hard

Question ID cfff8f8e

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: cfff8f8e

At the time of posting a video, a social media channel had **53** subscribers. Each day for five days after the video was posted, the number of subscribers doubled from the number the previous day. Which equation gives the total number of subscribers, n , to the channel d days after the video was posted?

- A. $n = (53)^d$
- B. $n = 53(2)^d$
- C. $n = 53\left(\frac{1}{2}\right)^d$
- D. $n = (53)^2 + d$

ID: cfff8f8e Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that each day for five days after a social media channel posted a video, the number of subscribers doubled from the number the previous day. Since the number of subscribers doubled each day, the relationship between n and d can be represented by an exponential equation of the form $n = ab^d$, where a is the number of subscribers at the time of posting the video and the number of subscribers to the channel increases by a factor of b each day. It's given that at the time of posting the video, the channel had **53** subscribers. Therefore, $a = 53$. It's also given that the number of subscribers doubled, or increased by a factor of **2**, from the number the previous day. Therefore, $b = 2$. Substituting **53** for a and **2** for b in the equation $n = ab^d$ yields $n = 53(2)^d$.

Choice A is incorrect. This equation gives the total number of subscribers to a channel for which the initial number of subscribers was **1** and the number increased each day by **53** times the number from the previous day.

Choice C is incorrect. This equation gives the total number of subscribers to a channel for which the number of subscribers each day was half the number from the previous day, rather than double the number.

Choice D is incorrect and may result from conceptual errors.

Question Difficulty:

Easy

Question ID c4259674

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: c4259674

The function f is defined by $f(x) = 4x^{-1}$. What is the value of $f(21)$?

- A. -84
- B. $\frac{1}{84}$
- C. $\frac{4}{21}$
- D. $\frac{21}{4}$

ID: c4259674 Answer

Correct Answer:

C

Rationale

Choice C is correct. It's given that function f is defined by the equation $f(x) = 4x^{-1}$. The value of $f(21)$ is the value of $f(x)$ when $x = 21$. Substituting 21 for x in the given equation yields $f(21) = 4(21)^{-1}$, which is equivalent to $f(21) = 4(\frac{1}{21})$, or $f(21) = \frac{4}{21}$.

Choice A is incorrect. This is the value of $f(21)$ when $f(x) = -4x$, rather than $f(x) = 4x^{-1}$.

Choice B is incorrect. This is the value of $f(21)$ when $f(x) = (4x)^{-1}$, rather than $f(x) = 4x^{-1}$.

Choice D is incorrect. This is the value of $f(21)$ when $f(x) = (4^{-1})x$, rather than $f(x) = 4x^{-1}$.

Question Difficulty:

Medium

Question ID 88867d37

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 88867d37

$$(x + 2)(x - 5)(x + 9) = 0$$

What is a positive solution to the given equation?

- A. 3
- B. 4
- C. 5
- D. 18

ID: 88867d37 Answer

Correct Answer:

C

Rationale

Choice C is correct. Applying the zero product property to the given equation yields three equations: $x + 2 = 0$, $x - 5 = 0$, and $x + 9 = 0$. Subtracting 2 from both sides of the equation $x + 2 = 0$ yields $x = -2$. Adding 5 to both sides of the equation $x - 5 = 0$ yields $x = 5$. Subtracting 9 from both sides of the equation $x + 9 = 0$ yields $x = -9$. Therefore, the solutions to the given equation are -2 , 5 , and -9 . It follows that a positive solution to the given equation is 5 .

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

Question ID 88a0c425

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 88a0c425

$$-2x^2 + 20x + c = 0$$

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

- A. -68
- B. -50
- C. -32
- D. 0

ID: 88a0c425 Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that the equation $-2x^2 + 20x + c = 0$, where c is a constant, has exactly one solution. A quadratic equation of the form $ax^2 + bx + c = 0$ has exactly one solution if and only if its discriminant, $b^2 - 4ac$, is equal to zero. It follows that for the given equation, $a = -2$ and $b = 20$. Substituting -2 for a and 20 for b in $b^2 - 4ac$ yields $20^2 - 4(-2)(c)$, or $400 + 8c$. Since the discriminant must equal zero, it follows that $400 + 8c = 0$. Subtracting 400 from both sides of this equation yields $8c = -400$. Dividing each side of this equation by 8 yields $c = -50$. Therefore, the value of c is -50 .

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:

Hard

Question ID 13e57f0a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #cccccc; height: 10px;"></div> |

ID: 13e57f0a

$$-4x^2 - 7x = -36$$

What is the positive solution to the given equation?

- A. $\frac{7}{4}$
- B. $\frac{9}{4}$
- C. 4
- D. 7

ID: 13e57f0a Answer

Correct Answer:

B

Rationale

Choice B is correct. Multiplying each side of the given equation by -16 yields $64x^2 + 112x = 576$. To complete the square, adding 49 to each side of this equation yields $64x^2 + 112x + 49 = 576 + 49$, or $(8x + 7)^2 = 625$. Taking the square root of each side of this equation yields two equations: $8x + 7 = 25$ and $8x + 7 = -25$. Subtracting 7 from each side of the equation $8x + 7 = 25$ yields $8x = 18$. Dividing each side of this equation by 8 yields $x = \frac{18}{8}$, or $x = \frac{9}{4}$. Therefore, $\frac{9}{4}$ is a solution to the given equation. Subtracting 7 from each side of the equation $8x + 7 = -25$ yields $8x = -32$. Dividing each side of this equation by 8 yields $x = -4$. Therefore, the given equation has two solutions, $\frac{9}{4}$ and -4 . Since $\frac{9}{4}$ is positive, it follows that $\frac{9}{4}$ is the positive solution to the given equation.

Alternate approach: Adding $4x^2$ and $7x$ to each side of the given equation yields $0 = 4x^2 + 7x - 36$. The right-hand side of this equation can be rewritten as $4x^2 + 16x - 9x - 36$. Factoring out the common factor of $4x$ from the first two terms of this expression and the common factor of -9 from the second two terms yields $4x(x + 4) - 9(x + 4)$. Factoring out the common factor of $(x + 4)$ from these two terms yields the expression $(4x - 9)(x + 4)$. Since this expression is equal to 0, it follows that either $4x - 9 = 0$ or $x + 4 = 0$. Adding 9 to each side of the equation $4x - 9 = 0$ yields $4x = 9$. Dividing each side of this equation by 4 yields $x = \frac{9}{4}$. Therefore, $\frac{9}{4}$ is a positive solution to the given equation. Subtracting 4 from each side of the equation $x + 4 = 0$ yields $x = -4$. Therefore, the given equation has two solutions, $\frac{9}{4}$ and -4 . Since $\frac{9}{4}$ is positive, it follows that $\frac{9}{4}$ is the positive solution to the given equation.

Choice A is incorrect. Substituting $\frac{7}{4}$ for x in the given equation yields $-\frac{49}{2} = -36$, which is false.

Choice C is incorrect. Substituting 4 for x in the given equation yields $-92 = -36$, which is false.

Choice D is incorrect. Substituting 7 for x in the given equation yields $-245 = -36$, which is false.

Question Difficulty:

Medium

Question ID 02489d55

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|---|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 75%; background-color: #cccccc; height: 10px;"></div> |

ID: 02489d55

Which expression is equivalent to $19(x^2 - 7)$?

- A. $19x^2 - 133$
- B. $19x^2 - 26$
- C. $19x^2 - 7$
- D. $19x^2 + 12$

ID: 02489d55 Answer

Correct Answer:

A

Rationale

Choice A is correct. The expression $19(x^2 - 7)$ can be rewritten as $19(x^2) - 19(7)$, which is equivalent to $19x^2 - 133$.

Choice B 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

Question ID be0c419e

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: be0c419e

Immanuel purchased a certain rare coin on January 1. The function $f(x) = 65(1.03)^x$, where $0 \leq x \leq 10$, gives the predicted value, in dollars, of the rare coin x years after Immanuel purchased it. What is the best interpretation of the statement " $f(8)$ is approximately equal to 82" in this context?

- A. When the rare coin's predicted value is approximately 82 dollars, it is 8% greater than the predicted value, in dollars, on January 1 of the previous year.
- B. When the rare coin's predicted value is approximately 82 dollars, it is 8 times the predicted value, in dollars, on January 1 of the previous year.
- C. From the day Immanuel purchased the rare coin to 8 years after Immanuel purchased the coin, its predicted value increased by a total of approximately 82 dollars.
- D. 8 years after Immanuel purchased the rare coin, its predicted value is approximately 82 dollars.

ID: be0c419e Answer

Correct Answer:

D

Rationale

Choice D is correct. It's given that the function $f(x) = 65(1.03)^x$ gives the predicted value, in dollars, of a certain rare coin x years after Immanuel purchased it. It follows that $f(x)$ represents the predicted value, in dollars, of the coin x years after Immanuel purchased it. Since the value of $f(8)$ is the value of $f(x)$ when $x = 8$, it follows that " $f(8)$ is approximately equal to 82" means that $f(x)$ is approximately equal to 82 when $x = 8$. Therefore, the best interpretation of the statement " $f(8)$ is approximately equal to 82" in this context is 8 years after Immanuel purchased the rare coin, its predicted value is approximately 82 dollars.

Choice A is incorrect and may result from conceptual errors.

Choice B is incorrect and may result from conceptual errors.

Choice C is incorrect and may result from conceptual errors.

Question Difficulty:

Medium

Question ID 8462b105

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 8462b105

The function f gives the product of a number, x , and a number that is 91 more than x . Which equation defines f ?

- A. $f(x) = x^2 + x + 91$
- B. $f(x) = x^2 + 91$
- C. $f(x) = x^2 + 91x$
- D. $f(x) = x^2 + 91x + 91$

ID: 8462b105 Answer

Correct Answer:

C

Rationale

Choice C is correct. It's given that the function f gives the product of a number, x , and a number that is 91 more than x . A number that is 91 more than x can be represented by the expression $x + 91$. Therefore, f can be defined by the equation $f(x) = x(x + 91)$, or $f(x) = x^2 + 91x$.

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:

Hard

Question ID ce579859

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: ce579859

A model estimates that at the end of each year from **2015** to **2020**, the number of squirrels in a population was **150%** more than the number of squirrels in the population at the end of the previous year. The model estimates that at the end of **2016**, there were **180** squirrels in the population. Which of the following equations represents this model, where n is the estimated number of squirrels in the population t years after the end of **2015** and $t \leq 5$?

- A. $n = 72(1.5)^t$
- B. $n = 72(2.5)^t$
- C. $n = 180(1.5)^t$
- D. $n = 180(2.5)^t$

ID: ce579859 Answer

Correct Answer:

B

Rationale

Choice B is correct. Since the model estimates that the number of squirrels in the population increased by a fixed percentage, **150%**, each year, the model can be represented by an exponential equation of the form $n = a\left(1 + \frac{p}{100}\right)^t$, where a is the estimated number of squirrels in the population at the end of **2015**, and the model estimates that at the end of each year, the number is $p\%$ more than the number at the end of the previous year. Since the model estimates that at the end of each year, the number was **150%** more than the number at the end of the previous year, $p = 150$. Substituting **150** for p in the equation $n = a\left(1 + \frac{p}{100}\right)^t$ yields $n = a\left(1 + \frac{150}{100}\right)^t$, which is equivalent to $n = a(1 + 1.5)^t$, or $n = a(2.5)^t$. It's given that the estimated number of squirrels at the end of **2016** was **180**. This means that when $t = 1$, $n = 180$. Substituting **1** for t and **180** for n in the equation $n = a(2.5)^t$ yields $180 = a(2.5)^1$, or $180 = 2.5a$. Dividing each side of this equation by **2.5** yields $72 = a$. Substituting **72** for a in the equation $n = a(2.5)^t$ yields $n = 72(2.5)^t$.

Choice A is incorrect. This equation represents a model where at the end of each year, the estimated number of squirrels was **150%** of, not **150%** more than, the estimated number at the end of the previous year.

Choice C is incorrect. This equation represents a model where at the end of each year, the estimated number of squirrels was **150%** of, not **150%** more than, the estimated number at the end of the previous year, and the estimated number of squirrels at the end of **2015**, not the end of **2016**, was **180**.

Choice D is incorrect. This equation represents a model where the estimated number of squirrels at the end of **2015**, not the end of **2016**, was **180**.

Question Difficulty:

Hard

Question ID 5355c0ef

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 5355c0ef

$$0.36x^2 + 0.63x + 1.17$$

The given expression can be rewritten as $a(4x^2 + 7x + 13)$, where a is a constant. What is the value of a ?

ID: 5355c0ef Answer

Correct Answer:

.09, 9/100

Rationale

The correct answer is .09. It's given that the expression $0.36x^2 + 0.63x + 1.17$ can be rewritten as $a(4x^2 + 7x + 13)$. Applying the distributive property to the expression $a(4x^2 + 7x + 13)$ yields $4ax^2 + 7ax + 13a$. Therefore, $0.36x^2 + 0.63x + 1.17$ can be rewritten as $4ax^2 + 7ax + 13a$. It follows that in the expressions $0.36x^2 + 0.63x + 1.17$ and $4ax^2 + 7ax + 13a$, the coefficients of x^2 are equivalent, the coefficients of x are equivalent, and the constant terms are equivalent. Therefore, $0.36 = 4a$, $0.63 = 7a$, and $1.17 = 13a$. Solving any of these equations for a yields the value of a . Dividing both sides of the equation $0.36 = 4a$ by 4 yields $0.09 = a$. Therefore, the value of a is 0.09. Note that .09 and 9/100 are examples of ways to enter a correct answer.

Question Difficulty:

Hard

Question ID 2f51abc2

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 2f51abc2

$$f(x) = |59 - 2x|$$

The function f is defined by the given equation. For which of the following values of k does $f(k) = 3k$?

- A. $\frac{59}{5}$
- B. $\frac{59}{2}$
- C. $\frac{177}{5}$
- D. 59

ID: 2f51abc2 Answer

Correct Answer:

A

Rationale

Choice A is correct. The value of k for which $f(k) = 3k$ can be found by substituting k for x and $3k$ for $f(x)$ in the given equation, $f(x) = |59 - 2x|$, which yields $3k = |59 - 2k|$. For this equation to be true, either $-3k = 59 - 2k$ or $3k = 59 - 2k$. Adding $2k$ to both sides of the equation $-3k = 59 - 2k$ yields $-k = 59$. Dividing both sides of this equation by -1 yields $k = -59$. To check whether -59 is the value of k , substituting -59 for k in the equation $3k = |59 - 2k|$ yields $3(-59) = |59 - 2(-59)|$, which is equivalent to $-177 = |177|$, or $-177 = 177$, which isn't a true statement. Therefore, -59 isn't the value of k . Adding $2k$ to both sides of the equation $3k = 59 - 2k$ yields $5k = 59$. Dividing both sides of this equation by 5 yields $k = \frac{59}{5}$. To check whether $\frac{59}{5}$ is the value of k , substituting $\frac{59}{5}$ for k in the equation $3k = |59 - 2k|$ yields $3\left(\frac{59}{5}\right) = |59 - 2\left(\frac{59}{5}\right)|$, which is equivalent to $\frac{177}{5} = \left|\frac{177}{5}\right|$, or $\frac{177}{5} = \frac{177}{5}$, which is a true statement. Therefore, the value of k for which $f(k) = 3k$ is $\frac{59}{5}$.

Choice B 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:

Hard

Question ID 17d0e87d

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 17d0e87d

$$\frac{14x}{7y} = 2\sqrt{w+19}$$

The given equation relates the distinct positive real numbers w , x , and y . Which equation correctly expresses w in terms of x and y ?

- A. $w = \sqrt{\frac{x}{y}} - 19$
- B. $w = \sqrt{\frac{28x}{14y}} - 19$
- C. $w = \left(\frac{x}{y}\right)^2 - 19$
- D. $w = \left(\frac{28x}{14y}\right)^2 - 19$

ID: 17d0e87d Answer

Correct Answer:

C

Rationale

Choice C is correct. Dividing each side of the given equation by 2 yields $\frac{14x}{14y} = \frac{2\sqrt{w+19}}{2}$, or $\frac{x}{y} = \sqrt{w+19}$. Because it's given that each of the variables is positive, squaring each side of this equation yields the equivalent equation $\left(\frac{x}{y}\right)^2 = w+19$. Subtracting 19 from each side of this equation yields $\left(\frac{x}{y}\right)^2 - 19 = w$, or $w = \left(\frac{x}{y}\right)^2 - 19$.

Choice A is incorrect. This equation isn't equivalent to the given equation.

Choice B is incorrect. This equation isn't equivalent to the given equation.

Choice D is incorrect. This equation isn't equivalent to the given equation.

Question Difficulty:

Hard

Question ID a1bf1c4e

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: a1bf1c4e

$$x^2 + 6x + 4$$

Which of the following is equivalent to the expression above?

- A. $(x + 3)^2 + 5$
- B. $(x + 3)^2 - 5$
- C. $(x - 3)^2 + 5$
- D. $(x - 3)^2 - 5$

ID: a1bf1c4e Answer

Correct Answer:

B

Rationale

Choice B is correct. The given quadratic expression is in standard form, and each answer choice is in vertex form. Completing the square converts the expression from standard form to vertex form. The first step is to rewrite the expression as follows:

$$x^2 + 6x + 4 = x^2 + 6x + 9 + 4 - 9.$$

$$x^2 + 6x + 9 + 4 - 9 = (x + 3)^2 + 4 - 9.$$

Combining the constant terms gives $(x + 3)^2 - 5$.

Choice A is incorrect. Squaring the binomial and simplifying the expression in choice A gives $x^2 + 6x + 9 + 5$. Combining like terms gives $x^2 + 6x + 14$, not $x^2 + 6x + 4$. Choice C is incorrect. Squaring the binomial and simplifying the expression in choice C gives $x^2 - 6x + 9 + 5$. Combining like terms gives $x^2 - 6x + 14$, not $x^2 + 6x + 4$. Choice D is incorrect. Squaring the binomial and simplifying the expression in choice D gives $x^2 - 6x + 9 - 5$. Combining like terms gives $x^2 - 6x + 4$, not $x^2 + 6x + 4$.

Question Difficulty:

Medium

Question ID c81b6c57

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #005a9f; height: 10px;"></div> |

ID: c81b6c57

In the expression $3(2x^2 + px + 8) - 16x(p + 4)$, p is a constant. This expression is equivalent to the expression $6x^2 - 155x + 24$. What is the value of p ?

- A. -3
- B. 7
- C. 13
- D. 155

ID: c81b6c57 Answer

Correct Answer:

B

Rationale

Choice B is correct. Using the distributive property, the first given expression can be rewritten as $6x^2 + 3px + 24 - 16px - 64x + 24$, and then rewritten as $6x^2 + (3p - 16p - 64)x + 24$. Since the expression $6x^2 + (3p - 16p - 64)x + 24$ is equivalent to $6x^2 - 155x + 24$, the coefficients of the x terms from each expression are equivalent to each other; thus $3p - 16p - 64 = -155$. Combining like terms gives $-13p - 64 = -155$. Adding 64 to both sides of the equation gives $-13p = -71$. Dividing both sides of the equation by -13 yields $p = 7$.

Choice A is incorrect. If $p = -3$, then the first expression would be equivalent to $6x^2 - 25x + 24$. Choice C is incorrect. If $p = 13$, then the first expression would be equivalent to $6x^2 - 233x + 24$. Choice D is incorrect. If $p = 155$, then the first expression would be equivalent to $6x^2 - 2,079x + 24$.

Question Difficulty:

Hard

Question ID d139cf4b

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 100px; height: 10px; background-color: #0056b3;"></div> <div style="width: 100px; height: 10px; background-color: #0056b3;"></div> <div style="width: 100px; height: 10px; background-color: #0056b3;"></div> |

ID: d139cf4b

$$f(t) = 55t - 2t^2$$

The function f is defined by the given equation. The function g is defined by $g(t) = f(t) + 3$. Which expression represents the maximum value of $g(t)$?

- A. $3 + \left(\frac{55}{2}\right)^2$
- B. $3 + 2\left(\frac{55}{4}\right)^2$
- C. $3 - 2\left(\frac{55}{4}\right)^2$
- D. $3 - \left(\frac{55}{2}\right)^2$

ID: d139cf4b Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that function g is defined by $g(t) = f(t) + 3$ and that $f(t) = 55t - 2t^2$. Substituting $55t - 2t^2$ for $f(t)$ in $g(t) = f(t) + 3$ yields $g(t) = 55t - 2t^2 + 3$, or $g(t) = -2t^2 + 55t + 3$. The maximum value of $g(t)$ can be found by completing the square to rewrite the equation defining g in the form $g(t) = a(t - h)^2 + k$, where the maximum value of the function is k , which occurs when $t = h$, and a is a negative constant. The equation $g(t) = -2t^2 + 55t + 3$ is equivalent to $g(t) = -2(t^2 - \frac{55}{2}t) + 3$, which can be rewritten as $g(t) = -2\left(t^2 - \frac{55}{2}t + \left(\frac{55}{4}\right)^2\right) + 3 + 2\left(\frac{55}{4}\right)^2$, or $g(t) = -2\left(t - \frac{55}{4}\right)^2 + 3 + 2\left(\frac{55}{4}\right)^2$. This equation is in the form $g(t) = a(t - h)^2 + k$, where $a = -2$, $h = \frac{55}{4}$, and $k = 3 + 2\left(\frac{55}{4}\right)^2$. Thus, the maximum value of $g(t)$ is $3 + 2\left(\frac{55}{4}\right)^2$.

Alternate approach: Since the function f is a quadratic function, the maximum value of $f(t)$ occurs at the value of t that's halfway between the two zeros of the function. The zeros of function f can be found by substituting 0 for $f(t)$ in the equation defining f , which yields $0 = 55t - 2t^2$. This equation can be rewritten as $0 = t(55 - 2t)$. By the zero product property, it follows that $t = 0$ or $55 - 2t = 0$. Subtracting 55 from each side of the equation $55 - 2t = 0$ yields $-2t = -55$. Dividing each side of this equation by -2 yields $t = \frac{55}{2}$. Therefore, the zeros of function f are 0 and $\frac{55}{2}$. The value that's halfway between 0 and $\frac{55}{2}$ can be found by calculating the average of 0 and $\frac{55}{2}$, which is $\frac{0 + \frac{55}{2}}{2}$, or $\frac{55}{4}$. It follows that the maximum of function f occurs when $t = \frac{55}{4}$. Substituting $\frac{55}{4}$ for t in the equation defining function f yields $f\left(\frac{55}{4}\right) = 55\left(\frac{55}{4}\right) - 2\left(\frac{55}{4}\right)^2$, which is equivalent to $f\left(\frac{55}{4}\right) = \frac{55^2}{4} - 2\left(\frac{55^2}{4^2}\right)$. Multiplying $\frac{55^2}{4}$ by $\frac{4}{4}$ in this equation to get a common denominator yields $f\left(\frac{55}{4}\right) = 4\left(\frac{55^2}{4^2}\right) - 2\left(\frac{55^2}{4^2}\right)$, or $f\left(\frac{55}{4}\right) = 2\left(\frac{55^2}{4^2}\right)$, which is equivalent to $f\left(\frac{55}{4}\right) = 2\left(\frac{55}{4}\right)^2$. Thus, the maximum value of $f(t)$ is $2\left(\frac{55}{4}\right)^2$. Since the equation defining $g(t)$ is $g(t) = f(t) + 3$, the maximum value of $g(t)$ is 3 greater than the maximum value of $f(t)$. It follows that the maximum value of $g(t)$ is $3 + 2\left(\frac{55}{4}\right)^2$.

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:
Hard

Question ID 802549ac

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

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 75a32330

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 60%; background-color: #e0e0e0; height: 10px;"></div> |

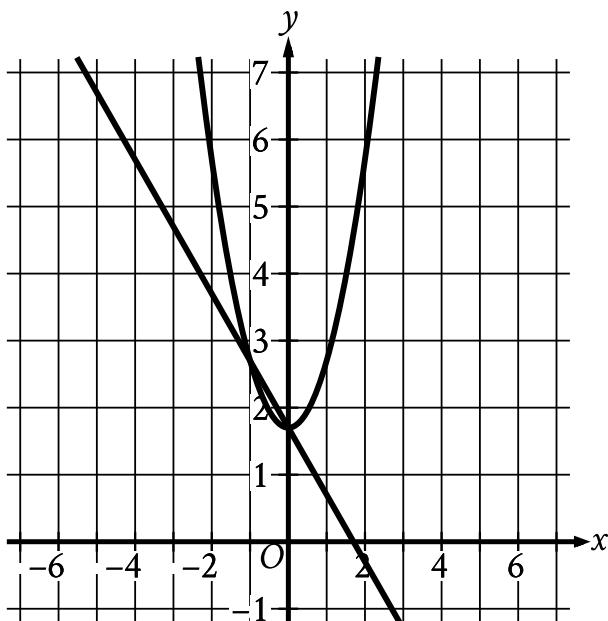
ID: 75a32330

$$y = x^2 + 1.7$$

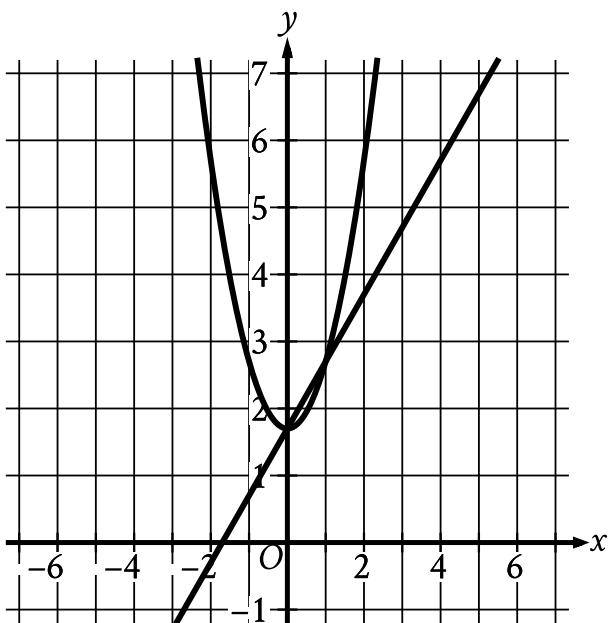
$$y = 1.7 - x$$

Which graph represents the given system of equations?

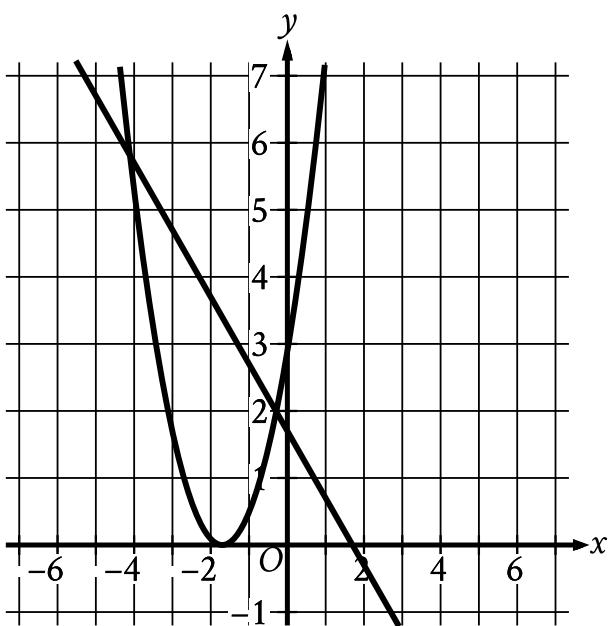
A.



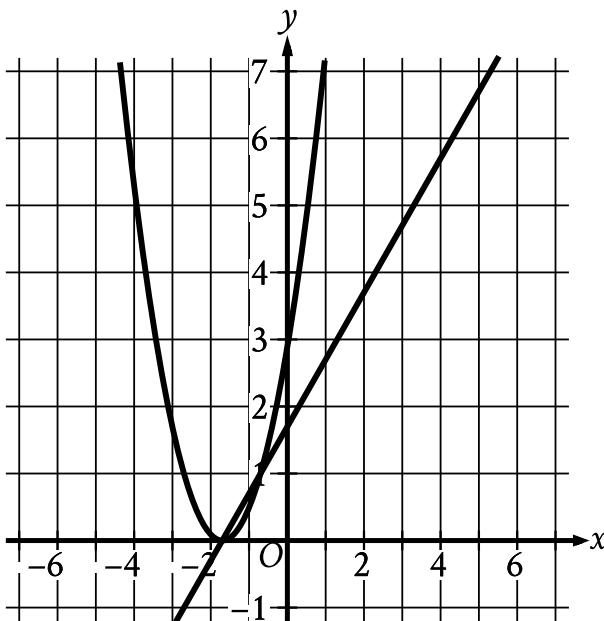
B.



C.



D.

**ID: 75a32330 Answer****Correct Answer:**

A

Rationale

Choice A is correct. The graph of a quadratic equation in the form $y = x^2 + c$ has its vertex at $(0, c)$. The first equation in the given system of equations is $y = x^2 + 1.7$, so the graph of this quadratic equation has its vertex at $(0, 1.7)$. The graph of a linear equation of the form $y = b - x$ has a slope of -1 and a y-intercept at $(0, b)$. The second equation in the given system of equations is $y = 1.7 - x$, so the graph of this linear equation has a slope of -1 and a y-intercept at $(0, 1.7)$. Of the choices, only choice A has the graph of a quadratic equation with its vertex at $(0, 1.7)$ and the graph of a linear equation with a slope of -1 and a y-intercept at $(0, 1.7)$.

Choice B is incorrect. This graph represents a system in which the second equation is $y = 1.7 + x$, not $y = 1.7 - x$.

Choice C is incorrect. This graph represents a system in which the first equation is $y = (x + 1.7)^2$, not $y = x^2 + 1.7$.

Choice D is incorrect. This graph represents a system in which the first equation is $y = (x + 1.7)^2$, not $y = x^2 + 1.7$, and the second equation is $y = 1.7 + x$, not $y = 1.7 - x$.

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 | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

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 e1f9000d

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: e1f9000d

$$h(t) = -16t^2 + b$$

The function h estimates an object's height, in feet, above the ground t seconds after the object is dropped, where b is a constant. The function estimates that the object is 3,364 feet above the ground when it is dropped at $t = 0$. Approximately how many seconds after being dropped does the function estimate the object will hit the ground?

- A. 7.25
- B. 14.50
- C. 105.13
- D. 210.25

ID: e1f9000d Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that the function h estimates that the object is 3,364 feet above the ground when it's dropped at $t = 0$. Substituting 3,364 for $h(t)$ and 0 for t in the function h yields $3,364 = -16(0)^2 + b$, or $3,364 = b$. Substituting 3,364 for b in the function h yields $h(t) = -16t^2 + 3,364$. When the object hits the ground, its height will be 0 feet above the ground. Substituting 0 for $h(t)$ in $h(t) = -16t^2 + 3,364$ yields $0 = -16t^2 + 3,364$. Adding $16t^2$ to each side of this equation yields $16t^2 = 3,364$. Dividing each side of this equation by 16 yields $t^2 = 210.25$. Since the object will hit the ground at a positive number of seconds after it's dropped, the value of t can be found by taking the positive square root of each side of this equation, which yields $t = 14.50$. It follows that the function estimates the object will hit the ground approximately 14.50 seconds after being dropped.

Choice A is incorrect. The function estimates that 7.25 seconds after being dropped, the object's height will be $-16(7.25)^2 + 3,364$ feet, or 2,523 feet, above the ground.

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:

Medium

Question ID a31417d1

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: a31417d1

From 2005 through 2014, the number of music CDs sold in the United States declined each year by approximately 15% of the number sold the preceding year. In 2005, approximately 600 million CDs were sold in the United States. Of the following, which best models C , the number of millions of CDs sold in the United States, t years after 2005?

A. $C = 600(0.15)^t$

B. $C = 600(0.85)^t$

C. $C = 600(1.15)^t$

D. $C = 600(1.85)^t$

ID: a31417d1 Answer

Correct Answer:

B

Rationale

Choice B is correct. A model for a quantity C that decreases by a certain percentage per time period t is an exponential equation in the form $C = I \left(1 - \frac{r}{100}\right)^t$, where I is the initial value at time $t = 0$ for $r\%$ annual decline. It's given that C is the number of millions of CDs sold in the United States and that t is the number of years after 2005. It's also given that 600 million CDs were sold at time $t = 0$, so $I = 600$. This number declines by 15% per year, so $r = 15$. Substituting these values into the equation produces

$$C = 600 \left(1 - \frac{15}{100}\right)^t, \text{ or } C = 600(0.85)^t.$$

Choice A is incorrect and may result from errors made when representing the percent decline. Choices C and D are incorrect. These equations model exponential increases in CD sales, not exponential decreases.

Question Difficulty:

Medium

Question ID 66bce0c1

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

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.

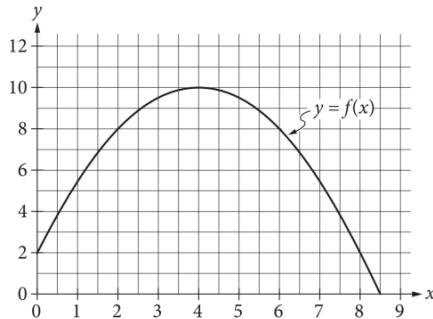
Question Difficulty:

Hard

Question ID 97e50fa2

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

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

Question ID 6d04c89d

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 20%; background-color: #0056b3;"></div> <div style="width: 20%; background-color: #0056b3;"></div> <div style="width: 60%; background-color: #e0e0e0;"></div> |

ID: 6d04c89d

The expression $\frac{24}{6x+42}$ is equivalent to $\frac{4}{x+b}$, where b is a constant and $x > 0$. What is the value of b ?

- A. 7
- B. 10
- C. 24
- D. 252

ID: 6d04c89d Answer

Correct Answer:

A

Rationale

Choice A is correct. Since the given expressions are equivalent and the numerator of the second expression is $\frac{1}{6}$ of the numerator of the first expression, the denominator of the second expression must also be $\frac{1}{6}$ of the denominator of the first expression. By the distributive property, $\frac{1}{6}(6x + 42)$ is equivalent to $\frac{1}{6}(6x) + \frac{1}{6}(42)$, or $x + 7$. Therefore, the value of b is 7.

Choice B 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:

Medium

Question ID ebb717ab

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: ebb717ab

$$x^2 - 34x + c = 0$$

In the given equation, c is a constant. The equation has no real solutions if $c > n$. What is the least possible value of n ?

ID: ebb717ab Answer

Correct Answer:

289

Rationale

The correct answer is 289. A quadratic equation of the form $ax^2 + bx + c = 0$, where a , b , and c are constants, has no real solutions when the value of the discriminant, $b^2 - 4ac$, is less than 0. In the given equation, $x^2 - 34x + c = 0$, $a = 1$ and $b = -34$. Therefore, the discriminant of the given equation can be expressed as $(-34)^2 - 4(1)(c)$, or $1,156 - 4c$. It follows that the given equation has no real solutions when $1,156 - 4c < 0$. Adding $4c$ to both sides of this inequality yields $1,156 < 4c$. Dividing both sides of this inequality by 4 yields $289 < c$, or $c > 289$. It's given that the equation $x^2 - 34x + c = 0$ has no real solutions when $c > n$. Therefore, the least possible value of n is 289.

Question Difficulty:

Hard

Question ID e51bf5b1

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: e51bf5b1

Which of the following expressions has a factor of $x + 2b$, where b is a positive integer constant?

- A. $3x^2 + 7x + 14b$
- B. $3x^2 + 28x + 14b$
- C. $3x^2 + 42x + 14b$
- D. $3x^2 + 49x + 14b$

ID: e51bf5b1 Answer

Correct Answer:

D

Rationale

Choice D is correct. Since each choice has a term of $3x^2$, which can be written as $(3x)(x)$, and each choice has a term of $14b$, which can be written as $(7)(2b)$, the expression that has a factor of $x + 2b$, where b is a positive integer constant, can be represented as $(3x + 7)(x + 2b)$. Using the distributive property of multiplication, this expression is equivalent to $3x(x + 2b) + 7(x + 2b)$, or $3x^2 + 6xb + 7x + 14b$. Combining the x -terms in this expression yields $3x^2 + (7 + 6b)x + 14b$. It follows that the coefficient of the x -term is equal to $7 + 6b$. Thus, from the given choices, $7 + 6b$ must be equal to 7, 28, 42, or 49. Therefore, $6b$ must be equal to 0, 21, 35, or 42, respectively, and b must be equal to $\frac{0}{6}$, $\frac{21}{6}$, $\frac{35}{6}$, or $\frac{42}{6}$, respectively. Of these four values of b , only $\frac{42}{6}$, or 7, is a positive integer. It follows that $7 + 6b$ must be equal to 49 because this is the only choice for which the value of b is a positive integer constant. Therefore, the expression that has a factor of $x + 2b$ is $3x^2 + 49x + 14b$.

Choice A is incorrect. If this expression has a factor of $x + 2b$, then the value of b is 0, which isn't positive.

Choice B is incorrect. If this expression has a factor of $x + 2b$, then the value of b is $\frac{21}{6}$, which isn't an integer.

Choice C is incorrect. If this expression has a factor of $x + 2b$, then the value of b is $\frac{35}{6}$, which isn't an integer.

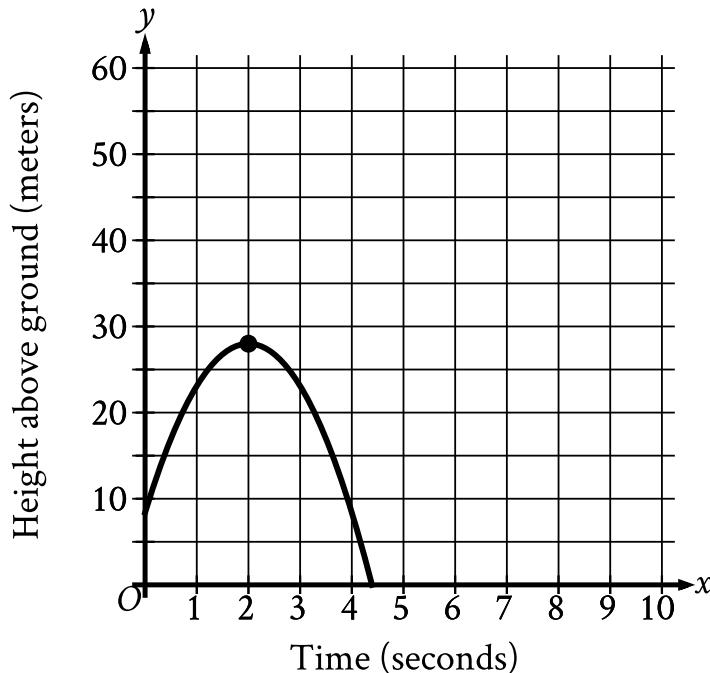
Question Difficulty:

Hard

Question ID 197bed38

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 60%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 197bed38



An object was launched upward from a platform. The graph shown models the height above ground, y , in meters, of the object x seconds after it was launched. For which of the following intervals of time was the height of the object increasing for the entire interval?

- A. From $x = 0$ to $x = 2$
- B. From $x = 0$ to $x = 4$
- C. From $x = 2$ to $x = 3$
- D. From $x = 3$ to $x = 4$

ID: 197bed38 Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that the variable y represents the height, in meters, of the object above the ground. The graph shows that the height of the object was increasing from $x = 0$ to $x = 2$, and decreasing from $x = 2$ to $x = 4$. Therefore, the height of the object was increasing for the entire interval of time from $x = 0$ to $x = 2$.

Choice B is incorrect. The height of the object wasn't increasing for this entire interval of time, as it was decreasing from $x = 2$ to $x = 4$.

Choice C is incorrect. The height of the object was decreasing, not increasing, for this entire interval of time.

Choice D is incorrect. The height of the object was decreasing, not increasing, for this entire interval of time.

Question Difficulty:

Medium

Question ID 9afe2370

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 9afe2370

The population P of a certain city y years after the last census is modeled by the equation below, where r is a constant and P_0 is the population when $y = 0$.

$$P = P_0(1 + r)^y$$

If during this time the population of the city decreases by a fixed percent each year, which of the following must be true?

- A. $r < -1$
- B. $-1 < r < 0$
- C. $0 < r < 1$
- D. $r > 1$

ID: 9afe2370 Answer

Correct Answer:

B

Rationale

Choice B is correct. The term $(1 + r)$ represents a percent change. Since the population is decreasing, the percent change must be between 0% and 100%. When the percent change is expressed as a decimal rather than as a percent, the percentage change must be between 0 and 1. Because $(1 + r)$ represents percent change, this can be expressed as $0 < 1 + r < 1$. Subtracting 1 from all three terms of this compound inequality results in $-1 < r < 0$.

Choice A is incorrect. If $r < -1$, then after 1 year, the population P would be a negative value, which is not possible. Choices C and D are incorrect. For any value of $r > 0$, $1 + r > 1$, and the exponential function models growth for positive values of the exponent. This contradicts the given information that the population is decreasing.

Question Difficulty:

Hard

Question ID 60fdb4d4

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 60fdb4d4

Which expression is equivalent to $(2x^2 - 4) - (-3x^2 + 2x - 7)$?

- A. $5x^2 - 2x + 3$
- B. $5x^2 + 2x - 3$
- C. $-x^2 - 2x - 11$
- D. $-x^2 + 2x - 11$

ID: 60fdb4d4 Answer

Correct Answer:

A

Rationale

Choice A is correct. The given expression $(2x^2 - 4) - (-3x^2 + 2x - 7)$ can be rewritten as $2x^2 - 4 + 3x^2 - 2x + 7$. Combining like terms yields $5x^2 - 2x + 3$.

Choices B, C, and D are incorrect and may be the result of errors when applying the distributive property.

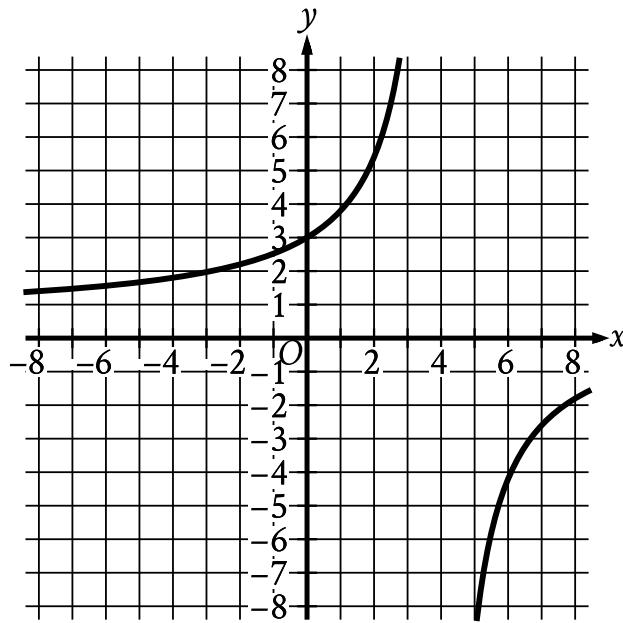
Question Difficulty:

Easy

Question ID ad376f1a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: ad376f1a



The graph of $y = f(x)$ is shown in the xy -plane. What is the value of $f(0)$?

- A. -3
- B. 0
- C. $\frac{3}{5}$
- D. 3

ID: ad376f1a Answer

Correct Answer:

D

Rationale

Choice D is correct. Because the graph of $y = f(x)$ is shown, the value of $f(0)$ is the value of y on the graph that corresponds with $x = 0$. When $x = 0$, the corresponding value of y is 3 . Therefore, the value of $f(0)$ is 3 .

Choice A is incorrect and may result from conceptual errors.

Choice B is incorrect and may result from conceptual errors.

Choice C is incorrect and may result from conceptual errors.

Question Difficulty:

Easy

Question ID bd4d0e0c

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: bd4d0e0c

The function f is defined by $f(x) = 10x^2 - 32x - 152$. What is the value of $f(0)$?

- A. -152
- B. -32
- C. 0
- D. 10

ID: bd4d0e0c Answer

Correct Answer:

A

Rationale

Choice A is correct. The value of $f(0)$ is the value of $f(x)$ when $x = 0$. The function f is defined by $f(x) = 10x^2 - 32x - 152$. Substituting 0 for x in this equation yields $f(0) = 10(0)^2 - 32(0) - 152$. This equation can be rewritten as $f(0) = 10(0) - 0 - 152$, or $f(0) = -152$. Therefore, the value of $f(0)$ is -152 .

Choice B 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.

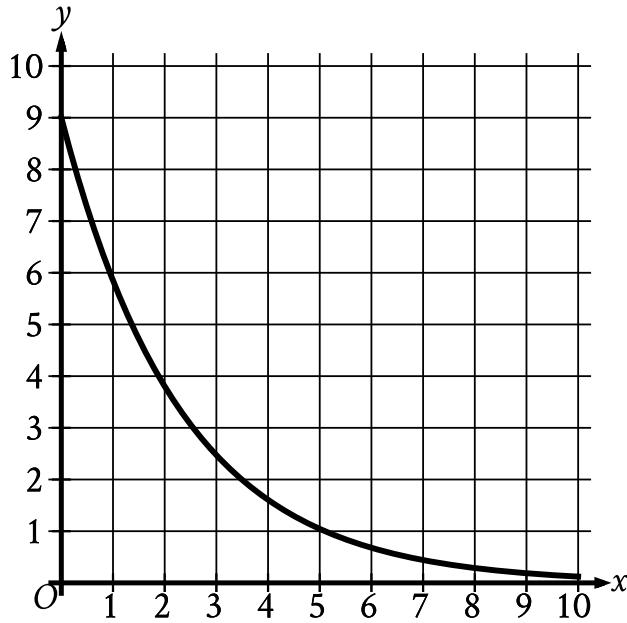
Question Difficulty:

Easy

Question ID db888cd6

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0070C0; height: 10px;"></div> <div style="width: 50%; background-color: #D9D9D9; height: 10px;"></div> |

ID: db888cd6



The graph gives the estimated number of catalogs y , in thousands, a company sent to its customers at the end of each year, where x represents the number of years since the end of 1992, where $0 \leq x \leq 10$. Which statement is the best interpretation of the y -intercept in this context?

- A. The estimated total number of catalogs the company sent to its customers during the first 10 years was 9,000.
- B. The estimated total number of catalogs the company sent to its customers from the end of 1992 to the end of 2002 was 90.
- C. The estimated number of catalogs the company sent to its customers at the end of 1992 was 9.
- D. The estimated number of catalogs the company sent to its customers at the end of 1992 was 9,000.

ID: db888cd6 Answer

Correct Answer:

D

Rationale

Choice D is correct. The y -intercept of the graph is the point at which the graph crosses the y -axis, or the point for which the value of x is 0. Therefore, the y -intercept of the given graph is the point $(0, 9)$. It's given that x represents the number of years since the end of 1992. Therefore, $x = 0$ represents 0 years since the end of 1992, which is the same as the end of 1992. It's also given that y represents the estimated number of catalogs, in thousands, that the company sent to its customers at the end of the year. Therefore, $y = 9$ represents 9,000 catalogs. It follows that the y -intercept $(0, 9)$ means that the estimated number of catalogs the company sent to its customers at the end of 1992 was 9,000.

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.

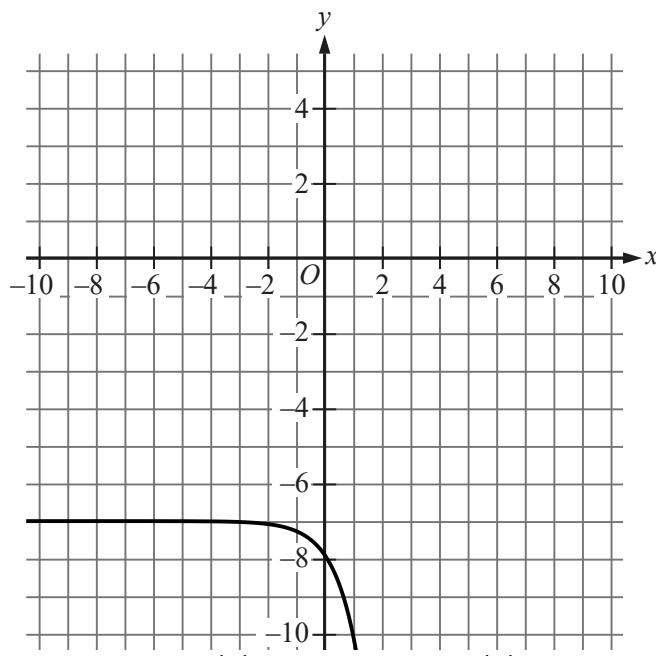
Question Difficulty:

Medium

Question ID df71424b

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 100px; height: 10px; background-color: #0056b3;"></div> <div style="width: 100px; height: 10px; background-color: #0056b3;"></div> <div style="width: 100px; height: 10px; background-color: #0056b3;"></div> |

ID: df71424b



The graph of $y = f(x)$ is shown, where $f(x) = ab^x + c$, and a , b , and c are constants. For how many values of x does $f(x) = 0$?

- A. Three
- B. Two
- C. One
- D. Zero

ID: df71424b Answer

Correct Answer:

D

Rationale

Choice D is correct. Each point (x, y) on the graph of $y = f(x)$ in the xy -plane gives a value of x and its corresponding value of $f(x)$, or y . For any value of x for which $f(x) = 0$, there is a corresponding point on the graph of $y = f(x)$ with a y -coordinate of 0. A point with a y -coordinate of 0 is a point where the graph intersects the x -axis. It's given that $f(x) = ab^x + c$, where a , b , and c are constants. In the xy -plane, the graph of an equation of this form will lie entirely either above or below the horizontal line defined by $y = c$. The part of the graph of $y = f(x)$ shown lies entirely below the horizontal line defined by $y = -7$, and thus the entire graph of $y = f(x)$ must lie below the line defined by $y = -7$. It follows that the graph of $y = f(x)$ will never intersect the x -axis. Therefore, there are zero values of x for which $f(x) = 0$.

Choice A is incorrect and may result from conceptual errors.

Choice B is incorrect and may result from conceptual errors.

Choice C is incorrect and may result from conceptual errors.

Question Difficulty:

Hard

Question ID 6ecdbcb4

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 6ecdbcb4

$$f(x) = (x + 6)(x + 5)(x - 4)$$

The function f is given. Which table of values represents $y = f(x) - 3$?

A.

| x | y |
|----|----|
| -6 | -9 |
| -5 | -8 |
| 4 | 1 |

B.

| x | y |
|----|----|
| -6 | -3 |
| -5 | -3 |
| 4 | -3 |

C.

| x | y |
|----|----|
| -6 | -3 |
| -5 | -2 |
| 4 | 7 |

D.

| x | y |
|----|---|
| -6 | 3 |
| -5 | 3 |
| 4 | 3 |

ID: 6ecdbcb4 Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that $f(x) = (x + 6)(x + 5)(x - 4)$ and $y = f(x) - 3$. Substituting $(x + 6)(x + 5)(x - 4)$ for $f(x)$ in the equation $y = f(x) - 3$ yields $y = (x + 6)(x + 5)(x - 4) - 3$. Substituting -6 for x in this equation yields $y = (-6 + 6)(-6 + 5)(-6 - 4) - 3$, or $y = -3$. Substituting -5 for x in the equation $y = (x + 6)(x + 5)(x - 4) - 3$ yields $y = (-5 + 6)(-5 + 5)(-5 - 4) - 3$, or $y = -3$. Substituting 4 for x in the equation $y = (x + 6)(x + 5)(x - 4) - 3$ yields $y = (4 + 6)(4 + 5)(4 - 4) - 3$, or $y = -3$. Therefore, when $x = -6$ then $y = -3$, when $x = -5$ then $y = -3$, and when $x = 4$ then $y = -3$. Thus, the table of values in choice B represents $y = f(x) - 3$.

Choice A is incorrect. This table represents $y = x - 3$ rather than $y = f(x) - 3$.

Choice C is incorrect. This table represents $y = x + 3$ rather than $y = f(x) - 3$.

Choice D is incorrect. This table represents $y = f(x) + 3$ rather than $y = f(x) - 3$.

Question Difficulty:

Medium

Question ID 7cb3a8ee

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #002B36; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> |

ID: 7cb3a8ee

$$|x - 5| = 10$$

What is one possible solution to the given equation?

ID: 7cb3a8ee Answer

Correct Answer:

15, -5

Rationale

The correct answer is 15 or -5. By the definition of absolute value, if $|x - 5| = 10$, then $x - 5 = 10$ or $x - 5 = -10$. Adding 5 to both sides of the first equation yields $x = 15$. Adding 5 to both sides of the second equation yields $x = -5$. Thus, the given equation has two possible solutions, 15 and -5. Note that 15 and -5 are examples of ways to enter a correct answer.

Question Difficulty:

Easy

Question ID 967ef685

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #005a9f; height: 10px;"></div> |

ID: 967ef685

Which expression is equivalent to $\frac{42a}{k} + 42ak$, where $k > 0$?

- A. $\frac{84a}{k}$
- B. $\frac{84ak^2}{k}$
- C. $\frac{42a(k+1)}{k}$
- D. $\frac{42a(k^2+1)}{k}$

ID: 967ef685 Answer

Correct Answer:

D

Rationale

Choice D is correct. Two fractions can be added together when they have a common denominator. Since $k > 0$, multiplying the second term in the given expression by $\frac{k}{k}$ yields $\frac{(42ak)k}{k}$, which is equivalent to $\frac{42ak^2}{k}$. Therefore, the expression $\frac{42a}{k} + 42ak$ can be written as $\frac{42a}{k} + \frac{42ak^2}{k}$ which is equivalent to $\frac{42a+42ak^2}{k}$. Since each term in the numerator of this expression has a factor of $42a$, the expression $\frac{42a+42ak^2}{k}$ can be rewritten as $\frac{42a(1)+42a(k^2)}{k}$, or $\frac{42a(1+k^2)}{k}$, which is equivalent to $\frac{42a(k^2+1)}{k}$.

Choice A is incorrect. This expression is equivalent to $\frac{42a}{k} + \frac{42a}{k}$.

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

Choice C is incorrect. This expression is equivalent to $\frac{42a}{k} + 42a$.

Question Difficulty:

Hard

Question ID 0bcbc08c

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 0bcbc08c

$$\begin{aligned}x &= 3 \\y &= (15 - x)^2\end{aligned}$$

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

- A. 432
- B. 54
- C. 45
- D. 18

ID: 0bcbc08c Answer

Correct Answer:

A

Rationale

Choice A is correct. The first equation in the given system of equations is $x = 3$. Substituting 3 for x in the second equation in the given system of equations yields $y = (15 - 3)^2$, or $y = 144$. Substituting 3 for x and 144 for y in the expression xy yields $(3)(144)$, or 432. Therefore, the value of xy is 432.

Choice B 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

Question ID c13016f9

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: c13016f9

The function f is defined by $f(x) = x^2 + x + 71$. What is the value of $f(2)$?

ID: c13016f9 Answer

Correct Answer:

77

Rationale

The correct answer is 77. It's given that the function f is defined by $f(x) = x^2 + x + 71$. Substituting 2 for x in function f yields $f(2) = (2)^2 + 2 + 71$, which is equivalent to $f(2) = 4 + 2 + 71$, or $f(2) = 77$. Therefore, the value of $f(2)$ is 77.

Question Difficulty:

Easy

Question ID 203774bc

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: 203774bc

The product of two positive integers is 546. If the first integer is 11 greater than twice the second integer, what is the smaller of the two integers?

- A. 7
- B. 14
- C. 39
- D. 78

ID: 203774bc Answer

Correct Answer:

B

Rationale

Choice B is correct. Let x be the first integer and let y be the second integer. If the first integer is 11 greater than twice the second integer, then $x = 2y + 11$. If the product of the two integers is 546, then $xy = 546$. Substituting $2y + 11$ for x in this equation results in $(2y + 11)y = 546$. Distributing the y to both terms in the parentheses results in $2y^2 + 11y = 546$. Subtracting 546 from both sides of this equation results in $2y^2 + 11y - 546 = 0$. The left-hand side of this equation can be factored by finding two values whose product is $2(-546)$, or $-1,092$, and whose sum is 11. The two values whose product is $-1,092$ and whose sum is 11 are 39 and -28 . Thus, the equation $2y^2 + 11y - 546 = 0$ can be rewritten as $2y^2 + 28y - 39y - 546 = 0$, which is equivalent to $2y(y - 14) + 39(y - 14) = 0$, or $(2y + 39)(y - 14) = 0$. By the zero product property, it follows that $2y + 39 = 0$ and $y - 14 = 0$. Subtracting 39 from both sides of the equation $2y + 39 = 0$ yields $2y = -39$. Dividing both sides of this equation by 2 yields $y = -\frac{39}{2}$. Since y is a positive integer, the value of y is not $-\frac{39}{2}$. Adding 14 to both sides of the equation $y - 14 = 0$ yields $y = 14$. Substituting 14 for y in the equation $xy = 546$ yields $x(14) = 546$. Dividing both sides of this equation by 14 results in $x = 39$. Therefore, the two integers are 14 and 39, so the smaller of the two integers is 14.

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

Choice C is incorrect. This is the larger of the two integers.

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

Question Difficulty:

Medium

Question ID b7c74b73

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: b7c74b73

$$f(x) = 5,470(0.64)^{\frac{x}{12}}$$

The function f gives the value, in dollars, of a certain piece of equipment after x months of use. If the value of the equipment decreases each year by $p\%$ of its value the preceding year, what is the value of p ?

- A. 4
- B. 5
- C. 36
- D. 64

ID: b7c74b73 Answer

Correct Answer:

C

Rationale

Choice C is correct. For a function of the form $f(x) = a(r)^{\frac{x}{k}}$, where a , r , and k are constants and $r < 1$, the value of $f(x)$ decreases by $100(1 - r)\%$ for every increase of x by k . In the given function, $a = 5,470$, $r = 0.64$, and $k = 12$. Therefore, for the given function, the value of $f(x)$ decreases by $100(1 - 0.64)\%$, or 36% , for every increase of x by 12 . Since $f(x)$ represents the value, in dollars, of the equipment after x months of use, it follows that the value of the equipment decreases every 12 months by 36% of its value the preceding 12 months. Since there are 12 months in a year, the value of the equipment decreases each year by 36% of its value the preceding year. Thus, the value of p is 36 .

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:

Hard

Question ID c1964c11

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: c1964c11

$$p + 34 = q + r$$

The given equation relates the variables p , q , and r . Which equation correctly expresses p in terms of q and r ?

- A. $p = q + r + 34$
- B. $p = q + r - 34$
- C. $p = -q - r + 34$
- D. $p = -q - r - 34$

ID: c1964c11 Answer

Correct Answer:

B

Rationale

Choice B is correct. Subtracting 34 from each side of the given equation yields $p = q + r - 34$. Thus, the equation $p = q + r - 34$ correctly expresses p in terms of q and r .

Choice A is incorrect. This equation can be rewritten as $p - 34 = q + r$.

Choice C is incorrect. This equation can be rewritten as $p - 34 = -q - r$.

Choice D is incorrect. This equation can be rewritten as $p + 34 = -q - r$.

Question Difficulty:

Easy

Question ID 3d12b1e0

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #005a9f; height: 10px;"></div> |

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

Question ID 2c88af4d

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 2c88af4d

$$\frac{x^{-2}y^{\frac{1}{2}}}{x^{\frac{1}{3}}y^{-1}}$$

The expression $\frac{x^{-2}y^{\frac{1}{2}}}{x^{\frac{1}{3}}y^{-1}}$, where $x > 1$ and $y > 1$, is equivalent to which of the following?

A. $\frac{\sqrt{y}}{\sqrt[3]{x^2}}$

B. $\frac{y\sqrt{y}}{\sqrt[3]{x^2}}$

C. $\frac{y\sqrt{y}}{x\sqrt{x}}$

D. $\frac{y\sqrt{y}}{x^2 \sqrt[3]{x}}$

ID: 2c88af4d Answer

Correct Answer:

D

Rationale

$$x^{\frac{1}{3}} \quad \text{and} \quad y^{\frac{1}{2}}$$

Choice D is correct. For $x > 1$ and $y > 1$, x^{-2} and y^{-1} are equivalent to $\frac{1}{x^2}$ and $\frac{1}{y}$, respectively. Therefore, the given expression can be rewritten as $\frac{y\sqrt{y}}{x^2 \sqrt[3]{x}}$.

Choices A, B, and C are incorrect because these choices are not equivalent to the given expression for $x > 1$ and $y > 1$.

$$2^{-\frac{5}{6}}$$

$$2^{-\frac{1}{3}} 2^{\frac{5}{6}}$$

For example, for $x = 2$ and $y = 2$, the value of the given expression is $2^{-\frac{5}{6}}$; the values of the choices, however, are $2^{-\frac{1}{3}}$, $2^{\frac{5}{6}}$, and 1, respectively.

