

Question ID 9c086e5a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 9c086e5a

| 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: 9c086e5a 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 4782fd69

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 4782fd69

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: 4782fd69 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 c9f2f07d

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: c9f2f07d

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

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: c9f2f07d 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 72bf9318

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 72bf9318

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: 72bf9318 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 f0b332e0

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: f0b332e0

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: f0b332e0 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 ed5b7c61

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: ed5b7c61

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

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: ed5b7c61 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 ID d39e9424

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: d39e9424

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: d39e9424 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 6075b3e6

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 6075b3e6

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: 6075b3e6 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 .

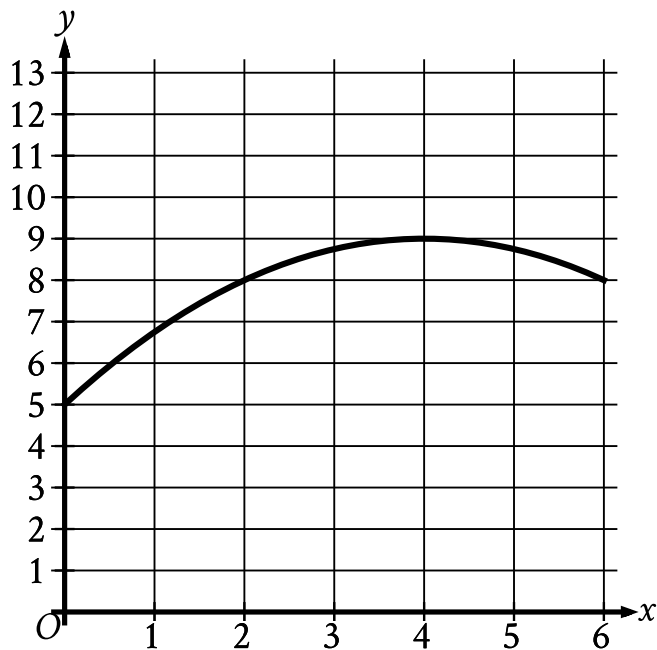
Choice D is incorrect. This is the value of C .

Question Difficulty: Medium

Question ID f1e48337

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: f1e48337



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: f1e48337 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 089f576c

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 089f576c

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

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: 089f576c 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 4fb712ae

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 4fb712ae

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

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: 4fb712ae 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.

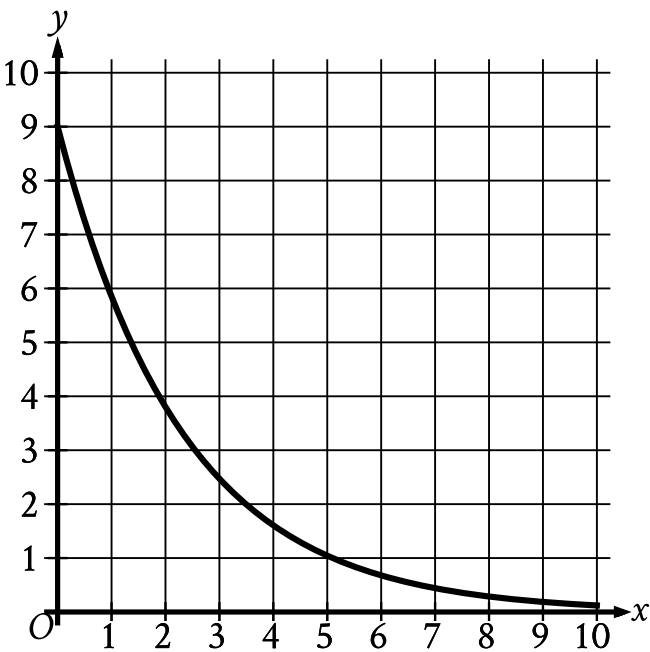
Choice D is incorrect and may result from conceptual or calculation errors.

Question Difficulty: Medium

Question ID 172e8982

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 172e8982



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: 172e8982 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 8df65561

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 8df65561

$$f(x) = x^2 - 18x - 360$$

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: 8df65561 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 f929d680

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: f929d680

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. $y = 44,000(2)^t$
- D. $y = 44,000(2)^t$

ID: f929d680 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 d1b142ac

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: d1b142ac

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: d1b142ac 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 ddcbf768

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: ddcbf768

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. $p = 0.96$
- B. $p = 1.04$
- C. $p = 15,000$
- D. $p = 15,000$

ID: ddcbf768 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 9dcc9dd4

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 9dcc9dd4

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: 9dcc9dd4 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 00efe3dc

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 00efe3dc

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

ID: 00efe3dc 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 eb1e2a4b

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: eb1e2a4b

| 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: eb1e2a4b 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 f5bdbb2d

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: f5bdbb2d

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: f5bdbb2d 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 bef1b84d

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: bef1b84d

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: bef1b84d Answer

Correct Answer: 11875

Rationale

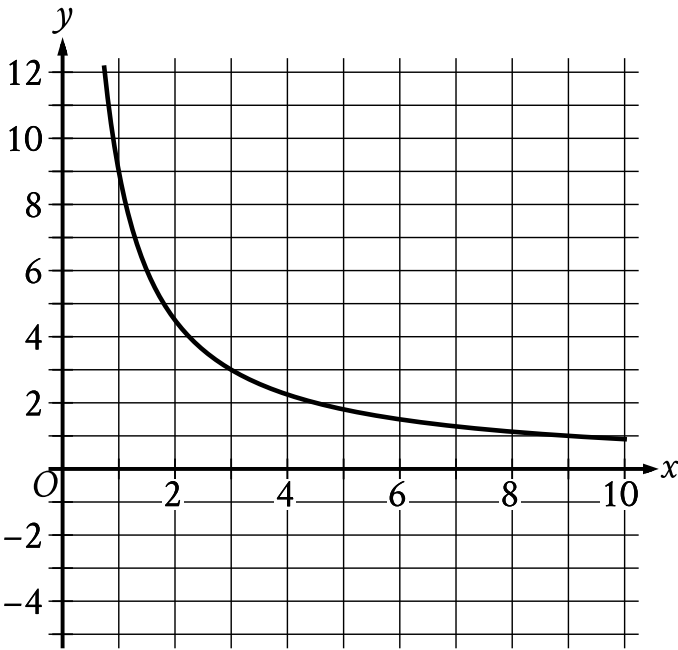
The correct answer is **11,875**. It's given that the exponential function g is defined by $g(x) = 19 \cdot a^x$, where a is a positive constant, and $g(3) = 2,375$. It follows that when $x = 3$, $g(x) = 2,375$. Substituting **3** for x and **2,375** for $g(x)$ in the given equation yields $2,375 = 19 \cdot a^3$. 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