Question Difficulty:

Hard

Question ID c4cd5bcc

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|----------------------------------|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 60%;"> </div> |

ID: c4cd5bcc

In the xy -plane, the y -coordinate of the y -intercept of the graph of the function f is c .

Which of the following must be equal to c ?

- A. $f(0)$
- B. $f(1)$
- C. $f(2)$
- D. $f(3)$

ID: c4cd5bcc Answer

Correct Answer:

A

Rationale

Choice A is correct. A y -intercept is the point in the xy -plane where the graph of the function crosses the y -axis, which is where $x = 0$. It's given that the y -coordinate of the y -intercept of the graph of function f is c . It follows that the coordinate pair representing the y -intercept must be $(0, c)$. Therefore, c must equal $f(0)$.

Choices B, C, and D are incorrect because $f(1)$, $f(2)$, and $f(3)$ would represent the y -value of the coordinate where $x = 1$, $x = 2$, and $x = 3$, respectively.

Question Difficulty:

Medium

Question ID dc77e0dc

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: dc77e0dc

$$f(t) = 500(0.5)^{\frac{t}{12}}$$

The function f models the intensity of an X-ray beam, in number of particles in the X-ray beam, t millimeters below the surface of a sample of iron. According to the model, what is the estimated number of particles in the X-ray beam when it is at the surface of the sample of iron?

- A. 500
- B. 12
- C. 5
- D. 2

ID: dc77e0dc Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that the function f models the intensity of an X-ray beam, in number of particles in the X-ray beam, t millimeters below the surface of a sample of iron. When the X-ray beam is at the surface of the sample of iron, it is 0 millimeters below the surface, so the value of t is 0. Substituting 0 for t in the function $f(t) = 500(0.5)^{\frac{t}{12}}$ yields $f(0) = 500(0.5)^{\frac{0}{12}}$. Since any positive number raised to the power of 0 is equal to 1, it follows that $f(0) = 500(1)$, or $f(0) = 500$. Therefore, the estimated number of particles in the X-ray beam at the surface of the sample of iron is 500.

Choice B 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:

Medium

Question ID 062f86db

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 062f86db

$$5x^2 - 37x - 24 = 0$$

What is the positive solution to the given equation?

- A. $\frac{3}{5}$
- B. 3
- C. 8
- D. 37

ID: 062f86db Answer

Correct Answer:

C

Rationale

Choice C is correct. The left-hand side of the given equation can be factored as $(5x + 3)(x - 8)$. Therefore, the given equation, $5x^2 - 37x - 24 = 0$, can be written as $(5x + 3)(x - 8) = 0$. Applying the zero product property to this equation yields $5x + 3 = 0$ and $x - 8 = 0$. Subtracting 3 from both sides of the equation $5x + 3 = 0$ yields $5x = -3$. Dividing both sides of this equation by 5 yields $x = -\frac{3}{5}$. Adding 8 to both sides of the equation $x - 8 = 0$ yields $x = 8$. Therefore, the two solutions to the given equation, $5x^2 - 37x - 24 = 0$, are $-\frac{3}{5}$ and 8. It follows that 8 is the positive solution to the given equation.

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:

Medium

Question ID ffdbcad4

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|---|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%;"><div style="display: inline-block; width: 100%; height: 10px; background-color: #005a9f;"></div></div> |

ID: ffdbcad4

The expression $4x^2 + bx - 45$, where b is a constant, can be rewritten as $(hx + k)(x + j)$, where h , k , and j are integer constants. Which of the following must be an integer?

- A. $\frac{b}{h}$
- B. $\frac{b}{k}$
- C. $\frac{45}{h}$
- D. $\frac{45}{k}$

ID: ffdbcad4 Answer

Correct Answer:

D

Rationale

Choice D is correct. It's given that $4x^2 + bx - 45$ can be rewritten as $(hx + k)(x + j)$. The expression $(hx + k)(x + j)$ can be rewritten as $hx^2 + jhx + kx + kj$, or $hx^2 + (jh + k)x + kj$. Therefore, $hx^2 + (jh + k)x + kj$ is equivalent to $4x^2 + bx - 45$. It follows that $kj = -45$. Dividing each side of this equation by k yields $j = \frac{-45}{k}$. Since j is an integer, $\frac{45}{k}$ must be an integer. Therefore, $\frac{45}{k}$ must also be an integer.

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

Question ID 735a0a00

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: 735a0a00

$$y = 0.25x^2 - 7.5x + 90.25$$

The equation gives the estimated stock price y , in dollars, for a certain company x days after a new product launched, where $0 \leq x \leq 20$. Which statement is the best interpretation of $(x, y) = (1, 83)$ in this context?

- A. The company's estimated stock price increased \$83 every day after the new product launched.
- B. The company's estimated stock price increased \$1 every 83 days after the new product launched.
- C. 1 day after the new product launched, the company's estimated stock price is \$83.
- D. 83 days after the new product launched, the company's estimated stock price is \$1.

ID: 735a0a00 Answer

Correct Answer:

C

Rationale

Choice C is correct. In the given equation, x represents the number of days after a new product launched, where $0 \leq x \leq 20$, and y represents the estimated stock price, in dollars, for a certain company. Therefore, the best interpretation of $(x, y) = (1, 83)$ in this context is that 1 day after the new product launched, the company's estimated stock price is \$83.

Choice A is incorrect and may result from conceptual errors.

Choice B is incorrect and may result from conceptual errors.

Choice D is incorrect and may result from conceptual errors.

Question Difficulty:

Medium

Question ID 68607eca

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 60%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 68607eca

On April 1, there were **233** views of an advertisement posted on a website. Every **2** days after April 1, the number of views of the advertisement had increased by **70%** of the number of views **2** days earlier. The function f gives the predicted number of views x days after April 1. Which equation defines f ?

- A. $f(x) = 233(0.70)^{\frac{x}{2}}$
- B. $f(x) = 233(0.70)^{2x}$
- C. $f(x) = 233(1.70)^{\frac{x}{2}}$
- D. $f(x) = 233(1.70)^{2x}$

ID: 68607eca Answer

Correct Answer:

C

Rationale

Choice C is correct. It's given that on April 1, there were **233** views of the advertisement. It's also given that every **2** days after April 1, the number of views of the advertisement had increased by **70%** of the number of views **2** days earlier. This situation can be represented by an exponential function of the form $f(x) = a(1 + \frac{r}{100})^{\frac{x}{c}}$, where a is the number of views on April 1 and every c days after April 1, the number of views had increased by $r\%$ of the number of views c days earlier. It follows that $a = 233$, $r = 70$, and $c = 2$. Substituting **233** for a , **70** for r , and **2** for c in the equation $f(x) = a(1 + \frac{r}{100})^{\frac{x}{c}}$ yields $f(x) = 233(1 + \frac{70}{100})^{\frac{x}{2}}$, or $f(x) = 233(1.70)^{\frac{x}{2}}$.

Choice A is incorrect. This function gives the predicted number of views for an advertisement for which every **2** days, the number of views was **70%**, rather than increased by **70%**, of the number of views **2** days earlier.

Choice B is incorrect. This function gives the predicted number of views for an advertisement for which every $\frac{1}{2}$ days, the number of views was **70%** of the number of views $\frac{1}{2}$ days earlier, rather than an advertisement for which every **2** days, the number of views had increased by **70%** of the number of views **2** days earlier.

Choice D is incorrect. This function gives the predicted number of views for an advertisement for which every $\frac{1}{2}$ days, rather than every **2** days, the number of views had increased by **70%** of the number of views $\frac{1}{2}$ days earlier, rather than **2** days earlier.

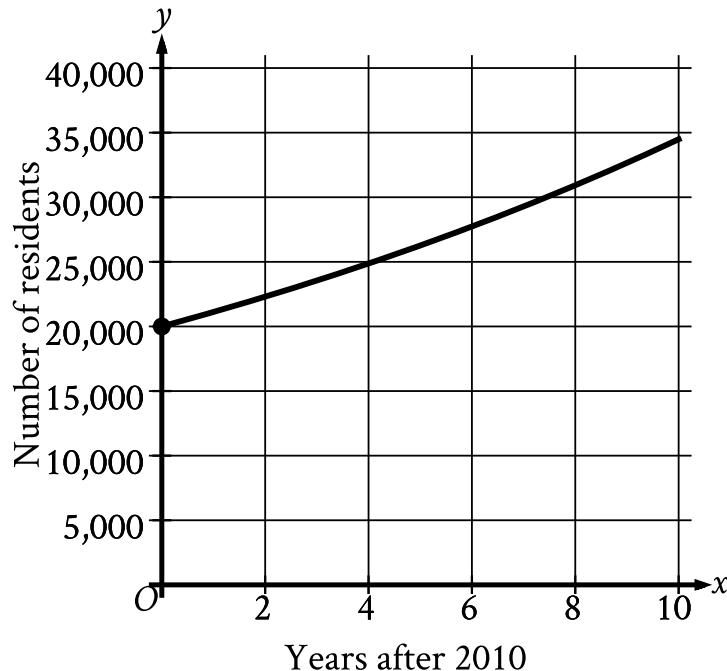
Question Difficulty:

Medium

Question ID 2d394c28

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #e0e0e0;"></div> <div style="width: 25%; background-color: #e0e0e0;"></div> |

ID: 2d394c28



The graph shown models the number of residents of a certain city x years after **2010**. How many residents does this model estimate the city had in **2010**?

- A. 0
- B. 2,000
- C. 20,000
- D. 25,000

ID: 2d394c28 Answer

Correct Answer:

C

Rationale

Choice C is correct. It's given that x represents years after **2010**. Therefore, **2010** is represented by $x = 0$. On the model shown, the point with an x -coordinate of **0** has a y -coordinate of **20,000**. Thus, the model estimates that in **2010**, the city had **20,000** residents.

Choice A is incorrect. This is the value of x that represents the year **2010**.

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

Choice D is incorrect. This is approximately the number of residents the model estimates the city had in **2014**, not **2010**.

Question Difficulty:
Easy

Question ID 71014fb1

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 30%; background-color: #0056b3; height: 10px;"></div> <div style="width: 30%; background-color: #0056b3; height: 10px;"></div> <div style="width: 30%; background-color: #0056b3; height: 10px;"></div> |

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

Question ID 5639dd1a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #002B36; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> |

ID: 5639dd1a

$$x^2 = (22)(22)$$

What is the positive solution to the given equation?

ID: 5639dd1a Answer

Correct Answer:

22

Rationale

The correct answer is **22**. The given equation, $x^2 = (22)(22)$, is equivalent to $x^2 = (22)^2$. Taking the square root of each side of this equation yields $x = \pm 22$. Thus, the positive solution to the given equation is **22**.

Question Difficulty:

Easy

Question ID 4a5af623

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 4a5af623

Which expression is a factor of $2x^2 + 38x + 10$?

- A. 2
- B. $5x$
- C. $38x$
- D. $2x^2$

ID: 4a5af623 Answer

Correct Answer:

A

Rationale

Choice A is correct. Since 2 is a common factor of each of the terms in the given expression, the expression can be rewritten as $2(x^2 + 19x + 5)$. Therefore, the factors of the given expression are 2 and $x^2 + 19x + 5$. Of these two factors, only 2 is listed as a choice.

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

Choice C is incorrect. This is a term of the given expression, not a factor of the given expression.

Choice D is incorrect. This is a term of the given expression, not a factor of the given expression.

Question Difficulty:

Easy

Question ID 22fd3e1f

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 22fd3e1f

$$f(x) = x^3 - 9x$$

$$g(x) = x^2 - 2x - 3$$

Which of the following expressions is

equivalent to $\frac{f(x)}{g(x)}$, for $x > 3$?

A. $\frac{1}{x+1}$

B. $\frac{x+3}{x+1}$

C. $\frac{x(x-3)}{x+1}$

D. $\frac{x(x+3)}{x+1}$

ID: 22fd3e1f Answer

Correct Answer:

D

Rationale

Choice D is correct. Since $x^3 - 9x = x(x+3)(x-3)$ and $x^2 - 2x - 3 = (x+1)(x-3)$, the fraction $\frac{f(x)}{g(x)}$ can be written as

$$\frac{x(x+3)(x-3)}{(x+1)(x-3)}$$
. It is given that $x > 3$, so the common factor $x - 3$ is not equal to 0. Therefore, the fraction can be further

simplified to $\frac{x(x+3)}{x+1}$.

Choice A is incorrect. The expression $\frac{1}{x+1}$ is not equivalent to $\frac{f(x)}{g(x)}$ because at $x = 0$, $\frac{1}{x+1}$ has a value of 1 and $\frac{f(x)}{g(x)}$ has a value of 0.

Choice B is incorrect and results from omitting the factor x in the factorization of $f(x)$. Choice C is incorrect and may result from incorrectly factoring $g(x)$ as $(x+1)(x+3)$ instead of $(x+1)(x-3)$.

Question Difficulty:
Hard

Question ID 717a1964

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 50%; background-color: #cccccc; height: 10px;"></div> |

ID: 717a1964

$$z^2 + 10z - 24 = 0$$

What is one of the solutions to the given equation?

ID: 717a1964 Answer

Correct Answer:

2, -12

Rationale

The correct answer is either **2** or **-12**. The left-hand side of the given equation can be rewritten by factoring. The two values that multiply to **-24** and add to **10** are **12** and **-2**. It follows that the given equation can be rewritten as $(z + 12)(z - 2) = 0$. Setting each factor equal to **0** yields two equations: $z + 12 = 0$ and $z - 2 = 0$. Subtracting **12** from both sides of the equation $z + 12 = 0$ results in $z = -12$. Adding **2** to both sides of the equation $z - 2 = 0$ results in $z = 2$. Note that **2** and **-12** are examples of ways to enter a correct answer.

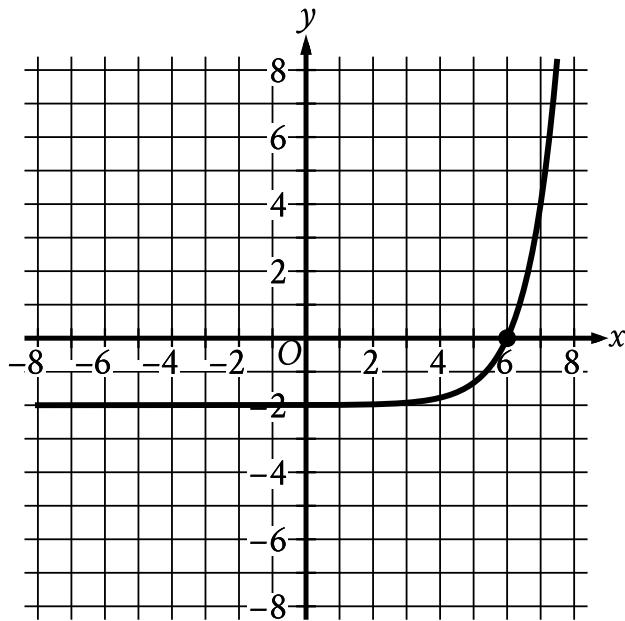
Question Difficulty:

Medium

Question ID 2b6c12eb

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 75%; background-color: #cccccc; height: 10px;"></div> <div style="width: 75%; background-color: #cccccc; height: 10px;"></div> |

ID: 2b6c12eb



What is the x -coordinate of the x -intercept of the graph shown?

ID: 2b6c12eb Answer

Correct Answer:

6

Rationale

The correct answer is **6**. An x -intercept of a graph is a point on the graph where it intersects the x -axis, or where the value of y is **0**. The graph shown intersects the x -axis at the point **(6, 0)**. Therefore, the x -coordinate of the x -intercept of the graph shown is **6**.

Question Difficulty:

Easy

Question ID 4dc5c6f9

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 30%; background-color: #0056b3; height: 10px;"></div> <div style="width: 30%; background-color: #0056b3; height: 10px;"></div> <div style="width: 30%; background-color: #0056b3; height: 10px;"></div> |

ID: 4dc5c6f9

$$\begin{aligned}y &= 18 \\y &= -3(x - 18)^2 + 15\end{aligned}$$

If the given equations are graphed in the xy -plane, at how many points do the graphs of the equations intersect?

- A. Exactly one
- B. Exactly two
- C. Infinitely many
- D. Zero

ID: 4dc5c6f9 Answer

Correct Answer:

D

Rationale

Choice D is correct. A point (x, y) is a solution to a system of equations if it lies on the graphs of both equations in the xy -plane. In other words, a solution to a system of equations is a point (x, y) at which the graphs intersect. It's given that the first equation is $y = 18$. Substituting 18 for y in the second equation yields $18 = -3(x - 18)^2 + 15$. Subtracting 15 from each side of this equation yields $3 = -3(x - 18)^2$. Dividing each side of this equation by -3 yields $-1 = (x - 18)^2$. Since the square of a real number is at least 0, this equation can't have any real solutions. Therefore, the graphs of the equations intersect at zero points.

Alternate approach: The graph of the second equation is a parabola that opens downward and has a vertex at $(18, 15)$. Therefore, the maximum value of this parabola occurs when $y = 15$. The graph of the first equation is a horizontal line at 18 on the y -axis, or $y = 18$. Since 18 is greater than 15, or the horizontal line is above the vertex of the parabola, the graphs of these equations intersect at zero points.

Choice A is incorrect. The graph of $y = 15$, not $y = 18$, and the graph of the second equation intersect at exactly one point.

Choice B is incorrect. The graph of any horizontal line such that the value of y is less than 15, not greater than 15, and the graph of the second equation intersect at exactly two points.

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

Question Difficulty:

Hard

Question ID 78d5f91a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 78d5f91a

$$f(x) = x^3 + 3x^2 - 6x - 1$$

For the function f defined above, what is the value of $f(-1)$?

- A. -11
- B. -7
- C. 7
- D. 11

ID: 78d5f91a Answer

Correct Answer:

C

Rationale

Choice C is correct. Substituting -1 for x in the given function f gives $f(-1) = (-1)^3 + 3(-1)^2 - 6(-1) - 1$, which simplifies to $f(-1) = -1 + 3(1) - 6(-1) - 1$. This further simplifies to $f(-1) = -1 + 3 + 6 - 1$, or $f(-1) = 7$.

Choice A is incorrect and may result from correctly substituting -1 for x in the function but incorrectly simplifying the resulting expression to $f(-1) = -1 - 3 - 6 - 1$, or -11 . Choice B is incorrect and may result from arithmetic errors. Choice D is incorrect and may result from correctly substituting -1 for x in the function but incorrectly simplifying the expression to $f(-1) = 1 + 3 + 6 + 1$, or 11.

Question Difficulty:

Medium

Question ID d675744f

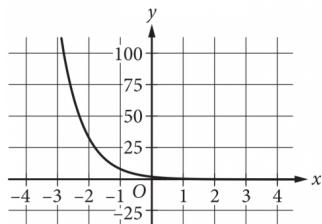
| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: d675744f

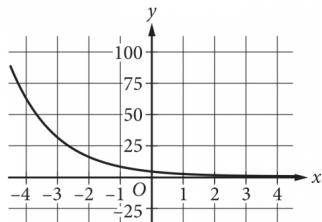
$$y = 4(2^x)$$

Which of the following is the graph in the xy -plane of the given equation?

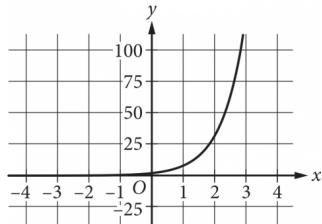
A.



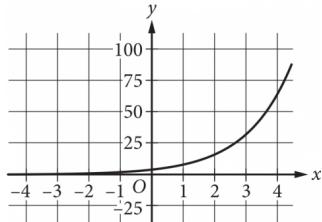
B.



C.



D.



ID: d675744f Answer

Correct Answer:

D

Rationale

Choice D is correct. The y-intercept of the graph of an equation is the point $(0, b)$, where b is the value of y when $x = 0$. For the given equation, $y = 4$ when $x = 0$. It follows that the y-intercept of the graph of the given equation is $(0, 4)$. Additionally, for the given equation, the value of y doubles for each increase of 1 in the value of x . Therefore, the graph contains the points $(1, 8)$, $(2, 16)$, $(3, 32)$, and $(4, 64)$. Only the graph shown in choice D passes through these points.

Choices A and B are incorrect because these are graphs of decreasing, not increasing, exponential functions. Choice C is incorrect because the value of y increases by a growth factor greater than 2 for each increase of 1 in the value of x .

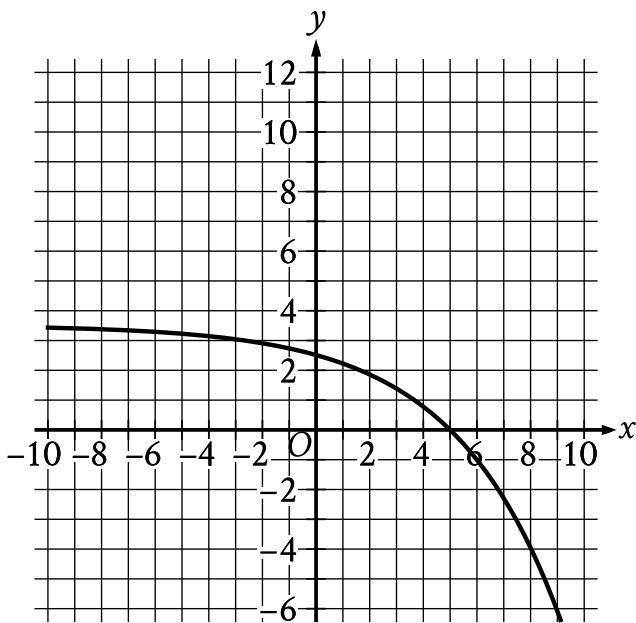
Question Difficulty:

Medium

Question ID 79e6ec70

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 79e6ec70



What is the x -intercept of the graph shown?

- A. $(-5, 0)$
- B. $(5, 0)$
- C. $(-2, 0)$
- D. $(2, 0)$

ID: 79e6ec70 Answer

Correct Answer:

B

Rationale

Choice B is correct. An x -intercept of a graph in the xy -plane is a point at which the graph crosses the x -axis. The graph shown crosses the x -axis at the point $(5, 0)$. Therefore, the x -intercept of the graph shown is $(5, 0)$.

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

Question ID a0b4103e

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: a0b4103e

The expression $\frac{1}{3}x^2 - 2$ can be rewritten as $\frac{1}{3}(x-k)(x+k)$, where k is a positive constant. What is the value of k ?

- A. 2
- B. 6
- C. $\sqrt{2}$
- D. $\sqrt{6}$

ID: a0b4103e Answer

Correct Answer:

D

Rationale

Choice D is correct. Factoring out the coefficient $\frac{1}{3}$, the given expression can be rewritten as $\frac{1}{3}(x^2 - 6)$. The expression $x^2 - 6$ can be approached as a difference of squares and rewritten as $(x - \sqrt{6})(x + \sqrt{6})$. Therefore, k must be $\sqrt{6}$.

Choice A is incorrect. If k were 2, then the expression given would be rewritten as $\frac{1}{3}(x-2)(x+2)$, which is equivalent to $\frac{1}{3}x^2 - \frac{4}{3}$, not $\frac{1}{3}x^2 - 2$.

Choice B is incorrect. This may result from incorrectly factoring the expression and finding $(x-6)(x+6)$ as the factored form of the expression. Choice C is incorrect. This may result from incorrectly distributing the $\frac{1}{3}$ and rewriting the expression as $\frac{1}{3}(x^2 - 2)$.

Question Difficulty:

Hard

Question ID 5377d9cf

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #e0e0e0;"></div> <div style="width: 25%; background-color: #e0e0e0;"></div> |

ID: 5377d9cf

If $f(x) = \frac{x^2 - 6x + 3}{x - 1}$,

what is $f(-1)$?

- A. -5
- B. -2
- C. 2
- D. 5

ID: 5377d9cf Answer

Correct Answer:

A

Rationale

$$f(-1) = \frac{(-1)^2 - 6(-1) + 3}{(-1) - 1}$$

Choice A is correct. Substituting -1 for x in the equation that defines f gives

expressions in the numerator and denominator yields $\frac{1+6+3}{-2}$, which is equal to $\frac{10}{-2}$ or -5.

Choices B, C, and D are incorrect and may result from misapplying the order of operations when substituting -1 for x.

Question Difficulty:

Easy

Question ID 2cd6b22d

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 2cd6b22d

$$5x^2 + 10x + 16 = 0$$

How many distinct real solutions does the given equation have?

- A. Exactly one
- B. Exactly two
- C. Infinitely many
- D. Zero

ID: 2cd6b22d Answer

Correct Answer:

D

Rationale

Choice D is correct. The number of solutions of a quadratic equation of the form $ax^2 + bx + c = 0$, where a , b , and c are constants, can be determined by the value of the discriminant, $b^2 - 4ac$. If the value of the discriminant is positive, then the quadratic equation has exactly two distinct real solutions. If the value of the discriminant is equal to zero, then the quadratic equation has exactly one real solution. If the value of the discriminant is negative, then the quadratic equation has zero real solutions. In the given equation, $5x^2 + 10x + 16 = 0$, $a = 5$, $b = 10$, and $c = 16$. Substituting these values for a , b , and c in $b^2 - 4ac$ yields $(10)^2 - 4(5)(16)$, or -220 . Since the value of its discriminant is negative, the given equation has zero real solutions. Therefore, the number of distinct real solutions the given equation has is zero.

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

Question ID f2d60b99

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: f2d60b99

The function $f(x) = \frac{1}{9}(x - 7)^2 + 3$ gives a metal ball's height above the ground $f(x)$, in inches, x seconds after it started moving on a track, where $0 \leq x \leq 10$. Which of the following is the best interpretation of the vertex of the graph of $y = f(x)$ in the xy -plane?

- A. The metal ball's minimum height was 3 inches above the ground.
- B. The metal ball's minimum height was 7 inches above the ground.
- C. The metal ball's height was 3 inches above the ground when it started moving.
- D. The metal ball's height was 7 inches above the ground when it started moving.

ID: f2d60b99 Answer

Correct Answer:

A

Rationale

Choice A is correct. The graph of a quadratic equation in the form $y = a(x - h)^2 + k$, where a , h , and k are positive constants, is a parabola that opens upward with vertex (h, k) . The given function $f(x) = \frac{1}{9}(x - 7)^2 + 3$ is in the form $y = a(x - h)^2 + k$, where $y = f(x)$, $a = \frac{1}{9}$, $h = 7$, and $k = 3$. Therefore, the graph of $y = f(x)$ is a parabola that opens upward with vertex $(7, 3)$.

Since the parabola opens upward, the vertex is the lowest point on the graph. It follows that the y -coordinate of the vertex of the graph of $y = f(x)$ is the minimum value of $f(x)$. Therefore, the minimum value of $f(x)$ is 3. It's given that

$f(x) = \frac{1}{9}(x - 7)^2 + 3$ represents the metal ball's height above the ground, in inches, x seconds after it started moving on a track. Therefore, the best interpretation of the vertex of the graph of $y = f(x)$ is that the metal ball's minimum height was 3 inches above the ground.

Choice B 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:

Hard

Question ID f880f910

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: f880f910

The area of a triangle is **270** square centimeters. The length of the base of the triangle is **12** centimeters greater than the height of the triangle. What is the height, in centimeters, of the triangle?

- A. **15**
- B. **18**
- C. **30**
- D. **36**

ID: f880f910 Answer

Correct Answer:

B

Rationale

Choice B is correct. The area, A , of a triangle is given by the formula $A = \frac{1}{2}bh$, where b represents the length of the base of the triangle and h represents its height. It's given that the area of a triangle is **270** square centimeters and that the length of the base of this triangle is **12** centimeters greater than the height of the triangle. Let x represent the height, in centimeters, of the triangle. It follows that the length of the base of the triangle can be expressed as $x + 12$. Substituting **270** for A , x for h , and $x + 12$ for b in the formula $A = \frac{1}{2}bh$ yields $270 = \frac{1}{2}(x + 12)(x)$, or $270 = \frac{1}{2}x(x + 12)$. Multiplying both sides of this equation by 2 yields $540 = x(x + 12)$. Applying the distributive property on the right-hand side of this equation yields $540 = x^2 + 12x$. Subtracting **540** from both sides of this equation yields $0 = x^2 + 12x - 540$. In factored form, this equation is equivalent to $(x + 30)(x - 18) = 0$. Applying the zero product property, it follows that $x + 30 = 0$ or $x - 18 = 0$. Subtracting **30** from both sides of the equation $x + 30 = 0$ yields $x = -30$. Adding **18** to both sides of the equation $x - 18 = 0$ yields $x = 18$. Since x represents the height of the triangle, it must be positive. Therefore, the height, in centimeters, of the triangle is **18**.

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:

Medium

Question ID e9349667

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

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

Question ID 67f4b449

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 67f4b449

The function $f(w) = 6w^2$ gives the area of a rectangle, in square feet (ft^2), if its width is w ft and its length is 6 times its width. Which of the following is the best interpretation of $f(14) = 1,176$?

- A. If the width of the rectangle is 14 ft, then the area of the rectangle is 1,176 ft^2 .
- B. If the width of the rectangle is 14 ft, then the length of the rectangle is 1,176 ft.
- C. If the width of the rectangle is 1,176 ft, then the length of the rectangle is 14 ft.
- D. If the width of the rectangle is 1,176 ft, then the area of the rectangle is 14 ft^2 .

ID: 67f4b449 Answer

Correct Answer:

A

Rationale

Choice A is correct. The function f gives the area of the rectangle, in ft^2 , if its width is w ft. Since the value of $f(14)$ is the value of $f(w)$ if $w = 14$, it follows that $f(14) = 1,176$ means that $f(w)$ is 1,176 if $w = 14$. In the given context, this means that if the width of the rectangle is 14 ft, then the area of the rectangle is 1,176 ft^2 .

Choice B is incorrect and may result from conceptual errors.

Choice C is incorrect and may result from conceptual errors.

Choice D is incorrect and may result from interpreting $f(w)$ as the width, in ft, of the rectangle if its area is $w \text{ ft}^2$, rather than as the area, in ft^2 , of the rectangle if its width is w ft.

Question Difficulty:

Medium

Question ID 49efde89

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 49efde89

The expression $2x^2 + ax$ is equivalent to $x(2x + 7)$ for some constant a . What is the value of a ?

- A. 2
- B. 3
- C. 4
- D. 7

ID: 49efde89 Answer

Correct Answer:

D

Rationale

Choice D is correct. It's given that $2x^2 + ax$ is equivalent to $x(2x + 7)$ for some constant a . Distributing the x over each term in the parentheses gives $2x^2 + 7x$, which is in the same form as the first given expression, $2x^2 + ax$. The coefficient of the second term in $2x^2 + 7x$ is 7. Therefore, the value of a is 7.

Choice A is incorrect. If the value of a were 2, then $2x^2 + ax$ would be equivalent to $2x^2 + 2x$, which isn't equivalent to $x(2x + 7)$.

Choice B is incorrect. If the value of a were 3, then $2x^2 + ax$ would be equivalent to $2x^2 + 3x$, which isn't equivalent to $x(2x + 7)$.

Choice C is incorrect. If the value of a were 4, then $2x^2 + ax$ would be equivalent to $2x^2 + 4x$, which isn't equivalent to $x(2x + 7)$.

Question Difficulty:

Easy

Question ID 44076c7d

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 44076c7d

| x | $f(x)$ |
|-----|--------|
| -1 | 10 |
| 0 | 14 |
| 1 | 20 |

For the quadratic function f , the table shows three values of x and their corresponding values of $f(x)$. Which equation defines f ?

- A. $f(x) = 3x^2 + 3x + 14$
- B. $f(x) = 5x^2 + x + 14$
- C. $f(x) = 9x^2 - x + 14$
- D. $f(x) = x^2 + 5x + 14$

ID: 44076c7d Answer

Correct Answer:

D

Rationale

Choice D is correct. The equation of a quadratic function can be written in the form $f(x) = a(x - h)^2 + k$, where a , h , and k are constants. It's given in the table that when $x = -1$, the corresponding value of $f(x)$ is 10. Substituting -1 for x and 10 for $f(x)$ in the equation $f(x) = a(x - h)^2 + k$ gives $10 = a(-1 - h)^2 + k$, which is equivalent to $10 = a(1 + 2h + h^2) + k$, or $10 = a + 2ah + ah^2 + k$. It's given in the table that when $x = 0$, the corresponding value of $f(x)$ is 14. Substituting 0 for x and 14 for $f(x)$ in the equation $f(x) = a(x - h)^2 + k$ gives $14 = a(0 - h)^2 + k$, or $14 = ah^2 + k$. It's given in the table that when $x = 1$, the corresponding value of $f(x)$ is 20. Substituting 1 for x and 20 for $f(x)$ in the equation $f(x) = a(x - h)^2 + k$ gives $20 = a(1 - h)^2 + k$, which is equivalent to $20 = a(1 - 2h + h^2) + k$, or $20 = a - 2ah + ah^2 + k$. Adding $20 = a - 2ah + ah^2 + k$ to the equation $10 = a + 2ah + ah^2 + k$ gives $30 = 2a + 2ah^2 + 2k$. Dividing both sides of this equation by 2 gives $15 = a + ah^2 + k$. Since $14 = ah^2 + k$, substituting 14 for $ah^2 + k$ into the equation $15 = a + ah^2 + k$ gives $15 = a + 14$. Subtracting 14 from both sides of this equation gives $a = 1$. Substituting 1 for a in the equations $14 = ah^2 + k$ and $20 = ah^2 - 2ah + a + k$ gives $14 = h^2 + k$ and $20 = 1 - 2h + h^2 + k$, respectively. Since $14 = h^2 + k$, substituting 14 for $h^2 + k$ in the equation $20 = 1 - 2h + h^2 + k$ gives $20 = 1 - 2h + 14$, or $20 = 15 - 2h$. Subtracting 15 from both sides of this equation gives $5 = -2h$. Dividing both sides of this equation by -2 gives $-\frac{5}{2} = h$.

Substituting $-\frac{5}{2}$ for h into the equation $14 = h^2 + k$ gives $14 = (-\frac{5}{2})^2 + k$, or $14 = \frac{25}{4} + k$. Subtracting $\frac{25}{4}$ from both sides of this equation gives $\frac{31}{4} = k$. Substituting 1 for a , $-\frac{5}{2}$ for h , and $\frac{31}{4}$ for k in the equation $f(x) = a(x - h)^2 + k$ gives $f(x) = (x + \frac{5}{2})^2 + \frac{31}{4}$, which is equivalent to $f(x) = x^2 + 5x + \frac{25}{4} + \frac{31}{4}$, or $f(x) = x^2 + 5x + 14$. Therefore, $f(x) = x^2 + 5x + 14$ defines f .

Choice A is incorrect. If $f(x) = 3x^2 + 3x + 14$, then when $x = -1$, the corresponding value of $f(x)$ is 14, not 10.

Choice B is incorrect. If $f(x) = 5x^2 + x + 14$, then when $x = -1$, the corresponding value of $f(x)$ is 18, not 10.

Choice C is incorrect. If $f(x) = 9x^2 - x + 14$, then when $x = -1$, the corresponding value of $f(x)$ is 24, not 10, and when $x = 1$, the corresponding value of $f(x)$ is 22, not 20.

Question Difficulty:

Medium

Question ID 1f353a9e

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 1f353a9e

$$f(t) = 8,000(0.65)^t$$

The given function f models the number of coupons a company sent to their customers at the end of each year, where t represents the number of years since the end of 1998, and $0 \leq t \leq 5$. If $y = f(t)$ is graphed in the ty -plane, which of the following is the best interpretation of the y -intercept of the graph in this context?

- A. The minimum estimated number of coupons the company sent to their customers during the 5 years was 1,428.
- B. The minimum estimated number of coupons the company sent to their customers during the 5 years was 8,000.
- C. The estimated number of coupons the company sent to their customers at the end of 1998 was 1,428.
- D. The estimated number of coupons the company sent to their customers at the end of 1998 was 8,000.

ID: 1f353a9e Answer

Correct Answer:

D

Rationale

Choice D is correct. The y -intercept of a graph in the ty -plane is the point where $t = 0$. For the given function f , the y -intercept of the graph of $y = f(t)$ in the ty -plane can be found by substituting 0 for t in the equation $y = 8,000(0.65)^t$, which gives $y = 8,000(0.65)^0$. This is equivalent to $y = 8,000(1)$, or $y = 8,000$. Therefore, the y -intercept of the graph of $y = f(t)$ is $(0, 8,000)$. It's given that the function f models the number of coupons a company sent to their customers at the end of each year. Therefore, $f(t)$ represents the estimated number of coupons the company sent to their customers at the end of each year. It's also given that t represents the number of years since the end of 1998. Therefore, $t = 0$ represents 0 years since the end of 1998, or the end of 1998. Thus, the best interpretation of the y -intercept of the graph of $y = f(t)$ is that the estimated number of coupons the company sent to their customers at the end of 1998 was 8,000.

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.

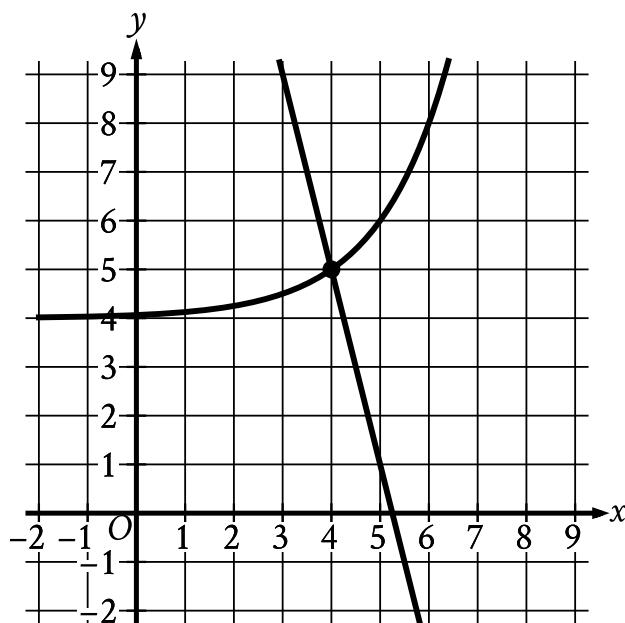
Question Difficulty:

Hard

Question ID 3f8d5876

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 25%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 3f8d5876



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. $(0, 4)$
- C. $(4, 5)$
- D. $(5, 0)$

ID: 3f8d5876 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 $(4, 5)$. Thus, the solution to the system is $(4, 5)$.

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

Question ID b03adde3

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: b03adde3

If $\frac{u-3}{t-2} = \frac{6}{u}$, what is t

in terms of u ?

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

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

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

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

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

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

Question Difficulty:

Hard

Question ID 1ce9ffcd

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 1ce9ffcd

$$-9x^2 + 30x + c = 0$$

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

- A. 3
- B. 0
- C. -25
- D. -53

ID: 1ce9ffcd Answer

Correct Answer:

C

Rationale

Choice C is correct. It's given that the equation $-9x^2 + 30x + c = 0$ has exactly one solution. A quadratic equation of the form $ax^2 + bx + c = 0$ has exactly one solution if and only if its discriminant, $-4ac + b^2$, is equal to zero. It follows that for the given equation, $a = -9$ and $b = 30$. Substituting -9 for a and 30 for b into $b^2 - 4ac$ yields $30^2 - 4(-9)(c)$, or $900 + 36c$. Since the discriminant must equal zero, $900 + 36c = 0$. Subtracting $36c$ from both sides of this equation yields $900 = -36c$. Dividing each side of this equation by -36 yields $-25 = c$. Therefore, the value of c is -25 .

Choice A is incorrect. If the value of c is 3, this would yield a discriminant that is greater than zero. Therefore, the given equation would have two solutions, rather than exactly one solution.

Choice B is incorrect. If the value of c is 0, this would yield a discriminant that is greater than zero. Therefore, the given equation would have two solutions, rather than exactly one solution.

Choice D is incorrect. If the value of c is -53, this would yield a discriminant that is less than zero. Therefore, the given equation would have no real solutions, rather than exactly one solution.

Question Difficulty:

Hard

Question ID 104bff62

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 100px; height: 10px; background-color: #005a9f;"></div> <div style="width: 100px; height: 10px; background-color: #005a9f;"></div> <div style="width: 100px; height: 10px; background-color: #005a9f;"></div> |

ID: 104bff62

$$\frac{x^2}{\sqrt{x^2-c^2}} = \frac{c^2}{\sqrt{x^2-c^2}} + 39$$

In the given equation, c is a positive constant. Which of the following is one of the solutions to the given equation?

- A. $-c$
- B. $-c^2 - 39^2$
- C. $-\sqrt{39^2 - c^2}$
- D. $-\sqrt{c^2 + 39^2}$

ID: 104bff62 Answer

Correct Answer:

D

Rationale

Choice D is correct. If $x^2 - c^2 \leq 0$, then neither side of the given equation is defined and there can be no solution. Therefore, $x^2 - c^2 > 0$. Subtracting $\frac{c^2}{\sqrt{x^2-c^2}}$ from both sides of the given equation yields $\frac{x^2}{\sqrt{x^2-c^2}} - \frac{c^2}{\sqrt{x^2-c^2}} = 39$, or $\frac{x^2-c^2}{\sqrt{x^2-c^2}} = 39$. Squaring both sides of this equation yields $\left(\frac{x^2-c^2}{\sqrt{x^2-c^2}}\right)^2 = 39^2$, or $\frac{(x^2-c^2)(x^2-c^2)}{x^2-c^2} = 39^2$. Since $x^2 - c^2$ is positive and, therefore, nonzero, the expression $\frac{x^2-c^2}{x^2-c^2}$ is defined and equivalent to 1. It follows that the equation $\frac{(x^2-c^2)(x^2-c^2)}{x^2-c^2} = 39^2$ can be rewritten as $(\frac{x^2-c^2}{x^2-c^2})(x^2 - c^2) = 39^2$, or $(1)(x^2 - c^2) = 39^2$, which is equivalent to $x^2 - c^2 = 39^2$. Adding c^2 to both sides of this equation yields $x^2 = c^2 + 39^2$. Taking the square root of both sides of this equation yields two solutions: $x = \sqrt{c^2 + 39^2}$ and $x = -\sqrt{c^2 + 39^2}$. Therefore, of the given choices, $-\sqrt{c^2 + 39^2}$ is one of the solutions to the given equation.

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

Question ID 270cf326

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 270cf326

Which of the following functions has(have) a minimum value at -3 ?

- I. $f(x) = -6(3)^x - 3$
- II. $g(x) = -3(6)^x$

- A. I only
- B. II only
- C. I and II
- D. Neither I nor II

ID: 270cf326 Answer

Correct Answer:

D

Rationale

Choice D is correct. A function of the form $f(x) = a(b)^x + c$, where $a < 0$ and $b > 1$, is a decreasing function. Both of the given functions are of this form; therefore, both are decreasing functions. If a function f is decreasing as the value of x increases, the corresponding value of $f(x)$ decreases; therefore, the function doesn't have a minimum value. Thus, neither of the given functions has a minimum value.

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

Question ID fad2f98c

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 50%; background-color: #cccccc; height: 10px;"></div> |

ID: fad2f98c

$$3x(x - 4)(x + 5) = 0$$

What is one of the solutions to the given equation?

- A. -4
- B. 0
- C. 3
- D. 5

ID: fad2f98c Answer

Correct Answer:

B

Rationale

Choice B is correct. Applying the zero product property to the given equation yields $3x = 0$, $x - 4 = 0$, and $x + 5 = 0$. Dividing each side of the equation $3x = 0$ by 3 yields $x = 0$. Adding 4 to each side of the equation $x - 4 = 0$ yields $x = 4$. Subtracting 5 from each side of the equation $x + 5 = 0$ yields $x = -5$. Therefore, the solutions to the given equation are 0 , 4 , and -5 . Thus, one of the solutions to the given equation is 0 .

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:

Medium

Question ID a267bd29

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: a267bd29

$$w^2 + 12w - 40 = 0$$

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

- A. $6 - 2\sqrt{19}$
- B. $2\sqrt{19}$
- C. $\sqrt{19}$
- D. $-6 + 2\sqrt{19}$

ID: a267bd29 Answer

Correct Answer:

D

Rationale

Choice D is correct. Adding 40 to both sides of the given equation yields $w^2 + 12w = 40$. To complete the square, adding $(\frac{12}{2})^2$, or 6^2 , to both sides of this equation yields $w^2 + 12w + 6^2 = 40 + 6^2$, or $(w + 6)^2 = 76$. Taking the square root of both sides of this equation yields $w + 6 = \pm\sqrt{76}$, or $w + 6 = \pm 2\sqrt{19}$. Subtracting 6 from both sides of this equation yields $w = -6 \pm 2\sqrt{19}$. Therefore, the solutions to the given equation are $-6 + 2\sqrt{19}$ and $-6 - 2\sqrt{19}$. Of these two solutions, only $-6 + 2\sqrt{19}$ is given as a choice.

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:

Medium

Question ID 75915e3c

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #cccccc;"></div> <div style="width: 25%; background-color: #cccccc;"></div> |

ID: 75915e3c

$$f(x) = 2(3^x)$$

For the function f defined above, what is the value of $f(2)$?

- A. 9
- B. 12
- C. 18
- D. 36

ID: 75915e3c Answer

Correct Answer:

C

Rationale

Choice C is correct. The value of $f(2)$ is found by evaluating the expression $2(3^x)$ when $x = 2$. Substituting 2 for x in the given equation yields $f(2) = 2(3^2)$. Simplifying 3^2 in the equation results in $f(2) = 2(9)$. Evaluating the right-hand side of the equation yields $f(2) = 18$. Therefore, the value of $f(2)$ is 18.

Choice A is incorrect and may result from evaluating the expression as (3^2) . Choice B is incorrect and may result from evaluating the expression as $2(3 \cdot 2)$. Choice D is incorrect and may result from evaluating the expression as $(2 \cdot 3)^2$.

Question Difficulty:

Easy

Question ID f44a29a8

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: f44a29a8

An object's kinetic energy, in joules, is equal to the product of one-half the object's mass, in kilograms, and the square of the object's speed, in meters per second. What is the speed, in meters per second, of an object with a mass of 4 kilograms and kinetic energy of 18 joules?

- A. 3
- B. 6
- C. 9
- D. 36

ID: f44a29a8 Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that an object's kinetic energy, in joules, is equal to the product of one-half the object's mass, in kilograms, and the square of the object's speed, in meters per second. This relationship can be represented by the equation

$K = \frac{1}{2}mv^2$, where K is the kinetic energy, m is the mass, and v is the speed. Substituting a mass of 4 kilograms for m and a

kinetic energy of 18 joules for K results in the equation $18 = \left(\frac{1}{2}\right)(4)v^2$, or $18 = 2v^2$. Dividing both sides of this equation by 2 yields $9 = v^2$. Taking the square root of both sides yields $v = -3$ and $v = 3$. Since speed can't be expressed as a negative number, the speed of the object is 3 meters per second.

Choice B is incorrect and may result from computation errors. Choice C is incorrect. This is the value of v^2 rather than v. Choice D is incorrect. This is the value of $4v^2$ rather than v.

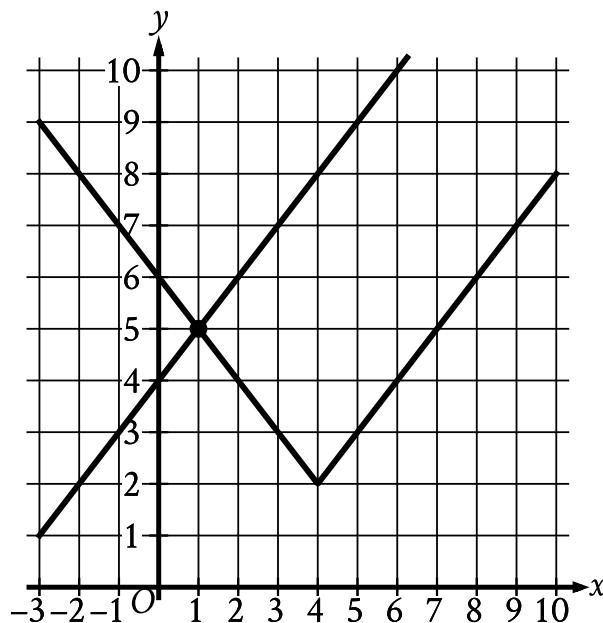
Question Difficulty:

Medium

Question ID d3f7c429

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: d3f7c429



The graph of a system of an absolute value function and a linear function is shown. What is the solution (x, y) to this system of two equations?

- A. $(-1, 5)$
- B. $(0, 4)$
- C. $(1, 5)$
- D. $(4, 2)$

ID: d3f7c429 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 function and the absolute value function shown intersect at the point $(1, 5)$. Thus, the solution to the system is $(1, 5)$.

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

Choice B is incorrect. This is the y -intercept of the graph of the linear function.

Choice D is incorrect. This is the vertex of the graph of the absolute value function.

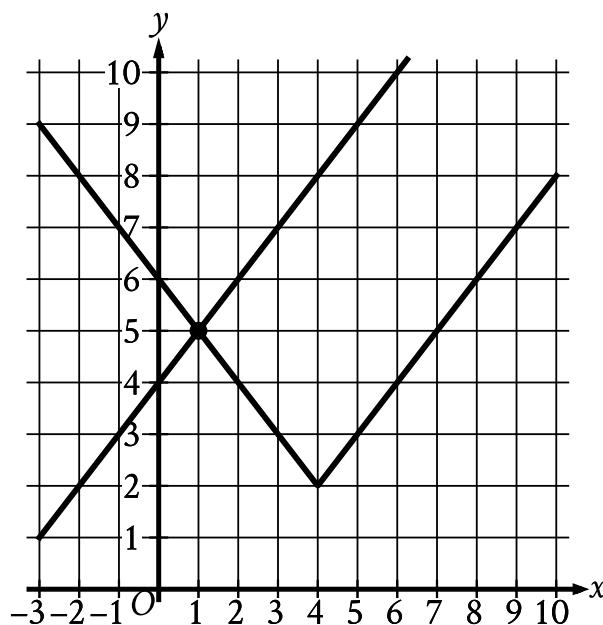
Question Difficulty:

Easy

Question ID d3f7c429

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: d3f7c429



The graph of a system of an absolute value function and a linear function is shown. What is the solution (x, y) to this system of two equations?

- A. $(-1, 5)$
- B. $(0, 4)$
- C. $(1, 5)$
- D. $(4, 2)$

ID: d3f7c429 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 function and the absolute value function shown intersect at the point $(1, 5)$. Thus, the solution to the system is $(1, 5)$.

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

Choice B is incorrect. This is the y -intercept of the graph of the linear function.

Choice D is incorrect. This is the vertex of the graph of the absolute value function.

Question Difficulty:

Easy

Question ID 92f812bb

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 92f812bb

In the xy -plane, a parabola has vertex $(9, -14)$ and intersects the x -axis at two points. If the equation of the parabola is written in the form $y = ax^2 + bx + c$, where a , b , and c are constants, which of the following could be the value of $a + b + c$?

- A. -23
- B. -19
- C. -14
- D. -12

ID: 92f812bb Answer

Correct Answer:

D

Rationale

Choice D is correct. The equation of a parabola in the xy -plane can be written in the form $y = a(x - h)^2 + k$, where a is a constant and (h, k) is the vertex of the parabola. If a is positive, the parabola will open upward, and if a is negative, the parabola will open downward. It's given that the parabola has vertex $(9, -14)$. Substituting 9 for h and -14 for k in the equation $y = a(x - h)^2 + k$ gives $y = a(x - 9)^2 - 14$, which can be rewritten as $y = a(x - 9)(x - 9) - 14$, or $y = a(x^2 - 18x + 81) - 14$. Distributing the factor of a on the right-hand side of this equation yields $y = ax^2 - 18ax + 81a - 14$. Therefore, the equation of the parabola, $y = ax^2 - 18ax + 81a - 14$, can be written in the form $y = ax^2 + bx + c$, where $a = a$, $b = -18a$, and $c = 81a - 14$. Substituting $-18a$ for b and $81a - 14$ for c in the expression $a + b + c$ yields $(a) + (-18a) + (81a - 14)$, or $64a - 14$. Since the vertex of the parabola, $(9, -14)$, is below the x -axis, and it's given that the parabola intersects the x -axis at two points, the parabola must open upward. Therefore, the constant a must have a positive value. Setting the expression $64a - 14$ equal to the value in choice D yields $64a - 14 = -12$. Adding 14 to both sides of this equation yields $64a = 2$. Dividing both sides of this equation by 64 yields $a = \frac{2}{64}$, which is a positive value. Therefore, if the equation of the parabola is written in the form $y = ax^2 + bx + c$, where a , b , and c are constants, the value of $a + b + c$ could be -12 .

Choice A is incorrect. If the equation of a parabola with a vertex at $(9, -14)$ is written in the form $y = ax^2 + bx + c$, where a , b , and c are constants and $a + b + c = -23$, then the value of a will be negative, which means the parabola will open downward, not upward, and will intersect the x -axis at zero points, not two points.

Choice B is incorrect. If the equation of a parabola with a vertex at $(9, -14)$ is written in the form $y = ax^2 + bx + c$, where a , b , and c are constants and $a + b + c = -19$, then the value of a will be negative, which means the parabola will open downward, not upward, and will intersect the x -axis at zero points, not two points.

Choice C is incorrect. If the equation of a parabola with a vertex at $(9, -14)$ is written in the form $y = ax^2 + bx + c$, where a , b , and c are constants and $a + b + c = -14$, then the value of a will be 0 , which is inconsistent with the equation of a parabola.

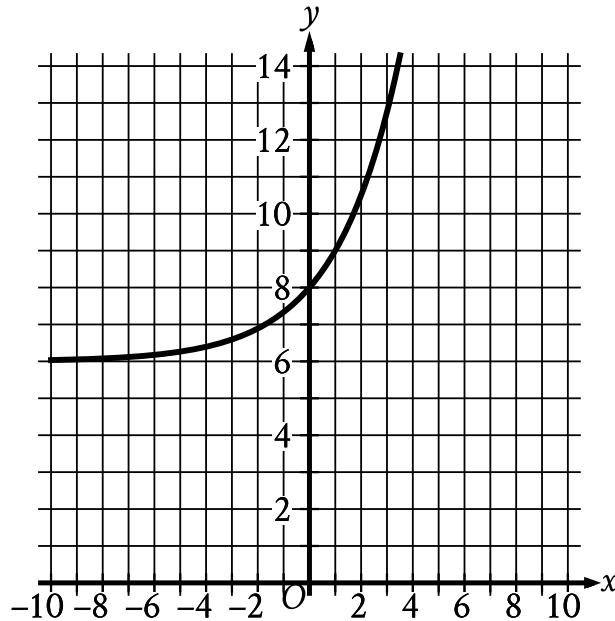
Question Difficulty:

Hard

Question ID f547a8b1

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: f547a8b1



What is the y -intercept of the graph shown?

- A. $(-8, 0)$
- B. $(-6, 0)$
- C. $(0, 6)$
- D. $(0, 8)$

ID: f547a8b1 Answer

Correct Answer:

D

Rationale

Choice D is correct. The y -intercept of a graph in the xy -plane is the point at which the graph crosses the y -axis. The graph shown crosses the y -axis at the point $(0, 8)$. Therefore, the y -intercept of the graph shown is $(0, 8)$.

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:

Easy

Question ID b8c4a1cd

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: b8c4a1cd

$$8j = k + 15m$$

The given equation relates the distinct positive numbers j , k , and m . Which equation correctly expresses j in terms of k and m ?

- A. $j = \frac{k}{8} + 15m$
- B. $j = k + \frac{15m}{8}$
- C. $j = 8(k + 15m)$
- D. $j = \frac{k+15m}{8}$

ID: b8c4a1cd Answer

Correct Answer:

D

Rationale

Choice D is correct. To express j in terms of k and m , the given equation must be solved for j . Dividing each side of the given equation by 8 yields $j = \frac{k+15m}{8}$.

Choice A is incorrect. This is equivalent to $8j = k + 120m$.

Choice B is incorrect. This is equivalent to $8j = 8k + 15m$.

Choice C is incorrect. This is equivalent to $\frac{j}{8} = k + 15m$.

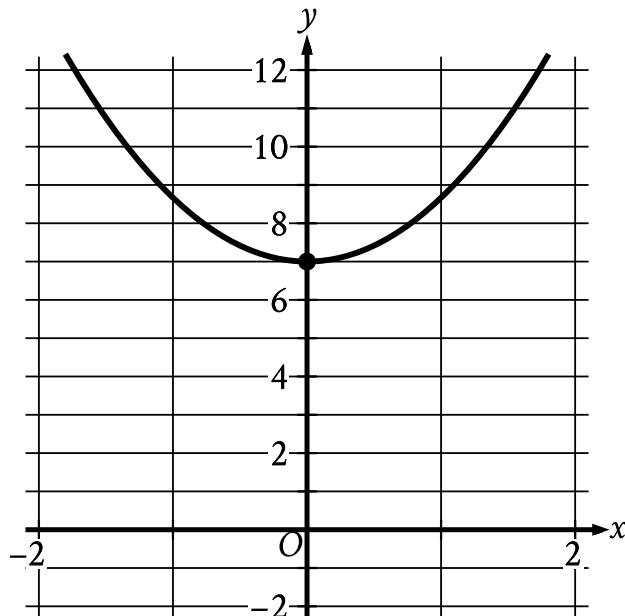
Question Difficulty:

Easy

Question ID 2f4eafcc

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 75%; background-color: #cccccc; height: 10px;"></div> <div style="width: 75%; background-color: #cccccc; height: 10px;"></div> |

ID: 2f4eafcc



The parabola shown intersects the y -axis at the point (x, y) . What is the value of y ?

ID: 2f4eafcc Answer

Correct Answer:

7

Rationale

The correct answer is 7. It's given that the parabola intersects the y -axis at the point (x, y) . The graph shows that the parabola intersects the y -axis at the point $(0, 7)$. Therefore, the value of y is 7.

Question Difficulty:

Easy

Question ID 7dbd46d9

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 7dbd46d9

$$\begin{aligned}8x + y &= -11 \\2x^2 &= y + 341\end{aligned}$$

The graphs of the equations in the given system of equations intersect at the point (x, y) in the xy -plane. What is a possible value of x ?

- A. -15
- B. -11
- C. 2
- D. 8

ID: 7dbd46d9 Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that the graphs of the equations in the given system of equations intersect at the point (x, y) . Therefore, this intersection point is a solution to the given system. The solution can be found by isolating y in each equation. The given equation $8x + y = -11$ can be rewritten to isolate y by subtracting $8x$ from both sides of the equation, which gives $y = -8x - 11$. The given equation $2x^2 = y + 341$ can be rewritten to isolate y by subtracting 341 from both sides of the equation, which gives $2x^2 - 341 = y$. With each equation solved for y , the value of y from one equation can be substituted into the other, which gives $2x^2 - 341 = -8x - 11$. Adding $8x$ and 11 to both sides of this equation results in $2x^2 + 8x - 330 = 0$. Dividing both sides of this equation by 2 results in $x^2 + 4x - 165 = 0$. This equation can be rewritten by factoring the left-hand side, which yields $(x + 15)(x - 11) = 0$. By the zero-product property, if $(x + 15)(x - 11) = 0$, then $(x + 15) = 0$, or $(x - 11) = 0$. It follows that $x = -15$, or $x = 11$. Since only -15 is given as a choice, a possible value of x is -15 .

Choice B 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:

Hard

Question ID 0121a235

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 0121a235

| x | $p(x)$ |
|----|--------|
| -2 | 5 |
| -1 | 0 |
| 0 | -3 |
| 1 | -1 |
| 2 | 0 |

The table above gives selected values of a polynomial function p . Based on the values in the table, which of the following must be a factor of p ?

- A. $(x - 3)$
- B. $(x + 3)$
- C. $(x - 1)(x + 2)$
- D. $(x + 1)(x - 2)$

ID: 0121a235 Answer

Correct Answer:

D

Rationale

Choice D is correct. According to the table, when x is -1 or 2 , $p(x) = 0$. Therefore, two x -intercepts of the graph of p are $(-1, 0)$ and $(2, 0)$. Since $(-1, 0)$ and $(2, 0)$ are x -intercepts, it follows that $(x + 1)$ and $(x - 2)$ are factors of the polynomial equation. This is because when $x = -1$, the value of $x + 1$ is 0. Similarly, when $x = 2$, the value of $x - 2$ is 0. Therefore, the product $(x + 1)(x - 2)$ is a factor of the polynomial function p .

Choice A is incorrect. The factor $x - 3$ corresponds to an x -intercept of $(3, 0)$, which isn't present in the table. Choice B is incorrect. The factor $x + 3$ corresponds to an x -intercept of $(-3, 0)$, which isn't present in the table. Choice C is incorrect. The factors $x - 1$ and $x + 2$ correspond to x -intercepts $(1, 0)$ and $(-2, 0)$, respectively, which aren't present in the table.