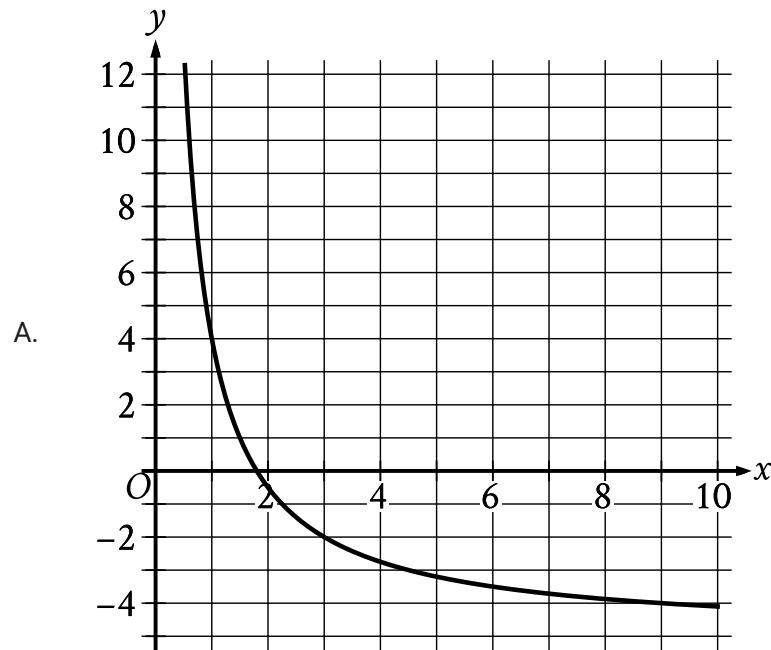
Question ID 36f0ebb0

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

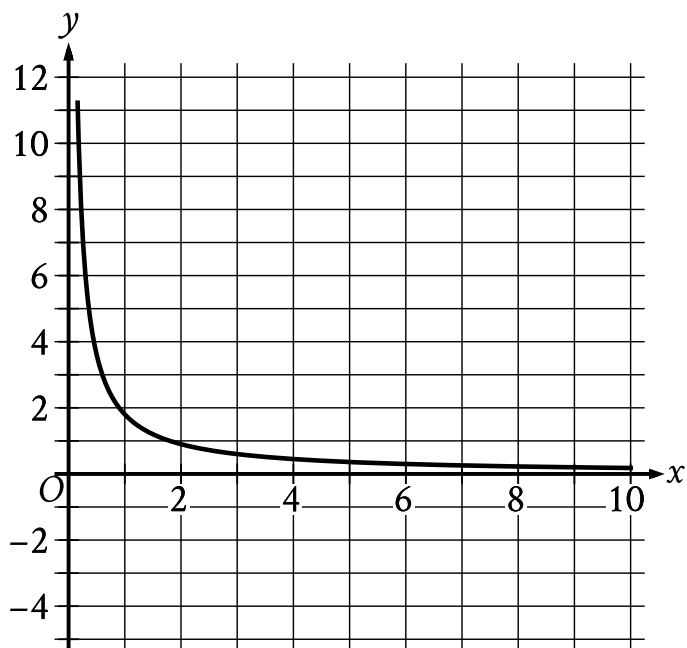
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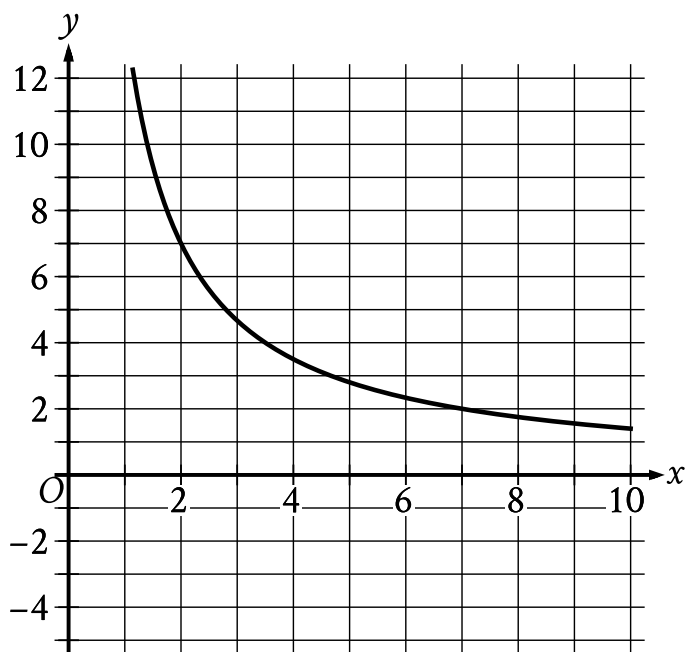
The graph of the rational function f is shown, where $y = f(x)$ and $x \geq 0$. Which of the following is the graph of $y = f(x) + 5$, where $x \geq 0$?



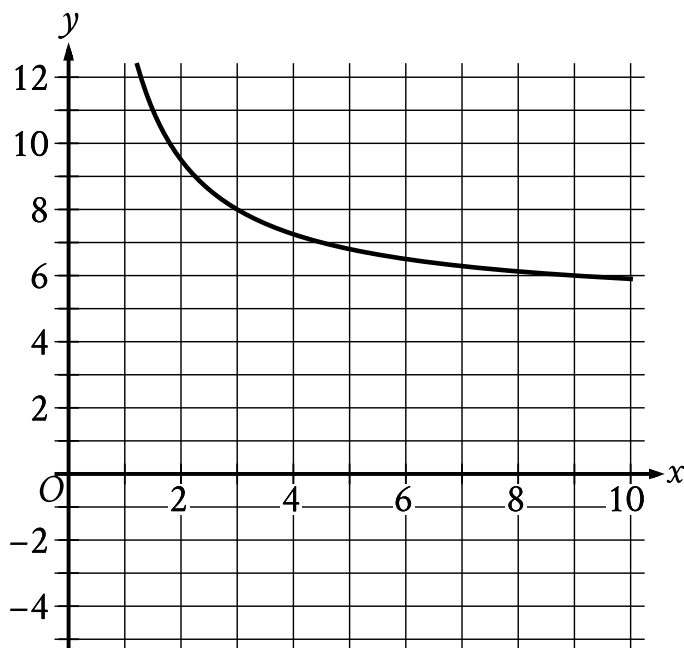
B.