Question Difficulty:

Hard

Question ID 9da41c80

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 30%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 30%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 9da41c80

A ball is dropped from an initial height of **22** feet and bounces off the ground repeatedly. The function h estimates that the maximum height reached after each time the ball hits the ground is **85%** of the maximum height reached after the previous time the ball hit the ground. Which equation defines h , where $h(n)$ is the estimated maximum height of the ball after it has hit the ground n times and n is a whole number greater than **1** and less than **10**?

- A. $h(n) = 22(0.22)^n$
- B. $h(n) = 22(0.85)^n$
- C. $h(n) = 85(0.22)^n$
- D. $h(n) = 85(0.85)^n$

ID: 9da41c80 Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that for the function h , $h(n)$ is the estimated maximum height, in feet, of the ball after it has hit the ground n times. It's also given that the function h estimates that the maximum height reached after each time the ball hits the ground is **85%** of the maximum height reached after the previous time the ball hit the ground. It follows that h is a decreasing exponential function that can be written in the form $h(n) = a\left(\frac{p}{100}\right)^n$, where a is the initial height, in feet, the ball was dropped from and the function estimates that the maximum height reached after each time the ball hits the ground is $p\%$ of the maximum height reached after the previous time the ball hit the ground. It's given that the ball is dropped from an initial height of **22** feet. Therefore, $a = 22$. Since the function h estimates that the maximum height reached after each time the ball hits the ground is **85%** of the maximum height reached after the previous time the ball hit the ground, $p = 85$. Substituting **22** for a and **85** for p in the equation $h(n) = a\left(\frac{p}{100}\right)^n$ yields $h(n) = 22\left(\frac{85}{100}\right)^n$, or $h(n) = 22(0.85)^n$.

Choice A is incorrect. This function estimates that the maximum height reached after each time the ball hits the ground is **22%**, not **85%**, of the maximum height reached after the previous time the ball hit the ground.

Choice C is incorrect. This function estimates that the ball is dropped from an initial height of **85** feet, not **22** feet, and that the maximum height reached after each time the ball hits the ground is **22%**, not **85%**, of the maximum height reached after the previous time the ball hit the ground.

Choice D is incorrect. This function estimates that the ball is dropped from an initial height of **85** feet, not **22** feet.

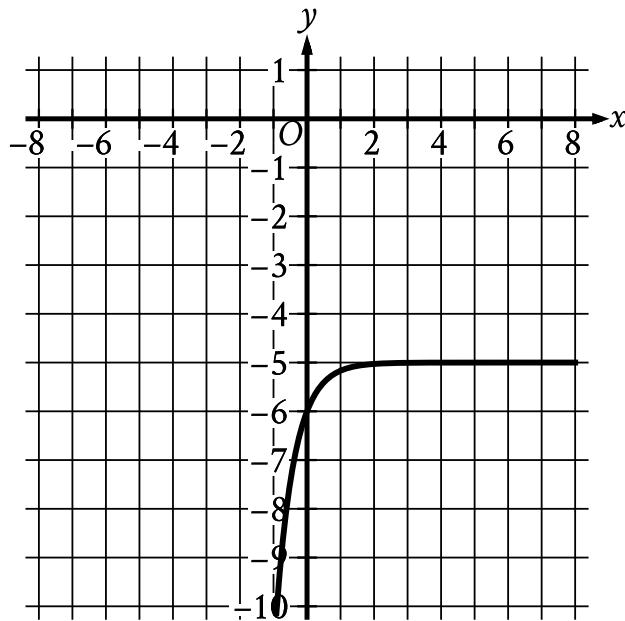
Question Difficulty:

Easy

Question ID 7160cbb3

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 25%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 7160cbb3



What is the y -intercept of the graph shown?

- A. $(0, -6)$
- B. $(-6, 0)$
- C. $(0, 0)$
- D. $(-5, -5)$

ID: 7160cbb3 Answer

Correct Answer:

A

Rationale

Choice A is correct. The y -intercept of a graph in the xy -plane is the point (x, y) on the graph where $x = 0$. For the graph shown, at $x = 0$, the corresponding value of y is -6 . Therefore, the y -intercept of the graph shown is $(0, -6)$.

Choice B is incorrect and may result from conceptual errors.

Choice C is incorrect and may result from conceptual errors.

Choice D is incorrect and may result from conceptual errors.

Question Difficulty:

Easy

Question ID d71f6dbf

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: d71f6dbf

The height, in feet, of an object x seconds after it is thrown straight up in the air can be modeled by the function $h(x) = -16x^2 + 20x + 5$. Based on the model, which of the following statements best interprets the equation $h(1.4) = 1.64$?

- A. The height of the object 1.4 seconds after being thrown straight up in the air is 1.64 feet.
- B. The height of the object 1.64 seconds after being thrown straight up in the air is 1.4 feet.
- C. The height of the object 1.64 seconds after being thrown straight up in the air is approximately 1.4 times as great as its initial height.
- D. The speed of the object 1.4 seconds after being thrown straight up in the air is approximately 1.64 feet per second.

ID: d71f6dbf Answer

Correct Answer:

A

Rationale

Choice A is correct. The value 1.4 is the value of x , which represents the number of seconds after the object was thrown straight up in the air. When the function h is evaluated for $x = 1.4$, the function has a value of 1.64, which is the height, in feet, of the object.

Choices B and C are incorrect and may result from misidentifying seconds as feet and feet as seconds. Additionally, choice C may result from incorrectly including the initial height of the object as the input x . Choice D is incorrect and may result from misidentifying height as speed.

Question Difficulty:

Medium

Question ID 630897df

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 60%; background-color: #e0e0e0; height: 10px;"></div> |

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. $T = \frac{v + 0.606}{331.3}$

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

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

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

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 $\frac{v - 331.3}{0.606} = T$.

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

Question Difficulty:

Medium

Question ID 20722644

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 20722644

The function f is defined by $f(x) = x^3 + 9$. What is the value of $f(2)$?

- A. 14
- B. 15
- C. 17
- D. 18

ID: 20722644 Answer

Correct Answer:

C

Rationale

Choice C is correct. It's given that $f(x) = x^3 + 9$. Substituting 2 for x in this equation yields $f(2) = (2)^3 + 9$. This is equivalent to $f(2) = 8 + 9$, or $f(2) = 17$.

Choice A is incorrect. This is the value of $2 + 3 + 9$, not $2^3 + 9$.

Choice B is incorrect. This is the value of $2(3) + 9$, not $2^3 + 9$.

Choice D is incorrect. This is the value of $3^2 + 9$, not $2^3 + 9$.

Question Difficulty:

Easy

Question ID 5805e747

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: 5805e747

Which expression is equivalent to $(7x^3 + 7x) - (6x^3 - 3x)$?

- A. $x^3 + 10x$
- B. $-13x^3 + 10x$
- C. $-13x^3 + 4x$
- D. $x^3 + 4x$

ID: 5805e747 Answer

Correct Answer:

A

Rationale

Choice A is correct. Applying the distributive property, the given expression can be written as $7x^3 + 7x - 6x^3 + 3x$. Grouping like terms in this expression yields $(7x^3 - 6x^3) + (7x + 3x)$. Combining like terms in this expression yields $x^3 + 10x$.

Choice B 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:

Medium

Question ID 158591f0

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 158591f0

$$x(x + 1) - 56 = 4x(x - 7)$$

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

ID: 158591f0 Answer

Correct Answer:

29/3, 9.666, 9.667

Rationale

The correct answer is $\frac{29}{3}$. Applying the distributive property to the left-hand side of the given equation, $x(x + 1) - 56$, yields $x^2 + x - 56$. Applying the distributive property to the right-hand side of the given equation, $4x(x - 7)$, yields $4x^2 - 28x$. Thus, the equation becomes $x^2 + x - 56 = 4x^2 - 28x$. Combining like terms on the left- and right-hand sides of this equation yields $0 = (4x^2 - x^2) + (-28x - x) + 56$, or $3x^2 - 29x + 56 = 0$. For a quadratic equation in the form $ax^2 + bx + c = 0$,

where a , b , and c are constants, the quadratic formula gives the solutions to the equation in the form $x = \frac{(-b \pm \sqrt{b^2 - 4ac})}{2a}$.

Substituting 3 for a , -29 for b , and 56 for c from the equation $3x^2 - 29x + 56 = 0$ into the quadratic formula yields

$$x = \frac{(29 \pm \sqrt{(-29)^2 - 4(3)(56)})}{2(3)}, \text{ or } x = \frac{29}{6} \pm \frac{13}{6}.$$

It follows that the solutions to the given equation are $\frac{29}{6} + \frac{13}{6}$ and $\frac{29}{6} - \frac{13}{6}$. Adding these two solutions gives the sum of the solutions: $\frac{29}{6} + \frac{13}{6} + \frac{29}{6} - \frac{13}{6}$, which is equivalent to $\frac{29}{6} + \frac{29}{6}$, or $\frac{29}{3}$. Note that 29/3, 9.666, and 9.667 are examples of ways to enter a correct answer.

Question Difficulty:

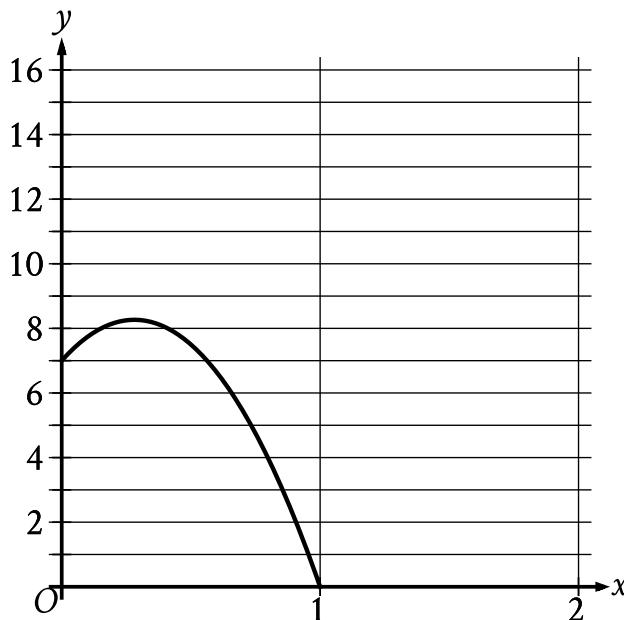
Hard

Question ID 7fe7cf26

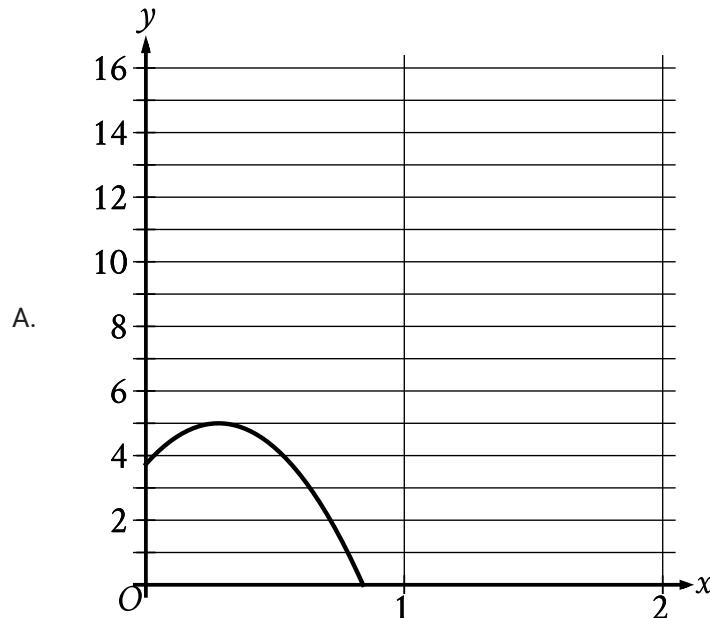
| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 25%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 7fe7cf26

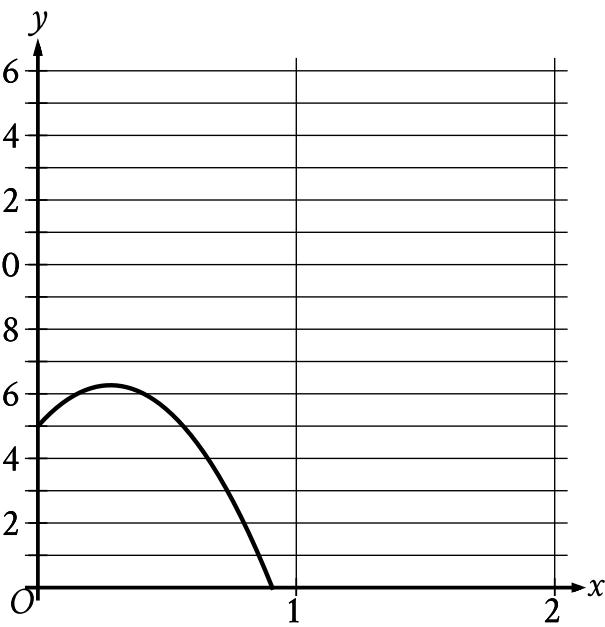
During the first part of an experiment, a ball was launched from a 7-foot-tall platform. The graph shows the height y , in feet, of the ball x seconds after it was launched during the first part of the experiment.



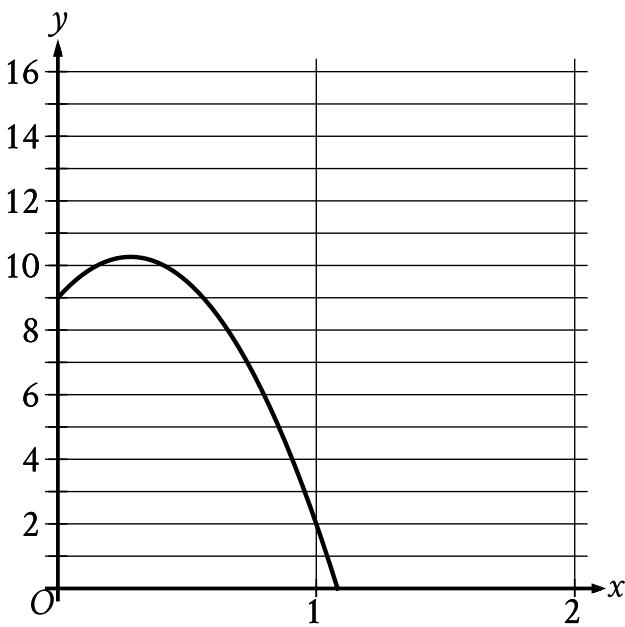
During the second part of the experiment, the ball was launched the same way, but from a platform that is 2 feet shorter than the first platform. Which of the following graphs could represent the height y , in feet, of the ball x seconds after it was launched during the second part of the experiment?



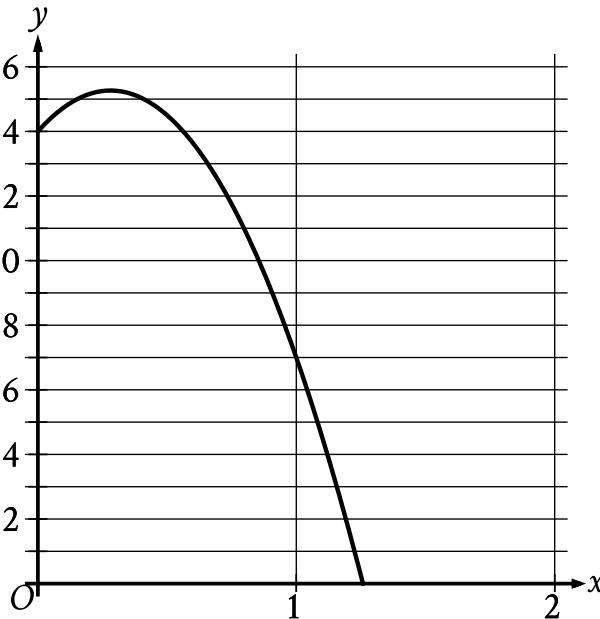
B.



C.



D.



ID: 7fe7cf26 Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that y represents the height, in feet, of the ball x seconds after it was launched. It's also given that during the first part of an experiment, a ball was launched from a 7-foot-tall platform. Therefore, the y -coordinate of the y -intercept of the given graph, 7, represents the platform height, in feet. During the second part of the experiment, the platform the ball was launched from was 2 feet shorter than the platform in the first part of the experiment. It follows that the height of the platform in the second part of the experiment was $7 - 2$ feet, or 5 feet. Therefore, the y -coordinate of the y -intercept of the graph representing the second part of the experiment must be 5. Only choice B satisfies this condition.

Choice A is incorrect. This could represent the graph if the ball were launched from a platform that was about 3 feet shorter rather than 2 feet shorter.

Choice C is incorrect. This could represent the graph if the ball were launched from a platform that was 2 feet taller rather than 2 feet shorter.

Choice D is incorrect. This could represent the graph if the ball were launched from a platform that was twice as tall rather than 2 feet shorter.

Question Difficulty:

Easy

Question ID bba18ecb

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: bba18ecb

When the quadratic function f is graphed in the xy -plane, where $y = f(x)$, its vertex is $(-3, 6)$. One of the x -intercepts of this graph is $(-\frac{17}{4}, 0)$. What is the other x -intercept of the graph?

- A. $(-\frac{29}{4}, 0)$
- B. $(-\frac{7}{4}, 0)$
- C. $(\frac{5}{4}, 0)$
- D. $(\frac{17}{4}, 0)$

ID: bba18ecb Answer

Correct Answer:

B

Rationale

Choice B is correct. Since the line of symmetry for the graph of a quadratic function contains the vertex of the graph, the x -coordinate of the vertex of the graph of $y = f(x)$ is the x -coordinate of the midpoint of its two x -intercepts. The midpoint of two points with x -coordinates x_1 and x_2 has x -coordinate x_m , where $x_m = \frac{x_1+x_2}{2}$. It's given that the vertex is $(-3, 6)$ and one of the x -intercepts is $(-\frac{17}{4}, 0)$. Substituting -3 for x_m and $-\frac{17}{4}$ for x_1 in the equation $x_m = \frac{x_1+x_2}{2}$ yields $-3 = \frac{-\frac{17}{4}+x_2}{2}$. Multiplying each side of this equation by 2 yields $-6 = -\frac{17}{4} + x_2$. Adding $\frac{17}{4}$ to each side of this equation yields $-\frac{7}{4} = x_2$. Therefore, the other x -intercept is $(-\frac{7}{4}, 0)$.

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:

Hard

Question ID 668f1863

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 668f1863

Function f is a quadratic function where $f(-20) = 0$ and $f(-4) = 0$. The graph of $y = f(x)$ in the xy -plane has a vertex at $(r, -64)$. What is the value of r ?

ID: 668f1863 Answer

Correct Answer:

-12

Rationale

The correct answer is **-12**. It's given that function f is a quadratic function where $f(-20) = 0$ and $f(-4) = 0$. It follows that the graph of $y = f(x)$ in the xy -plane passes through the points $(-20, 0)$ and $(-4, 0)$. When the graph of a quadratic function contains two points $(a, 0)$ and $(b, 0)$, the x -coordinate of the vertex of the graph is the average of a and b . Therefore, the x -coordinate of the vertex of the graph of $y = f(x)$ is $\frac{-20+(-4)}{2}$, or **-12**. It's given that the graph of $y = f(x)$ in the xy -plane has a vertex at $(r, -64)$. It follows that the value of r is **-12**.

Question Difficulty:

Hard

Question ID 70753f99

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 70753f99

The function f is defined by $f(x) = (x + 3)(x + 1)$. The graph of f in the xy -plane is a parabola. Which of the following intervals contains the x -coordinate of the vertex of the graph of f ?

- A. $-4 < x < -3$
- B. $-3 < x < 1$
- C. $1 < x < 3$
- D. $3 < x < 4$

ID: 70753f99 Answer

Correct Answer:

B

Rationale

Choice B is correct. The graph of a quadratic function in the xy -plane is a parabola. The axis of symmetry of the parabola passes through the vertex of the parabola. Therefore, the vertex of the parabola and the midpoint of the segment between the two x -intercepts of the graph have the same x -coordinate. Since $f(-3) = f(-1) = 0$, the x -coordinate of the vertex is

$\frac{(-3) + (-1)}{2} = -2$. Of the shown intervals, only the interval in choice B contains -2 . Choices A, C, and D are incorrect and may result from either calculation errors or misidentification of the graph's x -intercepts.

Question Difficulty:

Hard

Question ID c6e85cd7

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: c6e85cd7

If $4^{8c} = \sqrt[3]{4^7}$, what is the value of c ?

ID: c6e85cd7 Answer

Correct Answer:

.2916, .2917, 7/24

Rationale

The correct answer is $\frac{7}{24}$. An expression of the form $\sqrt[n]{a^m}$, where m and n are integers greater than 1 and $a \geq 0$, is equivalent to $a^{\frac{m}{n}}$. Therefore, the expression on the right-hand side of the given equation, $\sqrt[3]{4^7}$, is equivalent to $4^{\frac{7}{3}}$. Thus, $4^{8c} = 4^{\frac{7}{3}}$. It follows that $8c = \frac{7}{3}$. Dividing both sides of this equation by 8 yields $c = \frac{7}{24}$. Note that 7/24, .2916, .2917, 0.219, and 0.292 are examples of ways to enter a correct answer.

Question Difficulty:

Hard

Question ID 568aaf27

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|---|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 75%; background-color: #cccccc; height: 10px;"></div> |

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

Question ID 6aefc52b

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #005a9f; height: 10px;"></div> |

ID: 6aefc52b

$$\begin{aligned}y &= -2.5 \\y &= x^2 + 8x + k\end{aligned}$$

In the given system of equations, k is a positive integer constant. The system has no real solutions. What is the least possible value of k ?

ID: 6aefc52b Answer

Correct Answer:

14

Rationale

The correct answer is 14. It's given by the first equation of the system of equations that $y = -2.5$. Substituting -2.5 for y in the second given equation, $y = x^2 + 8x + k$, yields $-2.5 = x^2 + 8x + k$. Adding 2.5 to both sides of this equation yields $0 = x^2 + 8x + k + 2.5$. A quadratic equation of the form $0 = ax^2 + bx + c$, where a , b , and c are constants, has no real solutions if and only if its discriminant, $b^2 - 4ac$, is negative. In the equation $0 = x^2 + 8x + k + 2.5$, where k is a positive integer constant, $a = 1$, $b = 8$, and $c = k + 2.5$. Substituting 1 for a , 8 for b , and $k + 2.5$ for c in $b^2 - 4ac$ yields $8^2 - 4(1)(k + 2.5)$, or $64 - 4(k + 2.5)$. Since this value must be negative, $64 - 4(k + 2.5) < 0$. Adding $4(k + 2.5)$ to both sides of this inequality yields $64 < 4(k + 2.5)$. Dividing both sides of this inequality by 4 yields $16 < k + 2.5$. Subtracting 2.5 from both sides of this inequality yields $13.5 < k$. Since k is a positive integer constant, the least possible value of k is 14.

Question Difficulty:

Hard

Question ID 55c5d3c2

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 60%; background-color: #0056b3; height: 10px;"></div> |

ID: 55c5d3c2

The function f is defined by $f(x) = a^x + b$, where a and b are constants and $a > 0$. In the xy -plane, the graph of $y = f(x)$ has a y -intercept at $(0, -25)$ and passes through the point $(2, 23)$. What is the value of $a + b$?

ID: 55c5d3c2 Answer

Correct Answer:

-19

Rationale

The correct answer is **-19**. It's given that function f is defined by $f(x) = a^x + b$, where a and b are constants and $a > 0$. It's also given that the graph of $y = f(x)$ in the xy -plane has a y -intercept at $(0, -25)$ and passes through the point $(2, 23)$. Since the graph has a y -intercept at $(0, -25)$, $f(0) = -25$. Substituting 0 for x in the given equation yields $f(0) = a^0 + b$, or $f(0) = 1 + b$, and substituting -25 for $f(0)$ in this equation yields $-25 = 1 + b$. Subtracting 1 from each side of this equation yields $-26 = b$. Substituting -26 for b in the equation $f(x) = a^x + b$ yields $f(x) = a^x - 26$. Since the graph also passes through the point $(2, 23)$, $f(2) = 23$. Substituting 2 for x in the equation $f(x) = a^x - 26$ yields $f(2) = a^2 - 26$, and substituting 23 for $f(2)$ yields $23 = a^2 - 26$. Adding 26 to each side of this equation yields $49 = a^2$. Taking the square root of both sides of this equation yields $\pm 7 = a$. Since it's given that $a > 0$, the value of a is 7. It follows that the value of $a + b$ is $7 - 26$, or **-19**.

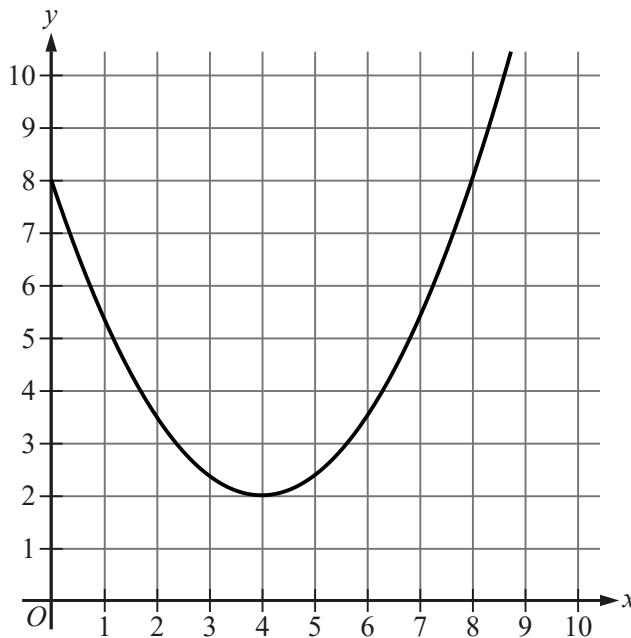
Question Difficulty:

Hard

Question ID 5e63b9cf

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 5e63b9cf



The graph shows a marble's height above the ground y , in inches, x seconds after it started moving on an elevated track of a marble run. Which of the following is the best interpretation of the y -intercept of the graph?

- A. The marble's height was 0 inches above the ground 8 seconds after it started moving.
- B. The marble's height was 8 inches above the ground when it started moving.
- C. The marble's minimum height was 0 inches above the ground.
- D. The marble's minimum height was 8 inches above the ground.

ID: 5e63b9cf Answer

Correct Answer:

B

Rationale

Choice B is correct. The y -intercept of a graph is the point at which the graph intersects the y -axis. The graph shown intersects the y -axis at the point $(0, 8)$. Therefore, the y -intercept of the graph is $(0, 8)$. It's given that y is the height of the marble above the ground, in inches, and x is the number of seconds after the marble started moving. It follows that the marble's height was 8 inches above the ground 0 seconds after it started moving. Therefore, the best interpretation of the y -intercept of the graph is that the marble's height was 8 inches above the ground when it started moving.

Choice A is incorrect and may result from conceptual errors.

Choice C is incorrect and may result from conceptual errors.

Choice D is incorrect and may result from conceptual errors.

Question Difficulty:
Easy

Question ID 6676f055

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 6676f055

$$f(\theta) = -0.28(\theta - 27)^2 + 880$$

An engineer wanted to identify the best angle for a cooling fan in an engine in order to get the greatest airflow. The engineer discovered that the function above models the airflow $f(\theta)$, in cubic feet per minute, as a function of the angle of the fan θ , in degrees. According to the model, what angle, in degrees, gives the greatest airflow?

- A. -0.28
- B. 0.28
- C. 27
- D. 880

ID: 6676f055 Answer

Correct Answer:

C

Rationale

Choice C is correct. The function f is quadratic, so it will have either a maximum or a minimum at the vertex of the graph. Since the coefficient of the quadratic term (-0.28) is negative, the vertex will be at a maximum. The equation $f(\theta) = -0.28(\theta - 27)^2 + 880$ is given in vertex form, so the vertex is at $\theta = 27$. Therefore, an angle of 27 degrees gives the greatest airflow.

Choices A and B are incorrect and may be the result of misidentifying which value in a quadratic equation in vertex form represents the vertex. Choice D is incorrect. This choice identifies the maximum value of $f(\theta)$ rather than the value of θ for which $f(\theta)$ is maximized.

Question Difficulty:

Medium

Question ID 29ed5d39

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 25%; background-color: #006699; height: 10px;"></div> <div style="width: 50%; background-color: #cccccc; height: 10px;"></div> |

ID: 29ed5d39

$$p = 20 + \frac{16}{n}$$

The given equation relates the numbers p and n , where n is not equal to 0 and $p > 20$. Which equation correctly expresses n in terms of p ?

- A. $n = \frac{p-20}{16}$
- B. $n = \frac{p}{16} + 20$
- C. $n = \frac{p}{16} - 20$
- D. $n = \frac{16}{p-20}$

ID: 29ed5d39 Answer

Correct Answer:

D

Rationale

Choice D is correct. To express n in terms of p , the given equation must be solved for n . Subtracting 9 from both sides of the given equation yields $p - 9 = \frac{14}{n}$. Since n is not equal to 0, multiplying both sides of this equation by n yields $(p - 9)(n) = 14$. It's given that $p > 9$, which means $p - 9$ is not equal to 0. Therefore, dividing both sides of $(p - 9)(n) = 14$ by $(p - 9)$ yields $\frac{(p-9)(n)}{p-9} = \frac{14}{p-9}$, or $n = \frac{14}{p-9}$.

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:

Medium

Question ID 90bcaa61

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 90bcaa61

The function $f(t) = 60,000(2)^{\frac{t}{410}}$ gives the number of bacteria in a population t minutes after an initial observation. How much time, in minutes, does it take for the number of bacteria in the population to double?

ID: 90bcaa61 Answer

Correct Answer:

410

Rationale

The correct answer is 410. It's given that t minutes after an initial observation, the number of bacteria in a population is $60,000(2)^{\frac{t}{410}}$. This expression consists of the initial number of bacteria, 60,000, multiplied by the expression $2^{\frac{t}{410}}$. The time it takes for the number of bacteria to double is the increase in the value of t that causes the expression $2^{\frac{t}{410}}$ to double. Since the base of the expression $2^{\frac{t}{410}}$ is 2, the expression $2^{\frac{t}{410}}$ will double when the exponent increases by 1. Since the exponent of the expression $2^{\frac{t}{410}}$ is $\frac{t}{410}$, the exponent will increase by 1 when t increases by 410. Therefore the time, in minutes, it takes for the number of bacteria in the population to double is 410.

Question Difficulty:

Medium

Question ID 895628b5

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 895628b5

$$y = (x - 2)(x + 4)$$

$$y = 6x - 12$$

Which ordered pair (x, y) is the solution to the given system of equations?

- A. $(0, 2)$
- B. $(-4, 2)$
- C. $(2, 0)$
- D. $(2, -4)$

ID: 895628b5 Answer

Correct Answer:

C

Rationale

Choice C is correct. The second equation in the given system of equations is $y = 6x - 12$. Substituting $6x - 12$ for y in the first equation of the given system yields $6x - 12 = (x - 2)(x + 4)$. Factoring 6 out of the left-hand side of this equation yields $6(x - 2) = (x - 2)(x + 4)$. An expression with a factor of the form $(x - a)$ is equal to zero when $x = a$. Each side of this equation has a factor of $(x - 2)$, so each side of the equation is equal to zero when $x = 2$. Substituting 2 for x into the equation $6(x - 2) = (x - 2)(x + 4)$ yields $6(2 - 2) = (2 - 2)(2 + 4)$, or $0 = 0$, which is true. Substituting 2 for x into the second equation in the given system of equations yields $y = 6(2) - 12$, or $y = 0$. Therefore, the solution to the system of equations is the ordered pair $(2, 0)$.

Choice A is incorrect and may result from switching the order of the solutions for x and y .

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:

Medium

Question ID 8f82ad81

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a99; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 8f82ad81

Which expression is equivalent to $4(x^2 + 6)$?

- A. $4x^2 + 24$
- B. $4x^2 + 10$
- C. $4x^2 + 6$
- D. $4x^2 - 2$

ID: 8f82ad81 Answer

Correct Answer:

A

Rationale

Choice A is correct. The expression $4(x^2 + 6)$ can be rewritten as $4(x^2) + 4(6)$, which is equivalent to $4x^2 + 24$.

Choice B is incorrect. This expression is equivalent to $4(x^2 + \frac{5}{2})$, not $4(x^2 + 6)$.

Choice C is incorrect. This expression is equivalent to $4(x^2 + \frac{3}{2})$, not $4(x^2 + 6)$.

Choice D is incorrect. This expression is equivalent to $4(x^2 - \frac{1}{2})$, not $4(x^2 + 6)$.

Question Difficulty:

Easy

Question ID 26eb61c1

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: 26eb61c1

Which expression is equivalent to $6x^8y^2 + 12x^2y^2$?

- A. $6x^2y^2(2x^6)$
- B. $6x^2y^2(x^4)$
- C. $6x^2y^2(x^6 + 2)$
- D. $6x^2y^2(x^4 + 2)$

ID: 26eb61c1 Answer

Correct Answer:

C

Rationale

Choice C is correct. Since each term of the given expression has a common factor of $6x^2y^2$, it may be rewritten as $6x^2y^2(x^6) + 6x^2y^2(2)$, or $6x^2y^2(x^6 + 2)$.

Choice A is incorrect. This expression is equivalent to $12x^8y^2$, not $6x^8y^2 + 12x^2y^2$.

Choice B is incorrect. This expression is equivalent to $6x^6y^2$, not $6x^8y^2 + 12x^2y^2$.

Choice D is incorrect. This expression is equivalent to $6x^6y^2 + 12x^2y^2$, not $6x^8y^2 + 12x^2y^2$.

Question Difficulty:

Medium

Question ID c9417793

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: c9417793

$$|x - 9| + 45 = 63$$

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

ID: c9417793 Answer

Correct Answer:

18

Rationale

The correct answer is **18**. Subtracting **45** from each side of the given equation yields $|x - 9| = 18$. By the definition of absolute value, if $|x - 9| = 18$, then $x - 9 = 18$ or $x - 9 = -18$. Adding **9** to each side of the equation $x - 9 = 18$ yields $x = 27$. Adding **9** to each side of the equation $x - 9 = -18$ yields $x = -9$. Therefore, the solutions to the given equation are **27** and **-9**, and it follows that the sum of the solutions to the given equation is $27 + (-9)$, or **18**.

Question Difficulty:

Hard

Question ID 8f65cddc

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 60%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 8f65cddc

$$\frac{1}{7b} = \frac{11x}{y}$$

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

- A. $x = \frac{7by}{11}$
- B. $x = y - 77b$
- C. $x = \frac{y}{77b}$
- D. $x = 77by$

ID: 8f65cddc Answer

Correct Answer:

C

Rationale

Choice C is correct. Multiplying each side of the given equation by y yields the equivalent equation $\frac{y}{7b} = 11x$. Dividing each side of this equation by 11 yields $\frac{y}{77b} = x$, or $x = \frac{y}{77b}$.

Choice A is incorrect. This equation is not equivalent to the given equation.

Choice B is incorrect. This equation is not equivalent to the given equation.

Choice D is incorrect. This equation is not equivalent to the given equation.

Question Difficulty:

Medium

Question ID 2926cc6d

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 2926cc6d

$$(5x + 4)(2x - 5) = 0$$

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

- A. $-\frac{5}{2}$
- B. $-\frac{5}{4}$
- C. $-\frac{4}{5}$
- D. $-\frac{2}{5}$

ID: 2926cc6d Answer

Correct Answer:

C

Rationale

Choice C is correct. Since a product of two factors is equal to 0 if and only if at least one of the factors is 0, either $5x + 4 = 0$ or $2x - 5 = 0$. Subtracting 4 from each side of the equation $5x + 4 = 0$ yields $5x = -4$. Dividing each side of this equation by 5 yields $x = -\frac{4}{5}$. Adding 5 to each side of the equation $2x - 5 = 0$ yields $2x = 5$. Dividing each side of this equation by 2 yields $x = \frac{5}{2}$. It follows that the solutions to the given equation are $-\frac{4}{5}$ and $\frac{5}{2}$. Therefore, $-\frac{4}{5}$ is a solution to the given equation.

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:

Medium

Question ID dd8ac009

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: dd8ac009

| Time (years) | Total amount (dollars) |
|--------------|------------------------|
| 0 | 670.00 |
| 1 | 674.02 |
| 2 | 678.06 |

Sara opened a savings account at a bank. The table shows the exponential relationship between the time t , in years, since Sara opened the account and the total amount d , in dollars, in the account. If Sara made no additional deposits or withdrawals, which of the following equations best represents the relationship between t and d ?

- A. $d = 0.006(1 + 670)^t$
- B. $d = 670(1 + 0.006)^t$
- C. $d = (1 + 0.006)^t$
- D. $d = (1 + 670)^t$

ID: dd8ac009 Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that the relationship between t and d is exponential. The table shows that the value of d increases as the value of t increases. Therefore, the relationship between t and d can be represented by an increasing exponential equation of the form $d = a(1 + b)^t$, where a and b are positive constants. The table shows that when $t = 0$, $d = 670$. Substituting 0 for t and 670 for d in the equation $d = a(1 + b)^t$ yields $670 = a(1 + b)^0$, which is equivalent to $670 = a(1)$, or $670 = a$. Substituting 670 for a in the equation $d = a(1 + b)^t$ yields $d = 670(1 + b)^t$. The table also shows that when $t = 1$, $d = 674.02$. Substituting 1 for t and 674.02 for d in the equation $d = 670(1 + b)^t$ yields $674.02 = 670(1 + b)^1$, or $674.02 = 670(1 + b)$. Dividing both sides of this equation by 670 yields $1.006 = 1 + b$. Subtracting 1 from both sides of this equation yields $b = 0.006$. Substituting 0.006 for b in the equation $d = 670(1 + b)^t$ yields $d = 670(1 + 0.006)^t$. Therefore, of the choices, choice B best represents the relationship between t and d .

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:

Medium

Question ID 3cce51ea

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 3cce51ea

$$|p| + 61 = 65$$

Which value is a solution to the given equation?

- A. $\frac{65}{61}$
- B. 4
- C. 126
- D. 130

ID: 3cce51ea Answer

Correct Answer:

B

Rationale

Choice B is correct. Subtracting 61 from each side of the given equation yields $|p| = 4$. By the definition of absolute value, if $|p| = 4$, then $p = 4$ or $p = -4$. Of the given choices, 4 is a solution to the given equation.

Choice A is incorrect. This is the quotient, not the difference, of 65 and 61.

Choice C is incorrect. This is the sum, not the difference, of 65 and 61.

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

Question Difficulty:

Easy

Question ID 58dcc59f

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 58dcc59f

A landscaper is designing a rectangular garden. The length of the garden is to be 5 feet longer than the width. If the area of the garden will be 104 square feet, what will be the length, in feet, of the garden?

ID: 58dcc59f Answer

Rationale

The correct answer is 13. Let w represent the width of the rectangular garden, in feet. Since the length of the garden will be 5 feet longer than the width of the garden, the length of the garden will be $w + 5$ feet. Thus the area of the garden will be $w(w + 5)$. It is also given that the area of the garden will be 104 square feet. Therefore, $w(w + 5) = 104$, which is equivalent to $w^2 + 5w - 104 = 0$. Factoring this equation results in $(w + 13)(w - 8) = 0$. Therefore, $w = 8$ and $w = -13$. Because width cannot be negative, the width of the garden must be 8 feet. This means the length of the garden must be $8 + 5 = 13$ feet.

Question Difficulty:

Hard

Question ID 2d1614a1

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 2d1614a1

$$P(t) = 290(1.04)^{(\frac{4}{6})t}$$

The function P models the population, in thousands, of a certain city t years after 2005. According to the model, the population is predicted to increase by $n\%$ every 18 months. What is the value of n ?

- A. 0.38
- B. 1.04
- C. 4
- D. 6

ID: 2d1614a1 Answer

Correct Answer:

C

Rationale

Choice C is correct. It's given that the function P models the population of the city t years after 2005. Since there are 12 months in a year, 18 months is equivalent to $\frac{18}{12}$ years. Therefore, the expression $\frac{18}{12}x$ can represent the number of years in x 18-month periods. Substituting $\frac{18}{12}x$ for t in the given equation yields $P(\frac{18}{12}x) = 290(1.04)^{(\frac{4}{6})(\frac{18}{12}x)}$, which is equivalent to $P(\frac{18}{12}x) = 290(1.04)^x$. Therefore, for each 18-month period, the predicted population of the city is 1.04 times, or 104% of, the previous population. This means that the population is predicted to increase by 4% every 18 months.

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

Choice B is incorrect. Each year, the predicted population of the city is 1.04 times the previous year's predicted population, which is not the same as an increase of 1.04%.

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

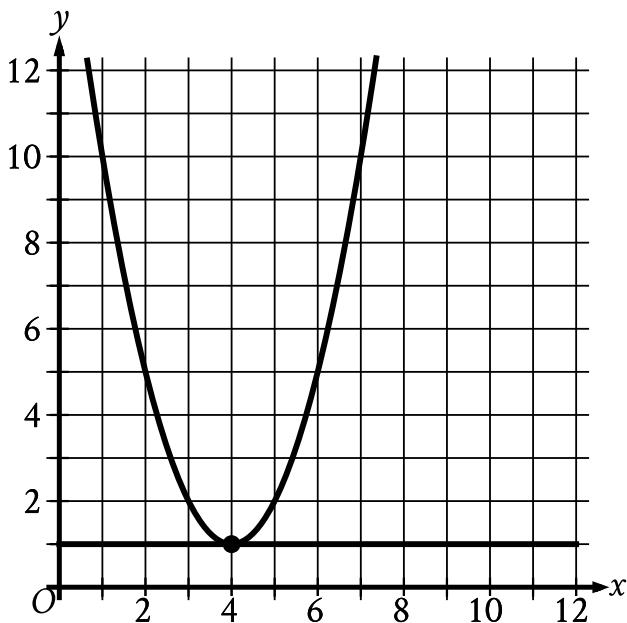
Question Difficulty:

Hard

Question ID d0e8e8f5

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: d0e8e8f5



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

- A. $(0, 0)$
- B. $(-4, 1)$
- C. $(4, -1)$
- D. $(4, 1)$

ID: d0e8e8f5 Answer

Correct Answer:

D

Rationale

Choice D is correct. The solution to the system corresponds to the point where the graphs of the equations intersect. The graphs of the linear equation and the quadratic equation shown intersect at the point $(4, 1)$. Therefore, $(4, 1)$ is the solution to this system.

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:

Easy

Question ID 9ed9f54d

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 9ed9f54d

Which of the following is equivalent to

$$2(x^2 - x) + 3(x^2 - x)$$

A. $5x^2 - 5x$

B. $5x^2 + 5x$

C. $5x$

D. $5x^2$

ID: 9ed9f54d Answer

Correct Answer:

A

Rationale

Choice A is correct. Since $(x^2 - x)$ is a common term in the original expression, like terms can be added:

$$2(x^2 - x) + 3(x^2 - x) = 5(x^2 - x). \text{ Distributing the constant term 5 yields } 5x^2 - 5x.$$

Choice B is incorrect and may result from not distributing the negative signs in the expressions within the parentheses. Choice C is incorrect and may result from not distributing the negative signs in the expressions within the parentheses and from incorrectly eliminating the x^2 -term. Choice D is incorrect and may result from incorrectly eliminating the x-term.

Question Difficulty:

Easy

Question ID 7a8cb72a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|---|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 75%; background-color: #cccccc; height: 10px;"></div> |

ID: 7a8cb72a

$$7m = 2(n + p)$$

The given equation relates the positive numbers m , n , and p . Which equation correctly gives m in terms of n and p ?

- A. $m = \frac{2(n+p)}{7}$
- B. $m = 2(n + p)$
- C. $m = 2(n + p) - 7$
- D. $m = 2 - n - p - 7$

ID: 7a8cb72a Answer

Correct Answer:

A

Rationale

Choice A is correct. Dividing each side of the given equation by 7 yields $m = \frac{2(n+p)}{7}$.

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

Choice C is incorrect. This equation is equivalent to $7 + m = 2(n + p)$, not $7m = 2(n + p)$.

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

Question Difficulty:

Easy

Question ID dbe9b217

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: dbe9b217

The function f is defined by $f(x) = 8x^3 + 4$. What is the value of $f(2)$?

ID: dbe9b217 Answer

Correct Answer:

68

Rationale

The correct answer is **68**. It's given that the function f is defined by $f(x) = 8x^3 + 4$. Substituting **2** for x in this equation yields $f(2) = 8(2)^3 + 4$, or $f(2) = 8(8) + 4$, which is equivalent to $f(2) = 68$. Therefore, the value of $f(2)$ is **68**.

Question Difficulty:

Medium

Question ID 18c7c3e0

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 75%; background-color: #e0e0e0;"></div> <div style="width: 75%; background-color: #e0e0e0;"></div> |

ID: 18c7c3e0

Which expression is equivalent to $13x^2 - 7x^2$?

- A. $-91x^2$
- B. $6x^2$
- C. $20x^2$
- D. $40x^2$

ID: 18c7c3e0 Answer

Correct Answer:

B

Rationale

Choice B is correct. Since each term in the given expression has a common factor of x^2 , it can be rewritten as $(13 - 7)x^2$, or $6x^2$. Therefore, the expression $6x^2$ is equivalent to $13x^2 - 7x^2$.

Alternate approach: Since the two terms of the given expression are both constant multiples of x^2 , they are like terms and can, therefore, be combined through subtraction. Subtracting like terms in the expression $13x^2 - 7x^2$ yields $6x^2$.

Choice A is incorrect. This expression is equivalent to $(13x)(-7x)$, not $13x^2 - 7x^2$.

Choice C is incorrect. This expression is equivalent to $13x^2 + 7x^2$, not $13x^2 - 7x^2$.

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

Question Difficulty:

Easy

Question ID 30281058

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

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: $\frac{16 - (-8)}{5 - 1} = \frac{24}{4}$, 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

Question ID 42f19012

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: 42f19012

Which expression is equivalent to $a^{\frac{11}{12}}$, where $a > 0$?

- A. $\sqrt[12]{a^{132}}$
- B. $\sqrt[144]{a^{132}}$
- C. $\sqrt[121]{a^{132}}$
- D. $\sqrt[11]{a^{132}}$

ID: 42f19012 Answer

Correct Answer:

B

Rationale

Choice B is correct. Since $\frac{12}{12} = 1$, multiplying the exponent of the given expression by $\frac{12}{12}$ yields an equivalent expression: $a^{\left(\frac{11}{12}\right)\left(\frac{12}{12}\right)} = a^{\left(\frac{132}{144}\right)}$. Since $\frac{132}{144} = 132\left(\frac{1}{144}\right)$, the expression $a^{\frac{132}{144}}$ can be rewritten as $a^{\left(132\right)\left(\frac{1}{144}\right)}$. Applying properties of exponents, this expression can be rewritten as $\left(a^{132}\right)^{\frac{1}{144}}$. An expression of the form $(m)^{\frac{1}{k}}$, where $m > 0$ and $k > 0$, is equivalent to $\sqrt[k]{m}$. Therefore, $\left(a^{132}\right)^{\frac{1}{144}}$ is equivalent to $\sqrt[144]{a^{132}}$.

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:

Medium

Question ID 294db8ec

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 294db8ec

Which of the following is equivalent to $2x^3 + 4$?

- A. $4(x^3 + 4)$
- B. $4(x^3 + 2)$
- C. $2(x^3 + 4)$
- D. $2(x^3 + 2)$

ID: 294db8ec Answer

Correct Answer:

D

Rationale

Choice D is correct. The expression $2x^3 + 4$ has two terms, $2x^3$ and 4. The greatest common factor of these two terms is 2. Factoring 2 from each of these terms yields $2(x^3) + 2(2)$, or $2(x^3 + 2)$.

Choices A and B are incorrect because 4 is not a factor of the term $2x^3$. Choice C is incorrect and may result from factoring 2 from $2x^3$ but not from 4.

Question Difficulty:

Easy

Question ID 84dd43f8

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 30%; background-color: #0056b3; height: 10px;"></div> <div style="width: 30%; background-color: #0056b3; height: 10px;"></div> <div style="width: 30%; background-color: #0056b3; height: 10px;"></div> |

ID: 84dd43f8

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 $f(2)$?

ID: 84dd43f8 Answer

Correct Answer:

3.44, 86/25

Rationale

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.

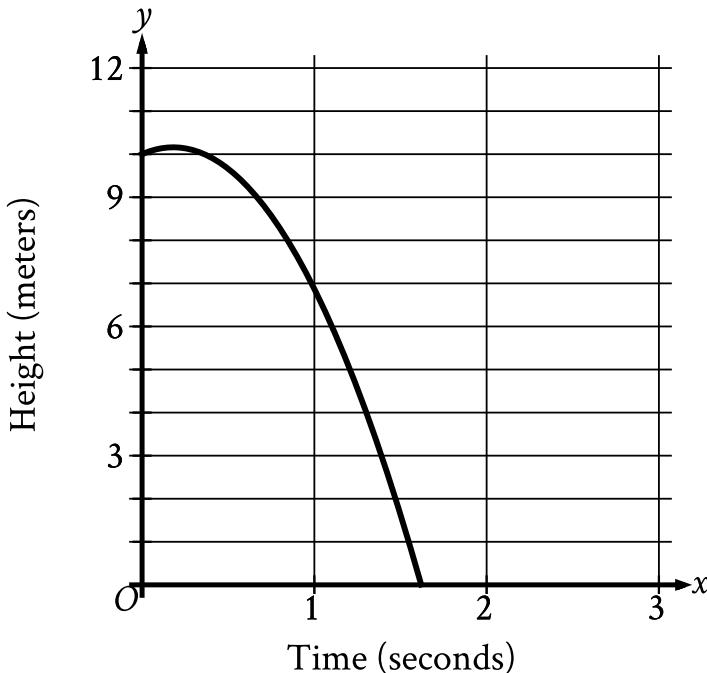
Question Difficulty:

Hard

Question ID 9ff88bb5

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 20%; background-color: #0056b3;"></div> <div style="width: 20%; background-color: #0056b3;"></div> <div style="width: 60%; background-color: #e0e0e0;"></div> |

ID: 9ff88bb5



A competitive diver dives from a platform into the water. The graph shown gives the height above the water y , in meters, of the diver x seconds after diving from the platform. What is the best interpretation of the x -intercept of the graph?

- A. The diver reaches a maximum height above the water at **1.6** seconds.
- B. The diver hits the water at **1.6** seconds.
- C. The diver reaches a maximum height above the water at **0.2** seconds.
- D. The diver hits the water at **0.2** seconds.

ID: 9ff88bb5 Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that the graph shows the height above the water y , in meters, of a diver x seconds after diving from a platform. The x -intercept of a graph is the point at which the graph intersects the x -axis, or when the value of y is 0. The graph shown intersects the x -axis between $x = 1$ and $x = 2$. In other words, the diver is 0 meters above the water, or hits the water, between 1 and 2 seconds after diving from the platform. Of the given choices, only choice B includes an interpretation where the diver hits the water between 1 and 2 seconds. Therefore, the best interpretation of the x -intercept of the graph is the diver hits the water at **1.6** seconds.

Choice A is incorrect and may result from conceptual errors.

Choice C is incorrect. This is the best interpretation of the maximum value, not the x-intercept, of the graph.

Choice D is incorrect and may result from conceptual errors.

Question Difficulty:

Medium

Question ID 94ff3e2d

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 94ff3e2d

The function h is defined by $h(x) = \frac{8}{5x+6}$. What is the value of $h(2)$?

ID: 94ff3e2d Answer

Correct Answer:

.5, 1/2

Rationale

The correct answer is $\frac{1}{2}$. The value of $h(2)$ is the value of $h(x)$ when $x = 2$. Substituting 2 for x in the given equation yields $h(2) = \frac{8}{5(2)+6}$, which is equivalent to $h(2) = \frac{8}{16}$, or $h(2) = \frac{1}{2}$. Therefore, the value of $h(2)$ is $\frac{1}{2}$. Note that 1/2 and .5 are examples of ways to enter a correct answer.

Question Difficulty:

Easy

Question ID 59d1f4b5

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 59d1f4b5

$$M = 1,800(1.02)^t$$

The equation above models the number of members, M , of a gym t years after the gym opens. Of the following, which equation models the number of members of the gym q quarter years after the gym opens?

A. $M = 1,800(1.02)^{\frac{q}{4}}$

B. $M = 1,800(1.02)^{4q}$

C. $M = 1,800(1.005)^{4q}$

D. $M = 1,800(1.082)^q$

ID: 59d1f4b5 Answer

Correct Answer:

A

Rationale

Choice A is correct. In 1 year, there are 4 quarter years, so the number of quarter years, q , is 4 times the number of years, t ; that is,

$$q = 4t. \text{ This is equivalent to } t = \frac{q}{4}, \text{ and substituting this into the expression for } M \text{ in terms of } t \text{ gives } M = 1,800(1.02)^{\frac{q}{4}}.$$

Choices B and D are incorrect and may be the result of incorrectly using $t = 4q$ instead of $q = 4t$. (Choices B and D are nearly the same since 1.02^{4q} is equivalent to $(1.02^4)^q$, which is approximately 1.082^q .) Choice C is incorrect and may be the result of incorrectly using $t = 4q$ and unnecessarily dividing 0.02 by 4.

Question Difficulty:

Hard

Question ID 281a4f3b

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 20%; background-color: #0056b3;"></div> <div style="width: 20%; background-color: #0056b3;"></div> <div style="width: 60%; background-color: #e0e0e0;"></div> |

ID: 281a4f3b

A certain college had 3,000 students enrolled in 2015. The college predicts that after 2015, the number of students enrolled each year will be 2% less than the number of students enrolled the year before. Which of the following functions models the relationship between the number of students enrolled, $f(x)$, and the number of years after 2015, x ?

- A. $f(x) = 0.02(3,000)^x$
- B. $f(x) = 0.98(3,000)^x$
- C. $f(x) = 3,000(0.02)^x$
- D. $f(x) = 3,000(0.98)^x$

ID: 281a4f3b Answer

Correct Answer:

D

Rationale

Choice D is correct. Because the change in the number of students decreases by the same percentage each year, the relationship between the number of students and the number of years can be modeled with a decreasing exponential function in the form $f(x) = a(1 - r)^x$, where $f(x)$ is the number of students, a is the number of students in 2015, r is the rate of decrease each year, and x is the number of years since 2015. It's given that 3,000 students were enrolled in 2015 and that the rate of decrease is predicted to be 2%, or 0.02. Substituting these values into the decreasing exponential function yields $f(x) = 3,000(1 - 0.02)^x$, which is equivalent to $f(x) = 3,000(0.98)^x$.

Choices A, B, and C are incorrect and may result from conceptual errors when translating the given information into a decreasing exponential function.

Question Difficulty:

Medium

Question ID 4fb8a648

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 4fb8a648

$$\begin{aligned}y &= x + 9 \\y &= x^2 + 16x + 63\end{aligned}$$

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

- A. **-6**
- B. **7**
- C. **9**
- D. **63**

ID: 4fb8a648 Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that $y = x + 9$ and $y = x^2 + 16x + 63$; therefore, it follows that $x + 9 = x^2 + 16x + 63$. This equation can be rewritten as $x + 9 = (x + 9)(x + 7)$. Subtracting $(x + 9)$ from both sides of this equation yields $0 = (x + 9)(x + 7) - (x + 9)$. This equation can be rewritten as $0 = (x + 9)((x + 7) - 1)$, or $0 = (x + 9)(x + 6)$. By the zero product property, $x + 9 = 0$ or $x + 6 = 0$. Subtracting 9 from both sides of the equation $x + 9 = 0$ yields $x = -9$. Subtracting 6 from both sides of the equation $x + 6 = 0$ yields $x = -6$. Therefore, the given system of equations has solutions, (x, y) , that occur when $x = -9$ and $x = -6$. Since -6 is greater than -9 , the greatest possible value of x is -6 .

Choice B is incorrect. This is the negative of the greatest possible value of x when $y = 0$ for the second equation in the given system of equations.

Choice C is incorrect. This is the value of y when $x = 0$ for the first equation in the given system of equations.

Choice D is incorrect. This is the value of y when $x = 0$ for the second equation in the given system of equations.

Question Difficulty:

Hard

Question ID 72ae8a87

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 72ae8a87

The function $f(x) = 200,000(1.21)^x$ gives a company's predicted annual revenue, in dollars, x years after the company started selling light bulbs online, where $0 < x \leq 10$. What is the best interpretation of the statement " $f(5)$ is approximately equal to 518,748" in this context?

- A. 5 years after the company started selling light bulbs online, its predicted annual revenue is approximately 518,748 dollars.
- B. 5 years after the company started selling light bulbs online, its predicted annual revenue will have increased by a total of approximately 518,748 dollars.
- C. When the company's predicted annual revenue is approximately 518,748 dollars, it is 5 times the predicted annual revenue for the previous year.
- D. When the company's predicted annual revenue is approximately 518,748 dollars, it is 5% greater than the predicted annual revenue for the previous year.

ID: 72ae8a87 Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that the function $f(x) = 200,000(1.21)^x$ gives a company's predicted annual revenue, in dollars, x years after the company started selling light bulbs online. It follows that $f(x)$ represents the company's predicted annual revenue, in dollars, x years after the company started selling light bulbs online. Since the value of $f(5)$ is the value of $f(x)$ when $x = 5$, it follows that " $f(5)$ is approximately equal to 518,748" means that $f(x)$ is approximately equal to 518,748 when $x = 5$.

Therefore, the best interpretation of the statement " $f(5)$ is approximately equal to 518,748" in this context is 5 years after the company started selling light bulbs online, its predicted annual revenue is approximately 518,748 dollars.

Choice B is incorrect and may result from conceptual errors.

Choice C is incorrect and may result from conceptual errors.

Choice D is incorrect and may result from conceptual errors.

Question Difficulty:

Easy

Question ID 5ae4803e

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 5ae4803e

$$\frac{(x+9)(x-9)}{x+9} = 7$$

What is the solution to the given equation?

- A. 7
- B. 9
- C. 16
- D. 63

ID: 5ae4803e Answer

Correct Answer:

C

Rationale

Choice C is correct. Since the left-hand side of the given equation has a factor of $x + 9$ in both the numerator and the denominator, the solution to the given equation can be found by solving the equation $x - 9 = 7$. Adding 9 to both sides of this equation yields $x = 16$. Substituting 16 for x in the given equation yields $\frac{(16+9)(16-9)}{16+9} = 7$, or $7 = 7$. Therefore, the solution to the given equation is 16.

Choice A is incorrect. Substituting 7 for x in the given equation yields $\frac{(7+9)(7-9)}{7+9} = 7$, or $-2 = 7$, which is false.

Choice B is incorrect. Substituting 9 for x in the given equation yields $\frac{(9+9)(9-9)}{9+9} = 7$, or $0 = 7$, which is false.

Choice D is incorrect. Substituting 63 for x in the given equation yields $\frac{(63+9)(63-9)}{63+9} = 7$, or $54 = 7$, which is false.

Question Difficulty:

Medium

Question ID 133f3e41

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 133f3e41

$$\frac{20}{p} = \frac{20}{q} - \frac{20}{r} - \frac{20}{s}$$

The given equation relates the positive variables p , q , r , and s . Which of the following is equivalent to q ?

- A. $p + r + s$
- B. $20(p + r + s)$
- C. $\frac{prs}{pr+ps+rs}$
- D. $\frac{prs}{20p+20r+20s}$

ID: 133f3e41 Answer

Correct Answer:

C

Rationale

Choice C is correct. Multiplying each side of the given equation by $\frac{1}{20}$ yields $\frac{1}{20} \left(\frac{20}{p} \right) = \frac{1}{20} \left(\frac{20}{q} - \frac{20}{r} - \frac{20}{s} \right)$. Distributing $\frac{1}{20}$ on each side of this equation yields $\frac{20}{20p} = \frac{20}{20q} - \frac{20}{20r} - \frac{20}{20s}$, or $\frac{1}{p} = \frac{1}{q} - \frac{1}{r} - \frac{1}{s}$. Adding $\frac{1}{r} + \frac{1}{s}$ to each side of this equation yields $\frac{1}{s} + \frac{1}{r} + \frac{1}{p} = \frac{1}{q}$. Multiplying $\frac{1}{s}$ by $\frac{pr}{pr}$, $\frac{1}{r}$ by $\frac{ps}{ps}$, and $\frac{1}{p}$ by $\frac{rs}{rs}$ yields $\frac{pr}{prs} + \frac{ps}{prs} + \frac{rs}{prs} = \frac{1}{q}$, which is equivalent to $\frac{pr+ps+rs}{prs} = \frac{1}{q}$. Since $\frac{pr+ps+rs}{prs} = \frac{1}{q}$, and it's given that p , q , r , and s are positive, it follows that the reciprocals of each side of this equation are also equal. Thus, $\frac{prs}{pr+ps+rs} = \frac{q}{1}$, or $\frac{prs}{pr+ps+rs} = q$. Therefore, $\frac{prs}{pr+ps+rs}$ is equivalent to q .