C.



D.



ID: 36f0ebb0 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 89da1199

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 89da1199

$$f(x) = \frac{a-19}{x} + 5$$

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: 89da1199 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 dbb64b2b

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: dbb64b2b

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: dbb64b2b 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.

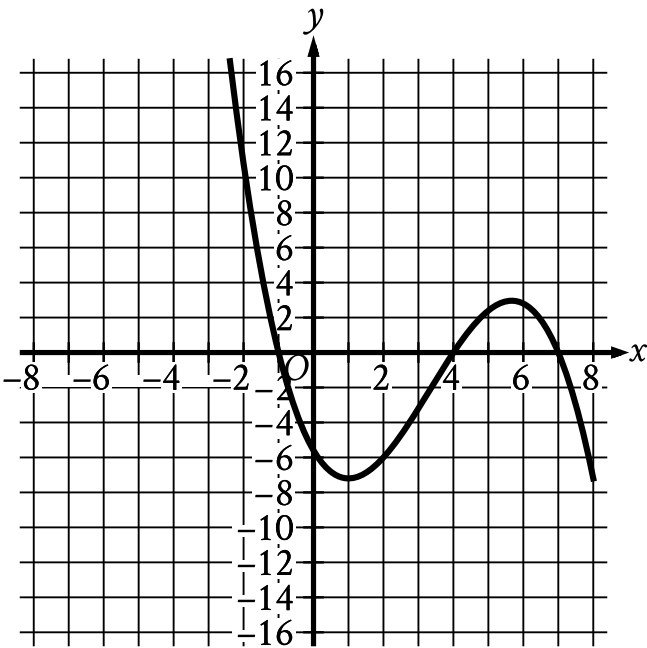
Choice C is incorrect and may result from conceptual errors.

Question Difficulty: Medium

Question ID 20d5ffc9

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 20d5ffc9



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: 20d5ffc9 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 3b82eccc

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 3b82eccc

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: 3b82eccc 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 9955f37a

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 9955f37a

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

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: 9955f37a 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 c38751a4

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: c38751a4

$$m(t) = -0.0274\left(\frac{t}{7}\right)^2 + 7.3873\left(\frac{t}{7}\right) + 75.032$$

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: c38751a4 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 55326c43

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 55326c43

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: 55326c43 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 6095e4fc

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 6095e4fc

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: 6095e4fc 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 a6b0b2d1

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: a6b0b2d1

$$p(x) + 57 = x^2$$

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: a6b0b2d1 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 a6dc0fde

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: a6dc0fde

| 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: a6dc0fde 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 ffc85a92

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: ffc85a92

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: ffc85a92 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.

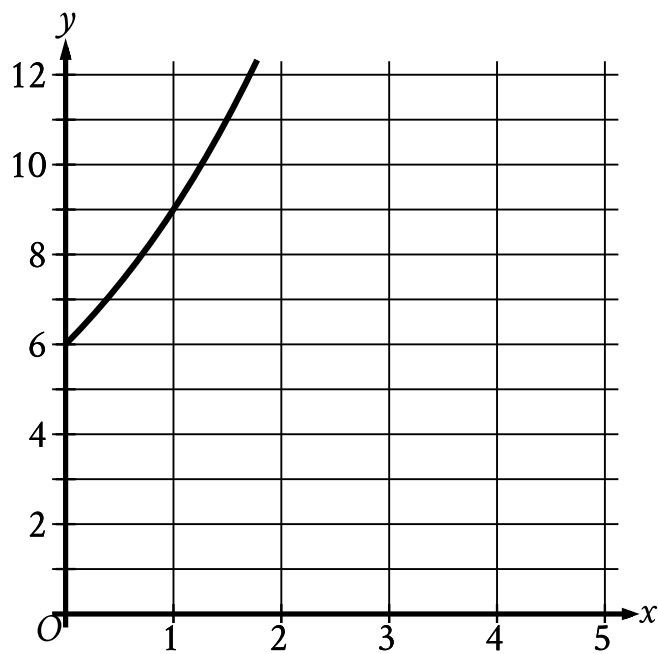
Choice C is incorrect. This is the value of $f(1)$, not $f(0)$.