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:

Hard

Question ID f237ccfc

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 50%; background-color: #cccccc; height: 10px;"></div> |

ID: f237ccfc

The sum of $-2x^2 + x + 31$ and $3x^2 + 7x - 8$ can be written in the form $ax^2 + bx + c$,

where a , b , and c are constants. What is the value of $a + b + c$?

ID: f237ccfc Answer

Rationale

The correct answer is 32. The sum of the given expressions is $(-2x^2 + x + 31) + (3x^2 + 7x - 8)$. Combining like terms yields $x^2 + 8x + 23$. Based on the form of the given equation, $a = 1$, $b = 8$, and $c = 23$. Therefore, $a + b + c = 32$.

Alternate approach: Because $a + b + c$ is the value of $ax^2 + bx + c$ when $x = 1$, it is possible to first make that substitution into each polynomial before adding them. When $x = 1$, the first polynomial is equal to $-2 + 1 + 31 = 30$ and the second polynomial is equal to $3 + 7 - 8 = 2$. The sum of 30 and 2 is 32.

Question Difficulty:

Medium

Question ID a391ed22

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: a391ed22

$$\left(\frac{1}{2}x + \frac{3}{2}\right)\left(\frac{3}{2}x + \frac{1}{2}\right)$$

The expression above is equivalent to $ax^2 + bx + c$, where a , b , and c are constants. What is the value of b ?

ID: a391ed22 Answer

Rationale

The correct answer is $\frac{5}{2}$. The expression $\left(\frac{1}{2}x + \frac{3}{2}\right)\left(\frac{3}{2}x + \frac{1}{2}\right)$ can be written in the form $ax^2 + bx + c$, where a , b , and c are constants, by multiplying out the expression using the distributive property of multiplication over addition. The result is $\left(\frac{1}{2}x\right)\left(\frac{3}{2}x\right) + \left(\frac{1}{2}x\right)\left(\frac{1}{2}\right) + \left(\frac{3}{2}\right)\left(\frac{3}{2}x\right) + \left(\frac{3}{2}\right)\left(\frac{1}{2}\right)$. This expression can be rewritten by multiplying as indicated to give $\frac{3}{4}x^2 + \frac{1}{4}x + \frac{9}{4}x + \frac{3}{4}$, which can be simplified to $\frac{3}{4}x^2 + \frac{10}{4}x + \frac{3}{4}$, or $\frac{3}{4}x^2 + \frac{5}{2}x + \frac{3}{4}$. This is in the form $ax^2 + bx + c$, where the value of b is $\frac{5}{2}$. Note that $5/2$ and 2.5 are examples of ways to enter a correct answer.

Question Difficulty:

Medium

Question ID 01668cd6

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 01668cd6

The functions f and g are defined by the given equations, where $x \geq 0$. Which of the following equations displays, as a constant or coefficient, the maximum value of the function it defines, where $x \geq 0$?

- I. $f(x) = 33(0.4)^{x+3}$
- II. $g(x) = 33(0.16)(0.4)^{x-2}$

- A. I only
- B. II only
- C. I and II
- D. Neither I nor II

ID: 01668cd6 Answer

Correct Answer:

B

Rationale

Choice B is correct. Functions f and g are both exponential functions with a base of 0.40 . Since 0.40 is less than 1 , functions f and g are both decreasing exponential functions. This means that $f(x)$ and $g(x)$ decrease as x increases. Since $f(x)$ and $g(x)$ decrease as x increases, the maximum value of each function occurs at the least value of x for which the function is defined. It's given that functions f and g are defined for $x \geq 0$. Therefore, the maximum value of each function occurs at $x = 0$. Substituting 0 for x in the equation defining f yields $f(0) = 33(0.4)^{0+3}$, which is equivalent to $f(0) = 33(0.4)^3$, or $f(0) = 2.112$.

Therefore, the maximum value of f is 2.112 . Since the equation $f(x) = 33(0.4)^{x+3}$ doesn't display the value 2.112 , the equation defining f doesn't display the maximum value of f . Substituting 0 for x in the equation defining g yields

$g(0) = 33(0.16)(0.4)^{0-2}$, which can be rewritten as $g(0) = 33(0.16)\left(\frac{1}{0.4^2}\right)$, or $g(0) = 33(0.16)\left(\frac{1}{0.16}\right)$, which is equivalent to $g(0) = 33$. Therefore, the maximum value of g is 33 . Since the equation $g(x) = 33(0.16)(0.4)^{x-2}$ displays the value 33 , the equation defining g displays the maximum value of g . Thus, only equation II displays, as a constant or coefficient, the maximum value of the function it defines.

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:

Hard

Question ID 95eeeb5b

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 60%; background-color: #0056b3; height: 10px;"></div> |

ID: 95eeeb5b

The function f is defined by $f(x) = ax^2 + bx + c$, where a , b , and c are constants. The graph of $y = f(x)$ in the xy -plane passes through the points $(7, 0)$ and $(-3, 0)$. If a is an integer greater than 1, which of the following could be the value of $a + b$?

- A. -6
- B. -3
- C. 4
- D. 5

ID: 95eeeb5b Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that the graph of $y = f(x)$ in the xy -plane passes through the points $(7, 0)$ and $(-3, 0)$. It follows that when the value of x is either 7 or -3 , the value of $f(x)$ is 0 . It's also given that the function f is defined by $f(x) = ax^2 + bx + c$, where a , b , and c are constants. It follows that the function f is a quadratic function and, therefore, may be written in factored form as $f(x) = a(x - u)(x - v)$, where the value of $f(x)$ is 0 when x is either u or v . Since the value of $f(x)$ is 0 when the value of x is either 7 or -3 , and the value of $f(x)$ is 0 when the value of x is either u or v , it follows that u and v are equal to 7 and -3 . Substituting 7 for u and -3 for v in the equation $f(x) = a(x - u)(x - v)$ yields $f(x) = a(x - 7)(x - (-3))$, or $f(x) = a(x - 7)(x + 3)$. Distributing the right-hand side of this equation yields $f(x) = a(x^2 - 7x + 3x - 21)$, or $f(x) = ax^2 - 4ax - 21a$. Since it's given that $f(x) = ax^2 + bx + c$, it follows that $b = -4a$. Adding a to each side of this equation yields $a + b = -3a$. Since $a + b = -3a$, if a is an integer, the value of $a + b$ must be a multiple of 3 . If a is an integer greater than 1 , it follows that $a \geq 2$. Therefore, $-3a \leq -3(2)$. It follows that the value of $a + b$ is less than or equal to $-3(2)$, or -6 . Of the given choices, only -6 is a multiple of 3 that's less than or equal to -6 .

Choice B is incorrect. This is the value of $a + b$ if a is equal to, not greater than, 1 .

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:

Hard

Question ID c77ef2fb

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: c77ef2fb

Blood volume, V_B , in a human can be determined using the equation $V_B = \frac{V_P}{1-H}$, 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. $H = 1 - \frac{V_P}{V_B}$

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

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

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 $V_B = \frac{V_P}{1-H}$ 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 $1-H = \frac{V_P}{V_B}$. Subtracting 1 from both sides yields $-H = -1 + \frac{V_P}{V_B}$. Dividing both sides by -1 yields $H = 1 - \frac{V_P}{V_B}$.

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

Question Difficulty:

Medium

Question ID 7399c3b0

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 7399c3b0

$$k^2 - 53 = 91$$

What is the positive solution to the given equation?

- A. 144
- B. 72
- C. 38
- D. 12

ID: 7399c3b0 Answer

Correct Answer:

D

Rationale

Choice D is correct. Adding 53 to each side of the given equation yields $k^2 = 144$. Taking the square root of each side of this equation yields $k = \pm 12$. Therefore, the positive solution to the given equation is 12.

Choice A is incorrect. This is the positive solution to the equation $k^2 - 53 = 20,683$, not $k^2 - 53 = 91$.

Choice B is incorrect. This is the positive solution to the equation $k^2 - 53 = 5,131$, not $k^2 - 53 = 91$.

Choice C is incorrect. This is the positive solution to the equation $k^2 - 53 = 1,391$, not $k^2 - 53 = 91$.

Question Difficulty:

Easy

Question ID 99c5e794

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 20%; background-color: #0056b3;"></div> <div style="width: 20%; background-color: #0056b3;"></div> <div style="width: 60%; background-color: #e0e0e0;"></div> |

ID: 99c5e794

A model predicts that the population of Bergen was **15,000** in **2005**. The model also predicts that each year for the next **5** years, the population p increased by **4%** of the previous year's population. Which equation best represents this model, where x is the number of years after **2005**, for $x \leq 5$?

- A. $p = 0.96(15,000)^x$
- B. $p = 1.04(15,000)^x$
- C. $p = 15,000(0.96)^x$
- D. $p = 15,000(1.04)^x$

ID: 99c5e794 Answer

Correct Answer:

D

Rationale

Choice D is correct. It's given that a model predicts the population of Bergen in **2005** was **15,000**. The model also predicts that each year for the next **5** years, the population increased by **4%** of the previous year's population. The predicted population in one of these years can be found by multiplying the predicted population from the previous year by **1.04**. Since the predicted population in **2005** was **15,000**, the predicted population **1** year later is **15,000(1.04)**. The predicted population **2** years later is this value times **1.04**, which is **15,000(1.04)(1.04)**, or **15,000(1.04)²**. The predicted population **3** years later is this value times **1.04**, or **15,000(1.04)³**. More generally, the predicted population, p , x years after **2005** is represented by the equation $p = 15,000(1.04)^x$.

Choice A is incorrect. Substituting **0** for x in this equation indicates the predicted population in **2005** was **0.96** rather than **15,000**.

Choice B is incorrect. Substituting **0** for x in this equation indicates the predicted population in **2005** was **1.04** rather than **15,000**.

Choice C is incorrect. This equation indicates the predicted population is decreasing, rather than increasing, by **4%** each year.

Question Difficulty:

Medium

Question ID 99c5e794

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: 99c5e794

A model predicts that the population of Bergen was **15,000** in **2005**. The model also predicts that each year for the next **5** years, the population p increased by **4%** of the previous year's population. Which equation best represents this model, where x is the number of years after **2005**, for $x \leq 5$?

- A. $p = 0.96(15,000)^x$
- B. $p = 1.04(15,000)^x$
- C. $p = 15,000(0.96)^x$
- D. $p = 15,000(1.04)^x$

ID: 99c5e794 Answer

Correct Answer:

D

Rationale

Choice D is correct. It's given that a model predicts the population of Bergen in **2005** was **15,000**. The model also predicts that each year for the next **5** years, the population increased by **4%** of the previous year's population. The predicted population in one of these years can be found by multiplying the predicted population from the previous year by **1.04**. Since the predicted population in **2005** was **15,000**, the predicted population **1** year later is **15,000(1.04)**. The predicted population **2** years later is this value times **1.04**, which is **15,000(1.04)(1.04)**, or **15,000(1.04)²**. The predicted population **3** years later is this value times **1.04**, or **15,000(1.04)³**. More generally, the predicted population, p , x years after **2005** is represented by the equation $p = 15,000(1.04)^x$.

Choice A is incorrect. Substituting **0** for x in this equation indicates the predicted population in **2005** was **0.96** rather than **15,000**.

Choice B is incorrect. Substituting **0** for x in this equation indicates the predicted population in **2005** was **1.04** rather than **15,000**.

Choice C is incorrect. This equation indicates the predicted population is decreasing, rather than increasing, by **4%** each year.

Question Difficulty:

Medium

Question ID 5ae186b4

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 25%; background-color: #005599; height: 10px;"></div> <div style="width: 50%; background-color: #cccccc; height: 10px;"></div> |

ID: 5ae186b4

$$\frac{-54}{w} = 6$$

What is the solution to the given equation?

ID: 5ae186b4 Answer

Correct Answer:

-9

Rationale

The correct answer is -9 . Since w is in the denominator of a fraction in the given equation, w can't be equal to 0 . Since w isn't equal to 0 , multiplying both sides of the given equation by w yields an equivalent equation, $-54 = 6w$. Dividing both sides of this equation by 6 yields $-9 = w$. Therefore, -9 is the solution to the given equation.

Question Difficulty:

Medium

Question ID b76a2815

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

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 364a2d25

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 60%; background-color: #e0e0e0; height: 10px;"></div> |

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

Question ID 1be909aa

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 1be909aa

Which expression is equivalent to $\frac{h^{15}q^7}{h^5q^{21}}$, where $h > 0$ and $q > 0$?

- A. $\frac{h^{10}}{q^{14}}$
- B. $\frac{h^3}{q^3}$
- C. $h^{10}q^{14}$
- D. h^3q^3

ID: 1be909aa Answer

Correct Answer:

A

Rationale

Choice A is correct. For positive values of a , $\frac{a^m}{a^n} = a^{(m-n)}$, where m and n are integers. Since it's given that $h > 0$ and $q > 0$, this property can be applied to rewrite the given expression as $(h^{(15-5)})(q^{(7-21)})$, which is equivalent to $h^{10}q^{-14}$. For positive values of a , $a^{-n} = \frac{1}{a^n}$. This property can be applied to rewrite the expression $h^{10}q^{-14}$ as $(h^{10})\left(\frac{1}{q^{14}}\right)$, which is equivalent to $\frac{h^{10}}{q^{14}}$.

Choice B 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:

Medium

Question ID bdb0aa23

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: bdb0aa23

Which expression is equivalent to $5x^5 - 6x^4 + 8x^3$?

- A. $x^4(5x - 6)$
- B. $x^3(5x^2 - 6x + 8)$
- C. $8x^3(5x^2 - 6x + 1)$
- D. $6x^5(-6x^4 + 8x^3 + 1)$

ID: bdb0aa23 Answer

Correct Answer:

B

Rationale

Choice B is correct. Since x^3 is a common factor of each term in the given expression, the expression can be rewritten as $x^3(5x^2 - 6x + 8)$.

Choice A is incorrect. This expression is equivalent to $5x^5 - 6x^4$.

Choice C is incorrect. This expression is equivalent to $40x^5 - 48x^4 + 8x^3$.

Choice D is incorrect. This expression is equivalent to $-36x^9 + 48x^8 + 6x^5$.

Question Difficulty:

Easy

Question ID 100030d9

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: 100030d9

A rubber ball bounces upward one-half the height that it falls each time it hits the ground. If the ball was originally dropped from a distance of 20.0 feet above the ground, what was its maximum height above the ground, in feet, between the third and fourth time it hit the ground?

ID: 100030d9 Answer

Rationale

The correct answer is 2.5. After hitting the ground once, the ball bounces to $20.0 \div 2 = 10.0$ feet. After hitting the ground a second time, the ball bounces to $10.0 \div 2 = 5.0$ feet. After hitting the ground for the third time, the ball bounces to $5.0 \div 2 = 2.5$ feet. Note that 2.5 and $5/2$ are examples of ways to enter a correct answer.

Question Difficulty:

Medium

Question ID 09f58996

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 09f58996

The function f is defined by $f(x) = 6 + \sqrt{x}$. What is the value of $f(36)$?

ID: 09f58996 Answer

Correct Answer:

12

Rationale

The correct answer is **12**. The value of $f(36)$ is the value of $f(x)$ when $x = 36$. Substituting 36 for x in the given equation yields $f(36) = 6 + \sqrt{36}$, which is equivalent to $f(36) = 6 + 6$, or $f(36) = 12$. Thus, the value of $f(36)$ is **12**.

Question Difficulty:

Easy

Question ID d84a514a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: d84a514a

The function $f(x) = 240,000(1.22)^x$ gives a company's predicted annual revenue, in dollars, x years after the company started selling jewelry online, where $0 < x \leq 10$. What is the best interpretation of the statement " $f(5)$ is approximately equal to **648,650**" in this context?

- A. 5 years after the company started selling jewelry online, its predicted annual revenue is approximately **648,650** dollars.
- B. 5 years after the company started selling jewelry online, its predicted annual revenue will have increased by a total of approximately **648,650** dollars.
- C. When the company's predicted annual revenue is approximately **648,650** dollars, it is 5 times the predicted annual revenue for the previous year.
- D. When the company's predicted annual revenue is approximately **648,650** dollars, it is 5% greater than the predicted annual revenue for the previous year.

ID: d84a514a Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that the function f gives a company's predicted annual revenue, in dollars, x years after the company started selling jewelry online. Since the value of $f(5)$ is the value of $f(x)$ when $x = 5$, it follows that " $f(5)$ is approximately equal to **648,650**" means that $f(x)$ is approximately equal to **648,650** when $x = 5$. Therefore, the best interpretation of the given statement is that 5 years after the company started selling jewelry online, its predicted annual revenue is approximately **648,650** dollars.

Choice B is incorrect. The function f gives the predicted annual revenue, not the predicted increase in annual revenue.

Choice C is incorrect and may result from conceptual errors.

Choice D is incorrect. In the given function, x represents the number of years after the company started selling jewelry online, not the percent increase in revenue from the previous year.

Question Difficulty:

Easy

Question ID beb86a0c

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 75%; background-color: #e0e0e0;"></div> <div style="width: 75%; background-color: #e0e0e0;"></div> |

ID: beb86a0c

Which expression is equivalent to $9x^2 + 5x$?

- A. $x(9x + 5)$
- B. $5x(9x + 1)$
- C. $9x(x + 5)$
- D. $x^2(9x + 5)$

ID: beb86a0c Answer

Correct Answer:

A

Rationale

Choice A is correct. Since x is a factor of each term in the given expression, the expression is equivalent to $x(9x) + x(5)$, or $x(9x + 5)$.

Choice B is incorrect. This expression is equivalent to $45x^2 + 5x$, not $9x^2 + 5x$.

Choice C is incorrect. This expression is equivalent to $9x^2 + 45x$, not $9x^2 + 5x$.

Choice D is incorrect. This expression is equivalent to $9x^3 + 5x^2$, not $9x^2 + 5x$.

Question Difficulty:

Easy

Question ID 5910bfff

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #003366; height: 10px;"></div> |

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 7ba694f3

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 7ba694f3

The number of bacteria in a liquid medium doubles every day. There are **44,000** bacteria in the liquid medium at the start of an observation. Which represents the number of bacteria, y , in the liquid medium t days after the start of the observation?

- A. $y = \frac{1}{2}(44,000)^t$
- B. $y = 2(44,000)^t$
- C. $y = 44,000\left(\frac{1}{2}\right)^t$
- D. $y = 44,000(2)^t$

ID: 7ba694f3 Answer

Correct Answer:

D

Rationale

Choice D is correct. Since the number of bacteria doubles every day, the relationship between t and y can be represented by an exponential equation of the form $y = a(b)^t$, where a is the number of bacteria at the start of the observation and the number of bacteria increases by a factor of b every day. It's given that there are **44,000** bacteria at the start of the observation. Therefore, $a = 44,000$. It's also given that the number of bacteria doubles, or increases by a factor of **2**, every day. Therefore, $b = 2$.

Substituting **44,000** for a and **2** for b in the equation $y = a(b)^t$ yields $y = 44,000(2)^t$.

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. This equation represents a situation where the number of bacteria is decreasing by half, not doubling, every day.

Question Difficulty:

Medium

Question ID fbb96bb1

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%;"><div style="display: flex; justify-content: space-around;"><div style="width: 25%; height: 10px; background-color: #0056b3;"></div><div style="width: 25%; height: 10px; background-color: #0056b3;"></div><div style="width: 25%; height: 10px; background-color: #0056b3;"></div></div></div> |

ID: fbb96bb1

$$x - 29 = (x - a)(x - 29)$$

Which of the following are solutions to the given equation, where a is a constant and $a > 30$?

- I. a
 - II. $a + 1$
 - III. 29
- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II, and III

ID: fbb96bb1 Answer

Correct Answer:

C

Rationale

Choice C is correct. Subtracting the expression $(x - 29)$ from both sides of the given equation yields $0 = (x - a)(x - 29) - (x - 29)$, which can be rewritten as $0 = (x - a)(x - 29) + (-1)(x - 29)$. Since the two terms on the right-hand side of this equation have a common factor of $(x - 29)$, it can be rewritten as $0 = (x - 29)(x - a + (-1))$, or $0 = (x - 29)(x - a - 1)$. Since $x - a - 1$ is equivalent to $x - (a + 1)$, the equation $0 = (x - 29)(x - a - 1)$ can be rewritten as $0 = (x - 29)(x - (a + 1))$. By the zero product property, it follows that $x - 29 = 0$ or $x - (a + 1) = 0$. Adding 29 to both sides of the equation $x - 29 = 0$ yields $x = 29$. Adding $a + 1$ to both sides of the equation $x - (a + 1) = 0$ yields $x = a + 1$. Therefore, the two solutions to the given equation are 29 and $a + 1$. Thus, only $a + 1$ and 29, not a , are solutions to the given equation.

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:

Hard

Question ID 6e06a0a7

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 6e06a0a7

Which of the following expressions is equivalent to $2a^2(a+3)$?

- A. $5a^3$
- B. $8a^5$
- C. $2a^3 + 3$
- D. $2a^3 + 6a^2$

ID: 6e06a0a7 Answer

Correct Answer:

D

Rationale

Choice D is correct. Expanding the given expression using the distributive property yields $2a^2(a) + 2a^2(3)$. Combining like terms yields $2a^2(a^1) + (2 \times 3)(a^2)$, or $2a^{2+1} + 6a^2$, which is equivalent to $2a^3 + 6a^2$.

Choices A and B are incorrect and may result from incorrectly combining like terms. Choice C is incorrect and may result from distributing $2a^2$ only to a , and not to 3, in the given expression.

Question Difficulty:

Easy

Question ID ad038c19

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #005a9f; height: 10px;"></div> |

ID: ad038c19

Which of the following is

equivalent to $\left(a + \frac{b}{2}\right)^2$?

A. $a^2 + \frac{b^2}{2}$

B. $a^2 + \frac{b^2}{4}$

C. $a^2 + \frac{ab}{2} + \frac{b^2}{2}$

D. $a^2 + ab + \frac{b^2}{4}$

ID: ad038c19 Answer

Correct Answer:

D

Rationale

Choice D is correct. The expression $\left(a + \frac{b}{2}\right)^2$ can be rewritten as $\left(a + \frac{b}{2}\right)\left(a + \frac{b}{2}\right)$. Using the distributive property, the

expression yields $\left(a + \frac{b}{2}\right)\left(a + \frac{b}{2}\right) = a^2 + \frac{ab}{2} + \frac{ab}{2} + \frac{b^2}{4}$. Combining like terms gives $a^2 + ab + \frac{b^2}{4}$.

Choices A, B, and C are incorrect and may result from errors using the distributive property on the given expression or combining like terms.

Question Difficulty:

Hard

Question ID c7a187a7

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: c7a187a7

$$f(x) = x^2 - 18x - 360$$

If the given function f is graphed in the xy -plane, where $y = f(x)$, what is an x -intercept of the graph?

- A. $(-12, 0)$
- B. $(-30, 0)$
- C. $(-360, 0)$
- D. $(12, 0)$

ID: c7a187a7 Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that $y = f(x)$. The x -intercepts of a graph in the xy -plane are the points where $y = 0$. Thus, for an x -intercept of the graph of function f , $0 = f(x)$. Substituting 0 for $f(x)$ in the equation $f(x) = x^2 - 18x - 360$ yields $0 = x^2 - 18x - 360$. Factoring the right-hand side of this equation yields $0 = (x + 12)(x - 30)$. By the zero product property, $x + 12 = 0$ and $x - 30 = 0$. Subtracting 12 from both sides of the equation $x + 12 = 0$ yields $x = -12$. Adding 30 to both sides of the equation $x - 30 = 0$ yields $x = 30$. Therefore, the x -intercepts of the graph of $y = f(x)$ are $(-12, 0)$ and $(30, 0)$. Of these two x -intercepts, only $(-12, 0)$ is given as a choice.

Choice B 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.

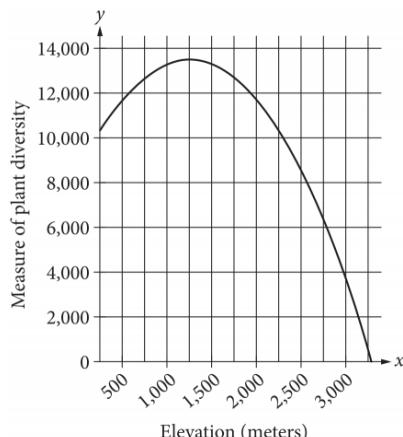
Question Difficulty:

Medium

Question ID ebe4bde0

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: ebe4bde0



The quadratic function graphed above models a particular measure of plant diversity as a function of the elevation in a region of Switzerland. According to the model, which of the following is closest to the elevation, in meters, at which plant diversity is greatest?

- A. 13,500
- B. 3,000
- C. 1,250
- D. 250

ID: ebe4bde0 Answer

Correct Answer:

C

Rationale

Choice C is correct. Each point (x, y) on the graph represents the elevation x , in meters, and the corresponding measure of plant diversity y in a region of Switzerland. Therefore, the point on the graph with the greatest y -coordinate represents the location that has the greatest measure of plant diversity in the region. The greatest y -coordinate of any point on the graph is approximately 13,500. The x -coordinate of that point is approximately 1,250. Therefore, the closest elevation at which the plant diversity is the greatest is 1,250 meters.

Choice A is incorrect. This value is closest to the greatest y -coordinate of any point on the graph and therefore represents the greatest measure of plant diversity, not the elevation where the greatest measure of plant diversity occurs. Choice B is incorrect. At an elevation of 3,000 meters the measure of plant diversity is approximately 4,000. Because there are points on the graph with greater y -coordinates, 4,000 can't be the greatest measure of plant diversity, and 3,000 meters isn't the elevation at which the greatest measure of plant diversity occurs. Choice D is incorrect. At an elevation of 250 meters, the measure of plant diversity is approximately 11,000. Because there are points on the graph with greater y -coordinates, 11,000 can't be the greatest measure of plant diversity and 250 meters isn't the elevation at which the greatest measure of plant diversity occurs.

Question Difficulty:

Easy

Question ID ef926848

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: ef926848

Square P has a side length of x inches. Square Q has a perimeter that is 176 inches greater than the perimeter of square P. The function f gives the area of square Q, in square inches. Which of the following defines f ?

- A. $f(x) = (x + 44)^2$
- B. $f(x) = (x + 176)^2$
- C. $f(x) = (176x + 44)^2$
- D. $f(x) = (176x + 176)^2$

ID: ef926848 Answer

Correct Answer:

A

Rationale

Choice A is correct. Let x represent the side length, in inches, of square P. It follows that the perimeter of square P is $4x$ inches. It's given that square Q has a perimeter that is 176 inches greater than the perimeter of square P. Thus, the perimeter of square Q is 176 inches greater than $4x$ inches, or $4x + 176$ inches. Since the perimeter of a square is 4 times the side length of the square, each side length of Q is $\frac{4x+176}{4}$, or $x + 44$ inches. Since the area of a square is calculated by multiplying the length of two sides, the area of square Q is $(x + 44)(x + 44)$, or $(x + 44)^2$ square inches. It follows that function f is defined by $f(x) = (x + 44)^2$.

Choice B is incorrect. This function represents a square with side lengths $(x + 176)$ inches.

Choice C is incorrect. This function represents a square with side lengths $(176x + 44)$ inches.

Choice D is incorrect. This function represents a square with side lengths $(176x + 176)$ inches.

Question Difficulty:

Hard

Question ID 77c0cced

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 77c0cced

$$y = 2x^2 - 21x + 64$$

$$y = 3x + a$$

In the given system of equations, a is a constant. The graphs of the equations in the given system intersect at exactly one point, (x, y) , in the xy -plane. What is the value of x ?

- A. -8
- B. -6
- C. 6
- D. 8

ID: 77c0cced Answer

Correct Answer:

C

Rationale

Choice C is correct. It's given that the graphs of the equations in the given system intersect at exactly one point, (x, y) , in the xy -plane. Therefore, (x, y) is the only solution to the given system of equations. The given system of equations can be solved by subtracting the second equation, $y = 3x + a$, from the first equation, $y = 2x^2 - 21x + 64$. This yields

$y - y = (2x^2 - 21x + 64) - (3x + a)$, or $0 = 2x^2 - 24x + 64 - a$. Since the given system has only one solution, this equation has only one solution.

A quadratic equation in the form $rx^2 + sx + t = 0$, where r , s , and t are constants, has one solution if and only if the discriminant, $s^2 - 4rt$, is equal to zero. Substituting 2 for r , -24 for s , and $-a + 64$ for t in the expression $s^2 - 4rt$ yields $(-24)^2 - (4)(2)(64 - a)$. Setting this expression equal to zero yields

$(-24)^2 - (4)(2)(64 - a) = 0$, or $8a + 64 = 0$. Subtracting 64 from both sides of this equation yields $8a = -64$. Dividing both sides of this equation by 8 yields $a = -8$.

Substituting -8 for a in the equation $0 = 2x^2 - 24x + 64 - a$ yields

$0 = 2x^2 - 24x + 64 + 8$, or $0 = 2x^2 - 24x + 72$.

Factoring 2 from the right-hand side of this equation yields $0 = 2(x^2 - 12x + 36)$. Dividing both sides of this equation by 2 yields $0 = x^2 - 12x + 36$, which is equivalent to $0 = (x - 6)(x - 6)$, or $0 = (x - 6)^2$. Taking the square root of both sides of this equation yields $0 = x - 6$. Adding 6 to both sides of this equation yields $x = 6$.

Choice A is incorrect. This is the value of a , not x .

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:

Hard

Question ID 635f54ee

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 635f54ee

$$6\left(\frac{a}{4}\right)^2$$

The surface area of a cube is $6\left(\frac{a}{4}\right)^2$, where a is a positive constant. Which of the following gives the perimeter of one face of the cube?

A. $\frac{a}{4}$

B. a

C. $4a$

D. $6a$

ID: 635f54ee Answer

Correct Answer:

B

Rationale

Choice B is correct. A cube has 6 faces of equal area, so if the total surface area of a cube is $6\left(\frac{a}{4}\right)^2$, then the area of one face is $\left(\frac{a}{4}\right)^2$. Likewise, the area of one face of a cube is the square of one of its edges; therefore, if the area of one face is $\left(\frac{a}{4}\right)^2$, then the length of one edge of the cube is $\frac{a}{4}$. Since the perimeter of one face of a cube is four times the length of one edge, the perimeter is $4\left(\frac{a}{4}\right) = a$.

Choice A is incorrect because if the perimeter of one face of the cube is $\frac{a}{4}$, then the total surface area of the cube is

$6\left(\frac{a}{4}\right)^2 = 6\left(\frac{a}{16}\right)^2$, which is not $6\left(\frac{a}{4}\right)^2$. Choice C is incorrect because if the perimeter of one face of the cube is $4a$, then the total surface area of the cube is $6\left(\frac{4a}{4}\right)^2 = 6a^2$, which is not $6\left(\frac{a}{4}\right)^2$. Choice D is incorrect because if the perimeter of one face of the cube is $6a$, then the total surface area of the cube is $6\left(\frac{6a}{4}\right)^2 = 6\left(\frac{3a}{2}\right)^2$, which is not $6\left(\frac{a}{4}\right)^2$.

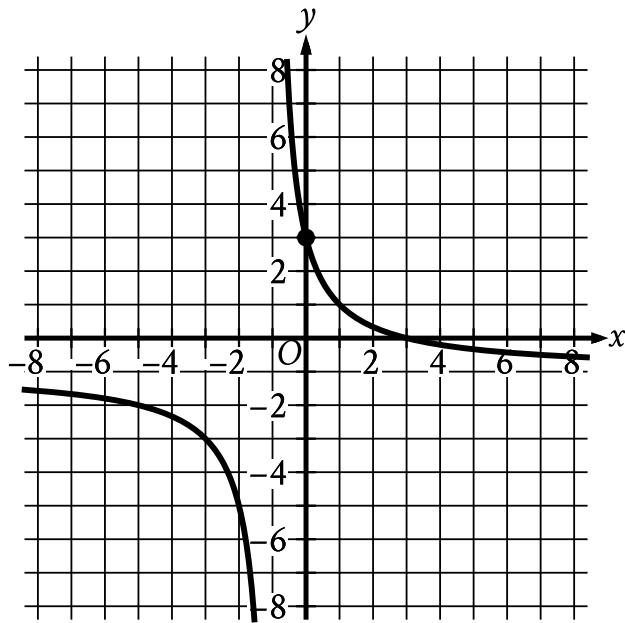
Question Difficulty:

Hard

Question ID c99d154a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: c99d154a



What is the y -coordinate of the y -intercept of the graph shown?

ID: c99d154a Answer

Correct Answer:

3

Rationale

The correct answer is 3. A y -intercept of a graph in the xy -plane is a point (x, y) on the graph where $x = 0$. For the graph shown, at $x = 0$, the corresponding value of y is 3. Therefore, the y -coordinate of the y -intercept of the graph shown is 3.

Question Difficulty:

Easy

Question ID a26c29f7

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: a26c29f7

The function f is defined by $f(x) = 7x^3$. In the xy -plane, the graph of $y = g(x)$ is the result of shifting the graph of $y = f(x)$ down 2 units. Which equation defines function g ?

- A. $g(x) = \frac{7}{2}x^3$
- B. $g(x) = 7x^{\frac{3}{2}}$
- C. $g(x) = 7x^3 + 2$
- D. $g(x) = 7x^3 - 2$

ID: a26c29f7 Answer

Correct Answer:

D

Rationale

Choice D is correct. If the graph of $y = g(x)$ is the result of shifting the graph of $y = f(x)$ down k units in the xy -plane, the function g can be defined by an equation of the form $g(x) = f(x) - k$. It's given that $f(x) = 7x^3$ and the graph of $y = g(x)$ is the result of shifting the graph of $y = f(x)$ down 2 units. Substituting $7x^3$ for $f(x)$ and 2 for k in the equation $g(x) = f(x) - k$ yields $g(x) = 7x^3 - 2$.

Choice A is incorrect and may result from conceptual errors.

Choice B is incorrect and may result from conceptual errors.

Choice C is incorrect. This equation defines a function g for which the graph of $y = g(x)$ is the result of shifting the graph of $y = f(x)$ up, not down, 2 units.

Question Difficulty:

Medium

Question ID 99269e03

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: 99269e03

| x | y |
|-----|-----|
| 1 | 11 |
| 2 | 19 |
| 3 | a |

The table shows three values of x and their corresponding values of y for the equation $y = 4(2)^x + 3$. In the table, a is a constant. What is the value of a ?

- A. 67
- B. 35
- C. 32
- D. 27

ID: 99269e03 Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that the table shows three values of x and their corresponding values of y for the equation $y = 4(2)^x + 3$. It's also given that when $x = 3$ the corresponding value of y is a , and a is a constant. Substituting 3 for x and a for y in the given equation yields $a = 4(2)^3 + 3$, or $a = 35$. Therefore, the value of a is 35.

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:

Medium

Question ID a1262cdb

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 50%; background-color: #cccccc; height: 10px;"></div> |

ID: a1262cdb

The equation $12t + b = c$ relates the variables t , b , and c . Which of the following correctly expresses the value of $c - b$ in terms of t ?

- A. $\frac{t}{12}$
- B. t
- C. $t + \frac{1}{12}$
- D. $12t$

ID: a1262cdb Answer

Correct Answer:

D

Rationale

Choice D is correct. Subtracting b from each side of the given equation yields $12t = c - b$. Therefore, the expression $12t$ correctly expresses the value of $c - b$ in terms of t .

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.

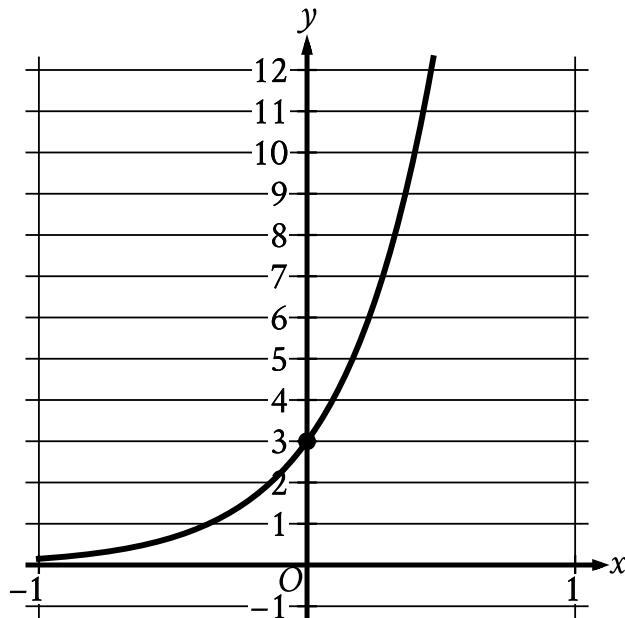
Question Difficulty:

Medium

Question ID 893c7519

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 25%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 893c7519



The graph of the exponential function f is shown, where $y = f(x)$. The y -intercept of the graph is $(0, y)$. What is the value of y ?

ID: 893c7519 Answer

Correct Answer:

3

Rationale

The correct answer is 3. For the graph of the exponential function f shown, where $y = f(x)$, it's given that the y -intercept of the graph is $(0, y)$. The graph intersects the y -axis at the point $(0, 3)$. Therefore, the value of y is 3.

Question Difficulty:

Easy

Question ID 0980fcdd

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 0980fcdd

$$\begin{aligned}x^2 &= 6x + y \\y &= -6x + 36\end{aligned}$$

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 e1391dd6

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: e1391dd6

According to Moore's law, the number of transistors included on microprocessors doubles every 2 years. In 1985, a microprocessor was introduced that had 275,000 transistors. Based on this information, in which of the following years does Moore's law estimate the number of transistors to reach 1.1 million?

- A. 1987
- B. 1989
- C. 1991
- D. 1994

ID: e1391dd6 Answer

Rationale

Choice B is correct. Let x be the number of years after 1985. It follows that $\frac{x}{2}$ represents the number of 2-year periods that will occur within an x -year period. According to Moore's law, every 2 years, the number of transistors included on microprocessors is estimated to double. Therefore, x years after 1985, the number of transistors will double $\frac{x}{2}$ times. Since the number of transistors included on a microprocessor was 275,000, or .275 million, in 1985, the estimated number of transistors, in millions, included x years after 1985 can be modeled as $0.275 \cdot 2^{\frac{x}{2}}$. The year in which the number of transistors is estimated to be 1.1 million is

represented by the value of x when $1.1 = 0.275 \cdot 2^{\frac{x}{2}}$. Dividing both sides of this equation by .275 yields $4 = 2^{\frac{x}{2}}$, which can be

rewritten as $2^2 = 2^{\frac{x}{2}}$. Since the exponential equation has equal bases on each side, it follows that the exponents must also be equal: $2 = \frac{x}{2}$. Multiplying both sides of the equation $2 = \frac{x}{2}$ by 2 yields $x = 4$. Therefore, according to Moore's law, 4 years after 1985, or in 1989, the number of transistors included on microprocessors is estimated to reach 1.1 million.

Alternate approach: According to Moore's law, 2 years after 1985 (in 1987), the number of transistors included on a microprocessor is estimated to be $2 \cdot 275,000$, or 550,000, and 2 years after 1987 (in 1989), the number of transistors included on microprocessors is estimated to be $2 \cdot 550,000$, or 1,100,000. Therefore, the year that Moore's law estimates the number of transistors on microprocessors to reach 1.1 million is 1989.

Choices A, C, and D are incorrect. According to Moore's law, the number of transistors included on microprocessors is estimated to reach 550,000 in 1987, 2.2 million in 1991, and about 6.2 million in 1994.

Question Difficulty:

Medium

Question ID 3c600337

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: 3c600337

The function f is defined by $f(x) = 270(0.1)^x$. What is the value of $f(0)$?

- A. 0
- B. 1
- C. 27
- D. 270

ID: 3c600337 Answer

Correct Answer:

D

Rationale

Choice D is correct. The value of $f(0)$ is the value of $f(x)$ when $x = 0$. Substituting 0 for x in the given function yields $f(0) = 270(0.1)^0$, or $f(0) = 270(1)$, which is equivalent to $f(0) = 270$. Therefore, the value of $f(0)$ is 270.

Choice A is incorrect. This is the value of x , not $f(x)$.

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

Choice C is incorrect. This is the value of $f(1)$, not $f(0)$.

Question Difficulty:

Medium

Question ID 3ea87153

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 3ea87153

The function g is defined by $g(x) = x^2 + 9$. For which value of x is $g(x) = 25$?

- A. 4
- B. 5
- C. 9
- D. 13

ID: 3ea87153 Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that $g(x) = x^2 + 9$. Substituting 25 for $g(x)$ in this equation yields $25 = x^2 + 9$. Subtracting 9 from both sides of this equation yields $16 = x^2$. Taking the square root of each side of this equation yields $x = \pm 4$. It follows that $g(x) = 25$ when the value of x is 4 or -4 . Only 4 is listed among the choices.

Choice B 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

Question ID 290cdc2c

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|---|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 75%; background-color: #cccccc; height: 10px;"></div> |

ID: 290cdc2c

Which expression is equivalent to $(x)^{\frac{1}{14}}$, where $x > 0$?

- A. $\frac{1}{14} \cdot x$
- B. $\sqrt[14]{x}$
- C. $14 \cdot x$
- D. $(x)^{14}$

ID: 290cdc2c Answer

Correct Answer:

B

Rationale

Choice B is correct. An expression in the form $x^{\frac{1}{k}}$, where $x > 0$ and $k > 0$, is equivalent to $\sqrt[k]{x}$. It follows that $x^{\frac{1}{14}}$, where $x > 0$, is equivalent to $\sqrt[14]{x}$.

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

Question ID 87a3de81

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0070C0; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 87a3de81

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

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

ID: 87a3de81 Answer

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 499cb491

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 499cb491

Which expression is equivalent to $5x^2 - 50xy^2$?

- A. $5x(x - 10y^2)$
- B. $5x(x - 50y^2)$
- C. $5x^2(10xy^2)$
- D. $5x^2(50xy^2)$

ID: 499cb491 Answer

Correct Answer:

A

Rationale

Choice A is correct. Since each term of the given expression has a factor of $5x$, it can be rewritten as $5x(x) - 5x(10y^2)$, or $5x(x - 10y^2)$.

Choice B 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

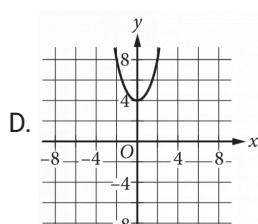
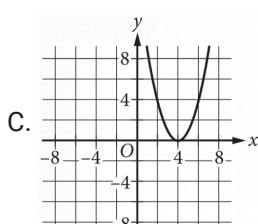
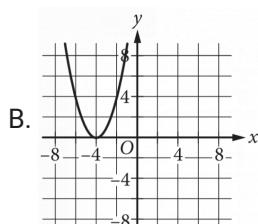
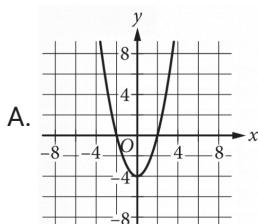
Question ID d46da42c

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: d46da42c

$$f(x) = x^2 + 4$$

The function f is defined as shown. Which of the following graphs in the xy -plane could be the graph of $y = f(x)$?



ID: d46da42c Answer

Correct Answer:

D

Rationale

Choice D is correct. For the quadratic function $f(x) = x^2 + 4$, the vertex of the graph is $(0, 4)$, and because the x^2 term is positive, the vertex is the minimum of the function. Choice D is the only option that meets these conditions.

Choices A, B, and C are incorrect. The vertex of each of these graphs doesn't correspond to the minimum of the given function.

Question Difficulty:

Easy

Question ID 4209aefe

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 4209aefe

The function $f(x) = 206(1.034)^x$ models the value, in dollars, of a certain bank account by the end of each year from 1957 through 1972, where x is the number of years after 1957. Which of the following is the best interpretation of " $f(5)$ is approximately equal to 243" in this context?

- A. The value of the bank account is estimated to be approximately 5 dollars greater in 1962 than in 1957.
- B. The value of the bank account is estimated to be approximately 243 dollars in 1962.
- C. The value, in dollars, of the bank account is estimated to be approximately 5 times greater in 1962 than in 1957.
- D. The value of the bank account is estimated to increase by approximately 243 dollars every 5 years between 1957 and 1972.

ID: 4209aefe Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that the function $f(x) = 206(1.034)^x$ models the value, in dollars, of a certain bank account by the end of each year from 1957 through 1972, where x is the number of years after 1957. It follows that $f(x)$ represents the estimated value, in dollars, of the bank account x years after 1957. Since the value of $f(5)$ is the value of $f(x)$ when $x = 5$, it follows that " $f(5)$ is approximately equal to 243" means that $f(x)$ is approximately equal to 243 when $x = 5$. In the given context, this means that the value of the bank account is estimated to be approximately 243 dollars 5 years after 1957. Therefore, the best interpretation of the statement " $f(5)$ is approximately equal to 243" in this context is the value of the bank account is estimated to be approximately 243 dollars in 1962.

Choice A is incorrect and may result from conceptual errors.

Choice C is incorrect and may result from conceptual errors.

Choice D is incorrect and may result from conceptual errors.

Question Difficulty:

Medium

Question ID 482a445b

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 20%; background-color: #005a9f;"></div> <div style="width: 20%; background-color: #005a9f;"></div> <div style="width: 60%; background-color: #e0e0e0;"></div> |

ID: 482a445b

Which expression is equivalent to $(x^2 + 11)^2 + (x - 5)(x + 5)$?

- A. $x^4 + 23x^2 - 14$
- B. $x^4 + 23x^2 + 96$
- C. $x^4 + 12x^2 + 121$
- D. $x^4 + x^2 + 146$

ID: 482a445b Answer

Correct Answer:

B

Rationale

Choice B is correct. The expression $(x^2 + 11)^2$ can be written as $(x^2 + 11)(x^2 + 11)$, which is equivalent to $x^2(x^2 + 11) + 11(x^2 + 11)$. Distributing x^2 and 11 to $(x^2 + 11)$ yields $x^4 + 11x^2 + 11x^2 + 121$, or $x^4 + 22x^2 + 121$. The expression $(x - 5)(x + 5)$ is equivalent to $(x - 5)x + (x - 5)5$. Distributing x and 5 to $(x - 5)$ yields $x^2 - 5x + 5x - 25$, or $x^2 - 25$. Therefore, the expression $(x^2 + 11)^2 + (x - 5)(x + 5)$ is equivalent to $(x^4 + 22x^2 + 121) + (x^2 - 25)$, or $x^4 + 22x^2 + 121 + x^2 - 25$. Combining like terms in this expression yields $x^4 + 23x^2 + 96$.

Choice A is incorrect. Equivalent expressions must be equivalent for any value of x . Substituting 0 for x in this expression yields -14, whereas substituting 0 for x in the given expression yields 96.

Choice C is incorrect. Equivalent expressions must be equivalent for any value of x . Substituting 0 for x in this expression yields 121, whereas substituting 0 for x in the given expression yields 96.

Choice D is incorrect. Equivalent expressions must be equivalent for any value of x . Substituting 0 for x in this expression yields 146, whereas substituting 0 for x in the given expression yields 96.

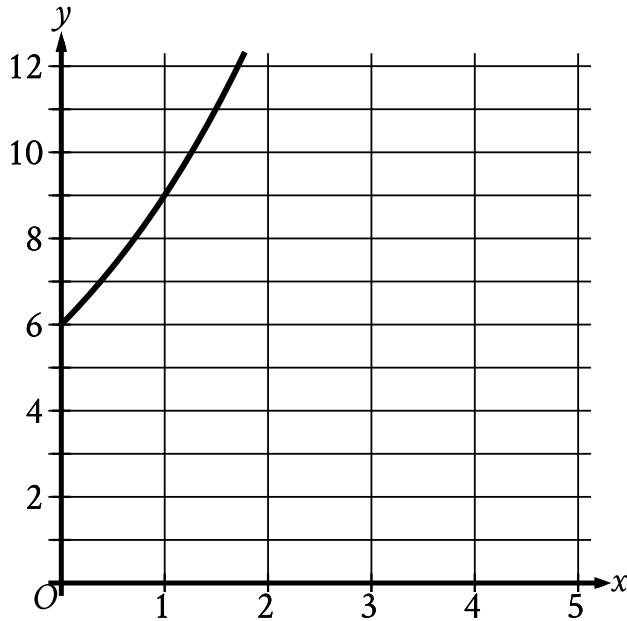
Question Difficulty:

Medium

Question ID f1fa0821

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: f1fa0821



The graph gives the estimated population y , in thousands, of a town x years since 2003, where $0 \leq x \leq 5$. Which of the following best describes the increase in the estimated population from $x = 0$ to $x = 1$?

- A. The estimated population at $x = 1$ is 0.5 times the estimated population at $x = 0$.
- B. The estimated population at $x = 1$ is 1.5 times the estimated population at $x = 0$.
- C. The estimated population at $x = 1$ is 2.5 times the estimated population at $x = 0$.
- D. The estimated population at $x = 1$ is 3.5 times the estimated population at $x = 0$.

ID: f1fa0821 Answer

Correct Answer:

B

Rationale

Choice B is correct. On the graph shown, the y -axis represents estimated population, in thousands. The graph shows that when $x = 0$, the y -coordinate is 6. Therefore, the estimated population at $x = 0$ is 6 thousand. The graph also shows that when $x = 1$, the y -coordinate is 9. Therefore, the estimated population at $x = 1$ is 9 thousand. Dividing 9 thousand by 6 thousand yields 1.5; therefore, 9 thousand is 1.5 times 6 thousand. It follows that the estimated population at $x = 1$ is 1.5 times the estimated population at $x = 0$.

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:

Medium

Question ID 1697ffcf

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

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

Question ID 5bf0f84a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 5bf0f84a

$$h(t) = -16t^2 + 110t + 72$$

The function above models the height h , in feet, of an object above ground t seconds after being launched straight up in the air. What does the number 72 represent in the function?

- A. The initial height, in feet, of the object
- B. The maximum height, in feet, of the object
- C. The initial speed, in feet per second, of the object
- D. The maximum speed, in feet per second, of the object

ID: 5bf0f84a Answer

Correct Answer:

A

Rationale

Choice A is correct. The variable t represents the seconds after the object is launched. Since $h(0) = 72$, this means that the height, in feet, at 0 seconds, or the initial height, is 72 feet.

Choices B, C, and D are incorrect and may be the result of misinterpreting the function in context.

Question Difficulty:

Medium

Question ID 4b6f0a3f

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 50%; background-color: #cccccc; height: 10px;"></div> |

ID: 4b6f0a3f

$$x^2 - 5x - 24 = 0$$

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

ID: 4b6f0a3f Answer

Correct Answer:

5

Rationale

The correct answer is 5. The given quadratic equation can be rewritten in factored form as $(x - 8)(x + 3) = 0$. Based on the zero product property, it follows that $x - 8 = 0$ or $x + 3 = 0$. Adding 8 to both sides of the equation $x - 8 = 0$ yields $x = 8$. Subtracting 3 from both sides of the equation $x + 3 = 0$ yields $x = -3$. Therefore, the solutions to the given equation are 8 and -3. It follows that the sum of the solutions to the given equation is $8 + (-3)$, or 5.

Question Difficulty:

Medium

Question ID 70ebd3d0

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 60%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 70ebd3d0

$$N(d) = 115(0.90)^d$$

The function N defined above can be used to model the number of species of brachiopods at various ocean depths d , where d is in hundreds of meters. Which of the following does the model predict?

- A. For every increase in depth by 1 meter, the number of brachiopod species decreases by 115.
- B. For every increase in depth by 1 meter, the number of brachiopod species decreases by 10%.
- C. For every increase in depth by 100 meters, the number of brachiopod species decreases by 115.
- D. For every increase in depth by 100 meters, the number of brachiopod species decreases by 10%.

ID: 70ebd3d0 Answer

Correct Answer:

D

Rationale

Choice D is correct. The function N is exponential, so it follows that $N(d)$ changes by a fixed percentage for each increase in d by 1. Since d is measured in hundreds of meters, it also follows that the number of brachiopod species changes by a fixed percentage for each increase in ocean depth by 100 meters. Since the base of the exponent in the model is 0.90, which is less than 1, the number of brachiopod species decreases as the ocean depth increases. Specifically, the number of brachiopod species at a depth of $d + 100$ meters is 90% of the number of brachiopod species at a depth of d meters. This means that for each increase in ocean depth by 100 meters, the number of brachiopod species decreases by 10%.

Choices A and C are incorrect. These describe situations where the number of brachiopod species are decreasing linearly rather than exponentially. Choice B is incorrect and results from interpreting the decrease in the number of brachiopod species as 10% for every 1-meter increase in ocean depth rather than for every 100-meter increase in ocean depth.

Question Difficulty:

Medium

Question ID 70fb357b

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 70fb357b

$$y = 576^{(2x+2)}$$

The graph of the given equation in the xy -plane has a y -intercept of (r, s) . Which of the following equivalent equations displays the value of s as a constant, a coefficient, or the base?

- A. $y = 331,776^{(x+1)}$
- B. $y = 24^{(4x+4)}$
- C. $y = \frac{1}{24} (24)^{(4x+5)}$
- D. $y = \frac{1}{576} (576)^{(2x+3)}$

ID: 70fb357b Answer

Correct Answer:

A

Rationale

Choice A is correct. The y -intercept of a graph in the xy -plane is the point where $x = 0$. Substituting 0 for x in the given equation, $y = 576^{(2x+2)}$, yields $y = 576^{(2(0)+2)}$, which is equivalent to $y = 576^2$, or $y = 331,776$. Therefore, the graph of the given equation in the xy -plane has a y -intercept of $(0, 331,776)$. It follows that $r = 0$ and $s = 331,776$. Thus, the equivalent equation $y = 331,776^{(x+1)}$ displays the value of s as the base.

Choice B 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:

Hard

Question ID 20291f47

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 20291f47

Which expression is equivalent to $\frac{y+12}{x-8} + \frac{y(x-8)}{x^2y-8xy}$?

A. $\frac{xy+y+4}{x^3y-16x^2y+64xy}$

B. $\frac{xy+9y+12}{x^2y-8xy+x-8}$

C. $\frac{xy^2+13xy-8y}{x^2y-8xy}$

D. $\frac{xy^2+13xy-8y}{x^3y-16x^2y+64xy}$

ID: 20291f47 Answer

Correct Answer:

C

Rationale

Choice C is correct. Factoring the denominator in the second term of the given expression gives $\frac{y+12}{x-8} + \frac{y(x-8)}{xy(x-8)}$. This expression can be rewritten with common denominators by multiplying the first term by $\frac{xy}{xy}$, giving $\frac{xy(y+12)}{xy(x-8)} + \frac{y(x-8)}{xy(x-8)}$. Adding these two terms yields $\frac{xy(y+12)+y(x-8)}{xy(x-8)}$. Using the distributive property to rewrite this expression gives $\frac{xy^2+12xy+xy-8y}{x^2y-8xy}$. Combining the like terms in the numerator of this expression gives $\frac{xy^2+13xy-8y}{x^2y-8xy}$.

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:

Hard

Question ID 42f8e4b4

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 42f8e4b4

One of the factors of $2x^3 + 42x^2 + 208x$ is $x + b$, where b is a positive constant. What is the smallest possible value of b ?

ID: 42f8e4b4 Answer

Correct Answer:

8

Rationale

The correct answer is 8. Since each term of the given expression, $2x^3 + 42x^2 + 208x$, has a factor of $2x$, the expression can be rewritten as $2x(x^2) + 2x(21x) + 2x(104)$, or $2x(x^2 + 21x + 104)$. Since the values 8 and 13 have a sum of 21 and a product of 104, the expression $x^2 + 21x + 104$ can be factored as $(x + 8)(x + 13)$. Therefore, the given expression can be factored as $2x(x + 8)(x + 13)$. It follows that the factors of the given expression are 2, x , $x + 8$, and $x + 13$. Of these factors, only $x + 8$ and $x + 13$ are of the form $x + b$, where b is a positive constant. Therefore, the possible values of b are 8 and 13. Thus, the smallest possible value of b is 8.

Question Difficulty:

Hard

Question ID a67a439d

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: a67a439d

$$\begin{aligned}x + 7 &= 10 \\(x + 7)^2 &= y\end{aligned}$$

Which ordered pair (x, y) is a solution to the given system of equations?

- A. $(3, 100)$
- B. $(3, 3)$
- C. $(3, 10)$
- D. $(3, 70)$

ID: a67a439d Answer

Correct Answer:

A

Rationale

Choice A is correct. The solution to a system of equations is the ordered pair (x, y) that satisfies all equations in the system. It's given by the first equation in the system that $x + 7 = 10$. Substituting 10 for $x + 7$ into the second equation yields $10^2 = y$, or $y = 100$. The x -coordinate of the solution to the system of equations can be found by subtracting 7 from both sides of the equation $x + 7 = 10$, which yields $x = 3$. Therefore, the ordered pair $(3, 100)$ is a solution to the given system of equations.

Choice B 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

Question ID de39858a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: de39858a

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 $(-2, \frac{325}{36})$. What is the value of ab ?

- A. $\frac{1}{4}$
- B. $\frac{1}{2}$
- C. 54
- D. 60

ID: de39858a Answer

Correct Answer:

C

Rationale

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 $(-2, \frac{325}{36})$. 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 $a^2 = 36$. 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.

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 .

Question Difficulty:

Hard

Question ID 2683b5db

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 60%; background-color: #e0e0e0; height: 10px;"></div> |

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 d41cf4d3

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: d41cf4d3

The function f is defined by $f(x) = a\sqrt{x+b}$, where a and b are constants. In the xy -plane, the graph of $y = f(x)$ passes through the point $(-24, 0)$, and $f(24) < 0$. Which of the following must be true?

- A. $f(0) = 24$
- B. $f(0) = -24$
- C. $a > b$
- D. $a < b$

ID: d41cf4d3 Answer

Correct Answer:

D

Rationale

Choice D is correct. It's given that $f(24) < 0$. Substituting 24 for $f(x)$ in the equation $f(x) = a\sqrt{x+b}$ yields $f(24) = a\sqrt{24+b}$. Therefore, $a\sqrt{24+b} < 0$. Since $\sqrt{24+b}$ can't be negative, it follows that $a < 0$. It's also given that the graph of $y = f(x)$ passes through the point $(-24, 0)$. It follows that when $x = -24$, $f(x) = 0$. Substituting -24 for x and 0 for $f(x)$ in the equation $f(x) = a\sqrt{x+b}$ yields $0 = a\sqrt{-24+b}$. By the zero product property, either $a = 0$ or $\sqrt{-24+b} = 0$. Since $a < 0$, it follows that $\sqrt{-24+b} = 0$. Squaring both sides of this equation yields $-24+b = 0$. Adding 24 to both sides of this equation yields $b = 24$. Since $a < 0$ and b is 24, it follows that $a < b$ must be true.

Choice A is incorrect. The value of $f(0)$ is $a\sqrt{b}$, which must be negative.

Choice B is incorrect. The value of $f(0)$ is $a\sqrt{b}$, which could be -24 , but doesn't have to be.

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

Question Difficulty:

Hard

Question ID 1178f2df

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 1178f2df

| x | y |
|----|----|
| 21 | -8 |
| 23 | 8 |
| 25 | -8 |

The table shows three values of x and their corresponding values of y , where $y = f(x) + 4$ and f is a quadratic function. What is the y-coordinate of the y-intercept of the graph of $y = f(x)$ in the xy-plane?