Question Difficulty: Medium

Question ID 92a352a9

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 92a352a9



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: 92a352a9 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 8746c762

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 8746c762

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: 8746c762 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 a2a2a711

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: a2a2a711

- 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: a2a2a711 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 ft^2 , rather than as the area, in ft^2 , of the rectangle if its width is w **ft**.

Question Difficulty: Medium

Question ID 7ed068cf

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 7ed068cf

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: 7ed068cf 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 8a89ef72

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 8a89ef72

| 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. $n = 604(1 + 0.004)^t$
- B. $n = 604(1 + 0.004)^t$
- C. $n = 604(1 + 0.004)^t$
- D. $n = 0.004(1 + 604)^t$

ID: 8a89ef72 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 ID c54102e2

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: c54102e2

$$g(x) = 11\left(\frac{1}{12}\right)^x$$

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: c54102e2 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.

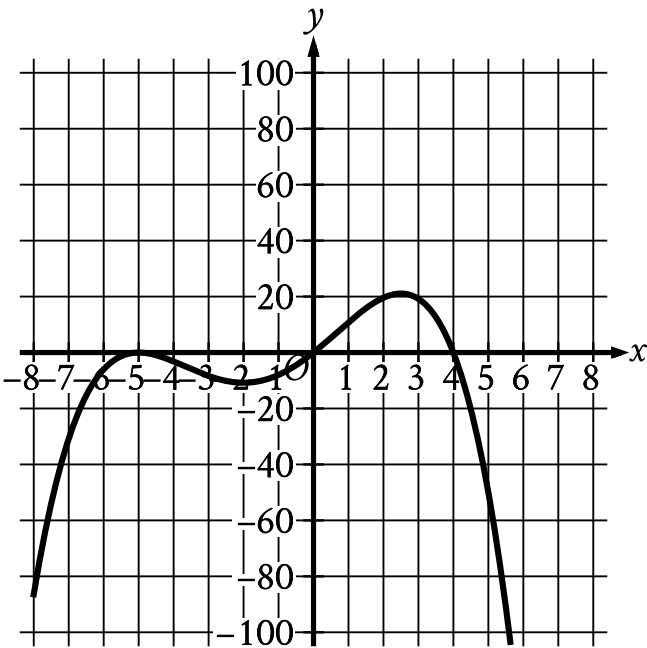
Choice D is incorrect and may result from conceptual or calculation errors.

Question Difficulty: Medium

Question ID fe5eca98

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: fe5eca98



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. $y = -\frac{1}{10}x^{\text{msup}}(x + 4)$

ID: fe5eca98 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 $x = 4$.

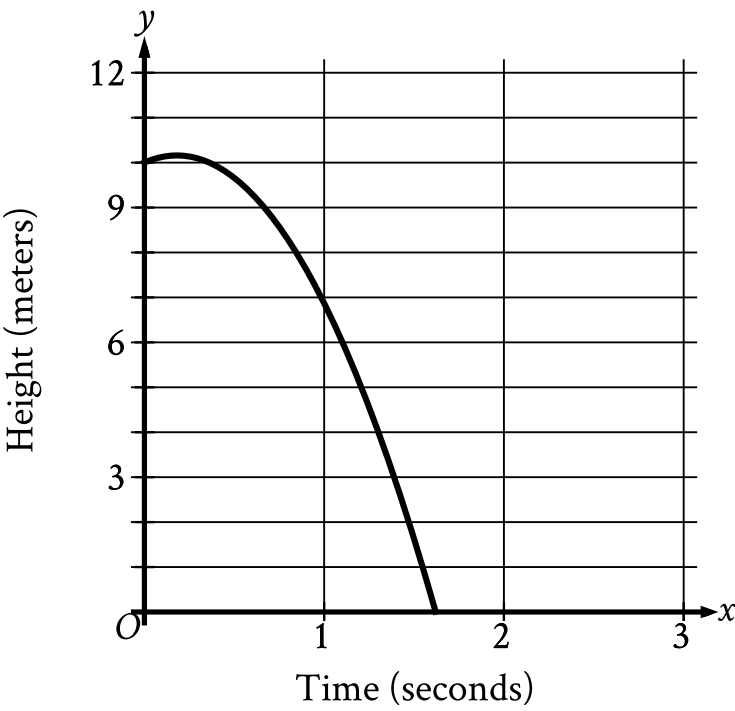
Choice D is incorrect. The graph of this equation has x -intercepts at $x = -4$, $x = 0$, and $x = 5$, rather than x -intercepts at $x = -5$, $x = 0$, and $x = 4$.