ID: 1178f2df Answer

Correct Answer:

-2,112

Rationale

The correct answer is -2,112. It's given that f is a quadratic function. It follows that f can be defined by an equation of the form $f(x) = a(x - h)^2 + k$, where a , h , and k are constants. It's also given that the table shows three values of x and their corresponding values of y , where $y = f(x) + 4$. Substituting $a(x - h)^2 + k$ for $f(x)$ in this equation yields $y = a(x - h)^2 + k + 4$. This equation represents a quadratic relationship between x and y , where $k + 4$ is either the maximum or the minimum value of y , which occurs when $x = h$. For quadratic relationships between x and y , the maximum or minimum value of y occurs at the value of x halfway between any two values of x that have the same corresponding value of y . The table shows that x-values of 21 and 25 correspond to the same y-value, -8. Since 23 is halfway between 21 and 25, the maximum or minimum value of y occurs at an x-value of 23. The table shows that when $x = 23$, $y = 8$. It follows that $h = 23$ and $k + 4 = 8$. Subtracting 4 from both sides of the equation $k + 4 = 8$ yields $k = 4$. Substituting 23 for h and 4 for k in the equation $y = a(x - h)^2 + k + 4$ yields $y = a(x - 23)^2 + 4 + 4$, or $y = a(x - 23)^2 + 8$. The value of a can be found by substituting any x-value and its corresponding y-value for x and y , respectively, in this equation. Substituting 25 for x and -8 for y in this equation yields $-8 = a(25 - 23)^2 + 8$, or $-8 = a(2)^2 + 8$. Subtracting 8 from both sides of this equation yields $-16 = a(2)^2$, or $-16 = 4a$. Dividing both sides of this equation by 4 yields $-4 = a$. Substituting -4 for a , 23 for h , and 4 for k in the equation $f(x) = a(x - h)^2 + k$ yields $f(x) = -4(x - 23)^2 + 4$. The y-intercept of the graph of $y = f(x)$ in the xy-plane is the point on the graph where $x = 0$. Substituting 0 for x in the equation $f(x) = -4(x - 23)^2 + 4$ yields $f(0) = -4(0 - 23)^2 + 4$, or $f(0) = -4(-23)^2 + 4$. This is equivalent to $f(0) = -2,112$, so the y-intercept of the graph of $y = f(x)$ in the xy-plane is (0, -2,112). Thus, the y-coordinate of the y-intercept of the graph of $y = f(x)$ in the xy-plane is -2,112.

Question Difficulty:

Hard

Question ID ce940f80

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #002B36; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> |

ID: ce940f80

$$\frac{x^2}{25} = 36$$

What is a solution to the given equation?

- A. 6
- B. 30
- C. 450
- D. 900

ID: ce940f80 Answer

Correct Answer:

B

Rationale

Choice B is correct. Multiplying the left- and right-hand sides of the given equation by 25 yields $x^2 = 900$. Taking the square root of the left- and right-hand sides of this equation yields $x = 30$ or $x = -30$. Of these two solutions, only 30 is given as a choice.

Choice A is incorrect. This is a solution to the equation $x^2 = 36$.

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

Question ID 45df91ee

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 45df91ee

$$g(x) = 11\left(\frac{1}{12}\right)^x$$

If the given function g is graphed in the xy -plane, where $y = g(x)$, what is the y -intercept of the graph?

- A. $(0, 11)$
- B. $(0, 132)$
- C. $(0, 1)$
- D. $(0, 12)$

ID: 45df91ee Answer

Correct Answer:

A

Rationale

Choice A is correct. The x -coordinate of any y -intercept of a graph is 0 . Substituting 0 for x in the given equation yields $g(0) = 11\left(\frac{1}{12}\right)^0$. Since any nonzero number raised to the 0 th power is 1 , this gives $g(0) = 11 \cdot 1$, or $g(0) = 11$. The y -intercept of the graph is, therefore, the point $(0, 11)$.

Choice B 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:

Medium

Question ID 67e866b5

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 25%; background-color: #e0e0e0;"></div> <div style="width: 25%; background-color: #e0e0e0;"></div> |

ID: 67e866b5

Which expression is equivalent to $9x^2 + 7x^2 + 9x$?

- A. $63x^4 + 9x$
- B. $9x^2 + 16x$
- C. $25x^5$
- D. $16x^2 + 9x$

ID: 67e866b5 Answer

Correct Answer:

D

Rationale

Choice D is correct. In the given expression, the first two terms, $9x^2$ and $7x^2$, are like terms. Combining these like terms yields $9x^2 + 7x^2$, or $16x^2$. It follows that the expression $9x^2 + 7x^2 + 9x$ is equivalent to $16x^2 + 9x$.

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:

Easy

Question ID 40f2e601

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 60%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 40f2e601

$$P = N(19 - C)$$

The given equation relates the positive numbers P , N , and C . Which equation correctly expresses C in terms of P and N ?

- A. $C = \frac{19+P}{N}$
- B. $C = \frac{19-P}{N}$
- C. $C = 19 + \frac{P}{N}$
- D. $C = 19 - \frac{P}{N}$

ID: 40f2e601 Answer

Correct Answer:

D

Rationale

Choice D is correct. It's given that the values of P , N , and C are positive. Therefore, dividing each side of the given equation by N yields $\frac{P}{N} = 19 - C$. Subtracting 19 from each side of this equation yields $\frac{P}{N} - 19 = -C$. Dividing each side of this equation by -1 yields $19 - \frac{P}{N} = C$, or $C = 19 - \frac{P}{N}$.

Choice A is incorrect. This equation is equivalent to $P = NC - 19$, not $P = N(19 - C)$.

Choice B is incorrect. This equation is equivalent to $P = 19 - NC$, not $P = N(19 - C)$.

Choice C is incorrect. This equation is equivalent to $P = N(C - 19)$, not $P = N(19 - C)$.

Question Difficulty:

Medium

Question ID fd65f47f

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|---|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 75%; background-color: #cccccc; height: 10px;"></div> |

ID: fd65f47f

Which expression is equivalent to $(2x^2 + x - 9) + (x^2 + 6x + 1)$?

- A. $2x^2 + 7x + 10$
- B. $2x^2 + 6x - 8$
- C. $3x^2 + 7x - 10$
- D. $3x^2 + 7x - 8$

ID: fd65f47f Answer

Correct Answer:

D

Rationale

Choice D is correct. The given expression is equivalent to $(2x^2 + x + (-9)) + (x^2 + 6x + 1)$, which can be rewritten as $(2x^2 + x^2) + (x + 6x) + (-9 + 1)$. Adding like terms in this expression yields $3x^2 + 7x + (-8)$, or $3x^2 + 7x - 8$.

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:

Easy

Question ID 7f87deff

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 7f87deff

What is an x -coordinate of an x -intercept of the graph of $y = 3(x - 14)(x + 5)(x + 4)$ in the xy -plane?

ID: 7f87deff Answer

Correct Answer:

14, -5, -4

Rationale

The correct answer is either **14**, **-5**, or **-4**. The x -intercepts of a graph in the xy -plane are the points at which the graph intersects the x -axis, or when the value of y is **0**. Substituting **0** for y in the given equation yields $0 = 3(x - 14)(x + 5)(x + 4)$. Dividing both sides of this equation by **3** yields $0 = (x - 14)(x + 5)(x + 4)$. Applying the zero product property to this equation yields three equations: $x - 14 = 0$, $x + 5 = 0$, and $x + 4 = 0$. Adding **14** to both sides of the equation $x - 14 = 0$ yields $x = 14$, subtracting **5** from both sides of the equation $x + 5 = 0$ yields $x = -5$, and subtracting **4** from both sides of the equation $x + 4 = 0$ yields $x = -4$. Therefore, the x -coordinates of the x -intercepts of the graph of the given equation are **14**, **-5**, and **-4**. Note that 14, -5, and -4 are examples of ways to enter a correct answer.

Question Difficulty:

Medium

Question ID 97158b3a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 97158b3a

The area A , in square centimeters, of a rectangular painting can be represented by the expression $w(w + 29)$, where w is the width, in centimeters, of the painting. Which expression represents the length, in centimeters, of the painting?

- A. w
- B. 29
- C. $(w + 29)$
- D. $w(w + 29)$

ID: 97158b3a Answer

Correct Answer:

C

Rationale

Choice C is correct. It's given that the expression $w(w + 29)$ represents the area, in square centimeters, of a rectangular painting, where w is the width, in centimeters, of the painting. The area of a rectangle can be calculated by multiplying its length by its width. It follows that the length, in centimeters, of the painting is represented by the expression $(w + 29)$.

Choice A is incorrect. This expression represents the width, in centimeters, of the painting, not its length, in centimeters.

Choice B is incorrect. This is the difference between the length, in centimeters, and the width, in centimeters, of the painting, not its length, in centimeters.

Choice D is incorrect. This expression represents the area, in square centimeters, of the painting, not its length, in centimeters.

Question Difficulty:

Medium

Question ID 84e8cc72

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #005a9f; height: 10px;"></div> |

ID: 84e8cc72

A quadratic function models the height, in feet, of an object above the ground in terms of the time, in seconds, after the object is launched off an elevated surface. The model indicates the object has an initial height of 10 feet above the ground and reaches its maximum height of 1,034 feet above the ground 8 seconds after being launched. Based on the model, what is the height, in feet, of the object above the ground 10 seconds after being launched?

- A. 234
- B. 778
- C. 970
- D. 1,014

ID: 84e8cc72 Answer

Correct Answer:

C

Rationale

Choice C is correct. It's given that a quadratic function models the height, in feet, of an object above the ground in terms of the time, in seconds, after the object is launched off an elevated surface. This quadratic function can be defined by an equation of the form $f(x) = a(x - h)^2 + k$, where $f(x)$ is the height of the object x seconds after it was launched, and a , h , and k are constants such that the function reaches its maximum value, k , when $x = h$. Since the model indicates the object reaches its maximum height of 1,034 feet above the ground 8 seconds after being launched, $f(x)$ reaches its maximum value, 1,034, when $x = 8$. Therefore, $k = 1,034$ and $h = 8$. Substituting 8 for h and 1,034 for k in the function $f(x) = a(x - h)^2 + k$ yields $f(x) = a(x - 8)^2 + 1,034$. Since the model indicates the object has an initial height of 10 feet above the ground, the value of $f(x)$ is 10 when $x = 0$. Substituting 0 for x and 10 for $f(x)$ in the equation $f(x) = a(x - 8)^2 + 1,034$ yields $10 = a(0 - 8)^2 + 1,034$, or $10 = 64a + 1,034$. Subtracting 1,034 from both sides of this equation yields $64a = -1,024$. Dividing both sides of this equation by 64 yields $a = -16$. Therefore, the model can be represented by the equation $f(x) = -16(x - 8)^2 + 1,034$. Substituting 10 for x in this equation yields $f(10) = -16(10 - 8)^2 + 1,034$, or $f(10) = 970$. Therefore, based on the model, 10 seconds after being launched, the height of the object above the ground is 970 feet.

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:

Hard

Question ID 0ad5012e

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 0ad5012e

$$y = -\frac{1}{4}x^2 + 2x + 29$$

The given equation models a company's scheduled deliveries over 8 months, where y is the estimated number of scheduled deliveries x months after the end of May 2012, where $0 \leq x \leq 8$. Which statement is the best interpretation of the y -intercept of the graph of this equation in the xy -plane?

- A. At the end of May 2012, the estimated number of scheduled deliveries was 0.
- B. At the end of May 2012, the estimated number of scheduled deliveries was 29.
- C. At the end of June 2012, the estimated number of scheduled deliveries was 0.
- D. At the end of June 2012, the estimated number of scheduled deliveries was 29.

ID: 0ad5012e Answer

Correct Answer:

B

Rationale

Choice B is correct. The y -intercept of a graph in the xy -plane is the point where $x = 0$. For the given equation, the y -intercept of the graph in the xy -plane can be found by substituting 0 for x in the equation, which yields $y = -\frac{1}{4}(0)^2 + 2(0) + 29$, or $y = 29$. Therefore, the y -intercept of the graph is $(0, 29)$. It's given that y is the estimated number of scheduled deliveries x months after the end of May 2012. Therefore, $x = 0$ represents 0 months after the end of May 2012, or the end of May 2012. Thus, the best interpretation of the y -intercept of the graph of this equation in the xy -plane is that at the end of May 2012, the estimated number of scheduled deliveries was 29.

Choice A is incorrect and may result from conceptual errors.

Choice C is incorrect and may result from conceptual errors.

Choice D is incorrect and may result from conceptual errors.

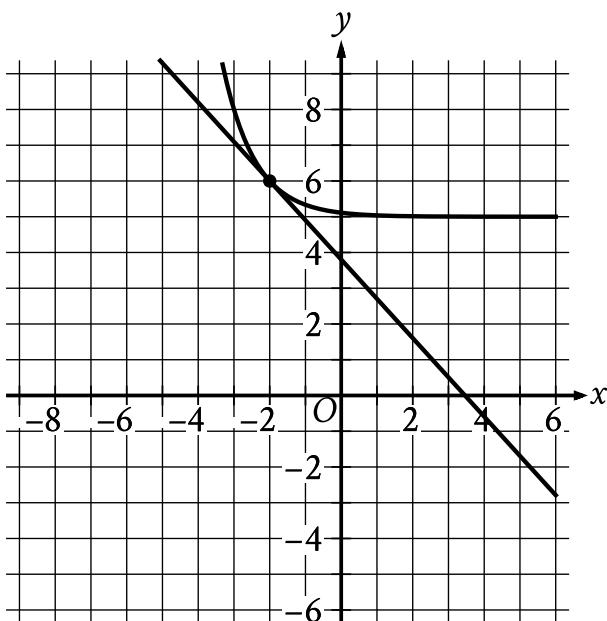
Question Difficulty:

Easy

Question ID 5c7d5744

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 25%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 5c7d5744



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. $(6, 0)$
- B. $(-2, 6)$
- C. $(0, -2)$
- D. $(0, 0)$

ID: 5c7d5744 Answer

Correct Answer:

B

Rationale

Choice B is correct. The solution (x, y) to the system of two equations corresponds to the point where the graphs of the equations intersect in the xy -plane. The graphs of the linear equation and the nonlinear equation shown intersect at the point $(-2, 6)$. Thus, the solution (x, y) to this system is $(-2, 6)$.

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

Question ID 12e7faf8

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 12e7faf8

The equation $\frac{x^2+6x-7}{x+7} = ax+d$ is true for all $x \neq -7$, where a and d are integers. What is the value of $a+d$?

- A. -6
- B. -1
- C. 0
- D. 1

ID: 12e7faf8 Answer

Correct Answer:

C

Rationale

Choice C is correct. Since the expression x^2+6x-7 can be factored as $(x+7)(x-1)$, the given equation can be rewritten as $\frac{(x+7)(x-1)}{x+7} = ax+d$. Since $x \neq -7$, $x+7$ is also not equal to 0, so both the numerator and denominator of $\frac{(x+7)(x-1)}{x+7}$ can be divided by $x+7$. This gives $x-1 = ax+d$. Equating the coefficient of x on each side of the equation gives $a=1$. Equating the constant terms gives $d=-1$. The sum is $1+(-1)=0$.

Choice A is incorrect and may result from incorrectly simplifying the equation. Choices B and D are incorrect. They are the values of d and a , respectively, not $a+d$.

Question Difficulty:

Hard

Question ID 24016dee

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: 24016dee

Which expression is equivalent to $(8x^3 + 8) - (x^3 - 2)$?

- A. $8x^3 + 6$
- B. $7x^3 + 10$
- C. $8x^3 + 10$
- D. $7x^3 + 6$

ID: 24016dee Answer

Correct Answer:

B

Rationale

Choice B is correct. The given expression is equivalent to $8x^3 + 8 - x^3 - (-2)$, or $8x^3 + 8 - x^3 + 2$. Combining like terms in this expression yields $7x^3 + 10$.

Choice A is incorrect. This expression is equivalent to $(8x^3 + 8) - 2$, not $(8x^3 + 8) - (x^3 - 2)$.

Choice C is incorrect. This expression is equivalent to $(8x^3 + 8) - (-2)$, not $(8x^3 + 8) - (x^3 - 2)$.

Choice D is incorrect. This expression is equivalent to $(8x^3 + 8) - (x^3 + 2)$, not $(8x^3 + 8) - (x^3 - 2)$.

Question Difficulty:

Medium

Question ID 89fc23af

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 89fc23af

Which of the following expressions is

$$\frac{x^2 - 2x - 5}{x - 3}$$

equivalent to ?

A. $x - 5 - \frac{20}{x-3}$

B. $x - 5 - \frac{10}{x-3}$

C. $x + 1 - \frac{8}{x-3}$

D. $x + 1 - \frac{2}{x-3}$

ID: 89fc23af Answer

Correct Answer:

D

Rationale

Choice D is correct. The numerator of the given expression can be rewritten in terms of the denominator, $x - 3$, as follows:

$$x^2 - 2x - 5 = x^2 - 3x + x - 3 - 2, \text{ which is equivalent to } x(x-3) + (x-3) - 2.$$

So the given expression is equivalent to $\frac{x(x-3) + (x-3) - 2}{x-3} = \frac{x(x-3)}{x-3} + \frac{x-3}{x-3} - \frac{2}{x-3}$. Since the given expression is defined for $x \neq 3$, the expression can be

rewritten as $x + 1 - \frac{2}{x-3}$.

Long division can also be used as an alternate approach. Choices A, B, and C are incorrect and may result from errors made when dividing the two polynomials or making use of structure.

Question Difficulty:

Hard

Question ID d8ace155

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: d8ace155

A company opens an account with an initial balance of **\$36,100.00**. The account earns interest, and no additional deposits or withdrawals are made. The account balance is given by an exponential function A , where $A(t)$ is the account balance, in dollars, t years after the account is opened. The account balance after **13** years is **\$68,071.93**. Which equation could define A ?

- A. $A(t) = 36,100.00(1.05)^t$
- B. $A(t) = 31,971.93(1.05)^t$
- C. $A(t) = 31,971.93(0.05)^t$
- D. $A(t) = 36,100.00(0.05)^t$

ID: d8ace155 Answer

Correct Answer:

A

Rationale

Choice A is correct. Since it's given that the account balance, $A(t)$, in dollars, after t years can be modeled by an exponential function, it follows that function A can be written in the form $A(t) = Nr^t$, where N is the initial value of the function and r is a constant related to the growth of the function. It's given that the initial balance of the account is **\$36,100.00**, so it follows that the initial value of the function, or N , must be **36,100.00**. Substituting **36,100.00** for N in the equation $A(t) = Nr^t$ yields $A(t) = 36,100.00r^t$. It's given that the account balance after **13** years, or when $t = 13$, is **\$68,071.93**. It follows that $A(13) = 68,071.93$, or $36,100.00r^{13} = 68,071.93$. Dividing each side of the equation $36,100.00r^{13} = 68,071.93$ by $36,100.00$ yields $r^{13} = \frac{68,071.93}{36,100.00}$. Taking the 13th root of both sides of this equation yields $r = \sqrt[13]{\frac{68,071.93}{36,100.00}}$, or r is approximately equal to **1.05**. Substituting **1.05** for r in the equation $A(t) = 36,100.00r^t$ yields $A(t) = 36,100.00(1.05)^t$, so the equation $A(t) = 36,100.00(1.05)^t$ could define A .

Choice B is incorrect. Substituting **0** for t in this function indicates an initial balance of **\$31,971.93**, rather than **\$36,100.00**.

Choice C is incorrect. Substituting **0** for t in this function indicates an initial balance of **\$31,971.93**, rather than **\$36,100.00**. Additionally, this function indicates the account balance is decreasing, rather than increasing, over time.

Choice D is incorrect. This function indicates the account balance is decreasing, rather than increasing, over time.

Question Difficulty:

Medium

Question ID c3a72da5

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 20%; background-color: #005a7a; height: 10px;"></div> <div style="width: 20%; background-color: #005a7a; height: 10px;"></div> <div style="width: 60%; background-color: #e0e0e0; height: 10px;"></div> |

ID: c3a72da5

Which of the following is equivalent to the sum of

$3x^4 + 2x^3$ and $4x^4 + 7x^3$?

- A. $16x^{14}$
- B. $7x^8 + 9x^6$
- C. $12x^4 + 14x^3$
- D. $7x^4 + 9x^3$

ID: c3a72da5 Answer

Correct Answer:

D

Rationale

Choice D is correct. Adding the two expressions yields $3x^4 + 2x^3 + 4x^4 + 7x^3$. Because the pair of terms $3x^4$ and $4x^4$ and the pair of terms $2x^3$ and $7x^3$ each contain the same variable raised to the same power, they are like terms and can be combined as $7x^4$ and $9x^3$, respectively. The sum of the given expressions therefore simplifies to $7x^4 + 9x^3$.

Choice A is incorrect and may result from adding the coefficients and the exponents in the given expressions. Choice B is incorrect and may result from adding the exponents as well as the coefficients of the like terms in the given expressions. Choice C is incorrect and may result from multiplying, rather than adding, the coefficients of the like terms in the given expressions.

Question Difficulty:

Medium

Question ID 5a74f696

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #e0e0e0;"></div> <div style="width: 25%; background-color: #e0e0e0;"></div> |

ID: 5a74f696

An investment account was opened with an initial value of \$890. The value of the account doubled every 10 years. Which equation represents the value of the account $M(t)$, in dollars, t years after the account was opened?

- A. $M(t) = 890\left(\frac{1}{2}\right)^{\frac{t}{10}}$
- B. $M(t) = 890\left(\frac{1}{10}\right)^{\frac{t}{2}}$
- C. $M(t) = 890(2)^{\frac{t}{10}}$
- D. $M(t) = 890(10)^{\frac{t}{2}}$

ID: 5a74f696 Answer

Correct Answer:

C

Rationale

Choice C is correct. It's given that t represents the number of years since the account was opened. Therefore, $\frac{t}{10}$ represents the number of 10-year periods since the account was opened. Since the value of the account doubles during each of these 10-year periods, the value of the account can be found by multiplying the initial value by $\frac{t}{10}$ factors of 2. This is equivalent to $2^{\frac{t}{10}}$. It's given that the initial value of the account is \$890. Therefore, the value of the account $M(t)$, in dollars, t years after the account was opened can be represented by $M(t) = 890(2)^{\frac{t}{10}}$.

Choice A is incorrect. This equation represents the value of an account if the value of the account halves, not doubles, every 10 years.

Choice B is incorrect. This equation represents the value of an account if the value of the account decreases by 90%, not doubles, every 2, not 10, years.

Choice D is incorrect. This equation represents the value of an account if the value of the account increases by a factor of 10, not doubles, every 2, not 10, years.

Question Difficulty:

Easy

Question ID 911c415b

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #005a9f; height: 10px;"></div> |

ID: 911c415b

$$(7532 + 100y^2) + 10(10y^2 - 110)$$

The expression above can be written in the form $ay^2 + b$, where a and b are constants. What is the value of $a + b$?

ID: 911c415b Answer

Rationale

The correct answer is 6632. Applying the distributive property to the expression yields $(7532 + 100y^2) + (100y^2 - 1100)$. Then adding together $7532 + 100y^2$ and $100y^2 - 1100$ and collecting like terms results in $200y^2 + 6432$. This is written in the form $ay^2 + b$, where $a = 200$ and $b = 6432$. Therefore $a + b = 200 + 6432 = 6632$.

Question Difficulty:

Hard

Question ID 1863e3be

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 1863e3be

The y -intercept of the graph of $y = x^2 + 31$ in the xy -plane is $(0, y)$. What is the value of y ?

ID: 1863e3be Answer

Correct Answer:

31

Rationale

The correct answer is **31**. It's given that the y -intercept of the graph of $y = x^2 + 31$ in the xy -plane is $(0, y)$. Substituting **0** for x in the given equation yields $y = (0)^2 + 31$, or $y = 31$. Thus, the value of y is **31**.

Question Difficulty:

Easy

Question ID dba7432e

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: dba7432e

| x | f(x) |
|---|---------------|
| 0 | 5 |
| 1 | $\frac{5}{2}$ |
| 2 | $\frac{5}{4}$ |
| 3 | $\frac{5}{8}$ |

The table above gives the values of the function f for some values of x . Which of the following equations could define f ?

A. $f(x) = 5(2^{x+1})$

B. $f(x) = 5(2^x)$

C. $f(x) = 5(2^{-(x+1)})$

D. $f(x) = 5(2^{-x})$

ID: dba7432e Answer

Correct Answer:

D

Rationale

Choice D is correct. Each choice has a function with coefficient 5 and base 2, so the exponents must be analyzed. When the input value of x increases, the output value of $f(x)$ decreases, so the exponent must be negative. An exponent of $-x$ yields the values in the table: $5 = 5(2^0)$, $\frac{5}{2} = 5(2^{-1})$, $\frac{5}{4} = 5(2^{-2})$, and $\frac{5}{8} = 5(2^{-3})$.

Choices A and B are incorrect and may result from choosing equations that yield an increasing, rather than decreasing, output value of $f(x)$ when the input value of x increases. Choice C is incorrect and may result from choosing an equation that doesn't yield the values in the table.

Question Difficulty:

Medium

Question ID b74f2feb

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: b74f2feb

The expression $6\sqrt[5]{3^5x^{45}} \cdot \sqrt[8]{2^8x}$ is equivalent to ax^b , where a and b are positive constants and $x > 1$. What is the value of $a + b$?

ID: b74f2feb Answer

Correct Answer:

361/8, 45.12, 45.13

Rationale

The correct answer is $\frac{361}{8}$. The rational exponent property is $\sqrt[n]{y^m} = y^{\frac{m}{n}}$, where $y > 0$, m and n are integers, and $n > 0$. This property can be applied to rewrite the given expression $6\sqrt[5]{3^5x^{45}} \cdot \sqrt[8]{2^8x}$ as $6(3^{\frac{5}{5}})(x^{\frac{45}{5}})(2^{\frac{8}{8}})(x^{\frac{1}{8}})$, or $6(3)(x^9)(2)(x^{\frac{1}{8}})$. This expression can be rewritten by multiplying the constants, which gives $36(x^9)(x^{\frac{1}{8}})$. The multiplication exponent property is $y^n \cdot y^m = y^{n+m}$, where $y > 0$. This property can be applied to rewrite the expression $36(x^9)(x^{\frac{1}{8}})$ as $36x^{9+\frac{1}{8}}$, or $36x^{\frac{73}{8}}$. Therefore, $6\sqrt[5]{3^5x^{45}} \cdot \sqrt[8]{2^8x} = 36x^{\frac{73}{8}}$. It's given that $6\sqrt[5]{3^5x^{45}} \cdot \sqrt[8]{2^8x}$ is equivalent to ax^b ; therefore, $a = 36$ and $b = \frac{73}{8}$. It follows that $a + b = 36 + \frac{73}{8}$. Finding a common denominator on the right-hand side of this equation gives $a + b = \frac{288}{8} + \frac{73}{8}$, or $a + b = \frac{361}{8}$. Note that 361/8, 45.12, and 45.13 are examples of ways to enter a correct answer.

Question Difficulty:

Hard

Question ID 16de54c7

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 16de54c7

$$2x^2 + 5x - 12$$

If the given expression is rewritten in the form $(2x - 3)(x + k)$, where k is a constant, what is the value of k ?

ID: 16de54c7 Answer

Rationale

The correct answer is 4. It's given that $2x^2 + 5x - 12$ can be rewritten as $(2x - 3)(x + k)$; it follows that $(2x - 3)(x + k) = 2x^2 + 5x - 12$. Expanding the left-hand side of this equation yields $2x^2 + 2kx - 3x - 3k = 2x^2 + 5x - 12$. Subtracting $2x^2$ from both sides of this equation yields $2kx - 3x - 3k = 5x - 12$. Using properties of equality, $2kx - 3x = 5x$ and $-3k = -12$. Either equation can be solved for k . Dividing both sides of $-3k = -12$ by -3 yields $k = 4$. The equation $2kx - 3x = 5x$ can be rewritten as $x(2k - 3) = 5x$. It follows that $2k - 3 = 5$. Solving this equation for k also yields $k = 4$. Therefore, the value of k is 4.

Question Difficulty:

Medium

Question ID 2f958af9

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 20%; background-color: #003366; height: 10px;"></div> <div style="width: 20%; background-color: #003366; height: 10px;"></div> <div style="width: 60%; background-color: #cccccc; height: 10px;"></div> |

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

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

Question ID cbc4c163

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: cbc4c163

The function f is defined by $f(x) = 5\left(\frac{1}{4} - x\right)^2 + \frac{11}{4}$. What is the value of $f\left(\frac{1}{4}\right)$?

ID: cbc4c163 Answer

Correct Answer:

11/4, 2.75

Rationale

The correct answer is $\frac{11}{4}$. It's given that the function f is defined by $f(x) = 5\left(\frac{1}{4} - x\right)^2 + \frac{11}{4}$. Substituting $\frac{1}{4}$ for x in this equation yields $f\left(\frac{1}{4}\right) = 5\left(\frac{1}{4} - \frac{1}{4}\right)^2 + \frac{11}{4}$, which is equivalent $f\left(\frac{1}{4}\right) = 5(0)^2 + \frac{11}{4}$, or $f\left(\frac{1}{4}\right) = \frac{11}{4}$. Therefore, the value of $f\left(\frac{1}{4}\right)$ is $\frac{11}{4}$. Note that 11/4 or 2.75 are examples of ways to enter a correct answer.

Question Difficulty:

Medium

Question ID 5edc8c98

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 5edc8c98

$$64x^2 - (16a + 4b)x + ab = 0$$

In the given equation, a and b are positive constants. The sum of the solutions to the given equation is $k(4a + b)$, where k is a constant. What is the value of k ?

ID: 5edc8c98 Answer

Correct Answer:

.0625, 1/16

Rationale

The correct answer is $\frac{1}{16}$. Let p and q represent the solutions to the given equation. Then, the given equation can be rewritten as $64(x - p)(x - q) = 0$, or $64x^2 - 64(p + q)x + pq = 0$. Since this equation is equivalent to the given equation, it follows that $-(16a + 4b) = -64(p + q)$. Dividing both sides of this equation by -64 yields $\frac{16a+4b}{64} = p + q$, or $\frac{1}{16}(4a + b) = p + q$. Therefore, the sum of the solutions to the given equation, $p + q$, is equal to $\frac{1}{16}(4a + b)$. Since it's given that the sum of the solutions to the given equation is $k(4a + b)$, where k is a constant, it follows that $k = \frac{1}{16}$. Note that $1/16$, $.0625$, 0.062 , and 0.063 are examples of ways to enter a correct answer.

Alternate approach: The given equation can be rewritten as $64x^2 - 4(4a + b)x + ab = 0$, where a and b are positive constants. Dividing both sides of this equation by 4 yields $16x^2 - (4a + b)x + \frac{ab}{4} = 0$. The solutions for a quadratic equation in the form $Ax^2 + Bx + C = 0$, where A , B , and C are constants, can be calculated using the quadratic formula, $x = \frac{-B + \sqrt{B^2 - 4AC}}{2A}$ and $x = \frac{-B - \sqrt{B^2 - 4AC}}{2A}$. It follows that the sum of the solutions to a quadratic equation in the form $Ax^2 + Bx + C = 0$ is $\frac{-B + \sqrt{B^2 - 4AC}}{2A} + \frac{-B - \sqrt{B^2 - 4AC}}{2A}$, which can be rewritten as $\frac{-B + -B + \sqrt{B^2 - 4AC} - \sqrt{B^2 - 4AC}}{2A}$, which is equivalent to $\frac{-2B}{2A}$, or $-\frac{B}{A}$. In the equation $16x^2 - (4a + b)x + \frac{ab}{4} = 0$, $A = 16$, $B = -(4a + b)$, and $C = \frac{ab}{4}$. Substituting 16 for A and $-(4a + b)$ for B in $-\frac{B}{A}$ yields $-\frac{-(4a+b)}{16}$, which can be rewritten as $\frac{1}{16}(4a + b)$. Thus, the sum of the solutions to the given equation is $\frac{1}{16}(4a + b)$. Since it's given that the sum of the solutions to the given equation is $k(4a + b)$, where k is a constant, it follows that $k = \frac{1}{16}$.

Question Difficulty:

Hard

Question ID c7789423

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #002B36; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> |

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 ca4ee54e

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #cccccc; height: 10px;"></div> <div style="width: 25%; background-color: #cccccc; height: 10px;"></div> |

ID: ca4ee54e

The graph shows the predicted value y , in dollars, of a certain sport utility vehicle x years after it is first purchased.



Which of the following is closest to the predicted value of the sport utility vehicle 3 years after it is first purchased?

- A. \$9,619
- B. \$13,632
- C. \$19,320
- D. \$23,000

ID: ca4ee54e Answer

Correct Answer:

B

Rationale

Choice B is correct. For the graph shown, the horizontal axis represents the number of years after a certain sport utility vehicle is first purchased, and the vertical axis represents the predicted value, in dollars, of the sport utility vehicle. According to the graph, 3 years after the sport utility vehicle is purchased, the predicted value of the sport utility vehicle is between \$10,000 and \$15,000. Of the given choices, only \$13,632 is between \$10,000 and \$15,000. Therefore, \$13,632 is closest to the predicted value of the sport utility vehicle 3 years after it is first purchased.

Choice A is incorrect. This is closest to the predicted value of the sport utility vehicle 5 years after it is first purchased.

Choice C is incorrect. This is closest to the predicted value of the sport utility vehicle 1 year after it is first purchased.

Choice D is incorrect. This is closest to the predicted value of the sport utility vehicle when it is first purchased.

Question Difficulty:

Easy

Question ID d9137a84

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 50%; background-color: #cccccc; height: 10px;"></div> |

ID: d9137a84

Which expression represents the product of $(x^{-6}y^3z^5)$ and $(x^4z^5 + y^8z^{-7})$?

- A. $x^{-2}z^{10} + y^{11}z^{-2}$
- B. $x^{-2}z^{10} + x^{-6}z^{-2}$
- C. $x^{-2}y^3z^{10} + y^8z^{-7}$
- D. $x^{-2}y^3z^{10} + x^{-6}y^{11}z^{-2}$

ID: d9137a84 Answer

Correct Answer:

D

Rationale

Choice D is correct. The product of $(x^{-6}y^3z^5)$ and $(x^4z^5 + y^8z^{-7})$ can be represented by the expression $(x^{-6}y^3z^5)(x^4z^5 + y^8z^{-7})$. Applying the distributive property to this expression yields $(x^{-6}y^3z^5)(x^4z^5) + (x^{-6}y^3z^5)(y^8z^{-7})$, or $x^{-6}x^4y^3z^5z^5 + x^{-6}y^3y^8z^5z^{-7}$. This expression is equivalent to $x^{-6+4}y^3z^{5+5} + x^{-6}y^{3+8}z^{5-7}$, or $x^{-2}y^3z^{10} + x^{-6}y^{11}z^{-2}$.

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:

Medium

Question ID 876a731c

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 876a731c

$$\begin{aligned}y &= x^2 \\2y + 6 &= 2(x + 3)\end{aligned}$$

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.

Question Difficulty:

Medium

Question ID cd358b89

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: cd358b89

Function f is defined by $f(x) = (x + 6)(x + 5)(x + 1)$. Function g is defined by $g(x) = f(x - 1)$. The graph of $y = g(x)$ in the xy -plane has x -intercepts at $(a, 0)$, $(b, 0)$, and $(c, 0)$, where a , b , and c are distinct constants. What is the value of $a + b + c$?

- A. -15
- B. -9
- C. 11
- D. 15

ID: cd358b89 Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that $g(x) = f(x - 1)$. Since $f(x) = (x + 6)(x + 5)(x + 1)$, it follows that $f(x - 1) = (x - 1 + 6)(x - 1 + 5)(x - 1 + 1)$. Combining like terms yields $f(x - 1) = (x + 5)(x + 4)(x)$. Therefore, $g(x) = x(x + 5)(x + 4)$. The x -intercepts of a graph in the xy -plane are the points where $y = 0$. The x -coordinates of the x -intercepts of the graph of $y = g(x)$ in the xy -plane can be found by solving the equation $0 = x(x + 5)(x + 4)$. Applying the zero product property to this equation yields three equations: $x = 0$, $x + 5 = 0$, and $x + 4 = 0$. Solving each of these equations for x yields $x = 0$, $x = -5$, and $x = -4$, respectively. Therefore, the x -intercepts of the graph of $y = g(x)$ are $(0, 0)$, $(-5, 0)$, and $(-4, 0)$. It follows that the values of a , b , and c are 0 , -5 , and -4 . Thus, the value of $a + b + c$ is $0 + (-5) + (-4)$, which is equal to -9 .

Choice A is incorrect. This is the value of $a + b + c$ if $g(x) = f(x + 1)$.

Choice C is incorrect. This is the value of $a + b + c - 1$ if $g(x) = (x - 6)(x - 5)(x - 1)$.

Choice D is incorrect. This is the value of $a + b + c$ if $f(x) = (x - 6)(x - 5)(x - 1)$.

Question Difficulty:

Hard

Question ID f89e1d6f

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: f89e1d6f

If $a = c + d$, which of the following is equivalent to the expression $x^2 - c^2 - 2cd - d^2$?

- A. $(x + a)^2$
- B. $(x - a)^2$
- C. $(x + a)(x - a)$
- D. $x^2 - ax - a^2$

ID: f89e1d6f Answer

Correct Answer:

C

Rationale

Choice C is correct. Factoring -1 from the second, third, and fourth terms gives $x^2 - c^2 - 2cd - d^2 = x^2 - (c^2 + 2cd + d^2)$. The expression $c^2 + 2cd + d^2$ is the expanded form of a perfect square: $c^2 + 2cd + d^2 = (c + d)^2$. Therefore, $x^2 - (c^2 + 2cd + d^2) = x^2 - (c + d)^2$. Since $a = c + d$, $x^2 - (c + d)^2 = x^2 - a^2$. Finally, because $x^2 - a^2$ is the difference of squares, it can be expanded as $x^2 - a^2 = (x + a)(x - a)$.

Choices A and B are incorrect and may be the result of making an error in factoring the difference of squares $x^2 - a^2$. Choice D is incorrect and may be the result of incorrectly combining terms.

Question Difficulty:

Hard

Question ID ff2e5c76

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #005a9f; height: 10px;"></div> |

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 $(\frac{40}{2})^2$, 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 $(20 + \sqrt{410}) + (20 - \sqrt{410})$, 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

Question ID c8bf5313

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #002B36; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> |

ID: c8bf5313

$$\begin{aligned}x &= 8 \\y &= x^2 + 8\end{aligned}$$

The graphs of the equations in the given system of equations intersect at the point (x, y) in the xy -plane. What is the value of y ?

- A. 8
- B. 24
- C. 64
- D. 72

ID: c8bf5313 Answer

Correct Answer:

D

Rationale

Choice D is correct. Since the graphs of the equations in the given system intersect at the point (x, y) , the point (x, y) represents a solution to the given system of equations. The first equation of the given system of equations states that $x = 8$. Substituting 8 for x in the second equation of the given system of equations yields $y = 8^2 + 8$, or $y = 72$. Therefore, the value of y is 72.

Choice A is incorrect. This is the value of x , not y .

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:

Easy

Question ID c1ead73

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: c1ead73

The function g is defined by $g(x) = |x + 18|$. What is the value of $g(4)$?

- A. -18
- B. -4
- C. 14
- D. 22

ID: c1ead73 Answer

Correct Answer:

D

Rationale

Choice D is correct. The value of $g(4)$ is the value of $g(x)$ when $x = 4$. Substituting 4 for x in the given equation yields $g(4) = |4 + 18|$, which is equivalent to $g(4) = |22|$, or $g(4) = 22$. Therefore, the value of $g(4)$ is 22.

Choice A is incorrect. This would be the value of $g(4)$ if function g was defined by $g(x) = -|18|$, not $g(x) = |x + 18|$.

Choice B is incorrect. This would be the value of $g(4)$ if function g was defined by $g(x) = -|x|$, not $g(x) = |x + 18|$.

Choice C is incorrect. This would be the value of $g(4)$ if function g was defined by $g(x) = |-x + 18|$, not $g(x) = |x + 18|$.

Question Difficulty:

Easy

Question ID df0ef054

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: df0ef054

$$(2x^3 + 3x)(x^3 - 2x)$$

Which of the following is equivalent to the expression above?

A. $x^3 + 5x$

B. $3x^3 + x$

C. $2x^6 - x^4 - 6x^2$

D. $3x^6 - x^4 - 6x^2$

ID: df0ef054 Answer

Correct Answer:

C

Rationale

Choice C is correct. Using the distributive property to multiply the terms in the parentheses yields $(2x^3 \cdot x^3) + (2x^3 \cdot -2x) + (3x \cdot x^3) + (3x \cdot -2x)$, which is equivalent to $2x^6 - 4x^4 + 3x^4 - 6x^2$. Combining like terms results in $2x^6 - x^4 - 6x^2$.

Choices A and D are incorrect and may result from conceptual errors when multiplying the terms in the given expression. Choice B is incorrect and may result from adding, instead of multiplying, $(2x^3 + 3x)$ and $(x^3 - 2x)$.

Question Difficulty:

Easy

Question ID f1c81b3b

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: f1c81b3b

The exponential function g is defined by $g(x) = 19 \cdot a^x$, where a is a positive constant. If $g(3) = 2,375$, what is the value of $g(4)$?

ID: f1c81b3b Answer

Correct Answer:

11875

Rationale

The correct answer is 11,875. It's given that the exponential function g is defined by $g(x) = 19 \cdot a^x$, where a is a positive constant, and $g(3) = 2,375$. It follows that when $x = 3$, $g(x) = 2,375$. Substituting 3 for x and 2,375 for $g(x)$ in the given equation yields $2,375 = 19 \cdot a^3$. Dividing each side of this equation by 19 yields $125 = a^3$. Taking the cube root of both sides of this equation gives $a = 5$. Substituting 4 for x and 5 for a in the equation $g(x) = 19 \cdot a^x$ yields $g(4) = 19 \cdot 5^4$, or $g(4) = 11,875$. Therefore, the value of $g(4)$ is 11,875.

Question Difficulty:

Medium

Question ID bef4b1c6

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 50%; background-color: #cccccc; height: 10px;"></div> |

ID: bef4b1c6

$$\frac{55}{x+6} = x$$

What is the positive solution to the given equation?

ID: bef4b1c6 Answer

Correct Answer:

5

Rationale

The correct answer is 5. Multiplying both sides of the given equation by $x + 6$ results in $55 = x(x + 6)$. Applying the distributive property of multiplication to the right-hand side of this equation results in $55 = x^2 + 6x$. Subtracting 55 from both sides of this equation results in $0 = x^2 + 6x - 55$. The right-hand side of this equation can be rewritten by factoring. The two values that multiply to -55 and add to 6 are 11 and -5 . It follows that the equation $0 = x^2 + 6x - 55$ can be rewritten as $0 = (x + 11)(x - 5)$. Setting each factor equal to 0 yields two equations: $x + 11 = 0$ and $x - 5 = 0$. Subtracting 11 from both sides of the equation $x + 11 = 0$ results in $x = -11$. Adding 5 to both sides of the equation $x - 5 = 0$ results in $x = 5$. Therefore, the positive solution to the given equation is 5.

Question Difficulty:

Medium

Question ID c19d1fb0

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: c19d1fb0

An egg is thrown from a rooftop. The equation $h = -4.9t^2 + 9t + 18$ represents this situation, where h is the height of the egg above the ground, in meters, t seconds after it is thrown. According to the equation, what is the height, in meters, from which the egg was thrown?

ID: c19d1fb0 Answer

Correct Answer:

18

Rationale

The correct answer is 18. It's given that an egg is thrown from a rooftop and that the equation $h = -4.9t^2 + 9t + 18$ represents this situation, where h is the height of the egg above the ground, in meters, t seconds after it is thrown. It follows that the height, in meters, from which the egg was thrown is the value of h when $t = 0$. Substituting 0 for t in the equation $h = -4.9t^2 + 9t + 18$ yields $h(0) = -4.9(0)^2 + 9(0) + 18$, or $h = 18$. Therefore, according to the equation, the height, in meters, from which the egg was thrown is 18.

Question Difficulty:

Medium

Question ID 3e9cc0c2

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #cccccc; height: 10px;"></div> |

ID: 3e9cc0c2

Which of the following is equivalent to $(1-p)(1+p+p^2+p^3+p^4+p^5+p^6)$?

- A. $1-p^8$
- B. $1-p^7$
- C. $1-p^6$
- D. $1-p^5$

ID: 3e9cc0c2 Answer

Correct Answer:

B

Rationale

Choice B is correct. Multiplying $(1 - p)$ by each term of the polynomial within the second pair of parentheses gives $(1 - p)1 = 1 - p$; $(1 - p)p = p - p^2$; $(1 - p)p^2 = p^2 - p^3$; $(1 - p)p^3 = p^3 - p^4$; $(1 - p)p^4 = p^4 - p^5$; $(1 - p)p^5 = p^5 - p^6$; and $(1 - p)p^6 = p^6 - p^7$. Adding these seven expressions together and combining like terms gives $1 + (p - p) + (p^2 - p^2) + (p^3 - p^3) + (p^4 - p^4) + (p^5 - p^5) + (p^6 - p^6) - p^7$, which can be simplified to $1 - p^7$.

Choices A, C, and D are incorrect and may result from incorrectly identifying the highest power of p in the expressions or incorrectly combining like terms.

Question Difficulty:

Medium

Question ID 2c5c22d0

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

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.

Question Difficulty:
Hard

Question ID f678483b

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: f678483b

A submersible device is used for ocean research. The function $g(x) = -\frac{1}{55}(x + 19)(x - 35)$ gives the depth below the surface of the ocean, in meters, of the submersible device x minutes after collecting a sample, where $x > 0$. How many minutes after collecting the sample did it take for the submersible device to reach the surface of the ocean?

ID: f678483b Answer

Correct Answer:

35

Rationale

The correct answer is **35**. It's given that the function $g(x) = -\frac{1}{55}(x + 19)(x - 35)$ gives the depth below the surface of the ocean, in meters, of the submersible device x minutes after collecting a sample, where $x > 0$. It follows that when the submersible device is at the surface of the ocean, the value of $g(x)$ is 0. Substituting 0 for $g(x)$ in the equation $g(x) = -\frac{1}{55}(x + 19)(x - 35)$ yields $0 = -\frac{1}{55}(x + 19)(x - 35)$. Multiplying both sides of this equation by -55 yields $0 = (x + 19)(x - 35)$. Since a product of two factors is equal to 0 if and only if at least one of the factors is 0, either $x + 19 = 0$ or $x - 35 = 0$. Subtracting 19 from both sides of the equation $x + 19 = 0$ yields $x = -19$. Adding 35 to both sides of the equation $x - 35 = 0$ yields $x = 35$. Since $x > 0$, 35 minutes after collecting the sample the submersible device reached the surface of the ocean.

Question Difficulty:

Hard

Question ID 7348f046

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 50%; background-color: #cccccc; height: 10px;"></div> |

ID: 7348f046

$$(2x + 3) - (x - 7)$$

Which of the following is equivalent to the given expression?

- A. $x - 4$
- B. $3x - 4$
- C. $x + 10$
- D. $2x^2 + 21$

ID: 7348f046 Answer

Correct Answer:

C

Rationale

Choice C is correct. Distributing the negative sign to the terms in the second parentheses yields $(2x + 3) - x + 7$. This expression can be rewritten as $2x - x + 3 + 7$. Combining like terms results in $x + 10$.

Choice A is incorrect and may result from not distributing the negative sign to the 7. Choice B is incorrect and may result from adding $(x - 7)$ to $2x + 3$ instead of subtracting $(x - 7)$. Choice D is incorrect and may result from adding the product of $2x$ and x to the product of 3 and 7.

Question Difficulty:

Medium

Question ID 0aaef7aa

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 60%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 0aaef7aa

The function p is defined by $p(n) = 7n^3$. What is the value of n when $p(n)$ is equal to 56?

- A. 2
- B. $\frac{8}{3}$
- C. 7
- D. 8

ID: 0aaef7aa Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that $p(n) = 7n^3$. Substituting 56 for $p(n)$ in this equation yields $56 = 7n^3$. Dividing each side of this equation by 7 yields $8 = n^3$. Taking the cube root of each side of this equation yields $2 = n$. Therefore, when $p(n)$ is equal to 56, the value of n is 2.

Choice B 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:

Medium

Question ID 928498f3

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 60%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 928498f3

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

What are the solutions to the given equation?

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

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

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

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

ID: 928498f3 Answer

Correct Answer:

A

Rationale

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Choice A is correct. The quadratic formula, $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$, 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

$$\frac{-5 \pm \sqrt{5^2 - 4(6)(-7)}}{2(6)} \text{, or } \frac{-5 \pm \sqrt{25 + 168}}{12}.$$

$$\frac{-a \pm \sqrt{b^2 - 4ac}}{2a}$$

Choice B is incorrect and may result from using the quadratic formula. Choice C is incorrect and may result

$$\frac{-b \pm \sqrt{a^2 + 4ac}}{2a}$$

$$\frac{-a \pm \sqrt{a^2 + 4ac}}{2a}$$

from using the quadratic formula. Choice D is incorrect and may result from using the quadratic formula.

Question Difficulty:

Medium

Question ID 26e83bbc

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 26e83bbc

$$\begin{aligned}f(x) &= x^2 + bx \\g(x) &= 9x^2 - 27x\end{aligned}$$

Functions f and g are given, and in function f , b is a constant. If $f(x) \cdot g(x) = 9x^4 - 26x^3 - 3x^2$, what is the value of b ?

- A. -26
- B. $-\frac{26}{9}$
- C. $\frac{1}{9}$
- D. 9

ID: 26e83bbc Answer

Correct Answer:

C

Rationale

Choice C is correct. Multiplying the given functions f and g yields $f(x) \cdot g(x) = (x^2 + bx)(9x^2 - 27x)$. Applying the distributive property to the right-hand side of this equation yields $f(x) \cdot g(x) = (x^2)(9x^2 - 27x) + (bx)(9x^2 - 27x)$.

Applying the distributive property once again to the right-hand side of this equation yields

$f(x) \cdot g(x) = (x^2)(9x^2) - (x^2)(27x) + (bx)(9x^2) - (bx)(27x)$, which is equivalent to

$f(x) \cdot g(x) = 9x^4 - 27x^3 + 9bx^3 - 27bx^2$. Factoring out x^3 from the second and third terms yields

$f(x) \cdot g(x) = 9x^4 + (-27 + 9b)x^3 - 27bx^2$. Since the left-hand sides of $f(x) \cdot g(x) = 9x^4 + (-27 + 9b)x^3 - 27bx^2$ and

$f(x) \cdot g(x) = 9x^4 - 26x^3 - 3x^2$ are equal, it follows that $(-27 + 9b)x^3 = -26x^3$, or $-27 + 9b = -26$, and

$-27bx^2 = -3x^2$, or $-27b = -3$. Adding 27 to each side of $-27 + 9b = -26$ yields $9b = 1$. Dividing each side of this

equation by 9 yields $b = \frac{1}{9}$. Similarly, dividing each side of $-27b = -3$ by -27 yields $b = \frac{1}{9}$. Therefore, the value of b is $\frac{1}{9}$.

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:

Medium

Question ID b7cd6ca6

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: b7cd6ca6

The equation $E(t) = 5(1.8)^t$ gives the estimated number of employees at a restaurant, where t is the number of years since the restaurant opened. Which of the following is the best interpretation of the number 5 in this context?

- A. The estimated number of employees when the restaurant opened
- B. The increase in the estimated number of employees each year
- C. The number of years the restaurant has been open
- D. The percent increase in the estimated number of employees each year

ID: b7cd6ca6 Answer

Correct Answer:

A

Rationale

Choice A is correct. For an exponential function of the form $E(t) = a(b)^t$, where a and b are constants, the initial value of the function—that is, the value of the function when $t = 0$ —is a and the value of the function increases by a factor of b each time t increases by 1. Since the function $E(t) = 5(1.8)^t$ gives the estimated number of employees at a restaurant and t is the number of years since the restaurant opened, the best interpretation of the number 5 in this context is the estimated number of employees when $t = 0$, or when the restaurant opened.

Choice B is incorrect and may result from conceptual errors.

Choice C is incorrect and may result from conceptual errors.

Choice D is incorrect and may result from conceptual errors.

Question Difficulty:

Medium

Question ID 04b985e6

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 04b985e6

The kinetic energy, in joules, of an object with mass **9** kilograms traveling at a speed of v meters per second is given by the function K , where $K(v) = \frac{9}{2}v^2$. Which of the following is the best interpretation of $K(34) = 5,202$ in this context?

- A. The object traveling at **34** meters per second has a kinetic energy of **5,202** joules.
- B. The object traveling at **340** meters per second has a kinetic energy of **5,202** joules.
- C. The object traveling at **5,202** meters per second has a kinetic energy of **34** joules.
- D. The object traveling at **23,409** meters per second has a kinetic energy of **34** joules.

ID: 04b985e6 Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that the kinetic energy, in joules, of an object with a mass of **9** kilograms traveling at a speed of v meters per second is given by the function K , where $K(v) = \frac{9}{2}v^2$. It follows that in the equation $K(34) = 5,202$, **34** is the value of v , or the speed of the object, in meters per second, and **5,202** is the kinetic energy, in joules, of the object at that speed. Therefore, the best interpretation of $K(34) = 5,202$ in this context is the object traveling at **34** meters per second has a kinetic energy of **5,202** joules.

Choice B is incorrect. The object traveling at **340** meters per second has a kinetic energy of **520,200** joules.

Choice C is incorrect. The object traveling at **5,202** meters per second has a kinetic energy of **121,773,618** joules.

Choice D is incorrect. The object traveling at **23,409** meters per second has a kinetic energy of **2,465,915,764.5** joules.

Question Difficulty:

Easy

Question ID b47419f4

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 60%; background-color: #e0e0e0; height: 10px;"></div> |

ID: b47419f4

$$\left(\frac{1}{2}x + 3\right) - \left(\frac{2}{3}x - 5\right)$$

Which of the following is equivalent to the expression above?

A. $-\frac{1}{6}x + 8$

B. $-\frac{1}{6}x - 2$

C. $-\frac{1}{3}x^2 + \frac{1}{2}x + 15$

D. $-\frac{1}{3}x^2 - \frac{9}{2}x - 15$

ID: b47419f4 Answer

Correct Answer:

A

Rationale

Choice A is correct. By distributing the minus sign through the expression $\left(\frac{2}{3}x - 5\right)$, the given expression can be rewritten as $\left(\frac{1}{2}x + 3\right) - \frac{2}{3}x + 5$, which is equivalent to $\frac{1}{2}x - \frac{2}{3}x + 3 + 5$. Combining like terms gives $\left(\frac{1}{2} - \frac{2}{3}\right)x + (3 + 5)$, or $-\frac{1}{6}x + 8$.

Choice B is incorrect and may be the result of failing to distribute the minus sign appropriately through the second term and simplifying the expression $\frac{1}{2}x + 3 - \frac{2}{3}x - 5$. Choice C is incorrect and may be the result of multiplying the expressions $\left(\frac{1}{2}x + 3\right)$ and $\left(-\frac{2}{3}x + 5\right)$. Choice D is incorrect and may be the result of multiplying the expressions $\left(\frac{1}{2}x + 3\right)$ and $\left(-\frac{2}{3}x - 5\right)$.

Question Difficulty:

Medium

Question ID fc3dfa26

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

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. $-\frac{1}{2}$

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

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

$$\frac{4x^2}{x^2-9} - \frac{2x^2-6x}{x^2-9} = \frac{x+3}{x^2-9}$$

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 $x = \frac{1}{2}$.

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

Question ID 8838a672

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: 8838a672

$$(4x^3 - 5x^2 + 3) - (6x^3 + 2x^2 - x)$$

Which of the following expressions is equivalent to the expression above?

- A. $-10x^3 - 3x^2 + x + 3$
- B. $-2x^3 - 7x^2 + x + 3$
- C. $-2x^3 - 3x^2 + x + 3$
- D. $10x^3 - 7x^2 - x + 3$

ID: 8838a672 Answer

Correct Answer:

B

Rationale

Choice B is correct. Using the distributive property, the given expression can be rewritten as $4x^3 - 5x^2 + 3 - 6x^3 - 2x^2 + x$. Combining like terms, this expression can be rewritten as $(4 - 6)x^3 + (-5 - 2)x^2 + x + 3$, which is equivalent to $-2x^3 - 7x^2 + x + 3$.

Choices A, C, and D are incorrect and may result from an error when applying the distributive property or an error when combining like terms.

Question Difficulty:

Medium

Question ID eb268057

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|---|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 75%; background-color: #cccccc; height: 10px;"></div> |

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

Question ID f76c1858

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: f76c1858

$$7x^2 - 20x - 32 = 0$$

What is the positive solution to the given equation?

ID: f76c1858 Answer

Correct Answer:

4

Rationale

The correct answer is 4. The left-hand side of the given equation can be factored as $(7x + 8)(x - 4)$. Therefore, the given equation, $7x^2 - 20x - 32 = 0$, can be written as $(7x + 8)(x - 4) = 0$. Applying the zero product property to this equation yields $7x + 8 = 0$ and $x - 4 = 0$. Subtracting 8 from both sides of the equation $7x + 8 = 0$ yields $7x = -8$. Dividing both sides of this equation by 7 yields $x = -\frac{8}{7}$. Adding 4 to both sides of the equation $x - 4 = 0$ yields $x = 4$. Therefore, the two solutions to the given equation, $7x^2 - 20x - 32 = 0$, are $-\frac{8}{7}$ and 4. It follows that 4 is the positive solution to the given equation.

Question Difficulty:

Medium

Question ID 6d9e01a2

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 6d9e01a2

$$f(x) = 4x^2 - 50x + 126$$

The given equation defines the function f . For what value of x does $f(x)$ reach its minimum?

ID: 6d9e01a2 Answer

Correct Answer:

25/4, 6.25

Rationale

The correct answer is $\frac{25}{4}$. The given equation can be rewritten in the form $f(x) = a(x - h)^2 + k$, where a , h , and k are constants. When $a > 0$, h is the value of x for which $f(x)$ reaches its minimum. The given equation can be rewritten as $f(x) = 4\left(x^2 - \frac{50}{4}x\right) + 126$, which is equivalent to $f(x) = 4\left(x^2 - \frac{50}{4}x + \left(\frac{50}{8}\right)^2 - \left(\frac{50}{8}\right)^2\right) + 126$. This equation can be rewritten as $f(x) = 4\left(\left(x - \frac{50}{8}\right)^2 - \left(\frac{50}{8}\right)^2\right) + 126$, or $f(x) = 4\left(x - \frac{50}{8}\right)^2 - 4\left(\frac{50}{8}\right)^2 + 126$, which is equivalent to $f(x) = 4\left(x - \frac{25}{4}\right)^2 - \frac{121}{4}$. Therefore, $h = \frac{25}{4}$, so the value of x for which $f(x)$ reaches its minimum is $\frac{25}{4}$. Note that 25/4 and 6.25 are examples of ways to enter a correct answer.

Question Difficulty:

Hard

Question ID 0af701e7

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 0af701e7

The function f is defined by $f(x) = |x - 4x|$. What value of a satisfies $f(5) - f(a) = -15$?

- A. **-20**
- B. **5**
- C. **10**
- D. **45**

ID: 0af701e7 Answer

Correct Answer:

C

Rationale

Choice C is correct. It's given that the function f is defined by $f(x) = |x - 4x|$. It's also given that $f(5) - f(a) = -15$. Substituting 5 for x in the function $f(x) = |x - 4x|$ yields $f(5) = |5 - 4(5)|$ and substituting a for x in the function $f(x) = |x - 4x|$ yields $f(a) = |a - 4a|$. Therefore, $f(5) = 15$ and $f(a) = |-3a|$. Substituting 15 for $f(5)$ and $|-3a|$ for $f(a)$ in the equation $f(5) - f(a) = -15$ yields $15 - |-3a| = -15$. Subtracting 15 from both sides of this equation yields $-|-3a| = -30$. Dividing both sides of this equation by -1 yields $|-3a| = 30$. By the definition of absolute value, if $|-3a| = 30$, then $-3a = 30$ or $-3a = -30$. Dividing both sides of each of these equations by -3 yields $a = -10$ or $a = 10$, respectively. Thus, of the given choices, a value of a that satisfies $f(5) - f(a) = -15$ is 10.

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:

Medium

Question ID 9f2ecade

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 9f2ecade

$$h(x) = x^3 + ax^2 + bx + c$$

The function h is defined above, where a , b , and c are integer constants. If the zeros of the function are -5 , 6 , and 7 , what is the value of c ?

ID: 9f2ecade Answer

Rationale

The correct answer is 210. Since -5 , 6 , and 7 are zeros of the function, the function can be rewritten as

$$h(x) = (x + 5)(x - 6)(x - 7)$$
. Expanding the function yields $h(x) = x^3 - 8x^2 - 23x + 210$. Thus, $a = -8$, $b = -23$, and $c = 210$.

Therefore, the value of c is 210.

Question Difficulty:

Hard

Question ID 2cf7f039

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 2cf7f039

The function f is defined by $f(x) = 8\sqrt{x}$. For what value of x does $f(x) = 48$?

- A. 6
- B. 8
- C. 36
- D. 64

ID: 2cf7f039 Answer

Correct Answer:

C

Rationale

Choice C is correct. It's given that $f(x) = 8\sqrt{x}$. Substituting 48 for $f(x)$ in this equation yields $48 = 8\sqrt{x}$. Dividing both sides of this equation by 8 yields $6 = \sqrt{x}$. This can be rewritten as $\sqrt{x} = 6$. Squaring both sides of this equation yields $x = 36$. Therefore, the value of x for which $f(x) = 48$ is 36.

Choice A is incorrect. If $x = 6$, $f(x) = 8\sqrt{6}$, not 48.

Choice B is incorrect. If $x = 8$, $f(x) = 8\sqrt{8}$, not 48.

Choice D is incorrect. If $x = 64$, $f(x) = 8\sqrt{64}$, which is equivalent to 64, not 48.

Question Difficulty:

Easy

Question ID 0b3d25c5

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 0b3d25c5

Which of the following is equivalent to

$$\sqrt[4]{x^2 + 8x + 16}, \text{ where } x > 0?$$

A. $(x+4)^4$

B. $(x+4)^2$

C. $(x+4)$

D. $(x+4)^{\frac{1}{2}}$

ID: 0b3d25c5 Answer

Correct Answer:

D

Rationale

$$(x^2 + 8x + 16)^{\frac{1}{4}}$$

Choice D is correct. The given expression can also be written as

. The trinomial $x^2 + 8x + 16$ can be rewritten in

$$((x+4)^2)^{\frac{1}{4}}$$

factored form as $(x+4)^2$. Thus, the entire expression can be rewritten as

$$(x+4)^{\frac{1}{2}}$$

. Simplifying the exponents yields

$$((x+4)^2)^{\frac{1}{4}}$$

Choices A, B, and C are incorrect and may result from errors made when simplifying the exponents in the expression

Question Difficulty:

Medium

Question ID 083ef63a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 083ef63a

$$f(x) = (x - 2)(x + 15)$$

The function f is defined by the given equation. For what value of x does $f(x)$ reach its minimum?

ID: 083ef63a Answer

Correct Answer:

-13/2, -6.5

Rationale

The correct answer is $-\frac{13}{2}$. The value of x for which $f(x)$ reaches its minimum can be found by rewriting the given equation in the form $f(x) = (x - h)^2 + k$, where $f(x)$ reaches its minimum, k , when the value of x is h . The given equation, $f(x) = (x - 2)(x + 15)$, can be rewritten as $f(x) = x^2 + 13x - 30$. By completing the square, this equation can be rewritten as $f(x) = \left(x^2 + 13x + \left(\frac{13}{2}\right)^2\right) - 30 - \left(\frac{13}{2}\right)^2$, which is equivalent to $f(x) = \left(x + \frac{13}{2}\right)^2 - \frac{289}{4}$, or $f(x) = \left(x - \left(-\frac{13}{2}\right)\right)^2 - \frac{289}{4}$. Therefore, $f(x)$ reaches its minimum when the value of x is $-\frac{13}{2}$. Note that -13/2 and -6.5 are examples of ways to enter a correct answer.

Alternate approach: The graph of $y = f(x)$ in the xy -plane is a parabola. The value of x for the vertex of a parabola is the x -value of the midpoint between the two x -intercepts of the parabola. Since it's given that $f(x) = (x - 2)(x + 15)$, it follows that the two x -intercepts of the graph of $y = f(x)$ in the xy -plane occur when $x = 2$ and $x = -15$, or at the points $(2, 0)$ and $(-15, 0)$. The midpoint between two points, (x_1, y_1) and (x_2, y_2) , is $\left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$. Therefore, the midpoint between $(2, 0)$ and $(-15, 0)$ is $\left(\frac{2-15}{2}, \frac{0+0}{2}\right)$, or $\left(-\frac{13}{2}, 0\right)$. It follows that $f(x)$ reaches its minimum when the value of x is $-\frac{13}{2}$. Note that -13/2 and -6.5 are examples of ways to enter a correct answer.

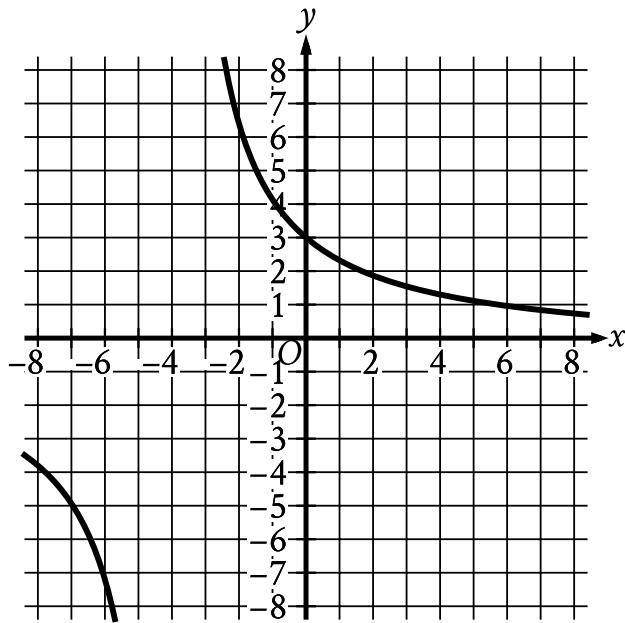
Question Difficulty:

Hard

Question ID d45572cc

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: d45572cc



The graph of $y = f(x)$ is shown in the xy -plane. The value of $f(0)$ is an integer. What is the value of $f(0)$?

ID: d45572cc Answer

Correct Answer:

3

Rationale

The correct answer is 3. The value of $f(0)$ is the value of y on the graph of $y = f(x)$ in the xy -plane that corresponds with $x = 0$. It's given that the value of $f(0)$ is an integer. For the graph of $y = f(x)$ shown, when $x = 0$, the corresponding integer value of y is 3. Therefore, the value of $f(0)$ is 3.

Question Difficulty:

Easy

Question ID 6011a3f8

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 6011a3f8

$$64x^2 + bx + 25 = 0$$

In the given equation, b is a constant. For which of the following values of b will the equation have more than one real solution?

- A. -91
- B. -80
- C. 5
- D. 40

ID: 6011a3f8 Answer

Correct Answer:

A

Rationale

Choice A is correct. A quadratic equation of the form $ax^2 + bx + c = 0$, where a , b , and c are constants, has either no real solutions, exactly one real solution, or exactly two real solutions. That is, for the given equation to have more than one real solution, it must have exactly two real solutions. When the value of the discriminant, or $b^2 - 4ac$, is greater than 0, the given equation has exactly two real solutions. In the given equation, $64x^2 + bx + 25 = 0$, $a = 64$ and $c = 25$. Therefore, the given equation has exactly two real solutions when $(b)^2 - 4(64)(25) > 0$, or $b^2 - 6,400 > 0$. Adding 6,400 to both sides of this inequality yields $b^2 > 6,400$. Taking the square root of both sides of $b^2 > 6,400$ yields two possible inequalities: $b < -80$ or $b > 80$. Of the choices, only choice A satisfies $b < -80$ or $b > 80$.

Choice B 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:

Hard

Question ID 0e61101e

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 0e61101e

$$f(x) = 9(4)^x$$

The function f is defined by the given equation. If $g(x) = f(x + 2)$, which of the following equations defines the function g ?

- A. $g(x) = 18(4)^x$
- B. $g(x) = 144(4)^x$
- C. $g(x) = 18(8)^x$
- D. $g(x) = 81(16)^x$

ID: 0e61101e Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that $f(x) = 9(4)^x$ and $g(x) = f(x + 2)$. Substituting $x + 2$ for x in $f(x) = 9(4)^x$ gives $f(x + 2) = 9(4)^{x+2}$. Rewriting this equation using properties of exponents gives $f(x + 2) = 9(4)^x(4)^2$, which is equivalent to $f(x + 2) = 9(4)^x(16)$. Multiplying 9 and 16 in this equation gives $f(x + 2) = 144(4)^x$. Since $g(x) = f(x + 2)$, $g(x) = 144(4)^x$.

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:

Hard

Question ID e117d3b8

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: e117d3b8

If a and c are positive numbers, which of the following is equivalent to $\sqrt{(a+c)^3} \cdot \sqrt{a+c}$?

- A. $a+c$
- B. a^2+c^2
- C. $a^2+2ac+c^2$
- D. a^2c^2

ID: e117d3b8 Answer

Correct Answer:

C

Rationale

Choice C is correct. Using the property that $\sqrt{x}\sqrt{y} = \sqrt{xy}$ for positive numbers x and y , with $x = (a+c)^3$ and $y = a+c$, it follows that $\sqrt{(a+c)^3} \cdot \sqrt{a+c} = \sqrt{(a+c)^4}$. By rewriting $(a+c)^4$ as $((a+c)^2)^2$, it is possible to simplify the square root expression as follows: $\sqrt{((a+c)^2)^2} = (a+c)^2 = a^2+2ac+c^2$.

Choice A is incorrect and may be the result of $\sqrt{(a+c)^3} \div \sqrt{(a+c)}$. Choice B is incorrect and may be the result of incorrectly rewriting $(a+c)^2$ as $a^2 + c^2$. Choice D is incorrect and may be the result of incorrectly applying properties of exponents.

Question Difficulty:

Hard

Question ID f44b4125

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: f44b4125

The functions f and g are defined by the given equations, where $x \geq 0$. Which of the following equations displays, as a constant or coefficient, the maximum value of the function it defines, where $x \geq 0$?

- I. $f(x) = 18(1.25)^x + 41$
- II. $g(x) = 9(0.73)^x$

- A. I only
- B. II only
- C. I and II
- D. Neither I nor II

ID: f44b4125 Answer

Correct Answer:

B

Rationale

Choice B is correct. For the function f , since the base of the exponent, 1.25 , is greater than 1 , the value of $(1.25)^x$ increases as x increases. Therefore, the value of $18(1.25)^x$ and the value of $18(1.25)^x + 41$ also increase as x increases. Since f is therefore an increasing function where $x \geq 0$, the function f has no maximum value. For the function g , since the base of the exponent, 0.73 , is less than 1 , the value of $(0.73)^x$ decreases as x increases. Therefore, the value of $9(0.73)^x$ also decreases as x increases. It follows that the maximum value of $g(x)$ for $x \geq 0$ occurs when $x = 0$. Substituting 0 for x in the function g yields $g(0) = 9(0.73)^0$, which is equivalent to $g(0) = 9(1)$, or $g(0) = 9$. Therefore, the maximum value of $g(x)$ for $x \geq 0$ is 9 , which appears as a coefficient in equation II. So, of the two equations given, only II displays, as a constant or coefficient, the maximum value of the function it defines, where $x \geq 0$.

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:

Hard

Question ID 7a6d06bf

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 7a6d06bf

A rectangle has an area of **155** square inches. The length of the rectangle is **4** inches less than **7** times the width of the rectangle. What is the width of the rectangle, in inches?

ID: 7a6d06bf Answer

Correct Answer:

5

Rationale

The correct answer is **5**. Let x represent the width, in inches, of the rectangle. It's given that the length of the rectangle is **4** inches less than **7** times its width, or $7x - 4$ inches. The area of a rectangle is equal to its width multiplied by its length. Multiplying the width, x inches, by the length, $7x - 4$ inches, yields $x(7x - 4)$ square inches. It's given that the rectangle has an area of **155** square inches, so it follows that $x(7x - 4) = 155$, or $7x^2 - 4x = 155$. Subtracting **155** from both sides of this equation yields $7x^2 - 4x - 155 = 0$. Factoring the left-hand side of this equation yields $(7x + 31)(x - 5) = 0$. Applying the zero product property to this equation yields two solutions: $x = -\frac{31}{7}$ and $x = 5$. Since x is the rectangle's width, in inches, which must be positive, the value of x is **5**. Therefore, the width of the rectangle, in inches, is **5**.

Question Difficulty:

Hard

Question ID 04bbce67

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 04bbce67

$$f(x) = (x + 7)^2 + 4$$

The function f is defined by the given equation. For what value of x does $f(x)$ reach its minimum?

ID: 04bbce67 Answer

Correct Answer:

-7

Rationale

The correct answer is -7 . For a quadratic function defined by an equation of the form $f(x) = a(x - h)^2 + k$, where a , h , and k are constants and $a > 0$, the function reaches its minimum when $x = h$. In the given function, $a = 1$, $h = -7$, and $k = 4$. Therefore, the value of x for which $f(x)$ reaches its minimum is -7 .

Question Difficulty:

Hard

Question ID 4880eecb

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 4880eecb

The product of a positive number x and the number that is 8 more than x is 180. What is the value of x ?

- A. 5
- B. 10
- C. 18
- D. 36

ID: 4880eecb Answer

Correct Answer:

B

Rationale

Choice B is correct. The number that's 8 more than x can be represented by the expression $x + 8$. It's given that the product of x and $x + 8$ is 180, so it follows that $(x)(x + 8) = 180$, or $x^2 + 8x = 180$. Subtracting 180 from each side of this equation yields $x^2 + 8x - 180 = 0$. Factoring the left-hand side of this equation yields $(x - 10)(x + 18) = 0$. Applying the zero product property to this equation yields two solutions: $x = 10$ and $x = -18$. Since x is a positive number, the value of x is 10.

Choice A is incorrect. If $x = 5$, the product of x and the number that's 8 more than x would be $(5)(13)$, or 65, not 180.

Choice C is incorrect. This is the value of the number that's 8 more than x , not the value of x .

Choice D is incorrect. If $x = 36$, the product of x and the number that's 8 more than x would be $(36)(44)$, or 1,584, not 180.

Question Difficulty:

Medium

Question ID e8779461

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: e8779461

$$y = x^2 + 14x + 48$$

$$x + 8 = 11$$

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

ID: e8779461 Answer

Correct Answer:

99

Rationale

The correct answer is 99. In the given system of equations, the second equation is $x + 8 = 11$. Subtracting 8 from both sides of this equation yields $x = 3$. In the given system of equations, the first equation is $y = x^2 + 14x + 48$. Substituting 3 for x in this equation yields $y = (3)^2 + 14(3) + 48$, or $y = 99$. Therefore, the solution to the given system of equations is $(x, y) = (3, 99)$. Thus, the value of y is 99.

Question Difficulty:

Medium

Question ID 50338a48

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|---|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 75%; background-color: #cccccc; height: 10px;"></div> |

ID: 50338a48

Which expression is equivalent to $15w^2 + 8w$?

- A. $w(15w + 8)$
- B. $8w(15w + 1)$
- C. $15w^2(8w + 1)$
- D. $23(w^2 + w)$

ID: 50338a48 Answer

Correct Answer:

A

Rationale

Choice A is correct. Since each term of the given expression has a common factor of w , it may be rewritten as $w(15w + 8)$. Therefore, the expression $w(15w + 8)$ is equivalent to $15w^2 + 8w$.

Choice B is incorrect. This expression is equivalent to $120w^2 + 8w$, not $15w^2 + 8w$.

Choice C is incorrect. This expression is equivalent to $120w^3 + 15w^2$, not $15w^2 + 8w$.

Choice D is incorrect. This expression is equivalent to $23w^2 + 23w$, not $15w^2 + 8w$.

Question Difficulty:

Easy

Question ID 98f735f2

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|---|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 75%; background-color: #cccccc; height: 10px;"></div> |

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. $Q = \frac{P}{T}$

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

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 $\frac{T}{P} = Q$, or $Q = \frac{T}{P}$. Therefore, $Q = \frac{T}{P}$ 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

Question ID 79ba511a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 79ba511a

The function f is defined by $f(x) = x^3 + 15$. What is the value of $f(2)$?

- A. 20
- B. 21
- C. 23
- D. 24

ID: 79ba511a Answer

Correct Answer:

C

Rationale

Choice C is correct. The value of $f(2)$ is the value of $f(x)$ when $x = 2$. Substituting 2 for x in the given function yields $f(2) = (2)^3 + 15$, or $f(2) = 8 + 15$, which is equivalent to $f(2) = 23$. Therefore, the value of $f(2)$ is 23.

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

Choice B is incorrect. This is the value of $f(2)$ when $f(x) = x(3) + 15$, rather than $f(x) = x^3 + 15$.

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

Question Difficulty:

Easy

Question ID dcf63c94

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: dcf63c94

$$f(x) = 272(2)^x$$

The function f is defined by the given equation. If $h(x) = f(x - 4)$, which of the following equations defines function h ?

- A. $h(x) = 17(2)^x$
- B. $h(x) = 68(2)^x$
- C. $h(x) = 272(16)^x$
- D. $h(x) = 272(8)^x$

ID: dcf63c94 Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that $f(x) = 272(2)^x$ and $h(x) = f(x - 4)$. Substituting $x - 4$ for x in $f(x) = 272(2)^x$ yields $f(x - 4) = 272(2)^{x-4}$. Substituting $h(x)$ for $f(x - 4)$ in this equation yields $h(x) = 272(2)^{x-4}$. Using the properties of exponents, the function $h(x) = 272(2)^{x-4}$ can be rewritten as $h(x) = \frac{272(2)^x}{2^4}$, which is equivalent to $h(x) = \frac{272(2)^x}{16}$, or $h(x) = 17(2)^x$. Therefore, of the given choices, an equation that defines function h is $h(x) = 17(2)^x$.

Choice B is incorrect. This equation defines function h if $h(x) = f(x - 2)$, not $h(x) = f(x - 4)$.

Choice C is incorrect. This equation defines function h if $h(x) = f(4x)$, not $h(x) = f(x - 4)$.

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

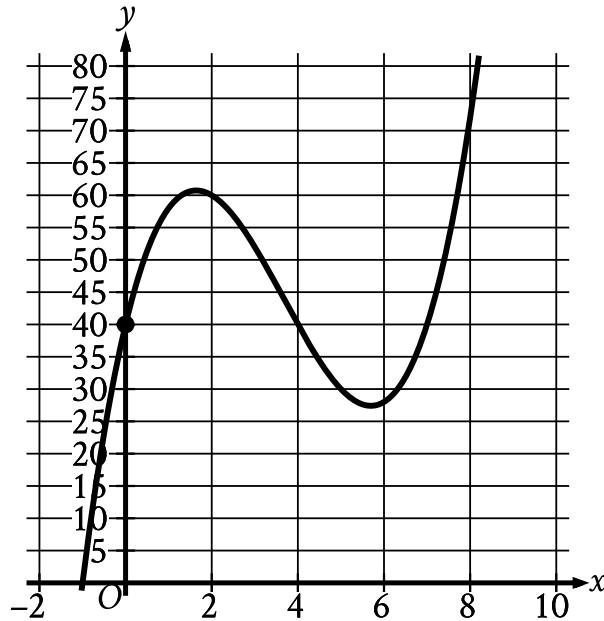
Question Difficulty:

Hard

Question ID 26f5269a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #e0e0e0;"></div> <div style="width: 25%; background-color: #e0e0e0;"></div> |

ID: 26f5269a



The y -intercept of the graph shown is (x, y) . What is the value of y ?

ID: 26f5269a Answer

Correct Answer:

40

Rationale

The correct answer is 40. The y -intercept of a graph in the xy -plane is the point (x, y) on the graph where $x = 0$. The y -intercept of the graph shown is $(0, 40)$. Therefore, the value of y is 40.

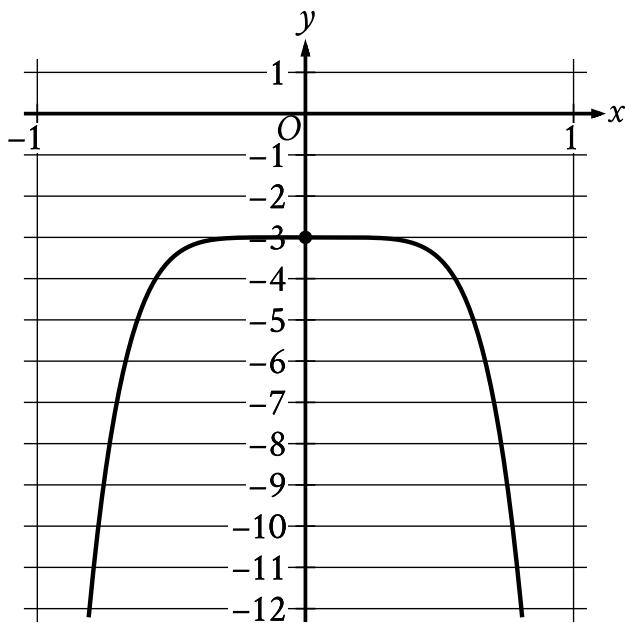
Question Difficulty:

Easy

Question ID 50418728

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 50418728



The graph of the polynomial function f , where $y = f(x)$, is shown. The y -intercept of the graph is $(0, y)$. What is the value of y ?

ID: 50418728 Answer

Correct Answer:

-3

Rationale

The correct answer is -3 . The y -intercept of the graph of a function in the xy -plane is the point where the graph crosses the y -axis. The graph of the polynomial function shown crosses the y -axis at the point $(0, -3)$. It's given that the y -intercept of the graph is $(0, y)$. Thus, the value of y is -3 .

Question Difficulty:

Easy

Question ID 9cb9beec

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 9cb9beec

$$\begin{aligned}y &= -1.5 \\y &= x^2 + 8x + a\end{aligned}$$

In the given system of equations, a is a positive constant. The system has exactly one distinct real solution. What is the value of a ?

ID: 9cb9beec Answer

Correct Answer:

14.5, 29/2

Rationale

The correct answer is $\frac{29}{2}$. According to the first equation in the given system, the value of y is -1.5 . Substituting -1.5 for y in the second equation in the given system yields $-1.5 = x^2 + 8x + a$. Adding 1.5 to both sides of this equation yields $0 = x^2 + 8x + a + 1.5$. If the given system has exactly one distinct real solution, it follows that $0 = x^2 + 8x + a + 1.5$ has exactly one distinct real solution. A quadratic equation in the form $0 = px^2 + qx + r$, where p , q , and r are constants, has exactly one distinct real solution if and only if the discriminant, $q^2 - 4pr$, is equal to 0 . The equation $0 = x^2 + 8x + a + 1.5$ is in this form, where $p = 1$, $q = 8$, and $r = a + 1.5$. Therefore, the discriminant of the equation $0 = x^2 + 8x + a + 1.5$ is $(8)^2 - 4(1)(a + 1.5)$, or $58 - 4a$. Setting the discriminant equal to 0 to solve for a yields $58 - 4a = 0$. Adding $4a$ to both sides of this equation yields $58 = 4a$. Dividing both sides of this equation by 4 yields $\frac{58}{4} = a$, or $\frac{29}{2} = a$. Therefore, if the given system of equations has exactly one distinct real solution, the value of a is $\frac{29}{2}$. Note that $29/2$ and 14.5 are examples of ways to enter a correct answer.

Question Difficulty:

Hard

Question ID f5e8ccf1

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 60%; background-color: #cccccc; height: 10px;"></div> |

ID: f5e8ccf1

$$f(x) = (x+4)(x-1)(2x-3)$$

The function f is defined above. Which of the following is NOT an x -intercept of the graph of the function in the xy -plane?

- A. $(-4, 0)$
- B. $\left(-\frac{2}{3}, 0\right)$
- C. $(1, 0)$
- D. $\left(\frac{3}{2}, 0\right)$

ID: f5e8ccf1 Answer

Correct Answer:

B

Rationale

Choice B is correct. The graph of the function f in the xy -plane has x -intercepts at the points (x, y) , where $y = f(x) = 0$. Substituting 0 for $f(x)$ in the given equation yields $0 = (x+4)(x-1)(2x-3)$. By the zero product property, if $0 = (x+4)(x-1)(2x-3)$, then $x+4 = 0$, $x-1 = 0$, or $2x-3 = 0$. Solving each of these linear equations for x , it follows that $x = -4$, $x = 1$, and $x = \frac{3}{2}$, respectively. This means that the graph of the function f in the xy -plane has three x -intercepts: $(-4, 0)$, $(1, 0)$, and $\left(\frac{3}{2}, 0\right)$. Therefore, $\left(-\frac{2}{3}, 0\right)$ isn't an x -intercept of the graph of the function f .

Alternate approach: Substitution may be used. Since by definition an x -intercept of any graph is a point in the form $(k, 0)$ where k is a constant, and since all points in the options are in this form, it need only be checked whether the points in the options lie on the graph of the function f . Substituting $-\frac{2}{3}$ for x and 0 for $f(x)$ in the given equation yields $0 = \left(-\frac{2}{3} + 4\right)\left(-\frac{2}{3} - 1\right)\left(2\left(-\frac{2}{3}\right) - 3\right)$, or $0 = \frac{650}{27}$. Therefore, the point $\left(-\frac{2}{3}, 0\right)$ doesn't lie on the graph of the function f and can't be an x -intercept of the graph.

Choices A, C, and D are incorrect because each of these points is an x -intercept of the graph of the function f in the xy -plane. By definition, an x -intercept is a point on the graph of the form $(k, 0)$, where k is a constant. Substituting -4 for x and 0 for $f(x)$ in the given equation yields $0 = (-4+4)(-4-1)(2(-4)-3)$, or $0 = 0$. Since this is a true statement, the point $(-4, 0)$ lies on the graph.

of the function f and is an x -intercept of the graph. Performing similar substitution using the points $(1, 0)$ and $\left(\frac{3}{2}, 0\right)$ also yields the true statement $0 = 0$, illustrating that these points also lie on the graph of the function f and are x -intercepts of the graph.

Question Difficulty:

Medium

Question ID 127b2759

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 127b2759

Which expression is equivalent to $8 + d^2 + 3$?

- A. $d^2 + 24$
- B. $d^2 + 11$
- C. $d^2 + 5$
- D. $d^2 - 11$

ID: 127b2759 Answer

Correct Answer:

B

Rationale

Choice B is correct. The given expression can be rewritten as $d^2 + 8 + 3$. Adding 8 and 3 in this expression yields $d^2 + 11$.

Choice A is incorrect. This expression is equivalent to $d^2 + 8(3)$.

Choice C is incorrect. This expression is equivalent to $8 + d^2 - 3$.

Choice D is incorrect. This expression is equivalent to $-8 + d^2 - 3$.

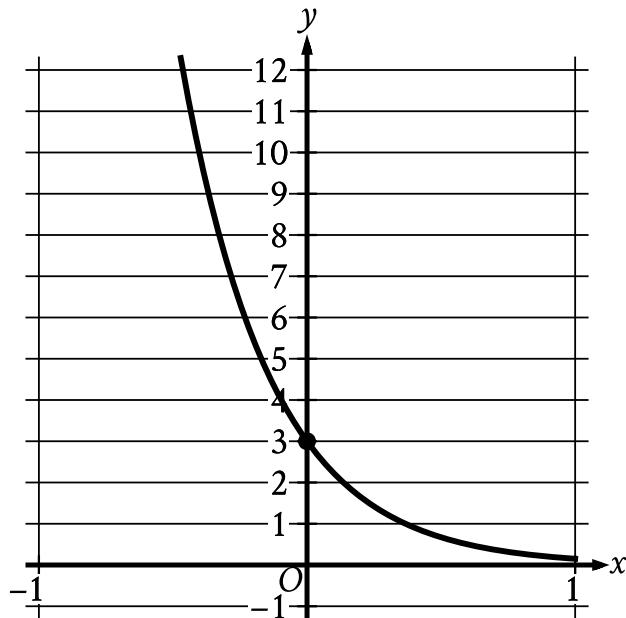
Question Difficulty:

Easy

Question ID 02c67921

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 02c67921



The graph of the exponential function f is shown, where $y = f(x)$. The y -intercept of the graph is $(0, y)$. What is the value of y ?

ID: 02c67921 Answer

Correct Answer:

3

Rationale

The correct answer is 3. It's given that the y -intercept of the graph shown is $(0, y)$. The graph passes through the point $(0, 3)$. Therefore, the value of y is 3.

Question Difficulty:

Easy

Question ID 2b1a27cd

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 60%; background-color: #0056b3; height: 10px;"></div> |

ID: 2b1a27cd

The quadratic function g models the depth, in meters, below the surface of the water of a seal t minutes after the seal entered the water during a dive. The function estimates that the seal reached its maximum depth of **302.4** meters **6** minutes after it entered the water and then reached the surface of the water **12** minutes after it entered the water. Based on the function, what was the estimated depth, to the nearest meter, of the seal **10** minutes after it entered the water?

ID: 2b1a27cd Answer

Correct Answer:

168

Rationale

The correct answer is **168**. The quadratic function g gives the estimated depth of the seal, $g(t)$, in meters, t minutes after the seal enters the water. It's given that function g estimates that the seal reached its maximum depth of **302.4** meters **6** minutes after it entered the water. Therefore, function g can be expressed in vertex form as $g(t) = a(t - 6)^2 + 302.4$, where a is a constant. Since it's also given that the seal reached the surface of the water after **12** minutes, $g(12) = 0$. Substituting **12** for t and **0** for $g(t)$ in $g(t) = a(t - 6)^2 + 302.4$ yields $0 = a(12 - 6)^2 + 302.4$, or $36a = -302.4$. Dividing both sides of this equation by **36** gives $a = -8.4$. Substituting **-8.4** for a in $g(t) = a(t - 6)^2 + 302.4$ gives $g(t) = -8.4(t - 6)^2 + 302.4$. Substituting **10** for t in $g(t)$ gives $g(10) = -8.4(10 - 6)^2 + 302.4$, which is equivalent to $g(10) = -8.4(4)^2 + 302.4$, or $g(10) = 168$. Therefore, the estimated depth, to the nearest meter, of the seal **10** minutes after it entered the water was **168** meters.

Question Difficulty:

Hard

Question ID 1073d70c

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 1073d70c

At the time that an article was first featured on the home page of a news website, there were **40** comments on the article. An exponential model estimates that at the end of each hour after the article was first featured on the home page, the number of comments on the article had increased by **190%** of the number of comments on the article at the end of the previous hour. Which of the following equations best represents this model, where C is the estimated number of comments on the article t hours after the article was first featured on the home page and $t \leq 4$?

- A. $C = 40(1.19)^t$
- B. $C = 40(1.9)^t$
- C. $C = 40(19)^t$
- D. $C = 40(2.9)^t$

ID: 1073d70c Answer

Correct Answer:

D

Rationale

Choice D is correct. It's given that an exponential model estimates that the number of comments on an article increased by a fixed percentage at the end of each hour. Therefore, the model can be represented by an exponential equation of the form $C = Ka^t$, where C is the estimated number of comments on the article t hours after the article was first featured on the home page and K and a are constants. It's also given that when the article was first featured on the home page of the news website, there were **40** comments on the article. This means that when $t = 0$, $C = 40$. Substituting **0** for t and **40** for C in the equation $C = Ka^t$ yields $40 = Ka^0$, or $40 = K$. It's also given that the number of comments on the article at the end of an hour had increased by **190%** of the number of comments on the article at the end of the previous hour. Multiplying the percent increase by the number of comments on the article at the end of the previous hour yields the number of estimated additional comments the article has on its home page: $(40) \left(\frac{190}{100}\right)$, or **76** comments. Thus, the estimated number of comments for the following hour is the sum of the comments from the end of the previous hour and the number of additional comments, which is **40 + 76**, or **116**. This means that when $t = 1$, $C = 116$. Substituting **1** for t , **116** for C , and **40** for K in the equation $C = Ka^t$ yields $116 = 40a^1$, or $116 = 40a$. Dividing both sides of this equation by **40** yields $2.9 = a$. Substituting **40** for K and **2.9** for a in the equation $C = Ka^t$ yields $C = 40(2.9)^t$. Thus, the equation that best represents this model is $C = 40(2.9)^t$.

Choice A is incorrect. This model represents a situation where the number of comments at the end of each hour increased by **19%** of the number of comments at the end of the previous hour, rather than **190%**.

Choice B is incorrect. This model represents a situation where the number of comments at the end of each hour increased by **90%** of the number of comments at the end of the previous hour, rather than **190%**.

Choice C is incorrect. This model represents a situation where the number of comments at the end of each hour was **19** times the number of comments at the end of the previous hour, rather than increasing by **190%** of the number of comments at the end of the previous hour.

Question Difficulty:

Hard

Question ID fb96a5b3

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|---|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 75%; background-color: #cccccc; height: 10px;"></div> |

ID: fb96a5b3

Which of the following expressions is equivalent to $2(ab - 3) + 2$?

- A. $2ab - 1$
- B. $2ab - 4$
- C. $2ab - 5$
- D. $2ab - 8$

ID: fb96a5b3 Answer

Correct Answer:

B

Rationale

Choice B is correct. Applying the distributive property to the given expression yields $2(ab) + 2(-3) + 2$, or $2ab - 6 + 2$. Adding the like terms -6 and 2 results in the expression $2ab - 4$.

Choice A is incorrect and may result from multiplying ab by 2 without multiplying -3 by 2 when applying the distributive property. Choices C and D are incorrect and may result from computational or conceptual errors.

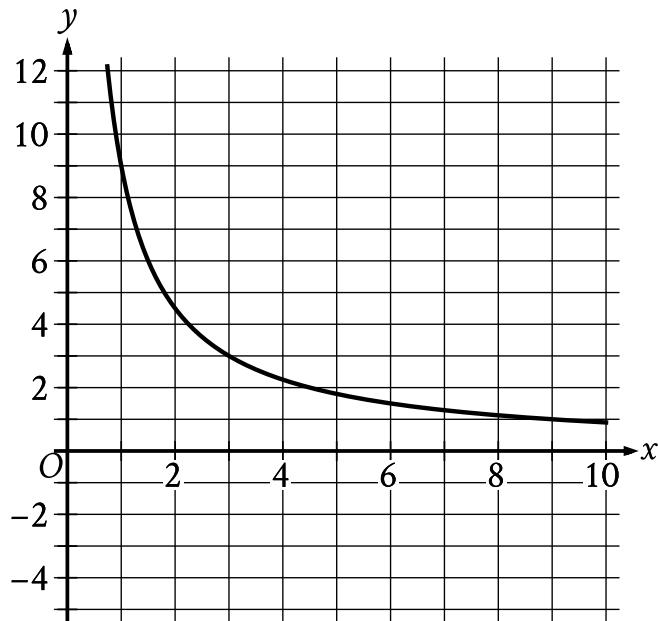
Question Difficulty:

Easy

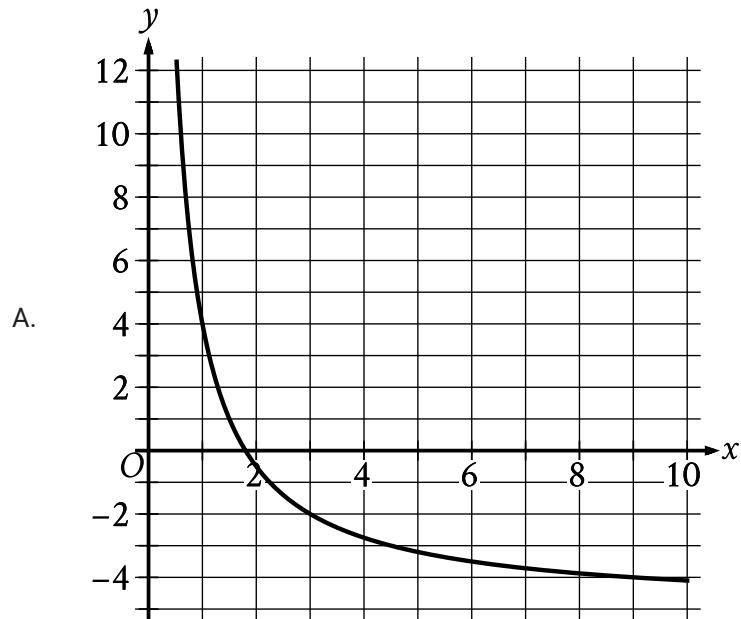
Question ID aa95fb33

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 60%; background-color: #e0e0e0; height: 10px;"></div> |

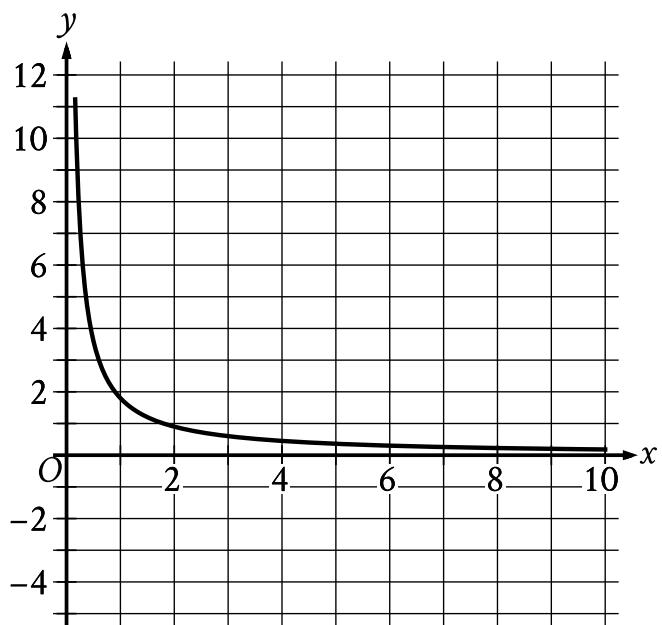
ID: aa95fb33



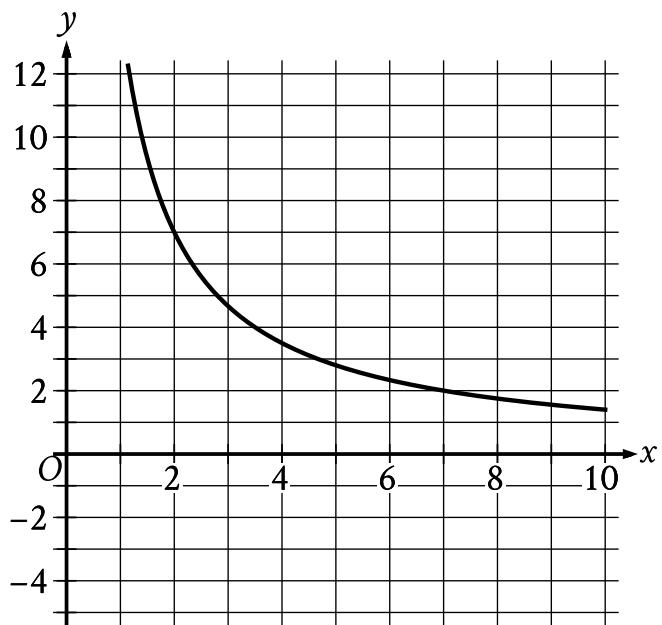
The graph of the rational function f is shown, where $y = f(x)$ and $x \geq 0$. Which of the following is the graph of $y = f(x) + 5$, where $x \geq 0$?



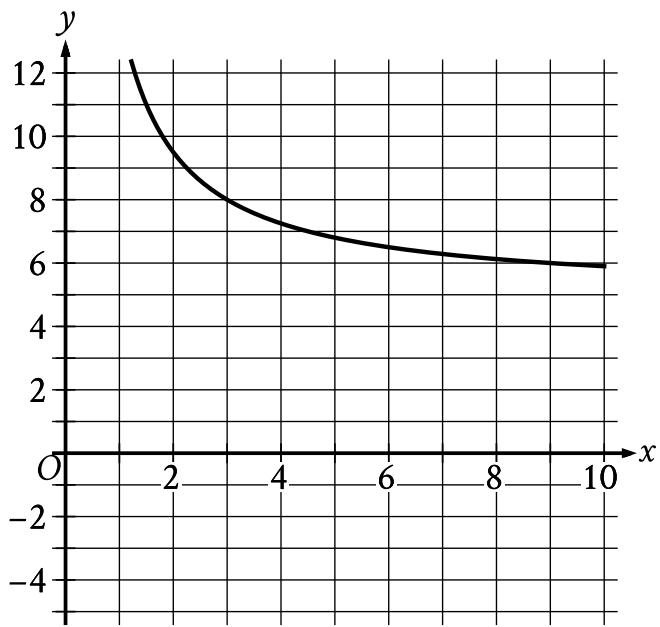
B.



C.



D.



ID: aa95fb33 Answer

Correct Answer:

D

Rationale

Choice D is correct. It's given that the graph of the rational function f is shown, where $y = f(x)$ and $x \geq 0$. The graph shown passes through the point $(3, 3)$. It follows that when the value of x is 3, the value of $f(x)$ is 3. When the value of $f(x)$ is 3, the value of $f(x) + 5$ is $3 + 5$, or 8. Therefore, the graph of $y = f(x) + 5$ passes through the point $(3, 8)$. Of the given choices, choice D is the only graph that passes through the point $(3, 8)$ and is therefore the graph of $y = f(x) + 5$.

Choice A is incorrect. This is the graph of $y = f(x) - 5$, rather than $y = f(x) + 5$.

Choice B is incorrect. This is the graph of $y = \frac{f(x)}{5}$, rather than $y = f(x) + 5$.

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

Question Difficulty:

Medium

Question ID 09e5e4d3

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 09e5e4d3

If $\frac{42}{x} = 7x$, what is the value of $7x^2$?

- A. 6
- B. 7
- C. 42
- D. 294

ID: 09e5e4d3 Answer

Correct Answer:

C

Rationale

Choice C is correct. Multiplying both sides of the given equation by x yields $42 = 7x^2$. Therefore, the value of $7x^2$ is 42.

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:

Medium

Question ID 1fe10d97

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 1fe10d97

$$p(t) = 90,000(1.06)^t$$

The given function p models the population of Lowell t years after a census. Which of the following functions best models the population of Lowell m months after the census?

- A. $r(m) = \frac{90,000}{12}(1.06)^m$
- B. $r(m) = 90,000\left(\frac{1.06}{12}\right)^m$
- C. $r(m) = 90,000\left(\frac{1.06}{12}\right)^{\frac{m}{12}}$
- D. $r(m) = 90,000(1.06)^{\frac{m}{12}}$

ID: 1fe10d97 Answer

Correct Answer:

D

Rationale

Choice D is correct. It's given that the function p models the population of Lowell t years after a census. Since there are 12 months in a year, m months after the census is equivalent to $\frac{m}{12}$ years after the census. Substituting $\frac{m}{12}$ for t in the equation $p(t) = 90,000(1.06)^t$ yields $p\left(\frac{m}{12}\right) = 90,000(1.06)^{\frac{m}{12}}$. Therefore, the function r that best models the population of Lowell m months after the census is $r(m) = 90,000(1.06)^{\frac{m}{12}}$.

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

Question ID 6acdcece

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 20%; background-color: #003366; height: 10px;"></div> <div style="width: 20%; background-color: #006699; height: 10px;"></div> <div style="width: 60%; background-color: #CCCCCC; height: 10px;"></div> |

ID: 6acdcece

$$b - 72 = \frac{x}{y}$$

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

- A. $x = \frac{b-72}{y}$
- B. $x = by - 72$
- C. $x = \frac{by-72}{y}$
- D. $x = by - 72y$

ID: 6acdcece Answer

Correct Answer:

D

Rationale

Choice D is correct. Multiplying both sides of the given equation by y yields $y(b - 72) = x$. Distributing on the left-hand side of this equation yields $by - 72y = x$, or $x = by - 72y$. Therefore, the equation $x = by - 72y$ correctly expresses x in terms of b and y .

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:

Medium

Question ID 7355b9d9

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 7355b9d9

If $k - x$ is a factor of the expression $-x^2 + \frac{1}{29}nk^2$, where n and k are constants and $k > 0$, what is the value of n ?

- A. -29
- B. $-\frac{1}{29}$
- C. $\frac{1}{29}$
- D. 29

ID: 7355b9d9 Answer

Correct Answer:

D

Rationale

Choice D is correct. If $k - x$ is a factor of the expression $-x^2 + (\frac{1}{29})nk^2$, then the expression can be written as $(k - x)(ax + b)$, where a and b are constants. This expression can be rewritten as $akx + bk - ax^2 - bx$, or $-ax^2 + (ak - b)x + bk$. Since this expression is equivalent to $-x^2 + (\frac{1}{29})nk^2$, it follows that $-a = -1$, $ak - b = 0$, and $bk = (\frac{1}{29})nk^2$. Dividing each side of the equation $-a = -1$ by -1 yields $a = 1$. Substituting 1 for a in the equation $ak - b = 0$ yields $k - b = 0$. Adding b to each side of this equation yields $k = b$. Substituting k for b in the equation $bk = (\frac{1}{29})nk^2$ yields $k^2 = (\frac{1}{29})nk^2$. Since k is positive, dividing each side of this equation by k^2 yields $1 = (\frac{1}{29})n$. Multiplying each side of this equation by 29 yields $29 = n$.

Alternate approach: The expression $x^2 - y^2$ can be written as $(x - y)(x + y)$, which is a difference of two squares. It follows that $(\frac{1}{29})nk^2 - x^2$ is equivalent to $\left(\left(\sqrt{\frac{1}{29}}n\right)k - x\right)\left(\left(\sqrt{\frac{1}{29}}n\right)k + x\right)$. It's given that $k - x$ is a factor of $-x^2 + (\frac{1}{29})nk^2$, so the factor $\left(\sqrt{\frac{1}{29}}n\right)k - x$ is equal to $k - x$. Adding x to both sides of the equation $\left(\sqrt{\frac{1}{29}}n\right)k - x = k - x$ yields $\left(\sqrt{\frac{1}{29}}n\right)k = k$. Since k is positive, dividing both sides of this equation by k yields $\sqrt{\frac{1}{29}}n = 1$. Squaring both sides of this equation yields $\frac{1}{29}n = 1$. Multiplying both sides of this equation by 29 yields $n = 29$.

Choice A is incorrect. This value of n gives the expression $-x^2 + (\frac{1}{29})(-29)k^2$, or $-x^2 - k^2$. This expression doesn't have $k - x$ as a factor.

Choice B is incorrect. This value of n gives the expression $-x^2 + (\frac{1}{29})(-\frac{1}{29})k^2$, or $-x^2 + (-\frac{1}{841})k^2$. This expression doesn't have $k - x$ as a factor.

Choice C is incorrect. This value of n gives the expression $-x^2 + (\frac{1}{29})(\frac{1}{29})k^2$, or $-x^2 + (\frac{1}{841})k^2$. This expression doesn't have $k - x$ as a factor.

Question Difficulty:

Hard

Question ID b73ee6cf

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: b73ee6cf

The population of a town is currently 50,000, and the population is estimated to increase each year by 3% from the previous year. Which of the following equations can be used to estimate the number of years, t , it will take for the population of the town to reach 60,000?

- A. $50,000 = 60,000(0.03)^t$
- B. $50,000 = 60,000(3)^t$
- C. $60,000 = 50,000(0.03)^t$
- D. $60,000 = 50,000(1.03)^t$

ID: b73ee6cf Answer

Correct Answer:

D

Rationale

Choice D is correct. Stating that the population will increase each year by 3% from the previous year is equivalent to saying that the population each year will be 103% of the population the year before. Since the initial population is 50,000, the population after t years is given by $50,000(1.03)^t$. It follows that the equation $60,000 = 50,000(1.03)^t$ can be used to estimate the number of years it will take for the population to reach 60,000.

Choice A is incorrect. This equation models how long it will take the population to decrease from 60,000 to 50,000, which is impossible given the growth factor. Choice B is incorrect and may result from misinterpreting a 3% growth as growth by a factor of 3. Additionally, this equation attempts to model how long it will take the population to decrease from 60,000 to 50,000. Choice C is incorrect and may result from misunderstanding how to model percent growth by multiplying the initial amount by a factor greater than 1.

Question Difficulty:

Hard

Question ID 08d03fe4

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #005a9f; height: 10px;"></div> |

ID: 08d03fe4

For the exponential function f , the value of $f(1)$ is k , where k is a constant. Which of the following equivalent forms of the function f shows the value of k as the coefficient or the base?

- A. $f(x) = 50(2)^{x+1}$
- B. $f(x) = 80(2)^x$
- C. $f(x) = 128(2)^{x-1}$
- D. $f(x) = 205(2)^{x-2}$

ID: 08d03fe4 Answer

Correct Answer:

C

Rationale

Choice C is correct. For the form of the function in choice C, $f(x) = 128(1.6)^{x-1}$, the value of $f(1)$ can be found as $128(1.6)^{1-1}$, which is equivalent to $128(1.6)^0$, or 128. Therefore, $k = 128$, which is shown in $f(x) = 128(1.6)^{x-1}$ as the coefficient.

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:

Hard

Question ID df747160

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: df747160

Which expression is equivalent to $17(x^2 - 100y^2)$?

- A. $17(x - 2y)(x - 50y)$
- B. $17(x - 2y)(x + 50y)$
- C. $17(x - 10y)(x - 10y)$
- D. $17(x - 10y)(x + 10y)$

ID: df747160 Answer

Correct Answer:

D

Rationale

Choice D is correct. Expressions in the form $a^2 - b^2$ follow the difference of two squares pattern and can be factored as $(a - b)(a + b)$. In the given expression, $17(x^2 - 100y^2)$, the expression $x^2 - 100y^2$ follows the difference of two squares pattern. It follows that the expression $x^2 - 100y^2$ can be rewritten as $(x - 10y)(x + 10y)$. Therefore, the expression $17(x - 10y)(x + 10y)$ is equivalent to $17(x^2 - 100y^2)$.

Choice A is incorrect. This expression is equivalent to $17(x^2 - 52xy + 100y^2)$, not $17(x^2 - 100y^2)$.

Choice B is incorrect. This expression is equivalent to $17(x^2 + 48xy - 100y^2)$, not $17(x^2 - 100y^2)$.

Choice C is incorrect. This expression is equivalent to $17(x^2 - 20xy + 100y^2)$, not $17(x^2 - 100y^2)$.

Question Difficulty:

Easy

Question ID 3918e8bc

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: 3918e8bc

An object is kicked from a platform. The equation $h = -4.9t^2 + 7t + 9$ represents this situation, where h is the height of the object above the ground, in meters, t seconds after it is kicked. Which number represents the height, in meters, from which the object was kicked?

- A. 0
- B. 4.9
- C. 7
- D. 9

ID: 3918e8bc Answer

Correct Answer:

D

Rationale

Choice D is correct. It's given that the equation $h = -4.9t^2 + 7t + 9$ represents this situation, where h is the height, in meters, of the object t seconds after it is kicked. It follows that the height, in meters, from which the object was kicked is the value of h when $t = 0$. Substituting 0 for t in the equation $h = -4.9t^2 + 7t + 9$ yields $h = -4.9(0)^2 + 7(0) + 9$, or $h = 9$. Therefore, the object was kicked from a height of 9 meters.

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:

Medium

Question ID d964bc26

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: d964bc26

$$y - 57 = px$$

The given equation relates the positive numbers p , x , and y . Which equation correctly expresses y in terms of p and x ?

- A. $y = 57x + p$
- B. $y = px + 57$
- C. $y = 57px$
- D. $y = \frac{px}{57}$

ID: d964bc26 Answer

Correct Answer:

B

Rationale

Choice B is correct. Adding 57 to each side of the given equation yields $y = px + 57$. Therefore, the equation $y = px + 57$ correctly expresses y in terms of p and x .

Choice A is incorrect and may result from conceptual errors.

Choice C is incorrect and may result from conceptual errors.

Choice D is incorrect and may result from conceptual errors.

Question Difficulty:

Easy

Question ID 1dd13816

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 1dd13816

$$(5x^3 - 3) - (-4x^3 + 8)$$

The given expression is equivalent to $bx^3 - 11$, where b is a constant. What is the value of b ?

ID: 1dd13816 Answer

Correct Answer:

9

Rationale

The correct answer is 9. The given expression can be rewritten as $(5x^3 - 3) + (-1)(-4x^3 + 8)$. By applying the distributive property, this expression can be rewritten as $5x^3 - 3 + 4x^3 + (-8)$, which is equivalent to $(5x^3 + 4x^3) + (-3 + (-8))$. Adding like terms in this expression yields $9x^3 - 11$. Since it's given that $(5x^3 - 3) - (-4x^3 + 8)$ is equivalent to $bx^3 - 11$, it follows that $9x^3 - 11$ is equivalent to $bx^3 - 11$. Therefore, the coefficients of x^3 in these two expressions must be equivalent, and the value of b must be 9.

Question Difficulty:

Medium

Question ID e597050f

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|---|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 75%; background-color: #cccccc; height: 10px;"></div> |

ID: e597050f

Which expression is equivalent to $9x + 6x + 2y + 3y$?

- A. $3x + 5y$
- B. $6x + 8y$
- C. $12x + 8y$
- D. $15x + 5y$

ID: e597050f Answer

Correct Answer:

D

Rationale

Choice D is correct. Combining like terms in the given expression yields $(9x + 6x) + (2y + 3y)$, or $15x + 5y$.

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:

Easy

Question ID 7eed640d

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 7eed640d

$$h(x) = -16x^2 + 100x + 10$$

The quadratic function above models the height above the ground h , in feet, of a projectile x seconds after it had been launched vertically. If $y = h(x)$ is graphed in the xy -plane, which of the following represents the real-life meaning of the positive x -intercept of the graph?

- A. The initial height of the projectile
- B. The maximum height of the projectile
- C. The time at which the projectile reaches its maximum height
- D. The time at which the projectile hits the ground

ID: 7eed640d Answer

Correct Answer:

D

Rationale

Choice D is correct. The positive x -intercept of the graph of $y = h(x)$ is a point (x, y) for which $y = 0$. Since $y = h(x)$ models the height above the ground, in feet, of the projectile, a y -value of 0 must correspond to the height of the projectile when it is 0 feet above ground or, in other words, when the projectile is on the ground. Since x represents the time since the projectile was launched, it follows that the positive x -intercept, $(x, 0)$, represents the time at which the projectile hits the ground.

Choice A is incorrect and may result from misidentifying the y -intercept as a positive x -intercept. Choice B is incorrect and may result from misidentifying the y -value of the vertex of the graph of the function as an x -intercept. Choice C is incorrect and may result from misidentifying the x -value of the vertex of the graph of the function as an x -intercept.

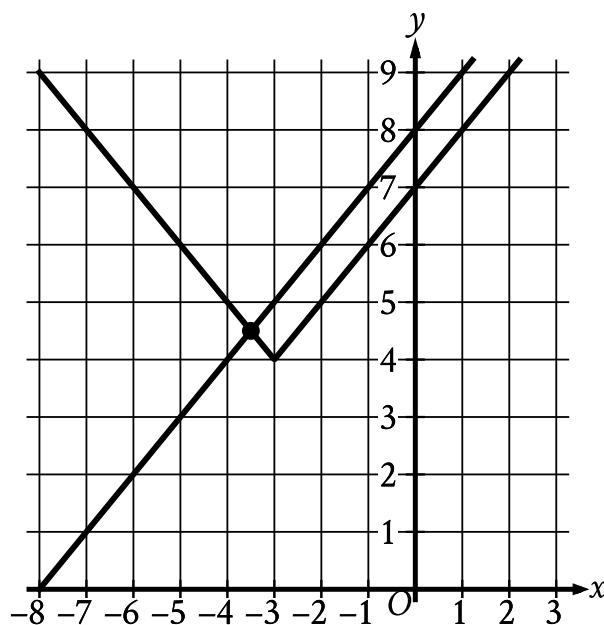
Question Difficulty:

Hard

Question ID 494d247d

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 25%; background-color: #cccccc; height: 10px;"></div> <div style="width: 25%; background-color: #cccccc; height: 10px;"></div> |

ID: 494d247d



The graph of a system of an absolute value function and a linear function is shown. What is the solution (x, y) to this system of two equations?

- A. $(0, 8)$
- B. $(\frac{7}{2}, \frac{9}{2})$
- C. $(-\frac{7}{2}, \frac{9}{2})$
- D. $(-3, 4)$

ID: 494d247d Answer

Correct Answer:

C

Rationale

Choice C is correct. The solution to a system of two equations corresponds to the point where the graphs of the equations intersect. The graphs of the linear function and the absolute value function shown intersect at a point with an x -coordinate between -4 and -3 and a y -coordinate between 4 and 5 . Of the given choices, only $(-\frac{7}{2}, \frac{9}{2})$ has an x -coordinate between -4 and -3 and a y -coordinate between 4 and 5 .

Choice A is incorrect. This is the y -intercept of the graph of the linear function.

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

Choice D is incorrect. This is the vertex of the graph of the absolute value function.

Question Difficulty:

Easy

Question ID 30a07668

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 30a07668

$$\begin{aligned}y &= 4x \\y &= x^2 - 12\end{aligned}$$

A solution to the given system of equations is (x, y) , where $x > 0$. What is the value of x ?

ID: 30a07668 Answer

Correct Answer:

6

Rationale

The correct answer is **6**. It's given that $y = 4x$ and $y = x^2 - 12$. Since $y = 4x$, substituting $4x$ for y in the second equation of the given system yields $4x = x^2 - 12$. Subtracting $4x$ from both sides of this equation yields $0 = x^2 - 4x - 12$. This equation can be rewritten as $0 = (x - 6)(x + 2)$. By the zero product property, $x - 6 = 0$ or $x + 2 = 0$. Adding **6** to both sides of the equation $x - 6 = 0$ yields $x = 6$. Subtracting **2** from both sides of the equation $x + 2 = 0$ yields $x = -2$. Therefore, solutions to the given system of equations occur when $x = 6$ and when $x = -2$. It's given that a solution to the given system of equations is (x, y) , where $x > 0$. Since **6** is greater than **0**, it follows that the value of x is **6**.

Question Difficulty:

Medium

Question ID 2d2ab76b

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0070C0; height: 10px;"></div> <div style="width: 50%; background-color: #D9E1F2; height: 10px;"></div> |

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 $x = \pm 2$. 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

Question ID de362c2f

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: de362c2f

The function f is defined by $f(x) = 5x^2$. What is the value of $f(8)$?

- A. 40
- B. 50
- C. 80
- D. 320

ID: de362c2f Answer

Correct Answer:

D

Rationale

Choice D is correct. It's given that the function f is defined by $f(x) = 5x^2$. Substituting 8 for x in $f(x) = 5x^2$ yields $f(8) = 5(8)^2$, which is equivalent to $f(8) = 5(64)$, or $f(8) = 320$. Therefore, the value of $f(8)$ is 320.

Choice A is incorrect. This is the value of $f(8)$ if $f(x) = 5x$.

Choice B is incorrect. This is the value of $f(8)$ if $f(x) = 5(x + 2)$.

Choice C is incorrect. This is the value of $f(8)$ if $f(x) = (5x)(2)$.

Question Difficulty:

Easy

Question ID 5dd53f73

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a99; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 5dd53f73

Which expression is equivalent to $34x + 34y$?

- A. $34xy$
- B. $34(x + y)$
- C. $68y$
- D. $68x$

ID: 5dd53f73 Answer

Correct Answer:

B

Rationale

Choice B is correct. Since 34 is a common factor of each term in the given expression, the expression can be rewritten as $34(x + y)$.

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

Choice C is incorrect. This expression is equivalent to $34y + 34y$.

Choice D is incorrect. This expression is equivalent to $34x + 34x$.

Question Difficulty:

Easy

Question ID da602115

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: da602115

If $|4x - 4| = 112$, what is the positive value of $x - 1$?

ID: da602115 Answer

Correct Answer:

28

Rationale

The correct answer is **28**. The given absolute value equation can be rewritten as two linear equations: $4x - 4 = 112$ and $-(4x - 4) = 112$, or $4x - 4 = -112$. Adding 4 to both sides of the equation $4x - 4 = 112$ results in $4x = 116$. Dividing both sides of this equation by 4 results in $x = 29$. Adding 4 to both sides of the equation $4x - 4 = -112$ results in $4x = -108$. Dividing both sides of this equation by 4 results in $x = -27$. Therefore, the two values of $x - 1$ are $29 - 1$, or **28**, and $-27 - 1$, or -28 . Thus, the positive value of $x - 1$ is **28**.

Alternate approach: The given equation can be rewritten as $|4(x - 1)| = 112$, which is equivalent to $4|x - 1| = 112$. Dividing both sides of this equation by 4 yields $|x - 1| = 28$. This equation can be rewritten as two linear equations: $x - 1 = 28$ and $-(x - 1) = 28$, or $x - 1 = -28$. Therefore, the positive value of $x - 1$ is **28**.

Question Difficulty:

Medium

Question ID 43926bd9

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 43926bd9

| x | f(x) |
|---|-------|
| 1 | a |
| 2 | a^5 |
| 3 | a^9 |

For the exponential function f , the table above shows several values of x and their corresponding values of $f(x)$, where a is a constant greater than 1. If k is a constant and $f(k) = a^{29}$, what is the value of k ?

ID: 43926bd9 Answer

Rationale

The correct answer is 8. The values of $f(x)$ for the exponential function f shown in the table increase by a factor of a^4 for each increase of 1 in x . This relationship can be represented by the equation $f(x) = a^{4x+b}$, where b is a constant. It's given that when $x=2, f(x) = a^5$. Substituting 2 for x and a^5 for $f(x)$ into $f(x) = a^{4x+b}$ yields $a^5 = a^{4(2)+b}$. Since $4(2)+b = 5$, it follows that $b = -3$. Thus, an equation that defines the function f is $f(x) = a^{4x-3}$. It follows that the value of k such that $f(k) = a^{29}$ can be found by solving the equation $4k - 3 = 29$, which yields $k = 8$.

Question Difficulty:

Hard

Question ID 1e8d7183

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 1e8d7183

Which expression is equivalent to $256w^2 - 676$?