Question Difficulty: Medium

Question ID 7248d5be

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 7248d5be



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: 7248d5be 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 e7696b61

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: e7696b61

| 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: e7696b61 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 $f(x) = \left(x + \frac{5}{2}\right)^2 + \frac{31}{4}$, 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 0f0a515f

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 0f0a515f

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: 0f0a515f 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 25683f71

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 25683f71

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

What is the minimum value of the given function?

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

ID: 25683f71 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 ddcbf768

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: ddcbf768

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. $p = 0.96$
- B. $p = 1.04$
- C. $p = 15,000$
- D. $p = 15,000$

ID: ddcbf768 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 ed5ae6c5

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: ed5ae6c5

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: ed5ae6c5 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 5513928b

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 5513928b

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: 5513928b 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 b8886c77

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: b8886c77

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: b8886c77 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 f42cbe82

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: f42cbe82

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

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: f42cbe82 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 60758fea

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 60758fea

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: 60758fea 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 3aaf7740

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 3aaf7740

| 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. $d = 0.006^{msup}$
- B. $d = 670^{msup}$
- C. $d = ^{msup}$
- D. $d = ^{msup}$

ID: 3aaf7740 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 ID b782b8f9

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: b782b8f9

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: b782b8f9 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.

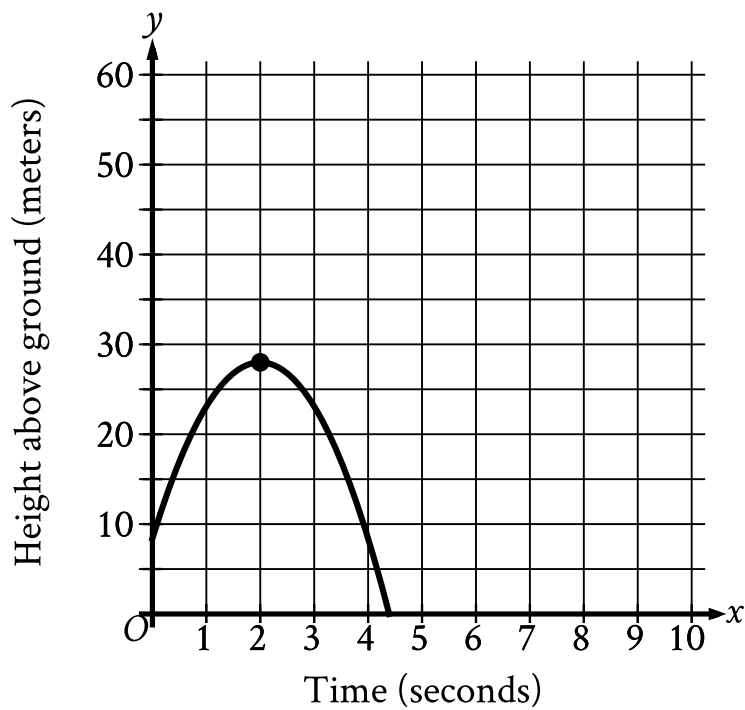
Choice D is incorrect and may result from conceptual or calculation errors.

Question Difficulty: Medium

Question ID 28a57ae5

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 28a57ae5



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: 28a57ae5 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 9e0f5f44

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 9e0f5f44

The function f is defined by $f(x) = 8x^3 + 4$. What is the value of $f(2)$?

ID: 9e0f5f44 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 b9dc1baa

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: b9dc1baa

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: b9dc1baa 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 06ee10bb

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 06ee10bb

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: 06ee10bb 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 **13**th 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 e9fc3093

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: e9fc3093

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: e9fc3093 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 17f72638

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 17f72638

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: 17f72638 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 e65d34a5

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: e65d34a5

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: e65d34a5 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 77899762

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: 77899762

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

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: 77899762 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 b465f388

| Assessment | Test | Domain | Skill | Difficulty |
|------------|------|---------------|---------------------|------------|
| SAT | Math | Advanced Math | Nonlinear functions | Medium |

ID: b465f388

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: b465f388 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