- A. $(16w - 26)(16w - 26)$
- B. $(8w - 13)(8w + 13)$
- C. $(8w - 13)(8w - 13)$
- D. $(16w - 26)(16w + 26)$

ID: 1e8d7183 Answer

Correct Answer:

D

Rationale

Choice D is correct. The given expression follows the difference of two squares pattern, $x^2 - y^2$, which factors as $(x - y)(x + y)$. Therefore, the expression $256w^2 - 676$ can be written as $(16w)^2 - 26^2$, or $(16w)(16w) - (26)(26)$, which factors as $(16w - 26)(16w + 26)$.

Choice A is incorrect. This expression is equivalent to $256w^2 - 832w + 676$.

Choice B is incorrect. This expression is equivalent to $64w^2 - 169$.

Choice C is incorrect. This expression is equivalent to $64w^2 - 208w + 169$.

Question Difficulty:

Easy

Question ID 044c1cb7

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #e0e0e0;"></div> <div style="width: 25%; background-color: #e0e0e0;"></div> |

ID: 044c1cb7

$$h(x) = x^2 - 3$$

Which table gives three values of x and their corresponding values of $h(x)$ for the given function h ?

- A.

| | | | |
|--------|---|---|---|
| x | 1 | 2 | 3 |
| $h(x)$ | 4 | 5 | 6 |
- B.

| | | | |
|--------|----|---|---|
| x | 1 | 2 | 3 |
| $h(x)$ | -2 | 1 | 6 |
- C.

| | | | |
|--------|----|---|---|
| x | 1 | 2 | 3 |
| $h(x)$ | -1 | 1 | 3 |
- D.

| | | | |
|--------|----|---|---|
| x | 1 | 2 | 3 |
| $h(x)$ | -2 | 1 | 3 |

ID: 044c1cb7 Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that $h(x) = x^2 - 3$. Each table gives 1, 2, and 3 as the three given values of x . Substituting 1 for x in the equation $h(x) = x^2 - 3$ yields $h(1) = (1)^2 - 3$, or $h(1) = -2$. Substituting 2 for x in the equation $h(x) = x^2 - 3$ yields $h(2) = (2)^2 - 3$, or $h(2) = 1$. Finally, substituting 3 for x in the equation $h(x) = x^2 - 3$ yields $h(3) = (3)^2 - 3$, or $h(3) = 6$. Therefore, $h(x)$ is -2 when x is 1, $h(x)$ is 1 when x is 2, and $h(x)$ is 6 when x is 3. Choice B is a table with these values of x and their corresponding values of $h(x)$.

Choice A is incorrect. This is a table of values for the function $h(x) = x + 3$, not $h(x) = x^2 - 3$.

Choice C is incorrect. This is a table of values for the function $h(x) = 2x - 3$, not $h(x) = x^2 - 3$.

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

Question Difficulty:

Easy

Question ID 7e5a3640

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 7e5a3640

Bacteria are growing in a liquid growth medium. There were **300,000** cells per milliliter during an initial observation. The number of cells per milliliter doubles every **3** hours. How many cells per milliliter will there be **15** hours after the initial observation?

- A. **1,500,000**
- B. **2,400,000**
- C. **4,500,000**
- D. **9,600,000**

ID: 7e5a3640 Answer

Correct Answer:

D

Rationale

Choice D is correct. Let y represent the number of cells per milliliter x hours after the initial observation. Since the number of cells per milliliter doubles every **3** hours, the relationship between x and y can be represented by an exponential equation of the form $y = a(b)^{\frac{x}{k}}$, where a is the number of cells per milliliter during the initial observation and the number of cells per milliliter increases by a factor of b every k hours. It's given that there were **300,000** cells per milliliter during the initial observation. Therefore, $a = 300,000$. It's also given that the number of cells per milliliter doubles, or increases by a factor of **2**, every **3** hours. Therefore, $b = 2$ and $k = 3$. Substituting **300,000** for a , **2** for b , and **3** for k in the equation $y = a(b)^{\frac{x}{k}}$ yields $y = 300,000(2)^{\frac{x}{3}}$. The number of cells per milliliter there will be **15** hours after the initial observation is the value of y in this equation when $x = 15$. Substituting **15** for x in the equation $y = 300,000(2)^{\frac{x}{3}}$ yields $y = 300,000(2)^{\frac{15}{3}}$, or $y = 300,000(2)^5$. This is equivalent to $y = 300,000(32)$, or $y = 9,600,000$. Therefore, **15** hours after the initial observation, there will be **9,600,000** cells per milliliter.

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:

Medium

Question ID 0354c7de

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 0354c7de

$$5x + 15$$

Which of the following is equivalent to the given expression?

- A. $5(x + 3)$
- B. $5(x + 10)$
- C. $5(x + 15)$
- D. $5(x + 20)$

ID: 0354c7de Answer

Correct Answer:

A

Rationale

Choice A is correct. Since 5 is a factor of both terms, $5x$ and 15, the given expression can be factored and rewritten as $5(x + 3)$.

Choice B is incorrect and may result from subtracting 5 from the constant when factoring 5 from the given expression. Choice C is incorrect and may result from factoring 5 from only the first term, not both terms, of the given expression. Choice D is incorrect and may result from adding 5 to the constant when factoring 5 from the given expression.

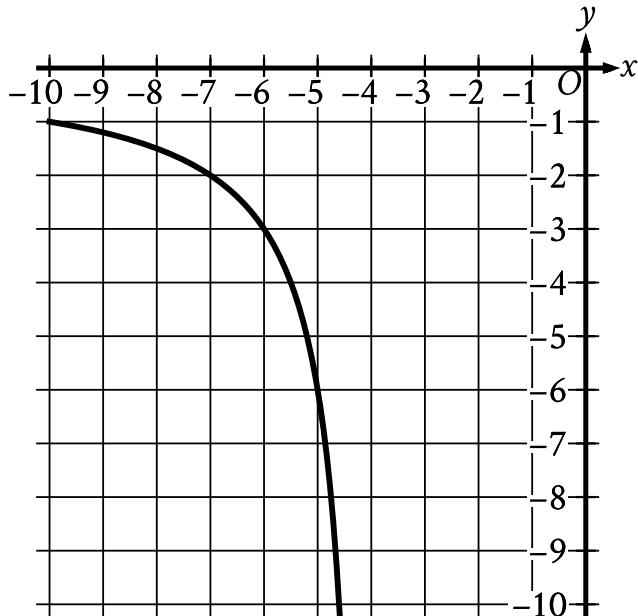
Question Difficulty:

Easy

Question ID 4d037075

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 100px; height: 10px; background-color: #0056b3;"></div> |

ID: 4d037075



The rational function f is defined by an equation in the form $f(x) = \frac{a}{x+b}$, where a and b are constants. The partial graph of $y = f(x)$ is shown. If $g(x) = f(x + 4)$, which equation could define function g ?

- A. $g(x) = \frac{6}{x}$
- B. $g(x) = \frac{6}{x+4}$
- C. $g(x) = \frac{6}{x+8}$
- D. $g(x) = \frac{6(x+4)}{x+4}$

ID: 4d037075 Answer

Correct Answer:

C

Rationale

Choice C is correct. It's given that $f(x) = \frac{a}{x+b}$ and that the graph shown is a partial graph of $y = f(x)$. Substituting y for $f(x)$ in the equation $f(x) = \frac{a}{x+b}$ yields $y = \frac{a}{x+b}$. The graph passes through the point $(-7, -2)$. Substituting -7 for x and -2 for y in the equation $y = \frac{a}{x+b}$ yields $-2 = \frac{a}{-7+b}$. Multiplying each side of this equation by $-7 + b$ yields $-2(-7 + b) = a$, or $14 - 2b = a$. The graph also passes through the point $(-5, -6)$. Substituting -5 for x and -6 for y in the equation $y = \frac{a}{x+b}$ yields $-6 = \frac{a}{-5+b}$. Multiplying each side of this equation by $-5 + b$ yields $-6(-5 + b) = a$, or $30 - 6b = a$. Substituting $14 - 2b$ for a in this equation yields $30 - 6b = 14 - 2b$. Adding $6b$ to each side of this equation yields $30 = 14 + 4b$. Subtracting 14 from each side of this equation yields $16 = 4b$. Dividing each side of this equation by 4 yields $4 = b$. Substituting 4 for b in the equation $14 - 2b = a$ yields $14 - 2(4) = a$, or $6 = a$. Substituting 6 for a and 4 for b in the equation $f(x) = \frac{a}{x+b}$

yields $f(x) = \frac{6}{x+4}$. It's given that $g(x) = f(x + 4)$. Substituting $x + 4$ for x in the equation $f(x) = \frac{6}{x+4}$ yields $f(x + 4) = \frac{6}{x+4+4}$, which is equivalent to $f(x + 4) = \frac{6}{x+8}$. It follows that $g(x) = \frac{6}{x+8}$.

Choice A is incorrect. This could define function g if $g(x) = f(x - 4)$.

Choice B is incorrect. This could define function g if $g(x) = f(x)$.

Choice D is incorrect. This could define function g if $g(x) = f(x) \cdot (x + 4)$.

Question Difficulty:

Hard

Question ID 39652e93

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 39652e93

The function f is defined by $f(x) = \frac{16}{x}$. What is the value of $f(x)$ when $x = 17$?

- A. $\frac{16}{17}$
- B. $\frac{17}{16}$
- C. 16
- D. 17

ID: 39652e93 Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that $f(x) = \frac{16}{x}$. Substituting 17 for x in this function yields $f(17) = \frac{16}{17}$. Therefore, when $x = 17$, the value of $f(x)$ is $\frac{16}{17}$.

Choice B is incorrect. This is the value of the reciprocal of $f(x)$ when $x = 17$.

Choice C is incorrect. This is the value of $f(x)$ when $x = 1$.

Choice D is incorrect. This is the value of x when $x = 17$.

Question Difficulty:

Easy

Question ID f25a34aa

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: f25a34aa

The area of a triangle is equal to x^2 square centimeters. The length of the base of the triangle is $2x + 22$ centimeters, and the height of the triangle is $x - 10$ centimeters. What is the value of x ?

ID: f25a34aa Answer

Correct Answer:

110

Rationale

The correct answer is 110. The area of a triangle is equal to one half of the product of the length of the base of the triangle and the height of the triangle. It's given that the length of the base of the triangle is $2x + 22$ centimeters and the height of the triangle is $x - 10$ centimeters; therefore, its area is $\frac{1}{2}(2x + 22)(x - 10)$ square centimeters. It's also given that the area of the triangle is equal to x^2 square centimeters. Therefore, it follows that $\frac{1}{2}(2x + 22)(x - 10) = x^2$. This equation can be rewritten as $(x + 11)(x - 10) = x^2$, or $x^2 + x - 110 = x^2$. Subtracting x^2 from both sides of this equation yields $x - 110 = 0$. Adding 110 to both sides of this equation yields $x = 110$. Therefore, the value of x is 110.

Question Difficulty:

Hard

Question ID 4d7064a6

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 4d7064a6

$$f(x) = (x - 10)(x + 13)$$

The function f is defined by the given equation. For what value of x does $f(x)$ reach its minimum?

- A. -130
- B. -13
- C. $-\frac{23}{2}$
- D. $-\frac{3}{2}$

ID: 4d7064a6 Answer

Correct Answer:

D

Rationale

Choice D is correct. It's given that $f(x) = (x - 10)(x + 13)$, which can be rewritten as $f(x) = x^2 + 3x - 130$. Since the coefficient of the x^2 -term is positive, the graph of $y = f(x)$ in the xy -plane opens upward and reaches its minimum value at its vertex. The x -coordinate of the vertex is the value of x such that $f(x)$ reaches its minimum. For an equation in the form $f(x) = ax^2 + bx + c$, where a , b , and c are constants, the x -coordinate of the vertex is $-\frac{b}{2a}$. For the equation $f(x) = x^2 + 3x - 130$, $a = 1$, $b = 3$, and $c = -130$. It follows that the x -coordinate of the vertex is $-\frac{3}{2(1)}$, or $-\frac{3}{2}$. Therefore, $f(x)$ reaches its minimum when the value of x is $-\frac{3}{2}$.

Alternate approach: The value of x for the vertex of a parabola is the x -value of the midpoint between the two x -intercepts of the parabola. Since it's given that $f(x) = (x - 10)(x + 13)$, it follows that the two x -intercepts of the graph of $y = f(x)$ in the xy -plane occur when $x = 10$ and $x = -13$, or at the points $(10, 0)$ and $(-13, 0)$. The midpoint between two points, (x_1, y_1) and (x_2, y_2) , is $(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2})$. Therefore, the midpoint between $(10, 0)$ and $(-13, 0)$ is $(\frac{10+(-13)}{2}, \frac{0+0}{2})$, or $(-\frac{3}{2}, 0)$. It follows that $f(x)$ reaches its minimum when the value of x is $-\frac{3}{2}$.

Choice A is incorrect. This is the y -coordinate of the y -intercept of the graph of $y = f(x)$ in the xy -plane.

Choice B is incorrect. This is one of the x -coordinates of the x -intercepts of the graph of $y = f(x)$ in the xy -plane.

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

Question Difficulty:

Hard

Question ID 4eaf0a3a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 4eaf0a3a

Which expression is equivalent to $\sqrt[7]{x^9y^9}$, where x and y are positive?

- A. $(xy)^{\frac{7}{9}}$
- B. $(xy)^{\frac{9}{7}}$
- C. $(xy)^{16}$
- D. $(xy)^{63}$

ID: 4eaf0a3a Answer

Correct Answer:

B

Rationale

Choice B is correct. For positive values of a and b , $a^m b^m = (ab)^m$, $\sqrt[n]{a} = (a)^{\frac{1}{n}}$, and $(a^j)^k = a^{jk}$. Therefore, the given expression, $\sqrt[7]{x^9y^9}$, can be rewritten as $\sqrt[7]{(xy)^9}$. This expression is equivalent to $((xy)^9)^{\frac{1}{7}}$, which can be rewritten as $(xy)^{9 \cdot \frac{1}{7}}$, or $(xy)^{\frac{9}{7}}$.

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:

Medium

Question ID c8e9a011

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: c8e9a011

$$\frac{12}{n} - \frac{2}{t} = -\frac{2}{w}$$

The given equation relates the variables n , t , and w , where $n > 0$, $t > 0$, and $w > t$. Which expression is equivalent to n ?

- A. $12tw$
- B. $6(t - w)$
- C. $\frac{w-t}{6tw}$
- D. $\frac{6tw}{w-t}$

ID: c8e9a011 Answer

Correct Answer:

D

Rationale

Choice D is correct. Adding $\frac{2}{t}$ to each side of the given equation yields $\frac{12}{n} = -\frac{2}{w} + \frac{2}{t}$. The fractions on the right side of this equation have a common denominator of tw ; therefore, the equation can be written as $\frac{12}{n} = \frac{2w}{tw} - \frac{2t}{tw}$, or $\frac{12}{n} = \frac{2w-2t}{tw}$, which is equivalent to $\frac{12}{n} = \frac{2(w-t)}{tw}$. Dividing each side of this equation by 2 yields $\frac{6}{n} = \frac{w-t}{tw}$. Since n , t , w , and $w - t$ are all positive quantities, taking the reciprocal of each side of the equation $\frac{6}{n} = \frac{w-t}{tw}$ yields an equivalent equation: $\frac{n}{6} = \frac{tw}{w-t}$. Multiplying each side of this equation by 6 yields $n = \frac{6tw}{w-t}$.

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. This is equivalent to $\frac{1}{n}$ rather than n .

Question Difficulty:

Hard

Question ID 52e589f9

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #cccccc; height: 10px;"></div> |

ID: 52e589f9

$$m(t) = -0.0274\left(\frac{t}{7}\right)^2 + 7.3873\left(\frac{t}{7}\right) + 75.032$$

The function m gives the predicted body mass $m(t)$, in kilograms (kg), of a certain animal t days after it was born in a wildlife reserve, where $t \leq 390$. Which of the following is the best interpretation of the statement " $m(330)$ is approximately equal to 362" in this context?

- A. The predicted body mass of the animal was approximately 330 kg 362 days after it was born.
- B. The predicted body mass of the animal was approximately 362 kg 330 days after it was born.
- C. The predicted body mass of the animal was approximately 362 kg $\frac{330}{7}$ days after it was born.
- D. The predicted body mass of the animal was approximately $\frac{330}{7}$ kg 362 days after it was born.

ID: 52e589f9 Answer

Correct Answer:

B

Rationale

Choice B is correct. In the statement " $m(330)$ is approximately equal to 362," the input of the function, 330, is the value of t , the elapsed time, in days, since the animal was born. The approximate value of the function, 362, is the predicted body mass, in kilograms, of the animal after that time has elapsed. Therefore, the predicted body mass of the animal was approximately 362 kg 330 days after it was born.

Choice A is incorrect. This would be the best interpretation of the statement " $m(362)$ is approximately equal to 330."

Choice C is incorrect. The number $\frac{330}{7}$ is the number of weeks, not the number of days, after the animal was born.

Choice D is incorrect. This would be the best interpretation of the statement " $m(362)$ is approximately equal to $\frac{330}{7}$."

Question Difficulty:

Medium

Question ID 7e6ea718

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 7e6ea718

$$y = 2(x - d)(x + d)(x + g)(x - d)$$

In the given equation, d and g are unique positive constants. When the equation is graphed in the xy -plane, how many distinct x -intercepts does the graph have?

- A. 4
- B. 3
- C. 2
- D. 1

ID: 7e6ea718 Answer

Correct Answer:

B

Rationale

Choice B is correct. An x -intercept of a graph in the xy -plane is a point on the graph where the value of y is 0. Substituting 0 for y in the given equation yields $0 = 2(x - d)(x + d)(x + g)(x - d)$. By the zero product property, the solutions to this equation are $x = d$, $x = -d$, $x = -g$, and $x = d$. However, $x = d$ and $x = d$ are identical. It's given that d and g are unique positive constants. It follows that the equation $0 = 2(x - d)(x + d)(x + g)(x - d)$ has 3 unique solutions: $x = d$, $x = -d$, and $x = -g$. Thus, the graph of the given equation has 3 distinct x -intercepts.

Choice A is incorrect and may result from conceptual errors.

Choice C is incorrect and may result from conceptual errors.

Choice D is incorrect and may result from conceptual errors.

Question Difficulty:

Hard

Question ID a58232b7

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: a58232b7

The functions g and h are defined by the given equations, where $x \geq 0$. Which of the following equations displays, as a constant or coefficient, the minimum value of the function it defines, where $x \geq 0$?

- I. $g(x) = 18(1.16)(1.4)^{x+2}$
- II. $h(x) = 18(1.4)^{x+4}$

- A. I only
- B. II only
- C. I and II
- D. Neither I nor II

ID: a58232b7 Answer

Correct Answer:

D

Rationale

Choice D is correct. A function defined by an equation in the form $f(x) = a(b)^{x+h}$, where a , b , and h are positive constants and $x \geq 0$, has a minimum value of $f(0)$. It's given that function g is defined by $g(x) = 18(1.16)(1.4)^{x+2}$, which is equivalent to $g(x) = 20.88(1.4)^{x+2}$. Substituting 0 for x in this equation yields $g(0) = 20.88(1.4)^{0+2}$, or $g(0) = 40.9248$. Therefore, the minimum value of $g(x)$ is 40.9248, so $g(x) = 18(1.16)(1.4)^{x+2}$ doesn't display its minimum value as a constant or coefficient. It's also given that function h is defined by $h(x) = 18(1.4)^{x+4}$. Substituting 0 for x in this equation yields $h(0) = 18(1.4)^{0+4}$, or $h(0) = 69.1488$. Therefore, the minimum value of $h(x)$ is 69.1488, so $h(x) = 18(1.4)^{x+4}$ doesn't display its minimum value as a constant or coefficient. Therefore, neither I nor II displays, as a constant or coefficient, the minimum value of the function it defines, where $x \geq 0$.

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

Question ID 4993b828

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 4993b828

The area A , in square centimeters, of a rectangular cutting board can be represented by the expression $w(w + 9)$, where w is the width, in centimeters, of the cutting board. Which expression represents the length, in centimeters, of the cutting board?

- A. $w(w + 9)$
- B. w
- C. 9
- D. $(w + 9)$

ID: 4993b828 Answer

Correct Answer:

D

Rationale

Choice D is correct. It's given that the expression $w(w + 9)$ represents the area, in square centimeters, of a rectangular cutting board, where w is the width, in centimeters, of the cutting board. The area of a rectangle can be calculated by multiplying its length by its width. It follows that the length, in centimeters, of the cutting board is represented by the expression $(w + 9)$.

Choice A is incorrect. This expression represents the area, in square centimeters, of the cutting board, not its length, in centimeters.

Choice B is incorrect. This expression represents the width, in centimeters, of the cutting board, not its length.

Choice C is incorrect. This is the difference between the length, in centimeters, and the width, in centimeters, of the cutting board, not its length, in centimeters.

Question Difficulty:

Medium

Question ID 508344ac

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 508344ac

Which expression is equivalent to $16(x + 15)$?

- A. $16x + 31$
- B. $16x + 240$
- C. $16x + 1$
- D. $16x + 15$

ID: 508344ac Answer

Correct Answer:

B

Rationale

Choice B is correct. The expression $16(x + 15)$ can be rewritten as $16(x) + 16(15)$, which is equivalent to $16x + 240$.

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

Question ID 1853bb35

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 60%; background-color: #0056b3; height: 10px;"></div> |

ID: 1853bb35

For the function q , the value of $q(x)$ decreases by 45% for every increase in the value of x by 1. If $q(0) = 14$, which equation defines q ?

- A. $q(x) = 0.55(14)^x$
- B. $q(x) = 1.45(14)^x$
- C. $q(x) = 14(0.55)^x$
- D. $q(x) = 14(1.45)^x$

ID: 1853bb35 Answer

Correct Answer:

C

Rationale

Choice C is correct. Since the value of $q(x)$ decreases by a fixed percentage, 45%, for every increase in the value of x by 1, the function q is a decreasing exponential function. A decreasing exponential function can be written in the form

$q(x) = a\left(1 - \frac{p}{100}\right)^x$, where a is the value of $q(0)$ and the value of $q(x)$ decreases by $p\%$ for every increase in the value of x by 1. If $q(0) = 14$, then $a = 14$. Since the value of $q(x)$ decreases by 45% for every increase in the value of x by 1, $p = 45$.

Substituting 14 for a and 45 for p in the equation $q(x) = a\left(1 - \frac{p}{100}\right)^x$ yields $q(x) = 14\left(1 - \frac{45}{100}\right)^x$, which is equivalent to $q(x) = 14(1 - 0.45)^x$, or $q(x) = 14(0.55)^x$.

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. For this function, the value of $q(x)$ increases, rather than decreases, by 45% for every increase in the value of x by 1.

Question Difficulty:

Hard

Question ID a54753ca

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: a54753ca

In the xy -plane, the graph of the equation $y = -x^2 + 9x - 100$ intersects the line $y = c$ at exactly one point. What is the value of c ?

- A. $-\frac{481}{4}$
- B. -100
- C. $-\frac{319}{4}$
- D. $-\frac{9}{2}$

ID: a54753ca Answer

Correct Answer:

C

Rationale

Choice C is correct. In the xy -plane, the graph of the line $y = c$ is a horizontal line that crosses the y -axis at $y = c$ and the graph of the quadratic equation $y = -x^2 + 9x - 100$ is a parabola. A parabola can intersect a horizontal line at exactly one point only at its vertex. Therefore, the value of c should be equal to the y -coordinate of the vertex of the graph of the given equation. For a quadratic equation in vertex form, $y = a(x - h)^2 + k$, the vertex of its graph in the xy -plane is (h, k) . The given quadratic equation, $y = -x^2 + 9x - 100$, can be rewritten as $y = -(x^2 - 2(\frac{9}{2})x + (\frac{9}{2})^2) + (\frac{9}{2})^2 - 100$, or $y = -(x - \frac{9}{2})^2 + (-\frac{319}{4})$. Thus, the value of c is equal to $-\frac{319}{4}$.

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:

Hard

Question ID c602140f

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 20%; background-color: #005a99; height: 10px;"></div> <div style="width: 20%; background-color: #005a99; height: 10px;"></div> <div style="width: 60%; background-color: #e0e0e0; height: 10px;"></div> |

ID: c602140f

$$(x - 11y)(2x - 3y) - 12y(-2x + 3y)$$

Which of the following is equivalent to the expression above?

- A. $x - 23y$
- B. $2x^2 - xy - 3y^2$
- C. $2x^2 + 24xy + 36y^2$
- D. $2x^2 - 49xy + 69y^2$

ID: c602140f Answer

Correct Answer:

B

Rationale

Choice B is correct. Expanding all terms yields $(x - 11y)(2x - 3y) - 12y(-2x + 3y)$, which is equivalent to $2x^2 - 22xy - 3xy + 33y^2 + 24xy - 36y^2$. Combining like terms gives $2x^2 - xy - 3y^2$.

Choice A is incorrect and may be the result of using the sums of the coefficients of the existing x and y terms as the coefficients of the x and y terms in the new expressions. Choice C is incorrect and may be the result of incorrectly combining like terms. Choice D is incorrect and may be the result of using the incorrect sign in front of the $12y$ term.

Question Difficulty:

Medium

Question ID fcb78856

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|---|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 75%; background-color: #cccccc; height: 10px;"></div> |

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

Question ID a8ae0d22

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #005a9f; height: 10px;"></div> |

ID: a8ae0d22

Two variables, x and y , are related such that for each increase of 1 in the value of x , the value of y increases by a factor of 4. When $x = 0$, $y = 200$. Which equation represents this relationship?

- A. $y = 4(x)^{200}$
- B. $y = 4(200)^x$
- C. $y = 200(x)^4$
- D. $y = 200(4)^x$

ID: a8ae0d22 Answer

Correct Answer:

D

Rationale

Choice D is correct. Since the value of y increases by a constant factor, 4, for each increase of 1 in the value of x , the relationship between x and y is exponential. An exponential relationship between x and y can be represented by an equation of the form $y = a(b)^x$, where a is the value of y when $x = 0$ and y increases by a factor of b for each increase of 1 in the value of x . Since $y = 200$ when $x = 0$, $a = 200$. Since y increases by a factor of 4 for each increase of 1 in the value of x , $b = 4$. Substituting 200 for a and 4 for b in the equation $y = a(b)^x$ yields $y = 200(4)^x$. Thus, the equation $y = 200(4)^x$ represents the relationship between x and y .

Choice A is incorrect and may result from conceptual errors.

Choice B is incorrect. This equation represents a relationship where for each increase of 1 in the value of x , the value of y increases by a factor of 200, not 4, and when $x = 0$, y is equal to 4, not 200.

Choice C is incorrect and may result from conceptual errors.

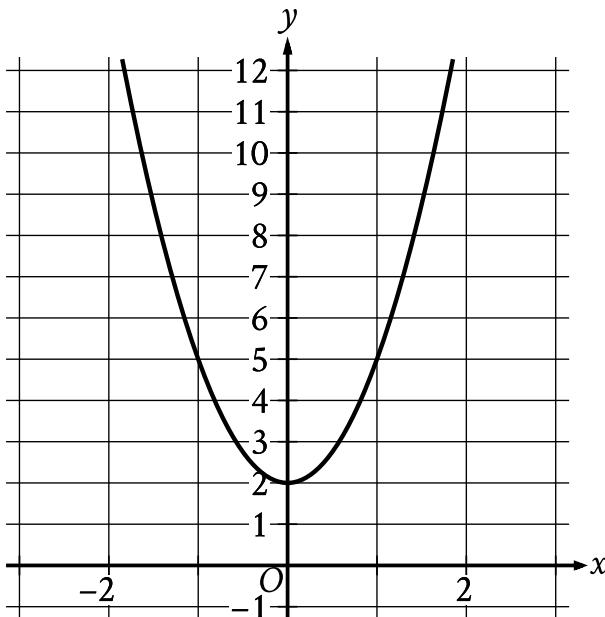
Question Difficulty:

Hard

Question ID 782a8a53

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 782a8a53



The graph of the quadratic function $y = f(x)$ is shown. What is the vertex of the graph?

- A. $(0, -2)$
- B. $(0, -3)$
- C. $(0, 2)$
- D. $(0, 3)$

ID: 782a8a53 Answer

Correct Answer:

C

Rationale

Choice C is correct. The vertex of the graph of a quadratic function in the xy -plane is the point at which the graph is either at its minimum or maximum y -value. In the graph shown, the minimum y -value occurs at the point $(0, 2)$.

Choice A is incorrect. The graph shown doesn't pass through the point $(0, -2)$.

Choice B is incorrect. The graph shown doesn't pass through the point $(0, -3)$.

Choice D is incorrect. The graph shown doesn't pass through the point $(0, 3)$.

Question Difficulty:

Easy

Question ID fd4b2aa0

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #002B36; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> |

ID: fd4b2aa0

Which expression is equivalent to $12x^3 - 5x^3$?

- A. $7x^6$
- B. $17x^3$
- C. $7x^3$
- D. $17x^6$

ID: fd4b2aa0 Answer

Correct Answer:

C

Rationale

Choice C is correct. The given expression shows subtraction of two like terms. The two terms can be subtracted as follows:

$$12x^3 - 5x^3 = (12 - 5)x^3, \text{ or } 7x^3.$$

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

Choice B is incorrect. This is the result of adding, not subtracting, the two like terms.

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

Question Difficulty:

Easy

Question ID 981aca65

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 981aca65

$$f(x) = \frac{a-19}{x} + 5$$

In the given function f , a is a constant. The graph of function f in the xy -plane, where $y = f(x)$, is translated 3 units down and 4 units to the right to produce the graph of $y = g(x)$. Which equation defines function g ?

- A. $g(x) = \frac{a-19}{x+4} + 2$
- B. $g(x) = \frac{a-19}{x-4} + 2$
- C. $g(x) = \frac{a-22}{x+4} + 5$
- D. $g(x) = \frac{a-22}{x-4} + 5$

ID: 981aca65 Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that the graph of $y = g(x)$ is produced by translating the graph of $y = f(x)$ 3 units down and 4 units to the right in the xy -plane. Therefore, function g can be defined by an equation in the form $g(x) = f(x - 4) - 3$. Function f is defined by the equation $f(x) = \frac{a-19}{x} + 5$, where a is a constant. Substituting $x - 4$ for x in the equation $f(x) = \frac{a-19}{x} + 5$ yields $f(x - 4) = \frac{a-19}{x-4} + 5$. Substituting $\frac{a-19}{x-4} + 5$ for $f(x - 4)$ in the equation $g(x) = f(x - 4) - 3$ yields $g(x) = \frac{a-19}{x-4} + 5 - 3$, or $g(x) = \frac{a-19}{x-4} + 2$. Therefore, the equation that defines function g is $g(x) = \frac{a-19}{x-4} + 2$.

Choice A is incorrect. This equation defines a function whose graph is produced by translating the graph of $y = f(x)$ 3 units down and 4 units to the left, not 3 units down and 4 units to the right.

Choice C is incorrect. This equation defines a function whose graph is produced by translating the graph of $y = f(x)$ 4 units to the left, not 3 units down and 4 units to the right.

Choice D is incorrect. This equation defines a function whose graph is produced by translating the graph of $y = f(x)$ 4 units to the right, not 3 units down and 4 units to the right.

Question Difficulty:

Medium

Question ID bf704c34

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|---|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 75%; background-color: #cccccc; height: 10px;"></div> |

ID: bf704c34

$$c - 7 = 25p + k$$

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

- A. $c = 25p + k + 7$
- B. $c = 25p + k - 7$
- C. $c = 7(25p + k)$
- D. $c = \frac{25p+k}{7}$

ID: bf704c34 Answer

Correct Answer:

A

Rationale

Choice A is correct. Adding 7 to each side of the given equation yields $c = 25p + k + 7$.

Choice B is incorrect. This equation is equivalent to $c + 7 = 25p + k$, not $c - 7 = 25p + k$.

Choice C is incorrect. This equation is equivalent to $\frac{c}{7} = 25p + k$, not $c - 7 = 25p + k$.

Choice D is incorrect. This equation is equivalent to $7c = 25p + k$, not $c - 7 = 25p + k$.

Question Difficulty:

Easy

Question ID 4236c5a3

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

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

Question ID 161126cf

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 161126cf

$$f(x) = (1.84)^{\frac{x}{4}}$$

The function f is defined by the given equation. The equation can be rewritten as $f(x) = \left(1 + \frac{p}{100}\right)^x$, where p is a constant. Which of the following is closest to the value of p ?

- A. 16
- B. 21
- C. 46
- D. 96

ID: 161126cf Answer

Correct Answer:

A

Rationale

Choice A is correct. The equation $f(x) = (1.84)^{\frac{x}{4}}$ can be rewritten as $f(x) = (1.84)^{(\frac{1}{4})(x)}$, which is equivalent to $f(x) = \left(1.84^{\frac{1}{4}}\right)^x$, or approximately $f(x) = (1.16467)^x$. Since it's given that $f(x) = (1.84)^{\frac{x}{4}}$ can be rewritten as $f(x) = \left(1 + \frac{p}{100}\right)^x$, where p is a constant, it follows that $1 + \frac{p}{100}$ is approximately equal to 1.16467. Therefore, $\frac{p}{100}$ is approximately equal to 0.16467. It follows that the value of p is approximately equal to 16.467. Of the given choices, 16 is closest to the value of p .

Choice B 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:

Hard

Question ID a7711fe8

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: a7711fe8

What is the minimum value of the function f defined by $f(x) = (x - 2)^2 - 4$?

A. -4

B. -2

C. 2

D. 4

ID: a7711fe8 Answer

Correct Answer:

A

Rationale

Choice A is correct. The given quadratic function f is in vertex form, $f(x) = (x - h)^2 + k$, where (h, k) is the vertex of the graph of $y = f(x)$ in the xy -plane. Therefore, the vertex of the graph of $y = f(x)$ is $(2, -4)$. In addition, the y -coordinate of the vertex represents either the minimum or maximum value of a quadratic function, depending on whether the graph of the function opens upward or downward. Since the leading coefficient of f (the coefficient of the term $(x - 2)^2$) is 1, which is positive, the graph of $y = f(x)$ opens upward. It follows that at $x = 2$, the minimum value of the function f is -4 .

Choice B is incorrect and may result from making a sign error and from using the x -coordinate of the vertex. Choice C is incorrect and may result from using the x -coordinate of the vertex. Choice D is incorrect and may result from making a sign error.

Question Difficulty:

Hard

Question ID 7a4475df

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: 7a4475df

A function p estimates that there were **2,000** animals in a population in **1998**. Each year from **1998** to **2010**, the function estimates that the number of animals in this population increased by **3%** of the number of animals in the population the previous year. Which equation defines this function, where $p(x)$ is the estimated number of animals in the population x years after **1998**?

- A. $p(x) = 2,000(3)^x$
- B. $p(x) = 2,000(1.97)^x$
- C. $p(x) = 2,000(1.03)^x$
- D. $p(x) = 2,000(0.97)^x$

ID: 7a4475df Answer

Correct Answer:

C

Rationale

Choice C is correct. It's given that a function p estimates that there were **2,000** animals in a population in **1998** and that each year from **1998** to **2010**, the number of animals in this population increased by **3%** of the number of animals in the population the previous year. It follows that this situation can be represented by the function $p(x) = a(1 + \frac{r}{100})^x$, where $p(x)$ is the estimated number of animals in the population x years after **1998**, a is the estimated number of animals in the population in **1998**, and each year the estimated number of animals increased by $r\%$. Substituting **2,000** for a and **3** for r in this function yields $p(x) = 2,000(1 + \frac{3}{100})^x$, or $p(x) = 2,000(1.03)^x$.

Choice A is incorrect. This function represents a population in which each year the number of animals increased by **200%**, not **3%**, of the number of animals in the population the previous year.

Choice B is incorrect. This function represents a population in which each year the number of animals increased by **97%**, not **3%**, of the number of animals in the population the previous year.

Choice D is incorrect. This function represents a population in which each year the number of animals decreased, rather than increased, by **3%** of the number of animals in the population the previous year.

Question Difficulty:

Medium

Question ID 3b4b8831

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

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

Question ID f5247e52

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #cccccc; height: 10px;"></div> |

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

Question ID 1a722d7d

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 1a722d7d

$$p(x) = \frac{(x-c)^2 + 160}{2c}$$

Let the function p be defined as $p(x) = \frac{(x-c)^2 + 160}{2c}$, where c is a constant. If

$p(c) = 10$, what is the value of $p(12)$?

- A. 10.00
- B. 10.25
- C. 10.75
- D. 11.00

ID: 1a722d7d Answer

Correct Answer:

D

Rationale

Choice D is correct. The value of $p(12)$ depends on the value of the constant c , so the value of c must first be determined. It is given that $p(c) = 10$. Based on the definition of p , it follows that:

$$p(c) = \frac{(c-c)^2 + 160}{2c} = 10$$

$$\frac{160}{2c} = 10$$

$$2c = 16$$

$$c = 8$$

$$p(x) = \frac{(x-8)^2 + 160}{16}$$

This means that $p(x) = \frac{(x-8)^2 + 160}{16}$ for all values of x . Therefore:

$$p(12) = \frac{(12-8)^2 + 160}{16}$$

$$= \frac{16 + 160}{16}$$

$$= 11$$

Choice A is incorrect. It is the value of $p(8)$, not $p(12)$. Choices B and C are incorrect. If one of these values were correct, then $x = 12$ and the selected value of $p(12)$ could be substituted into the equation to solve for c . However, the values of c that result from choices B and C each result in $p(c) < 10$.

Question Difficulty:

Hard

Question ID be1b8c74

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 20%; background-color: #003366; height: 10px;"></div> <div style="width: 20%; background-color: #003366; height: 10px;"></div> <div style="width: 60%; background-color: #cccccc; height: 10px;"></div> |

ID: be1b8c74

$$x = 8a(b + 9)$$

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

A. $a = \frac{x}{8} - (b + 9)$

B. $a = \frac{x}{8(b+9)}$

C. $a = \frac{8(b+9)}{x}$

D. $a = 8x(b + 9)$

ID: be1b8c74 Answer

Correct Answer:

B

Rationale

Choice B is correct. To express a in terms of b and x , the given equation can be rewritten such that a is isolated on one side of the equation. Since it's given that b is a positive number, $b + 9$ is not equal to zero. Therefore, dividing both sides of the given equation by $8(b + 9)$ yields the equivalent equation $\frac{x}{8(b+9)} = a$, or $a = \frac{x}{8(b+9)}$.

Choice A is incorrect. This equation is equivalent to $x = 8(a + (b + 9))$.

Choice C is incorrect. This equation is equivalent to $x = \frac{8(b+9)}{a}$.

Choice D is incorrect. This equation is equivalent to $x = \frac{a}{8(b+9)}$.

Question Difficulty:

Medium

Question ID f11ffa93

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #002B36; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> |

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 3a01a5ee

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 3a01a5ee

$$|-5x + 13| = 73$$

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

- A. $-\frac{146}{5}$
- B. -12
- C. 0
- D. $\frac{26}{5}$

ID: 3a01a5ee Answer

Correct Answer:

D

Rationale

Choice D is correct. By the definition of absolute value, if $|-5x + 13| = 73$, then $-5x + 13 = 73$ or $-5x + 13 = -73$. Subtracting 13 from both sides of the equation $-5x + 13 = 73$ yields $-5x = 60$. Dividing both sides of this equation by -5 yields $x = -12$. Subtracting 13 from both sides of the equation $-5x + 13 = -73$ yields $-5x = -86$. Dividing both sides of this equation by -5 yields $x = \frac{86}{5}$. Therefore, the solutions to the given equation are -12 and $\frac{86}{5}$, and it follows that the sum of the solutions to the given equation is $-12 + \frac{86}{5}$, or $\frac{26}{5}$.

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

Choice B is incorrect. This is a solution, not the sum of the solutions, to the given equation.

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

Question Difficulty:

Hard

Question ID 6e7ae9fc

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 6e7ae9fc

The function g is defined by $g(x) = x(x - 2)(x + 6)^2$. The value of $g(7 - w)$ is 0, where w is a constant. What is the sum of all possible values of w ?

ID: 6e7ae9fc Answer

Correct Answer:

25

Rationale

The correct answer is 25. The value of $g(7 - w)$ is the value of $g(x)$ when $x = 7 - w$, where w is a constant. Substituting $7 - w$ for x in the given equation yields $g(7 - w) = (7 - w)(7 - w - 2)(7 - w + 6)^2$, which is equivalent to $g(7 - w) = (7 - w)(5 - w)(13 - w)^2$. It's given that the value of $g(7 - w)$ is 0. Substituting 0 for $g(7 - w)$ in the equation $g(7 - w) = (7 - w)(5 - w)(13 - w)^2$ yields $0 = (7 - w)(5 - w)(13 - w)^2$. Since the product of the three factors on the right-hand side of this equation is equal to 0, at least one of these three factors must be equal to 0. Therefore, the possible values of w can be found by setting each factor equal to 0. Setting the first factor equal to 0 yields $7 - w = 0$. Adding w to both sides of this equation yields $7 = w$. Therefore, 7 is one possible value of w . Setting the second factor equal to 0 yields $5 - w = 0$. Adding w to both sides of this equation yields $5 = w$. Therefore, 5 is a second possible value of w . Setting the third factor equal to 0 yields $(13 - w)^2 = 0$. Taking the square root of both sides of this equation yields $13 - w = 0$. Adding w to both sides of this equation yields $13 = w$. Therefore, 13 is a third possible value of w . Adding the three possible values of w yields $7 + 5 + 13$, or 25. Therefore, the sum of all possible values of w is 25.

Question Difficulty:

Hard

Question ID ee05c84e

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: ee05c84e

$$f(x) = (x + 0.25x)(50 - x)$$

The function f is defined above. What is the value of $f(20)$?

- A. 250
- B. 500
- C. 750
- D. 2,000

ID: ee05c84e Answer

Correct Answer:

C

Rationale

Choice C is correct. Adding the like terms x and $0.25x$ yields the equation $f(x) = (1.25x)(50 - x)$. Substituting 20 for x yields $f(20) = (1.25(20))(50 - 20)$. The product $1.25(20)$ is equal to 25, and the difference $50 - 20$ is equal to 30. Substituting these values in the given equation gives $f(20) = (25)(30)$, and multiplying 25 by 30 results in $f(20) = 750$.

Choices A, B, and D are incorrect and may result from conceptual or computational errors when finding the value of $f(20)$.

Question Difficulty:

Easy

Question ID 5d93c782

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|---|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 75%; background-color: #cccccc; height: 10px;"></div> |

ID: 5d93c782

Which expression is equivalent to $x^2 + 3x - 40$?

- A. $(x - 4)(x + 10)$
- B. $(x - 5)(x + 8)$
- C. $(x - 8)(x + 5)$
- D. $(x - 10)(x + 4)$

ID: 5d93c782 Answer

Correct Answer:

B

Rationale

Choice B is correct. The given expression may be rewritten as $x^2 + 8x - 5x - 40$. Since the first two terms of this expression have a common factor of x and the last two terms of this expression have a common factor of -5 , this expression may be rewritten as $x(x) + x(8) - 5(x) - 5(8)$, or $x(x + 8) - 5(x + 8)$. Since each term of this expression has a common factor of $(x + 8)$, it may be rewritten as $(x - 5)(x + 8)$.

Alternate approach: An expression of the form $x^2 + bx + c$, where b and c are constants, can be factored if there are two values that add to give b and multiply to give c . In the given expression, $b = 3$ and $c = -40$. The values of -5 and 8 add to give 3 and multiply to give -40 , so the expression can be factored as $(x - 5)(x + 8)$.

Choice A is incorrect. This expression is equivalent to $x^2 + 6x - 40$, not $x^2 + 3x - 40$.

Choice C is incorrect. This expression is equivalent to $x^2 - 3x - 40$, not $x^2 + 3x - 40$.

Choice D is incorrect. This expression is equivalent to $x^2 - 6x - 40$, not $x^2 + 3x - 40$.

Question Difficulty:

Easy

Question ID 5c00c2c1

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 5c00c2c1

There were no jackrabbits in Australia before 1788 when 24 jackrabbits were introduced. By 1920 the population of jackrabbits had reached 10 billion. If the population had grown exponentially, this would correspond to a 16.2% increase, on average, in the population each year. Which of the following functions best models the population $p(t)$ of jackrabbits t years after 1788?

- A. $p(t) = 1.162(24)^t$
- B. $p(t) = 24(2)^{1.162t}$
- C. $p(t) = 24(1.162)^t$
- D. $p(t) = (24 \cdot 1.162)^t$

ID: 5c00c2c1 Answer

Correct Answer:

C

Rationale

Choice C is correct. This exponential growth model can be written in the form $p(t) = A(1 + r)^t$, where $p(t)$ is the population t years after 1788, A is the initial population, and r is the yearly growth rate, expressed as a decimal. Since there were 24 jackrabbits in Australia in 1788, $A = 24$. Since the number of jackrabbits increased by an average of 16.2% each year, $r = 0.162$. Therefore, the equation that best models this situation is $p(t) = 24(1.162)^t$.

Choices A, B, and D are incorrect and may result from misinterpreting the form of an exponential growth model.

Question Difficulty:

Medium

Question ID 974d33dc

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 974d33dc

Which of the following expressions is equivalent to the sum of $(r^3 + 5r^2 + 7)$ and $(r^2 + 8r + 12)$?

- A. $r^5 + 13r^3 + 19$
- B. $2r^3 + 13r^2 + 19$
- C. $r^3 + 5r^2 + 7r + 12$
- D. $r^3 + 6r^2 + 8r + 19$

ID: 974d33dc Answer

Correct Answer:

D

Rationale

Choice D is correct. Grouping like terms, the given expressions can be rewritten as $r^3 + (5r^2 + r^2) + 8r + (7 + 12)$. This can be rewritten as $r^3 + 6r^2 + 8r + 19$.

Choice A is incorrect and may result from adding the two sets of unlike terms, r^3 and r^2 as well as $5r^2$ and $8r$, and then adding the respective exponents. Choice B is incorrect and may result from adding the unlike terms r^3 and r^2 as if they were r^3 and r^3 and adding the unlike terms $5r^2$ and $8r$ as if they were $5r^2$ and $8r^2$. Choice C is incorrect and may result from errors when combining like terms.

Question Difficulty:

Easy

Question ID d4d513ff

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #002B36; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> |

ID: d4d513ff

Which expression is equivalent to $12x + 27$?

- A. $12(9x + 1)$
- B. $27(12x + 1)$
- C. $3(4x + 9)$
- D. $3(9x + 24)$

ID: d4d513ff Answer

Correct Answer:

C

Rationale

Choice C is correct. Each term in the given expression, $12x + 27$, has a common factor of 3. Therefore, the expression can be rewritten as $3(4x) + 3(9)$, or $3(4x + 9)$. Thus, the expression $3(4x + 9)$ is equivalent to the given expression.

Choice A is incorrect. This expression is equivalent to $108x + 12$, not $12x + 27$.

Choice B is incorrect. This expression is equivalent to $324x + 27$, not $12x + 27$.

Choice D is incorrect. This expression is equivalent to $27x + 72$, not $12x + 27$.

Question Difficulty:

Easy

Question ID 48f83c34

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 48f83c34

A right rectangular prism has a height of **9** inches. The length of the prism's base is x inches, which is **7** inches more than the width of the prism's base. Which function V gives the volume of the prism, in cubic inches, in terms of the length of the prism's base?

- A. $V(x) = x(x + 9)(x + 7)$
- B. $V(x) = x(x + 9)(x - 7)$
- C. $V(x) = 9x(x + 7)$
- D. $V(x) = 9x(x - 7)$

ID: 48f83c34 Answer

Correct Answer:

D

Rationale

Choice D is correct. The volume of a right rectangular prism can be represented by a function V that gives the volume of the prism, in cubic inches, in terms of the length of the prism's base. The volume of a right rectangular prism is equal to the area of its base times its height. It's given that the length of the prism's base is x inches, which is **7** inches more than the width of the prism's base. This means that the width of the prism's base is $x - 7$ inches. It follows that the area of the prism's base, in square inches, is $x(x - 7)$ and the volume, in cubic inches, of the prism is $x(x - 7)(9)$. Thus, the function V that gives the volume of this right rectangular prism, in cubic inches, in terms of the length of the prism's base, x , is $V(x) = 9x(x - 7)$.

Choice A is incorrect. This function would give the volume of the prism if the height were **9** inches more than the length of its base and the width of the base were **7** inches more than its length.

Choice B is incorrect. This function would give the volume of the prism if the height were **9** inches more than the length of its base.

Choice C is incorrect. This function would give the volume of the prism if the width of the base were **7** inches more than its length, rather than the length of the base being **7** inches more than its width.

Question Difficulty:

Hard

Question ID 58b109d4

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 30%; background-color: #005a9f; height: 10px;"></div> <div style="width: 30%; background-color: #005a9f; height: 10px;"></div> <div style="width: 30%; background-color: #005a9f; height: 10px;"></div> |

ID: 58b109d4

$$\begin{aligned}x^2 + y + 7 &= 7 \\20x + 100 - y &= 0\end{aligned}$$

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

Question ID beca03de

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: beca03de

A rectangle has a length that is **15** times its width. The function $y = (15w)(w)$ represents this situation, where y is the area, in square feet, of the rectangle and $y > 0$. Which of the following is the best interpretation of $15w$ in this context?

- A. The length of the rectangle, in feet
- B. The area of the rectangle, in square feet
- C. The difference between the length and the width of the rectangle, in feet
- D. The width of the rectangle, in feet

ID: beca03de Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that a rectangle has a length that is **15** times its width. It's also given that the function $y = (15w)(w)$ represents this situation, where y is the area, in square feet, of the rectangle and $y > 0$. The area of a rectangle can be calculated by multiplying the rectangle's length by its width. Since the rectangle has a length that is **15** times its width, it follows that w represents the width of the rectangle, in feet, and **15w** represents the length of the rectangle, in feet. Therefore, the best interpretation of **15w** in this context is that it's the length of the rectangle, in feet.

Choice B is incorrect. This is the best interpretation of y , not **15w**, in the given function.

Choice C is incorrect and may result from conceptual errors.

Choice D is incorrect. This is the best interpretation of w , not **15w**, in the given function.

Question Difficulty:

Medium

Question ID 4e18fc5d

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 20%; background-color: #003366; height: 10px;"></div> <div style="width: 20%; background-color: #003366; height: 10px;"></div> <div style="width: 60%; background-color: #cccccc; height: 10px;"></div> |

ID: 4e18fc5d

$$v = -\frac{w}{150x}$$

The given equation relates the distinct positive numbers v , w , and x . Which equation correctly expresses w in terms of v and x ?

- A. $w = -150vx$
- B. $w = -\frac{150v}{x}$
- C. $w = -\frac{x}{150v}$
- D. $w = v + 150x$

ID: 4e18fc5d Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that x is positive. Therefore, multiplying each side of the given equation by $-150x$ yields $-150xv = w$, which is equivalent to $w = -150vx$. Thus, the equation $w = -150vx$ correctly expresses w in terms of v and x .

Choice B is incorrect. This equation is equivalent to $v = -\frac{wx}{150}$.

Choice C is incorrect. This equation is equivalent to $v = -\frac{x}{150w}$.

Choice D is incorrect. This equation is equivalent to $v = w - 150x$.

Question Difficulty:

Medium

Question ID f5c3e3b8

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: f5c3e3b8

Which expression is equivalent to $(m^4q^4z^{-1})(mq^5z^3)$, where m , q , and z are positive?

- A. $m^4q^{20}z^{-3}$
- B. $m^5q^9z^2$
- C. $m^6q^8z^{-1}$
- D. $m^{20}q^{12}z^{-2}$

ID: f5c3e3b8 Answer

Correct Answer:

B

Rationale

Choice B is correct. Applying the commutative property of multiplication, the expression $(m^4q^4z^{-1})(mq^5z^3)$ can be rewritten as $(m^4m)(q^4q^5)(z^{-1}z^3)$. For positive values of x , $(x^a)(x^b) = x^{a+b}$. Therefore, the expression $(m^4m)(q^4q^5)(z^{-1}z^3)$ can be rewritten as $(m^{4+1})(q^{4+5})(z^{-1+3})$, or $m^5q^9z^2$.

Choice A is incorrect and may result from multiplying, not adding, the exponents.

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

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

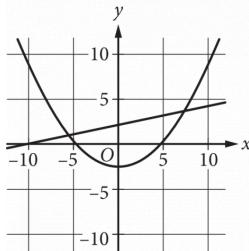
Question Difficulty:

Easy

Question ID a5663025

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

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

Question ID 3c95093c

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #002B36; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> |

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

Question ID d0a7871e

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0070C0; height: 10px;"></div> <div style="width: 50%; background-color: #D9E1F2; height: 10px;"></div> |

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 72ebc024

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 72ebc024

Which expression is equivalent to $16x^3y^2 + 14xy$?

- A. $2xy(8xy + 7)$
- B. $2xy(8x^2y + 7)$
- C. $14xy(2x^2y + 1)$
- D. $14xy(8x^2y + 1)$

ID: 72ebc024 Answer

Correct Answer:

B

Rationale

Choice B is correct. Since $2xy$ is a common factor of each term in the given expression, the expression can be rewritten as $2xy(8x^2y + 7)$.

Choice A is incorrect. This expression is equivalent to $16x^2y^2 + 14xy$.

Choice C is incorrect. This expression is equivalent to $28x^3y^2 + 14xy$.

Choice D is incorrect. This expression is equivalent to $112x^3y^2 + 14xy$.

Question Difficulty:

Easy

Question ID dd4ab4c4

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: dd4ab4c4

$$4a^2 + 20ab + 25b^2$$

Which of the following is a factor of the polynomial above?

- A. $a + b$
- B. $2a + 5b$
- C. $4a + 5b$
- D. $4a + 25b$

ID: dd4ab4c4 Answer

Correct Answer:

B

Rationale

Choice B is correct. The first and last terms of the polynomial are both squares such that $4a^2 = (2a)^2$ and $25b^2 = (5b)^2$. The second term is twice the product of the square root of the first and last terms: $20ab = 2(2a)(5b)$. Therefore, the polynomial is the square of a binomial such that $4a^2 + 20ab + 25b^2 = (2a + 5b)^2$, and $(2a + 5b)$ is a factor.

Choice A is incorrect and may be the result of incorrectly factoring the polynomial. Choice C is incorrect and may be the result of dividing the second and third terms of the polynomial by their greatest common factor. Choice D is incorrect and may be the result of not factoring the coefficients.

Question Difficulty:

Medium

Question ID b8caaf84

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 25%; background-color: #003366; height: 10px;"></div> <div style="width: 50%; background-color: #cccccc; height: 10px;"></div> |

ID: b8caaf84

If $p = 3x + 4$ and $v = x + 5$, which of the following is equivalent to $pv - 2p + v$?

- A. $3x^2 + 12x + 7$
- B. $3x^2 + 14x + 17$
- C. $3x^2 + 19x + 20$
- D. $3x^2 + 26x + 33$

ID: b8caaf84 Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that $p = 3x + 4$ and $v = x + 5$. Substituting the values for p and v into the expression $pv - 2p + v$ yields $(3x + 4)(x + 5) - 2(3x + 4) + x + 5$. Multiplying the terms $(3x + 4)(x + 5)$ yields $3x^2 + 4x + 15x + 20$. Using the distributive property to rewrite $-2(3x + 4)$ yields $-6x - 8$. Therefore, the entire expression can be represented as $3x^2 + 4x + 15x + 20 - 6x - 8 + x + 5$. Combining like terms yields $3x^2 + 14x + 17$.

Choice A is incorrect and may result from subtracting, instead of adding, the term $x + 5$. Choice C is incorrect. This is the result of multiplying the terms $(3x + 4)(x + 5)$. Choice D is incorrect and may result from distributing 2, instead of -2 , to the term $3x + 4$.

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 | <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 60%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 7f81d0c3

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

What values satisfy the equation above?

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

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

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

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

ID: 7f81d0c3 Answer

Correct Answer:

C

Rationale

Choice C is correct. Using the quadratic formula to solve the given expression yields

$$x = \frac{-(-1) \pm \sqrt{(-1)^2 - (4)(1)(-1)}}{(2)(1)} = \frac{1 \pm \sqrt{5}}{2}. \text{ Therefore, } x = \frac{1+\sqrt{5}}{2} \text{ and } x = \frac{1-\sqrt{5}}{2} \text{ satisfy the given equation.}$$

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

Question ID 332cd67b

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 332cd67b

$$3x^2 - 15x + 18 = 0$$

How many distinct real solutions are there to the given equation?

- A. Exactly one
- B. Exactly two
- C. Infinitely many
- D. Zero

ID: 332cd67b Answer

Correct Answer:

B

Rationale

Choice B is correct. The number of solutions to a quadratic equation of the form $ax^2 + bx + c = 0$, where a , b , and c are constants, can be determined by the value of the discriminant, $b^2 - 4ac$. If the value of the discriminant is positive, then the quadratic equation has exactly two distinct real solutions. If the value of the discriminant is equal to zero, then the quadratic equation has exactly one real solution. If the value of the discriminant is negative, then the quadratic equation has zero real solutions. In the given equation, $3x^2 - 15x + 18 = 0$, $a = 3$, $b = -15$, and $c = 18$. Substituting 3 for a , -15 for b , and 18 for c in $b^2 - 4ac$ yields $(-15)^2 - 4(3)(18)$, or 9. Since the value of the discriminant is positive, the given equation has exactly two distinct real solutions.

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

Question ID 301faf80

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 30%; background-color: #0056b3; height: 10px;"></div> <div style="width: 30%; background-color: #0056b3; height: 10px;"></div> <div style="width: 30%; background-color: #0056b3; height: 10px;"></div> |

ID: 301faf80

The product of two positive integers is 462. If the first integer is 5 greater than twice the second integer, what is the smaller of the two integers?

ID: 301faf80 Answer

Correct Answer:

14

Rationale

The correct answer is 14. Let x represent the first integer and y represent the second integer. If the first integer is 5 greater than twice the second integer, then $x = 2y + 5$. It's given that the product of the two integers is 462; therefore $xy = 462$. Substituting $2y + 5$ for x in this equation yields $(2y + 5)(y) = 462$, which can be written as $2y^2 + 5y = 462$. Subtracting 462 from each side of this equation yields $2y^2 + 5y - 462 = 0$. The left-hand side of this equation can be factored by finding two values whose product is $2(-462)$, or -924 , and whose sum is 5. The two values whose product is -924 and whose sum is 5 are 33 and -28 . Thus, the equation $2y^2 + 5y - 462 = 0$ can be rewritten as $2y^2 - 28y + 33y - 462 = 0$, which is equivalent to $2y(y - 14) + 33(y - 14) = 0$, or $(2y + 33)(y - 14) = 0$. By the zero product property, it follows that $2y + 33 = 0$ or $y - 14 = 0$. Subtracting 33 from both sides of the equation $2y + 33 = 0$ yields $2y = -33$. Dividing both sides of this equation by 2 yields $y = -\frac{33}{2}$. Since y is a positive integer, the value of y isn't $-\frac{33}{2}$. Adding 14 to both sides of the equation $y - 14 = 0$ yields $y = 14$. Substituting 14 for y in the equation $xy = 462$ yields $x(14) = 462$. Dividing both sides of this equation by 14 yields $x = 33$. Therefore, the two integers are 14 and 33, so the smaller of the two integers is 14.

Question Difficulty:

Hard

Question ID 128c75e2

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 30%; background-color: #0056b3; height: 10px;"></div> <div style="width: 30%; background-color: #0056b3; height: 10px;"></div> <div style="width: 30%; background-color: #0056b3; height: 10px;"></div> |

ID: 128c75e2

The function g is defined by $g(x) = \frac{|x|}{a} - 14$, where $a < 0$. What is the product of $g(15a)$ and $g(7a)$?

ID: 128c75e2 Answer

Correct Answer:

609

Rationale

The correct answer is 609. It's given that the function g is defined by $g(x) = \frac{|x|}{a} - 14$, where $a < 0$. Substituting $15a$ for x in function g yields $g(15a) = \frac{|15a|}{a} - 14$. This function can be rewritten as $g(15a) = \frac{15|a|}{a} - 14$, or $g(15a) = 15\left(\frac{|a|}{a}\right) - 14$. Since $a < 0$, it follows that $\frac{|a|}{a} = -1$. Substituting -1 for $\frac{|a|}{a}$ in $g(15a) = 15\left(\frac{|a|}{a}\right) - 14$ yields $g(15a) = 15(-1) - 14$, or $g(15a) = -29$. Similarly, substituting $7a$ for x in function g yields $g(7a) = \frac{|7a|}{a} - 14$. This function can be rewritten as $g(7a) = \frac{7|a|}{a} - 14$, or $g(7a) = 7\left(\frac{|a|}{a}\right) - 14$. Since $a < 0$, it again follows that $\frac{|a|}{a} = -1$. Substituting -1 for $\frac{|a|}{a}$ in $g(7a) = 7\left(\frac{|a|}{a}\right) - 14$ yields $g(7a) = 7(-1) - 14$, or $g(7a) = -21$. Therefore, $g(15a) = -29$ and $g(7a) = -21$. Thus, the product of $g(15a)$ and $g(7a)$ is $(-29)(-21)$, or 609.

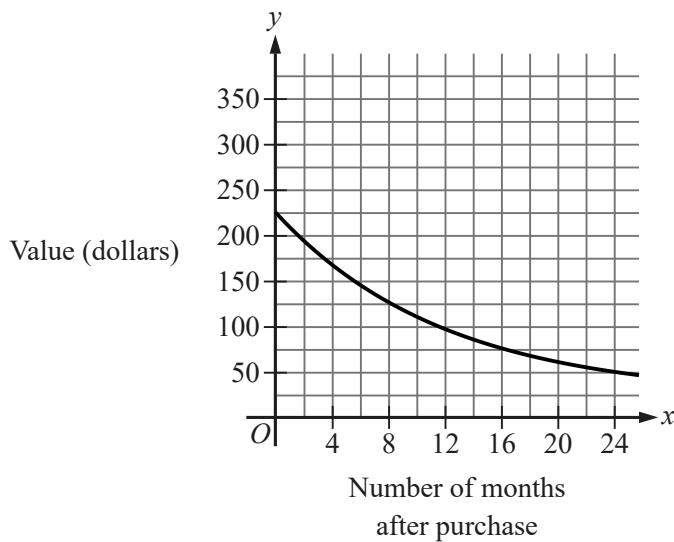
Question Difficulty:

Hard

Question ID 7f2524bf

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 7f2524bf



The graph shown gives the estimated value, in dollars, of a tablet as a function of the number of months since it was purchased. What is the best interpretation of the y -intercept of the graph in this context?

- A. The estimated value of the tablet was **\$225** when it was purchased.
- B. The estimated value of the tablet **24** months after it was purchased was **\$225**.
- C. The estimated value of the tablet had decreased by **\$225** in the **24** months after it was purchased.
- D. The estimated value of the tablet decreased by approximately **2.25%** each year after it was purchased.

ID: 7f2524bf Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that the graph shown gives the estimated value y , in dollars, of a tablet as a function of the number of months since it was purchased, x . The y -intercept of a graph is the point at which the graph intersects the y -axis, or when x is 0. The graph shown intersects the y -axis at the point $(0, 225)$. It follows that 0 months after the tablet was purchased, or when the tablet was purchased, the estimated value of the tablet was 225 dollars. Therefore, the best interpretation of the y -intercept is that the estimated value of the tablet was **\$225** when it was purchased.

Choice B is incorrect. The estimated value of the tablet **24** months after it was purchased was **\$50**, not **\$225**.

Choice C is incorrect. The estimated value of the tablet had decreased by **\$225 – \$50**, or **\$175**, not **\$225**, in the **24** months after it was purchased.

Choice D is incorrect and may result from conceptual errors.

Question Difficulty:

Easy

Question ID e312081b

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: e312081b

$$(x + 5) + (2x - 3)$$

Which of the following is equivalent to the given expression?

- A. $3x - 2$
- B. $3x + 2$
- C. $3x - 8$
- D. $3x + 8$

ID: e312081b Answer

Correct Answer:

B

Rationale

Choice B is correct. Using the associative and commutative properties of addition, the given expression $(x + 5) + (2x - 3)$ can be rewritten as $(x + 2x) + (5 - 3)$. Adding these like terms results in $3x + 2$.

Choice A is incorrect and may result from adding $(x - 5) + (2x + 3)$. Choice C is incorrect and may result from adding $(x - 5) + (2x - 3)$. Choice D is incorrect and may result from adding $(x + 5) + (2x + 3)$.

Question Difficulty:

Easy

Question ID 02060533

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 02060533

| x | $g(x)$ |
|-----|--------|
| -27 | 3 |
| -9 | 0 |
| 21 | 5 |

The table shows three values of x and their corresponding values of $g(x)$, where $g(x) = \frac{f(x)}{x+3}$ and f is a linear function. What is the y -intercept of the graph of $y = f(x)$ in the xy -plane?

- A. (0, 36)
- B. (0, 12)
- C. (0, 4)
- D. (0, -9)

ID: 02060533 Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that the table shows values of x and their corresponding values of $g(x)$, where $g(x) = \frac{f(x)}{x+3}$. It's also given that f is a linear function. It follows that an equation that defines f can be written in the form $f(x) = mx + b$, where m represents the slope and b represents the y -coordinate of the y -intercept $(0, b)$ of the graph of $y = f(x)$ in the xy -plane. The slope of the graph of $y = f(x)$ can be found using two points, (x_1, y_1) and (x_2, y_2) , that are on the graph of $y = f(x)$, and the formula $m = \frac{y_2 - y_1}{x_2 - x_1}$. Since the table shows values of x and their corresponding values of $g(x)$, substituting values of x and $g(x)$ in the equation $g(x) = \frac{f(x)}{x+3}$ can be used to define function f . Using the first pair of values from the table, $x = -27$ and $g(x) = 3$, yields $3 = \frac{f(-27)}{-27+3}$, or $3 = \frac{f(-27)}{-24}$. Multiplying each side of this equation by -24 yields $-72 = f(-27)$, so the point $(-27, -72)$ is on the graph of $y = f(x)$. Using the second pair of values from the table, $x = -9$ and $g(x) = 0$, yields $0 = \frac{f(-9)}{-9+3}$, or $0 = \frac{f(-9)}{-6}$. Multiplying each side of this equation by -6 yields $0 = f(-9)$, so the point $(-9, 0)$ is on the graph of $y = f(x)$. Substituting $(-27, -72)$ and $(-9, 0)$ for (x_1, y_1) and (x_2, y_2) , respectively, in the formula $m = \frac{y_2 - y_1}{x_2 - x_1}$ yields $m = \frac{0 - (-72)}{-9 - (-27)}$, or $m = 4$. Substituting 4 for m in the equation $f(x) = mx + b$ yields $f(x) = 4x + b$. Since $0 = f(-9)$, substituting -9 for x and 0 for $f(x)$ in the equation $f(x) = 4x + b$ yields $0 = 4(-9) + b$, or $0 = -36 + b$. Adding 36 to both sides of this equation yields $36 = b$. It follows that 36 is the y -coordinate of the y -intercept $(0, b)$ of the graph of $y = f(x)$. Therefore, the y -intercept of the graph of $y = f(x)$ is $(0, 36)$.

Choice B is incorrect. 12 is the y -coordinate of the y -intercept of the graph of $y = g(x)$.

Choice C is incorrect. 4 is the slope of the graph of $y = f(x)$.

Choice D is incorrect. -9 is the x -coordinate of the x -intercept of the graph of $y = f(x)$.

Question Difficulty:
Hard

Question ID 52931bfa

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 20%; background-color: #005a9f;"></div> <div style="width: 20%; background-color: #005a9f;"></div> <div style="width: 60%; background-color: #e0e0e0;"></div> |

ID: 52931bfa

Which expression is equivalent to $\frac{8x(x-7)-3(x-7)}{2x-14}$, where $x > 7$?

- A. $\frac{x-7}{5}$
- B. $\frac{8x-3}{2}$
- C. $\frac{8x^2-3x-14}{2x-14}$
- D. $\frac{8x^2-3x-77}{2x-14}$

ID: 52931bfa Answer

Correct Answer:

B

Rationale

Choice B is correct. The given expression has a common factor of 2 in the denominator, so the expression can be rewritten as $\frac{8x(x-7)-3(x-7)}{2(x-7)}$. The three terms in this expression have a common factor of $(x - 7)$. Since it's given that $x > 7$, x can't be equal to 7, which means $(x - 7)$ can't be equal to 0. Therefore, each term in the expression, $\frac{8x(x-7)-3(x-7)}{2(x-7)}$, can be divided by $(x - 7)$, which gives $\frac{8x-3}{2}$.

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:

Medium

Question ID 1e003284

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #002B36; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> <div style="width: 75%; background-color: #D9D9D9; height: 10px;"></div> |

ID: 1e003284

$$\begin{aligned}x &= 49 \\y &= \sqrt{x} + 9\end{aligned}$$

The graphs of the given equations intersect at the point (x, y) in the xy -plane. What is the value of y ?

- A. 16
- B. 40
- C. 81
- D. 130

ID: 1e003284 Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that the graphs of the given equations intersect at the point (x, y) in the xy -plane. It follows that (x, y) represents a solution to the system consisting of the given equations. The first equation given is $x = 49$. Substituting 49 for x in the second equation given, $y = \sqrt{x} + 9$, yields $y = \sqrt{49} + 9$, which is equivalent to $y = 7 + 9$, or $y = 16$. It follows that the graphs of the given equations intersect at the point $(49, 16)$. Therefore, the value of y is 16.

Choice B 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

Question ID 91e7ea5e

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 91e7ea5e

$$h(x) = 2(x - 4)^2 - 32$$

The quadratic function h is defined as shown. In the xy -plane, the graph of $y = h(x)$ intersects the x -axis at the points $(0, 0)$ and $(t, 0)$, where t is a constant. What is the value of t ?

- A. 1
- B. 2
- C. 4
- D. 8

ID: 91e7ea5e Answer

Correct Answer:

D

Rationale

Choice D is correct. It's given that the graph of $y = h(x)$ intersects the x -axis at $(0, 0)$ and $(t, 0)$, where t is a constant. Since this graph intersects the x -axis when $y = 0$ or when $h(x) = 0$, it follows that $h(0) = 0$ and $h(t) = 0$. If $h(t) = 0$, then $0 = 2(t - 4)^2 - 32$. Adding 32 to both sides of this equation yields $32 = 2(t - 4)^2$. Dividing both sides of this equation by 2 yields $16 = (t - 4)^2$. Taking the square root of both sides of this equation yields $4 = |t - 4|$. Adding 4 to both sides of this equation yields $8 = t$. Therefore, the value of t is 8.

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

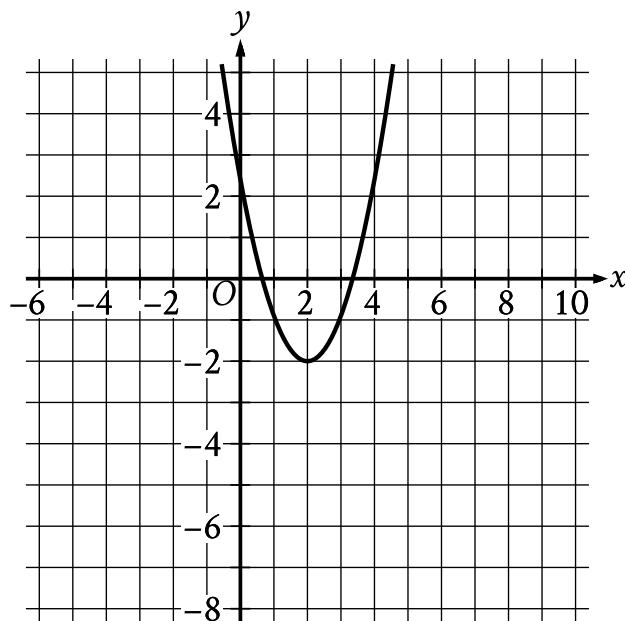
Question Difficulty:

Hard

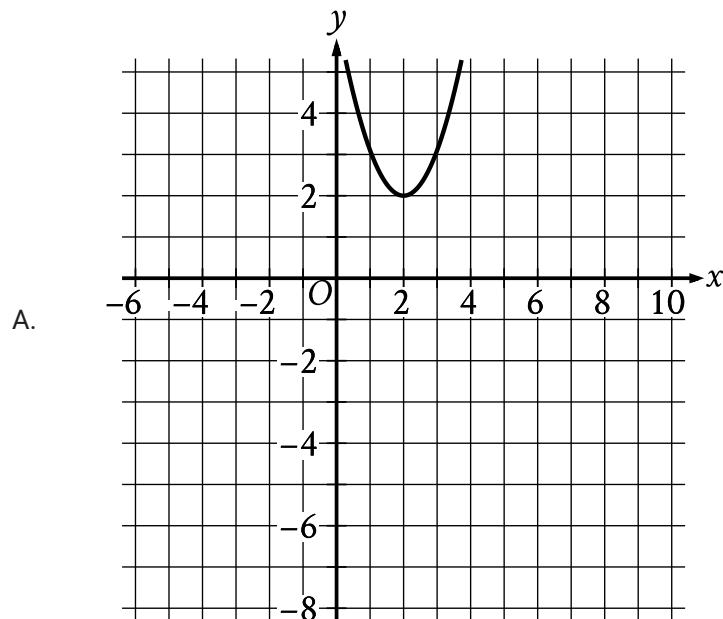
Question ID e9aed539

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #e0e0e0;"></div> <div style="width: 25%; background-color: #e0e0e0;"></div> |

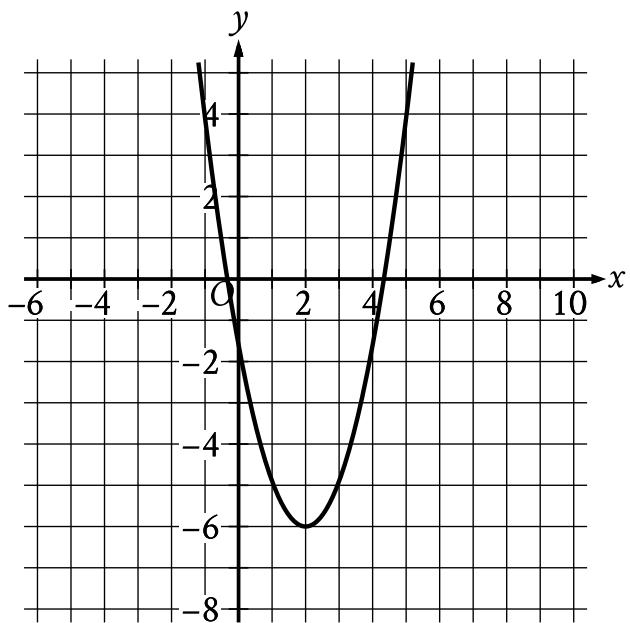
ID: e9aed539



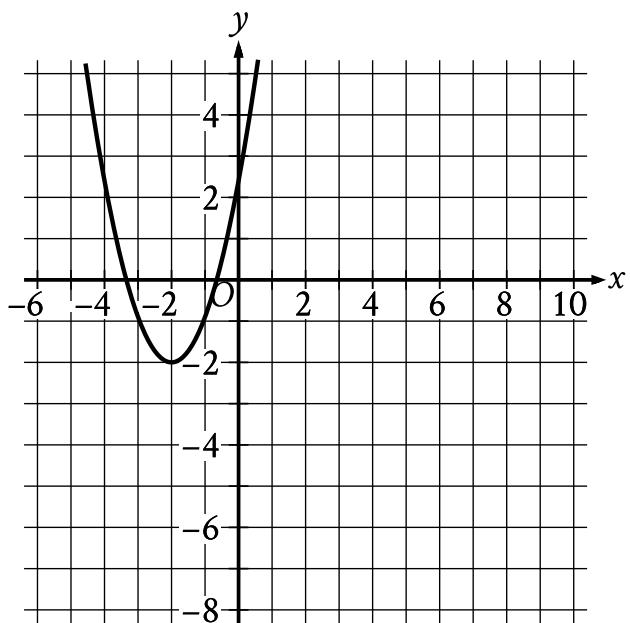
The graph shown will be translated up 4 units. Which of the following will be the resulting graph?



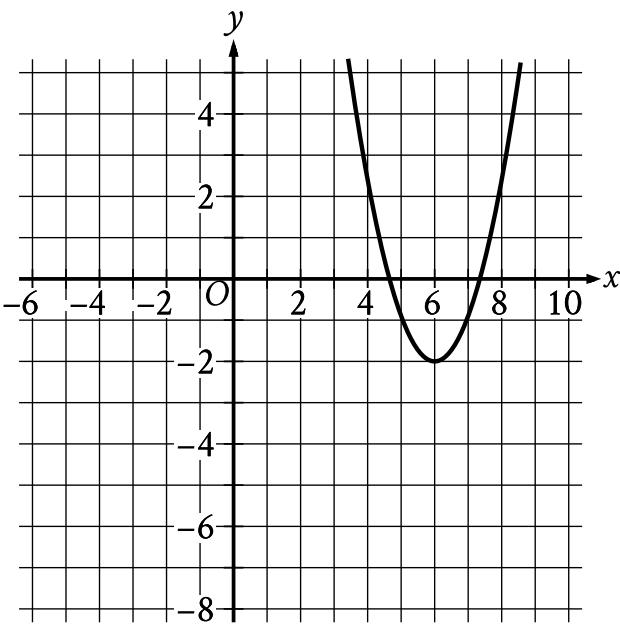
B.



C.



D.

**ID: e9aed539 Answer****Correct Answer:**

A

Rationale

Choice A is correct. When a graph is translated up 4 units, each point on the resulting graph is 4 units above the point on the original graph. In other words, the y-value of each point on the graph increases by 4. The graph shown passes through the points $(1, -1)$, $(2, -2)$, and $(3, -1)$. It follows that when the graph shown is translated up 4 units, the resulting graph will pass through the points $(1, -1 + 4)$, $(2, -2 + 4)$, and $(3, -1 + 4)$. These points are $(1, 3)$, $(2, 2)$, and $(3, 3)$, respectively. Of the given choices, only the graph in choice A passes through the points $(1, 3)$, $(2, 2)$, and $(3, 3)$.

Choice B is incorrect. This is the result of translating the graph down, rather than up, 4 units.

Choice C is incorrect. This is the result of translating the graph left, rather than up, 4 units.

Choice D is incorrect. This is the result of translating the graph right, rather than up, 4 units.

Question Difficulty:

Easy

Question ID 358f18bc

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 358f18bc

$$f(x) = x^2 - 48x + 2,304$$

What is the minimum value of the given function?

ID: 358f18bc Answer

Correct Answer:

1728

Rationale

The correct answer is 1,728. The given function can be rewritten in the form $f(x) = a(x - h)^2 + k$, where a is a positive constant and the minimum value, k , of the function occurs when the value of x is h . By completing the square,

$f(x) = x^2 - 48x + 2,304$ can be written as $f(x) = x^2 - 48x + (\frac{48}{2})^2 + 2,304 - (\frac{48}{2})^2$, or $f(x) = (x - 24)^2 + 1,728$.

This equation is in the form $f(x) = a(x - h)^2 + k$, where $a = 1$, $h = 24$, and $k = 1,728$. Therefore, the minimum value of the given function is 1,728.

Question Difficulty:

Hard

Question ID 3a9d60b2

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #005a9f; height: 10px;"></div> |

ID: 3a9d60b2

$$2|4 - x| + 3|4 - x| = 25$$

What is the positive solution to the given equation?

ID: 3a9d60b2 Answer

Correct Answer:

9

Rationale

The correct answer is 9. The given equation can be rewritten as $5|4 - x| = 25$. Dividing each side of this equation by 5 yields $|4 - x| = 5$. By the definition of absolute value, if $|4 - x| = 5$, then $4 - x = 5$ or $4 - x = -5$. Subtracting 4 from each side of the equation $4 - x = 5$ yields $-x = 1$. Dividing each side of this equation by -1 yields $x = -1$. Similarly, subtracting 4 from each side of the equation $4 - x = -5$ yields $-x = -9$. Dividing each side of this equation by -1 yields $x = 9$. Therefore, since the two solutions to the given equation are -1 and 9 , the positive solution to the given equation is 9 .

Question Difficulty:

Hard

Question ID 8490cc45

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 8490cc45

The function f is defined by $f(x) = (-8)(2)^x + 22$. What is the y -intercept of the graph of $y = f(x)$ in the xy -plane?

- A. $(0, 14)$
- B. $(0, 2)$
- C. $(0, 22)$
- D. $(0, -8)$

ID: 8490cc45 Answer

Correct Answer:

A

Rationale

Choice A is correct. The y -intercept of the graph of $y = f(x)$ in the xy -plane occurs at the point on the graph where $x = 0$. In other words, when $x = 0$, the corresponding value of $f(x)$ is the y -coordinate of the y -intercept. Substituting 0 for x in the given equation yields $f(0) = (-8)(2)^0 + 22$, which is equivalent to $f(0) = (-8)(1) + 22$, or $f(0) = 14$. Thus, when $x = 0$, the corresponding value of $f(x)$ is 14. Therefore, the y -intercept of the graph of $y = f(x)$ in the xy -plane is $(0, 14)$.

Choice B 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. This could be the y -intercept for $f(x) = (-8)(2)^x$, not $f(x) = (-8)(2)^x + 22$.

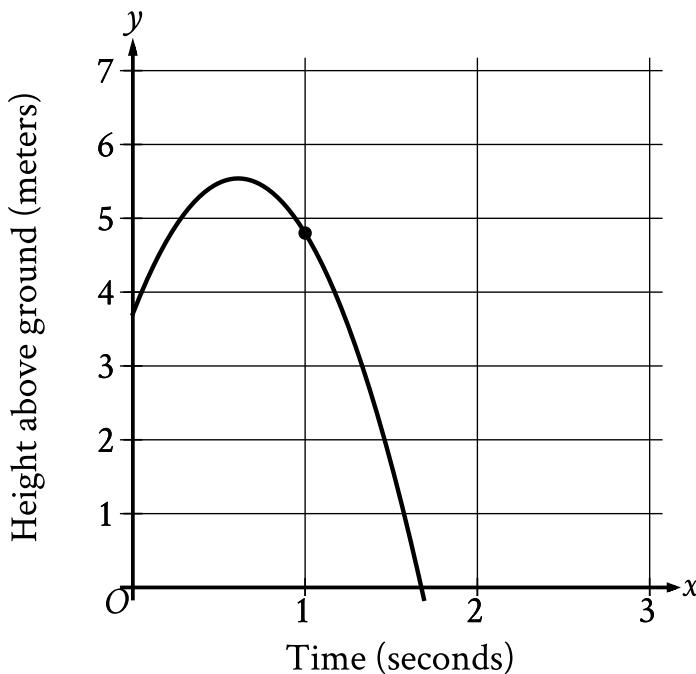
Question Difficulty:

Hard

Question ID 4bfff0a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 4bfff0a



The graph shows the height above ground, in meters, of a ball x seconds after the ball was launched upward from a platform. Which statement is the best interpretation of the marked point $(1.0, 4.8)$ in this context?

- A. 1.0 second after being launched, the ball's height above ground is 4.8 meters.
- B. 4.8 seconds after being launched, the ball's height above ground is 1.0 meter.
- C. The ball was launched from an initial height of 1.0 meter with an initial velocity of 4.8 meters per second.
- D. The ball was launched from an initial height of 4.8 meters with an initial velocity of 1.0 meter per second.

ID: 4bfff0a Answer

Correct Answer:

A

Rationale

Choice A is correct. It's given that the graph shows the height above ground, in meters, of a ball x seconds after the ball was launched upward from a platform. In the graph shown, the x -axis represents time, in seconds, and the y -axis represents the height of the ball above ground, in meters. It follows that for the marked point $(1.0, 4.8)$, 1.00 represents the time, in seconds, after the ball was launched upward from a platform and 4.80 represents the height of the ball above ground, in meters. Therefore, the best interpretation of the marked point $(1.0, 4.8)$ is 1.00 second after being launched, the ball's height above ground is 4.80 meters.

Choice B is incorrect and may result from conceptual errors.

Choice C is incorrect and may result from conceptual errors.

Choice D is incorrect and may result from conceptual errors.

Question Difficulty:

Easy

Question ID ebed7dc6

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: ebed7dc6

An auditorium has seats for 1,800 people. Tickets to attend a show at the auditorium currently cost \$4.00. For each \$1.00 increase to the ticket price, 100 fewer tickets will be sold. This situation can be modeled by the equation

$y = -100x^2 + 1,400x + 7,200$, where x represents the increase in ticket price, in dollars, and y represents the revenue, in dollars, from ticket sales. If this equation is graphed in the xy -plane, at what value of x is the maximum of the graph?

- A. 4
- B. 7
- C. 14
- D. 18

ID: ebed7dc6 Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that the situation can be modeled by the equation $y = -100x^2 + 1,400x + 7,200$, where x represents the increase in ticket price, in dollars, and y represents the revenue, in dollars, from ticket sales. Since the coefficient of the x^2 term is negative, the graph of this equation in the xy -plane opens downward and reaches its maximum value at its vertex. If a quadratic equation in the form $y = ax^2 + bx + c$, where a , b , and c are constants, is graphed in the xy -plane, the x -coordinate of the vertex is equal to $-\frac{b}{2a}$. For the equation $y = -100x^2 + 1,400x + 7,200$, $a = -100$, $b = 1,400$, and $c = 7,200$. It follows that the x -coordinate of the vertex is $-\frac{1,400}{2(-100)}$, or 7. Therefore, if the given equation is graphed in the xy -plane, the maximum of the graph occurs at an x -value of 7.

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:

Hard

Question ID ba0edc30

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|---|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%;"><div style="display: inline-block; width: 100%; height: 10px; background-color: #005a9f;"></div></div> |

ID: ba0edc30

$$x^2 - 2x - 9 = 0$$

One solution to the given equation can be written as $1 + \sqrt{k}$, where k is a constant. What is the value of k ?

- A. 8
- B. 10
- C. 20
- D. 40

ID: ba0edc30 Answer

Correct Answer:

B

Rationale

Choice B is correct. Adding 9 to each side of the given equation yields $x^2 - 2x = 9$. To complete the square, adding 1 to each side of this equation yields $x^2 - 2x + 1 = 9 + 1$, or $(x - 1)^2 = 10$. Taking the square root of each side of this equation yields $x - 1 = \pm\sqrt{10}$. Adding 1 to each side of this equation yields $x = 1 \pm \sqrt{10}$. Since it's given that one of the solutions to the equation can be written as $1 + \sqrt{k}$, the value of k must be 10.

Alternate approach: It's given that $1 + \sqrt{k}$ is a solution to the given equation. It follows that $x = 1 + \sqrt{k}$. Substituting $1 + \sqrt{k}$ for x in the given equation yields $(1 + \sqrt{k})^2 - 2(1 + \sqrt{k}) - 9 = 0$, or $(1 + \sqrt{k})(1 + \sqrt{k}) - 2(1 + \sqrt{k}) - 9 = 0$.

Expanding the products on the left-hand side of this equation yields $1 + 2\sqrt{k} + k - 2 - 2\sqrt{k} - 9 = 0$, or $k - 10 = 0$. Adding 10 to each side of this equation yields $k = 10$.

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:

Hard

Question ID 39714777

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 39714777

$$p(x) + 57 = x^2$$

The given equation relates the value of x and its corresponding value of $p(x)$ for the function p . What is the minimum value of the function p ?

- A. -3,249
- B. -57
- C. 57
- D. 3,249

ID: 39714777 Answer

Correct Answer:

B

Rationale

Choice B is correct. For a quadratic function defined by an equation of the form $p(x) = a(x - h)^2 + k$, where a , h , and k are constants and $a > 0$, the minimum value of the function is k . Subtracting 57 from both sides of the given equation yields $p(x) = x^2 - 57$. This function is in the form $p(x) = a(x - h)^2 + k$, where $a = 1$, $h = 0$, and $k = -57$. Therefore, the minimum value of the function p is -57.

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:

Medium

Question ID fc3d783a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

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

Question ID a9084ca4

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: a9084ca4

$$f(x) = 9,000(0.66)^x$$

The given function f models the number of advertisements a company sent to its clients each year, where x represents the number of years since 1997, and $0 \leq x \leq 5$. If $y = f(x)$ is graphed in the xy -plane, which of the following is the best interpretation of the y -intercept of the graph in this context?

- A. The minimum estimated number of advertisements the company sent to its clients during the 5 years was 1,708.
- B. The minimum estimated number of advertisements the company sent to its clients during the 5 years was 9,000.
- C. The estimated number of advertisements the company sent to its clients in 1997 was 1,708.
- D. The estimated number of advertisements the company sent to its clients in 1997 was 9,000.

ID: a9084ca4 Answer

Correct Answer:

D

Rationale

Choice D is correct. The y -intercept of a graph in the xy -plane is the point where $x = 0$. For the given function f , the y -intercept of the graph of $y = f(x)$ in the xy -plane can be found by substituting 0 for x in the equation $y = 9,000(0.66)^x$, which gives $y = 9,000(0.66)^0$. This is equivalent to $y = 9,000(1)$, or $y = 9,000$. Therefore, the y -intercept of the graph of $y = f(x)$ is $(0, 9,000)$. It's given that the function f models the number of advertisements a company sent to its clients each year. Therefore, $f(x)$ represents the estimated number of advertisements the company sent to its clients each year. It's also given that x represents the number of years since 1997. Therefore, $x = 0$ represents 0 years since 1997, or 1997. Thus, the best interpretation of the y -intercept of the graph of $y = f(x)$ is that the estimated number of advertisements the company sent to its clients in 1997 was 9,000.

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

Question ID 075b29b0

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 075b29b0

Which expression is equivalent to $(9x^3 + 5x + 7) + (6x^3 + 5x^2 - 5)$?

- A. $15x^6 + 5x^2 - 5x - 35$
- B. $15x^3 + 10x^2 + 2$
- C. $15x^6 + 5x^2 + 5x + 2$
- D. $15x^3 + 5x^2 + 5x + 2$

ID: 075b29b0 Answer

Correct Answer:

D

Rationale

Choice D is correct. The given expression can be rewritten as $(9x^3 + 6x^3) + 5x^2 + 5x + (7 - 5)$. Combining like terms in this expression yields $15x^3 + 5x^2 + 5x + 2$.

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:

Easy

Question ID 2c6f214f

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 2c6f214f

The first term of a sequence is **9**. Each term after the first is **4** times the preceding term. If w represents the n th term of the sequence, which equation gives w in terms of n ?

- A. $w = 4(9^n)$
- B. $w = 4(9^{n-1})$
- C. $w = 9(4^n)$
- D. $w = 9(4^{n-1})$

ID: 2c6f214f Answer

Correct Answer:

D

Rationale

Choice D is correct. Since w represents the n th term of the sequence and **9** is the first term of the sequence, the value of w is **9** when the value of n is **1**. Since each term after the first is **4** times the preceding term, the value of w is **9(4)** when the value of n is **2**. Therefore, the value of w is **9(4)(4)**, or **$9(4)^2$** , when the value of n is **3**. More generally, the value of w is **$9(4^{n-1})$** for a given value of n . Therefore, the equation $w = 9(4^{n-1})$ gives w in terms of n .

Choice A is incorrect. This equation describes a sequence for which the first term is **36**, rather than **9**, and each term after the first is **9**, rather than **4**, times the preceding term.

Choice B is incorrect. This equation describes a sequence for which the first term is **4**, rather than **9**, and each term after the first is **9**, rather than **4**, times the preceding term.

Choice C is incorrect. This equation describes a sequence for which the first term is **36**, rather than **9**.

Question Difficulty:

Hard

Question ID 781c2f6e

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 781c2f6e

The function f is defined by $f(x) = a(2.2^x + 2.2^b)$, where a and b are integer constants and $0 < a < b$. The functions g and h are equivalent to function f , where k and m are constants. Which of the following equations displays the y -coordinate of the y -intercept of the graph of $y = f(x)$ in the xy -plane as a constant or coefficient?

- I. $g(x) = a(2.2^x + k)$
- II. $h(x) = a(2.2)^x + m$

- A. I only
- B. II only
- C. I and II
- D. Neither I nor II

ID: 781c2f6e Answer

Correct Answer:

D

Rationale

Choice D is correct. A y -intercept of a graph in the xy -plane is a point where the graph intersects the y -axis, or a point where $x = 0$. Substituting 0 for x in the equation defining function f yields $f(0) = a(2.2^0 + 2.2^b)$, or $f(0) = a(1 + 2.2^b)$. So, the y -coordinate of the y -intercept of the graph is $a(1 + 2.2^b)$, or equivalently, $a + a(2.2)^b$. It's given that function g is equivalent to function f , where $0 < a < b$. It follows that $k = 2.2^b$. Since $a(2.2)^b$ can't be equal to 0, the coefficient a can't be equal to $a + a(2.2)^b$. Since $0 < a$, the constant k , which is equal to 2.2^b , can't be equal to $a + a(2.2)^b$. Therefore, function g doesn't display the y -coordinate of the y -intercept of the graph of $y = f(x)$ in the xy -plane as a constant or coefficient. It's also given that function h is equivalent to function f , where $0 < a < b$. The equation defining f can be rewritten as $f(x) = a(2.2)^x + a(2.2)^b$. It follows that $m = a(2.2)^b$. Since $a(2.2)^b$ can't be equal to 0, the coefficient a can't be equal to $a + a(2.2)^b$. Since $0 < a$, the constant m , which is equal to $a(2.2)^b$, can't be equal to $a + a(2.2)^b$. Therefore, function h doesn't display the y -coordinate of the y -intercept of the graph of $y = f(x)$ in the xy -plane as a constant or coefficient. Thus, neither function g nor function h displays the y -coordinate of the y -intercept of the graph of $y = f(x)$ in the xy -plane as a constant or coefficient.

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

Question ID cb29c54c

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: cb29c54c

A physics class is planning an experiment about a toy rocket. The equation $y = -16(x - 5.6)^2 + 502$ gives the estimated height y , in feet, of the toy rocket x seconds after it is launched into the air. Which of the following is the best interpretation of the vertex of the graph of the equation in the xy -plane?

- A. This toy rocket reaches an estimated maximum height of **502** feet **16** seconds after it is launched into the air.
- B. This toy rocket reaches an estimated maximum height of **502** feet **5.6** seconds after it is launched into the air.
- C. This toy rocket reaches an estimated maximum height of **16** feet **502** seconds after it is launched into the air.
- D. This toy rocket reaches an estimated maximum height of **5.6** feet **502** seconds after it is launched into the air.

ID: cb29c54c Answer

Correct Answer:

B

Rationale

Choice B is correct. The vertex of the graph of a quadratic equation is where it reaches its minimum or maximum value. When a quadratic equation is written in the form $y = a(x - h)^2 + k$, the vertex of the parabola represented by the equation is $(x, y) = (h, k)$. In the given equation $y = -16(x - 5.6)^2 + 502$, the value of h is **5.6** and the value of k is **502**. It follows that the vertex of the graph of this equation in the xy -plane is $(x, y) = (5.6, 502)$. Additionally, since $a = -16$ in the given equation, the graph of the quadratic equation opens down, and the vertex represents a maximum. It's given that the value of y represents the estimated height, in feet, of the toy rocket x seconds after it is launched into the air. Therefore, this toy rocket reaches an estimated maximum height of **502** feet **5.6** seconds after it is launched into the air.

Choice A is incorrect. The **16** in the equation is an indicator of how narrow the graph of the equation is rather than where it reaches its maximum.

Choice C is incorrect. The **16** in the equation is an indicator of how narrow the graph of the equation is rather than where it reaches its maximum.

Choice D is incorrect. This is an interpretation of the vertex of the graph of the equation $y = -16(x - 502)^2 + 5.6$, not of the equation $y = -16(x - 5.6)^2 + 502$.

Question Difficulty:

Medium

Question ID 4661e2a9

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

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 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.

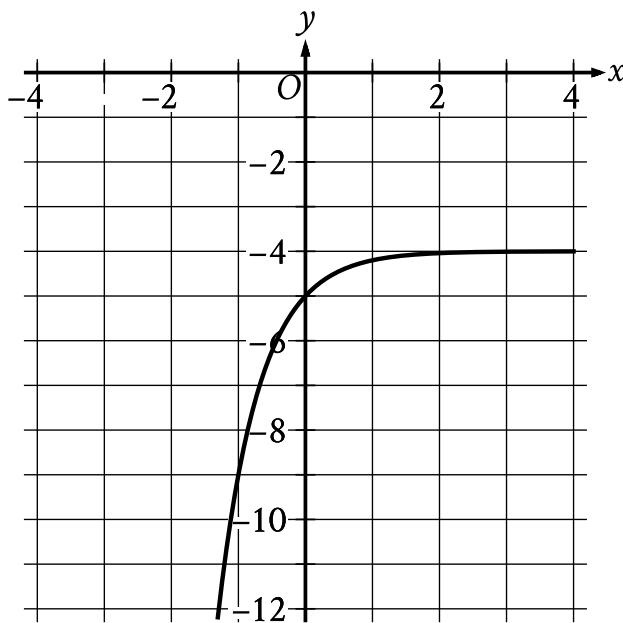
Question Difficulty:

Hard

Question ID 6abec9a8

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> <div style="width: 75%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 6abec9a8



What is the y -intercept of the graph shown?

- A. $(-1, -9)$
- B. $(0, -5)$
- C. $(0, -4)$
- D. $(0, 0)$

ID: 6abec9a8 Answer

Correct Answer:

B

Rationale

Choice B is correct. The y -intercept of a graph in the xy -plane is the point (x, y) on the graph where $x = 0$. At $x = 0$, the corresponding value of y is -5 . Therefore, the y -intercept of the graph shown is $(0, -5)$.

Choice A is incorrect and may result from conceptual errors.

Choice C is incorrect. This is the y -intercept of a graph in the xy -plane that intersects the y -axis at $y = -4$, not $y = -5$.

Choice D is incorrect. This is the y -intercept of a graph in the xy -plane that intersects the y -axis at $y = 0$, not $y = -5$.

Question Difficulty:

Easy

Question ID ad2ec615

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 20%; background-color: #0056b3; height: 10px;"></div> <div style="width: 60%; background-color: #e0e0e0; height: 10px;"></div> |

ID: ad2ec615

Which of the following is equivalent to the expression $x^4 - x^2 - 6$?

- A. $(x^2 + 1)(x^2 - 6)$
- B. $(x^2 + 2)(x^2 - 3)$
- C. $(x^2 + 3)(x^2 - 2)$
- D. $(x^2 + 6)(x^2 - 1)$

ID: ad2ec615 Answer

Correct Answer:

B

Rationale

Choice B is correct. The term x^4 can be factored as $(x^2)(x^2)$. Factoring -6 as $(2)(-3)$ yields values that add to -1 , the coefficient of x^2 in the expression.

Choices A, C, and D are incorrect and may result from finding factors of -6 that don't add to the coefficient of x^2 in the original expression.

Question Difficulty:

Medium

Question ID 42c71eb5

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 25%; background-color: #005a9f; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 42c71eb5

$$(2x + 5)^2 - (x - 2) + 2(x + 3)$$

Which of the following is equivalent to the expression above?

- A. $4x^2 + 21x + 33$
- B. $4x^2 + 21x + 29$
- C. $4x^2 + x + 29$
- D. $4x^2 + x + 33$

ID: 42c71eb5 Answer

Correct Answer:

A

Rationale

Choice A is correct. The given expression can be rewritten as $(2x + 5)^2 + (-1)(x - 2) + 2(x + 3)$. Applying the distributive property, the expression $(-1)(x - 2) + 2(x + 3)$ can be rewritten as $-1(x) + (-1)(-2) + 2(x) + 2(3)$, or $-x + 2 + 2x + 6$. Adding like terms yields $x + 8$. Substituting $x + 8$ for $(-1)(x - 2) + 2(x + 3)$ in the given expression yields $(2x + 5)^2 + x + 8$. By the rules of exponents, the expression $(2x + 5)^2$ is equivalent to $(2x + 5)(2x + 5)$. Applying the distributive property, this expression can be rewritten as $2x(2x) + 2x(5) + 5(2x) + 5(5)$, or $4x^2 + 10x + 10x + 25$. Adding like terms gives $4x^2 + 20x + 25$. Substituting $4x^2 + 20x + 25$ for $(2x + 5)^2$ in the rewritten expression yields $4x^2 + 20x + 25 + x + 8$, and adding like terms yields $4x^2 + 21x + 33$.

Choices B, C, and D are incorrect. Choices C and D may result from rewriting the expression $(2x + 5)^2$ as $4x^2 + 25$, instead of as $4x^2 + 20x + 25$. Choices B and C may result from rewriting the expression $-(x - 2)$ as $-x - 2$, instead of $-x + 2$.

Question Difficulty:

Medium

Question ID 52b1700c

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 52b1700c

| Time (years) | Total amount (dollars) |
|--------------|------------------------|
| 0 | 604.00 |
| 1 | 606.42 |
| 2 | 608.84 |

Rosa opened a savings account at a bank. The table shows the exponential relationship between the time t , in years, since Rosa opened the account and the total amount n , in dollars, in the account. If Rosa made no additional deposits or withdrawals, which of the following equations best represents the relationship between t and n ?

- A. $n = (1 + 604)^t$
- B. $n = (1 + 0.004)^t$
- C. $n = 604(1 + 0.004)^t$
- D. $n = 0.004(1 + 604)^t$

ID: 52b1700c Answer

Correct Answer:

C

Rationale

Choice C is correct. It's given that the relationship between t and n is exponential. The table shows that the value of n increases as the value of t increases. Therefore, the relationship between t and n can be represented by an increasing exponential equation of the form $n = a(1 + b)^t$, where a and b are positive constants. The table shows that when $t = 0$, $n = 604$. Substituting 0 for t and 604 for n in the equation $n = a(1 + b)^t$ yields $604 = a(1 + b)^0$, which is equivalent to $604 = a(1)$, or $604 = a$. Substituting 604 for a in the equation $n = a(1 + b)^t$ yields $n = 604(1 + b)^t$. The table also shows that when $t = 1$, $n = 606.42$. Substituting 1 for t and 606.42 for n in the equation $n = 604(1 + b)^t$ yields $606.42 = 604(1 + b)^1$, or $606.42 = 604(1 + b)$. Dividing both sides of this equation by 604 yields approximately $1.004 = 1 + b$. Subtracting 1 from both sides of this equation yields that the value of b is approximately 0.004. Substituting 0.004 for b in the equation $n = 604(1 + b)^t$ yields $n = 604(1 + 0.004)^t$. Therefore, of the choices, choice C best represents the relationship between t and n .

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:

Medium

Question ID 371cbf6b

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 371cbf6b

$$(ax + 3)(5x^2 - bx + 4) = 20x^3 - 9x^2 - 2x + 12$$

The equation above is true for all x , where a and b are constants. What is the value of ab ?

- A. 18
- B. 20
- C. 24
- D. 40

ID: 371cbf6b Answer

Correct Answer:

C

Rationale

Choice C is correct. If the equation is true for all x , then the expressions on both sides of the equation will be equivalent. Multiplying the polynomials on the left-hand side of the equation gives $5ax^3 - abx^2 + 4ax + 15x^2 - 3bx + 12$. On the right-hand side of the equation, the only x^2 -term is $-9x^2$. Since the expressions on both sides of the equation are equivalent, it follows that $-abx^2 + 15x^2 = -9x^2$, which can be rewritten as $(-ab + 15)x^2 = -9x^2$. Therefore, $-ab + 15 = -9$, which gives $ab = 24$.

Choice A is incorrect. If $ab = 18$, then the coefficient of x^2 on the left-hand side of the equation would be $-18 + 15 = -3$, which doesn't equal the coefficient of x^2 , -9 , on the right-hand side. Choice B is incorrect. If $ab = 20$, then the coefficient of x^2 on the left-hand side of the equation would be $-20 + 15 = -5$, which doesn't equal the coefficient of x^2 , -9 , on the right-hand side. Choice D is incorrect. If $ab = 40$, then the coefficient of x^2 on the left-hand side of the equation would be $-40 + 15 = -25$, which doesn't equal the coefficient of x^2 , -9 , on the right-hand side.

Question Difficulty:

Hard

Question ID b4acba95

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---|--|
| SAT | Math | Advanced Math | Nonlinear equations in one variable and systems of equations in two variables | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: b4acba95

$$x^2 - 12x + 27 = 0$$

How many distinct real solutions does the given equation have?

- A. Exactly two
- B. Exactly one
- C. Zero
- D. Infinitely many

ID: b4acba95 Answer

Correct Answer:

A

Rationale

Choice A is correct. The number of solutions of a quadratic equation of the form $ax^2 + bx + c = 0$, where a , b , and c are constants, can be determined by the value of the discriminant, $b^2 - 4ac$. If the value of the discriminant is positive, then the quadratic equation has exactly two distinct real solutions. If the value of the discriminant is equal to zero, then the quadratic equation has exactly one real solution. If the value of the discriminant is negative, then the quadratic equation has zero real solutions. In the given equation, $x^2 - 12x + 27 = 0$, $a = 1$, $b = -12$, and $c = 27$. Substituting these values for a , b , and c in $b^2 - 4ac$ yields $(-12)^2 - 4(1)(27)$, or 36. Since the value of its discriminant is positive, the given equation has exactly two distinct real solutions.

Choice B 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:

Medium

Question ID ff8c5844

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: ff8c5844

| x | $g(x)$ |
|-----|-----------------|
| -1 | 25 |
| 0 | 1 |
| 1 | $\frac{1}{25}$ |
| 2 | $\frac{1}{625}$ |

For the exponential function g , the table shows four values of x and their corresponding values of $g(x)$. Which equation defines g ?

- A. $g(x) = -25^x$
- B. $g(x) = -\left(\frac{1}{25}\right)^x$
- C. $g(x) = 25^x$
- D. $g(x) = \left(\frac{1}{25}\right)^x$

ID: ff8c5844 Answer

Correct Answer:

D

Rationale

Choice D is correct. It's given that function g is exponential. Therefore, an equation defining g can be written in the form $g(x) = a(b)^x$, where a and b are constants. The table shows that when $x = 0$, $g(x) = 1$. Substituting 0 for x and 1 for $g(x)$ in the equation $g(x) = a(b)^x$ yields $1 = a(b)^0$, which is equivalent to $1 = a$. Substituting 1 for a in the equation $g(x) = a(b)^x$ yields $g(x) = (b)^x$. The table also shows that when $x = 1$, $g(x) = \frac{1}{25}$. Substituting 1 for x and $\frac{1}{25}$ for $g(x)$ in the equation $g(x) = (b)^x$ yields $\frac{1}{25} = (b)^1$, which is equivalent to $\frac{1}{25} = b$. Substituting $\frac{1}{25}$ for b in the equation $g(x) = (b)^x$ yields $g(x) = \left(\frac{1}{25}\right)^x$.

Choice A is incorrect. For this function, $g(1)$ is equal to -25 , not $\frac{1}{25}$.

Choice B is incorrect. For this function, $g(1)$ is equal to $-\frac{1}{25}$, not $\frac{1}{25}$.

Choice C is incorrect. For this function, $g(1)$ is equal to 25 , not $\frac{1}{25}$.

Question Difficulty:

Medium

Question ID a05bd3a4

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 25%; background-color: #005a9f;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: a05bd3a4

Which of the following expressions is equivalent to $x^2 - 5$?

A. $(x + \sqrt{5})^2$

B. $(x - \sqrt{5})^2$

C. $(x + \sqrt{5})(x - \sqrt{5})$

D. $(x + 5)(x - 1)$

ID: a05bd3a4 Answer

Correct Answer:

C

Rationale

Choice C is correct. The expression can be written as a difference of squares $x^2 - y^2$, which can be factored as $(x + y)(x - y)$. Here, $y^2 = 5$, so $y = \sqrt{5}$, and the expression therefore factors as $(x + \sqrt{5})(x - \sqrt{5})$.

Choices A and B are incorrect and may result from misunderstanding how to factor a difference of squares. Choice D is incorrect; $(x + 5)(x - 1)$ can be rewritten as $x^2 + 4x - 5$, which is not equivalent to the original expression.

Question Difficulty:

Medium

Question ID c3b116d7

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|---|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%;"><div style="display: inline-block; width: 100%; height: 10px; background-color: #005a9f;"></div></div> |

ID: c3b116d7

Which of the following expressions is(are) a factor of $3x^2 + 20x - 63$?

- I. $x - 9$
- II. $3x - 7$

- A. I only
- B. II only
- C. I and II
- D. Neither I nor II

ID: c3b116d7 Answer

Correct Answer:

B

Rationale

Choice B is correct. The given expression can be factored by first finding two values whose sum is 20 and whose product is $3(-63)$, or -189 . Those two values are 27 and -7 . It follows that the given expression can be rewritten as $3x^2 + 27x - 7x - 63$. Since the first two terms of this expression have a common factor of $3x$ and the last two terms of this expression have a common factor of -7 , this expression can be rewritten as $3x(x + 9) - 7(x + 9)$. Since the two terms of this expression have a common factor of $(x + 9)$, it can be rewritten as $(3x - 7)(x + 9)$. Therefore, expression II, $3x - 7$, is a factor of $3x^2 + 20x - 63$, but expression I, $x - 9$, is not a factor of $3x^2 + 20x - 63$.

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:

Hard

Question ID 40c09d66

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|------------------------|--|
| SAT | Math | Advanced Math | Equivalent expressions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 40c09d66

If $\frac{\sqrt{x^5}}{3\sqrt[3]{x^4}} = x^{\frac{a}{b}}$ for all positive values of x ,

what is the value of $\frac{a}{b}$?

ID: 40c09d66 Answer

Rationale

The correct answer is $\frac{7}{6}$. The value of $\frac{a}{b}$ can be found by first rewriting the left-hand side of the given equation as $x^{\frac{5}{2} - \frac{4}{3}}$. Using the properties of exponents, this expression can be rewritten as $x^{\left(\frac{5}{2} - \frac{4}{3}\right)}$.

fractions in the exponent, which yields $x^{\frac{7}{6}}$. Thus, $\frac{a}{b}$ is $\frac{7}{6}$. Note that 7/6, 1.166, and 1.167 are examples of ways to enter a correct answer.

$$\frac{x^{\frac{5}{2}}}{x^{\frac{4}{3}}} = x^{\left(\frac{5}{2} - \frac{4}{3}\right)}$$

This expression can be rewritten by subtracting the

Question Difficulty:

Hard

Question ID f423771c

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: f423771c

| x | $h(x)$ |
|-----|--------|
| 0 | 1.23 |
| 2 | 1.54 |
| 4 | 1.94 |

The table shows the exponential relationship between the number of years, x , since Hana started training in pole vault, and the estimated height $h(x)$, in meters, of her best pole vault for that year. Which of the following functions best represents this relationship, where $x \leq 4$?

- A. $h(x) = 1.12(0.23)^x$
- B. $h(x) = 1.12(1.23)^x$
- C. $h(x) = 1.23(0.12)^x$
- D. $h(x) = 1.23(1.12)^x$

ID: f423771c Answer

Correct Answer:

D

Rationale

Choice D is correct. The table shows an increasing exponential relationship between the number of years, x , since Hana started training in pole vault and the estimated height $h(x)$, in meters, of her best pole vault for that year. The relationship can be written as $h(x) = Ca^x$, where C and a are positive constants. It's given that when $x = 0$, $h(x) = 1.23$. Substituting 0 for x and 1.23 for $h(x)$ in $h(x) = Ca^x$ yields $1.23 = Ca^0$, or $1.23 = C$. Substituting 1.23 for C in $h(x) = Ca^x$ yields $h(x) = 1.23a^x$. It's also given that when $x = 2$, $h(x) = 1.54$. Substituting 2 for x and 1.54 for $h(x)$ in $h(x) = 1.23a^x$ yields $1.54 = 1.23a^2$. Dividing each side of this equation by 1.23 yields $\frac{1.54}{1.23} = \frac{1.23a^2}{1.23}$, or a^2 is approximately equal to 1.252. Since a is positive, a is approximately equal to $\sqrt{1.252}$, or 1.12. Substituting 1.12 for a in $h(x) = 1.23a^x$ yields $h(x) = 1.23(1.12)^x$.

Choice A is incorrect. When $x = 0$, the value of $h(x)$ in this function is equal to 1.12 rather than 1.23, and it is decreasing rather than increasing.

Choice B is incorrect. When $x = 0$, the value of $h(x)$ in this function is equal to 1.12 rather than 1.23.

Choice C is incorrect. This function is decreasing rather than increasing.

Question Difficulty:

Medium

Question ID b8f13a3a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: b8f13a3a

Function f is defined by $f(x) = -a^x + b$, where a and b are constants. In the xy -plane, the graph of $y = f(x) - 12$ has a y -intercept at $(0, -\frac{75}{7})$. The product of a and b is $\frac{320}{7}$. What is the value of a ?

ID: b8f13a3a Answer

Correct Answer:

20

Rationale

The correct answer is 20. It's given that $f(x) = -a^x + b$. Substituting $-a^x + b$ for $f(x)$ in the equation $y = f(x) - 12$ yields $y = -a^x + b - 12$. It's given that the y -intercept of the graph of $y = f(x) - 12$ is $(0, -\frac{75}{7})$. Substituting 0 for x and $-\frac{75}{7}$ for y in the equation $y = -a^x + b - 12$ yields $-\frac{75}{7} = -a^0 + b - 12$, which is equivalent to $-\frac{75}{7} = -1 + b - 12$, or $-\frac{75}{7} = b - 13$. Adding 13 to both sides of this equation yields $\frac{16}{7} = b$. It's given that the product of a and b is $\frac{320}{7}$, or $ab = \frac{320}{7}$. Substituting $\frac{16}{7}$ for b in this equation yields $(a)(\frac{16}{7}) = \frac{320}{7}$. Dividing both sides of this equation by $\frac{16}{7}$ yields $a = 20$.

Question Difficulty:

Hard

Question ID 8e1da169

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 75%; background-color: #0056b3; height: 10px;"></div> |

ID: 8e1da169

$$f(x) = (x - 44)(x - 46)$$

The function f is defined by the given equation. For what value of x does $f(x)$ reach its minimum?

- A. 46
- B. 45
- C. 44
- D. -1

ID: 8e1da169 Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that $f(x) = (x - 44)(x - 46)$, which can be rewritten as $f(x) = x^2 - 90x + 2,024$. Since the coefficient of the x^2 -term is positive, the graph of $y = f(x)$ in the xy -plane opens upward and reaches its minimum value at its vertex. For an equation in the form $f(x) = ax^2 + bx + c$, where a , b , and c are constants, the x -coordinate of the vertex is $-\frac{b}{2a}$. For the equation $f(x) = x^2 - 90x + 2,024$, $a = 1$, $b = -90$, and $c = 2,024$. It follows that the x -coordinate of the vertex is $-\frac{(-90)}{2(1)}$, or 45. Therefore, $f(x)$ reaches its minimum when the value of x is 45.

Choice A is incorrect. This is one of the x -coordinates of the x -intercepts of the graph of $y = f(x)$ in the xy -plane.

Choice C is incorrect. This is one of the x -coordinates of the x -intercepts of the graph of $y = f(x)$ in the xy -plane.

Choice D is incorrect. This is the y -coordinate of the vertex of the graph of $y = f(x)$ in the xy -plane.

Question Difficulty:

Hard

Question ID 1d3c5c95

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 25%; background-color: #0056b3; height: 10px;"></div> <div style="width: 50%; background-color: #e0e0e0; height: 10px;"></div> |

ID: 1d3c5c95

$$f(x) = 4,000(0.75)^x$$

An entomologist recommended a program to reduce a certain invasive beetle population in an area. The given function estimates this beetle species' population x years after 2012, where $x \leq 7$. Which of the following is the best interpretation of 4,000 in this context?

- A. The estimated initial beetle population for this species and area in 2012
- B. The estimated beetle population for this species and area 7 years after 2012
- C. The estimated percent decrease in the beetle population for this species and area each year after 2012
- D. The estimated percent decrease in the beetle population for this species and area every 7 years after 2012

ID: 1d3c5c95 Answer

Correct Answer:

A

Rationale

Choice A is correct. For an exponential function in the form $f(x) = a(b)^x$, where a and b are positive constants and $b < 1$, the initial value of $f(x)$, or the value of $f(x)$ when $x = 0$, is a and the value of $f(x)$ decreases by $100(1 - b)\%$ each time x increases by 1. Therefore, the initial value of the function $f(x) = 4,000(0.75)^x$, or the value of $f(x)$ when $x = 0$, is 4,000. Therefore, the best interpretation of 4,000 in this context is the estimated initial beetle population for this species and area in 2012.

Choice B is incorrect. The estimated beetle population for this species and area 7 years after 2012 is $4,000(0.75)^7$, or approximately 534, not 4,000.

Choice C is incorrect. The estimated percent decrease in the beetle population for this species and area each year after 2012 is $100(1 - 0.75)$, or 25, not 4,000.

Choice D is incorrect. The estimated percent decrease in the beetle population for this species and area every 7 years after 2012 is $100(1 - 0.75^7)$, or approximately 87, not 4,000.

Question Difficulty:

Medium

Question ID ae05d37b

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 50%; background-color: #e0e0e0;"></div> |

ID: ae05d37b

The function $f(t) = 40,000(2)^{\frac{t}{790}}$ gives the number of bacteria in a population t minutes after an initial observation. How much time, in minutes, does it take for the number of bacteria in the population to double?

- A. 2
- B. 790
- C. 1,580
- D. 40,000

ID: ae05d37b Answer

Correct Answer:

B

Rationale

Choice B is correct. It's given that t minutes after an initial observation, the number of bacteria in a population is $40,000(2)^{\frac{t}{790}}$. This expression consists of the initial number of bacteria, 40,000, multiplied by the expression $2^{\frac{t}{790}}$. The time, in minutes, it takes for the number of bacteria to double is the increase in the value of t that causes the expression $2^{\frac{t}{790}}$ to double. Since the base is 2, the expression $2^{\frac{t}{790}}$ will double when the exponent increases by 1. Since the exponent of this expression is $\frac{t}{790}$, the exponent will increase by 1 when t increases by 790. Therefore, the time, in minutes, it takes for the number of bacteria in the population to double is 790.

Choice A is incorrect. This is the base of the exponent, not the time it takes for the number of bacteria in the population to double.

Choice C is incorrect. This is the number of minutes it takes for the population to double twice.

Choice D is incorrect. This is the number of bacteria that are initially observed, not the time it takes for the number of bacteria in the population to double.

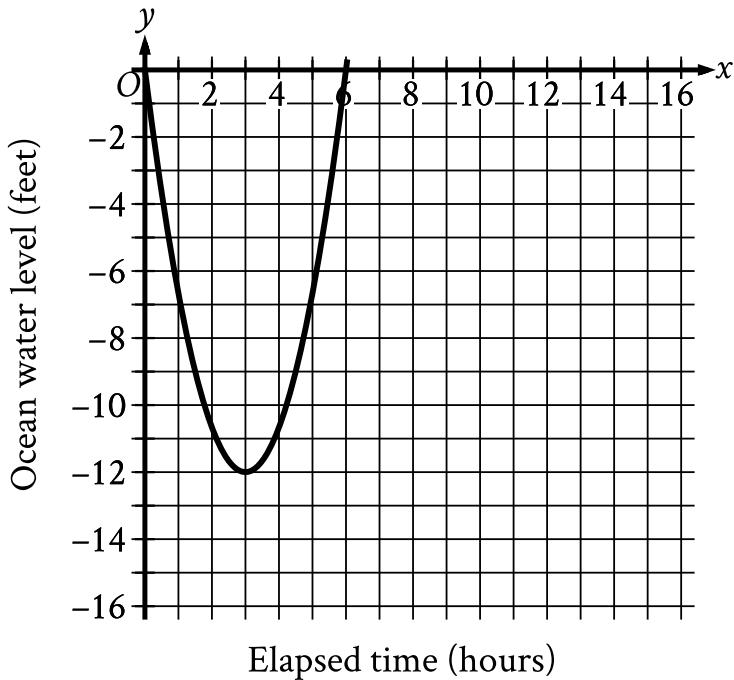
Question Difficulty:

Medium

Question ID 1ee962ec

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|--|
| SAT | Math | Advanced Math | Nonlinear functions | <div style="width: 25%; background-color: #0056b3;"></div> <div style="width: 25%; background-color: #e0e0e0;"></div> <div style="width: 25%; background-color: #e0e0e0;"></div> |

ID: 1ee962ec



Scientists recorded data about the ocean water levels at a certain location over a period of 6 hours. The graph shown models the data, where $y = 0$ represents sea level. Which table gives values of x and their corresponding values of y based on the model?

A.

| x | y |
|-----|-----|
| 0 | -12 |
| 0 | 3 |
| 3 | 6 |

B.

| x | y |
|-----|-----|
| 0 | 0 |
| 3 | 12 |
| 0 | -6 |

C.

| x | y |
|-----|-----|
| 0 | 0 |
| 3 | -12 |
| 6 | 0 |

| D. | x | y |
|----|-----|-----|
| | 0 | 0 |
| | 12 | 3 |
| | -6 | 0 |

ID: 1ee962ec Answer

Correct Answer:

C

Rationale

Choice C is correct. Each point (x, y) on the graph represents an elapsed time x , in hours, and the corresponding ocean water level y , in feet, at a certain location based on the model. The graph shown passes through the points $(0, 0)$, $(3, -12)$, and $(6, 0)$. Thus, the table in choice C gives the values of x and their corresponding values of y based on the model.

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