

# 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 Difficulty: Medium

# 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  $r$ .

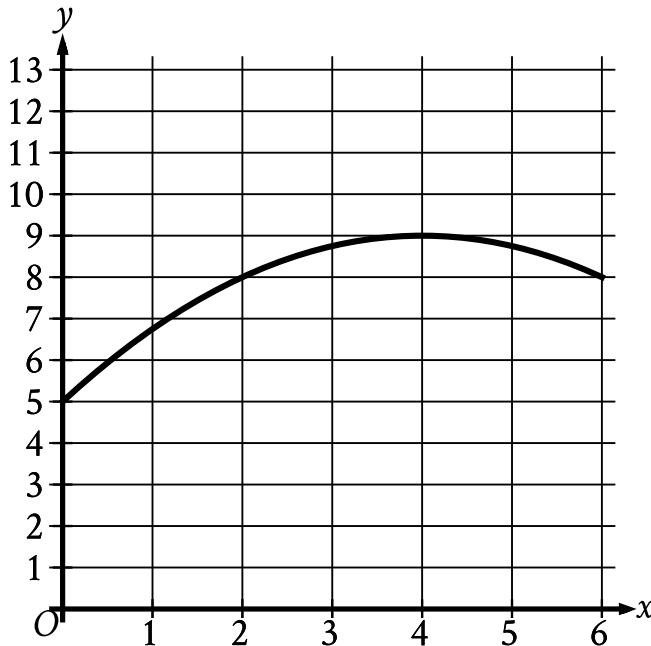
Choice D is incorrect. This is the value of  $C$ .

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.

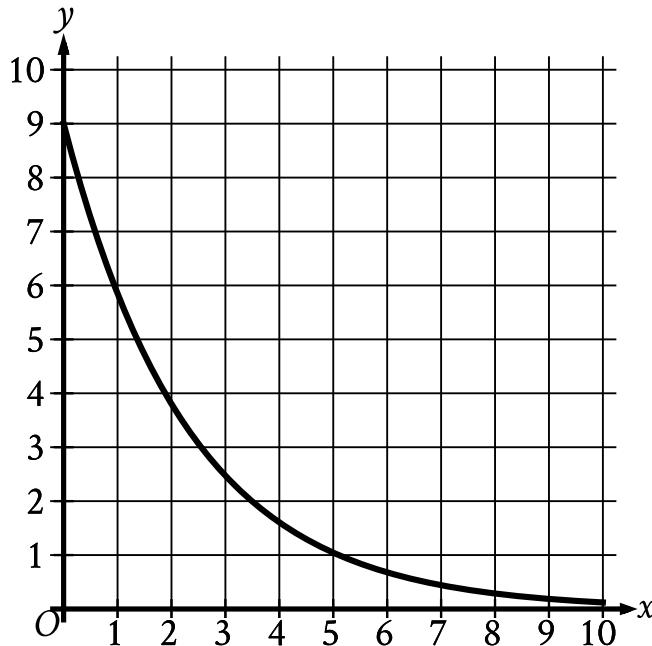
Choice D is incorrect and may result from conceptual or calculation errors.

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.  $y = \frac{1}{2}msup$
- B.  $y = 2msup$
- C.  $y = 44,000msup$
- D.  $y = 44,000msup$

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.  $p = 0.96^{msup}$
- B.  $p = 1.04^{msup}$
- C.  $p = 15,000^{msup}$
- D.  $p = 15,000^{msup}$

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.  $c = 1,300^{msup}$
- B.  $c = 1,300^{msup}$
- C.  $c = 1,300^{msup}$
- D.  $c = 1,300^{msup}$

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  $p(x) = a\left(1 + \frac{r}{100}\right)^x$ , 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  $p(x) = 2,000\left(1 + \frac{3}{100}\right)^x$ , 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

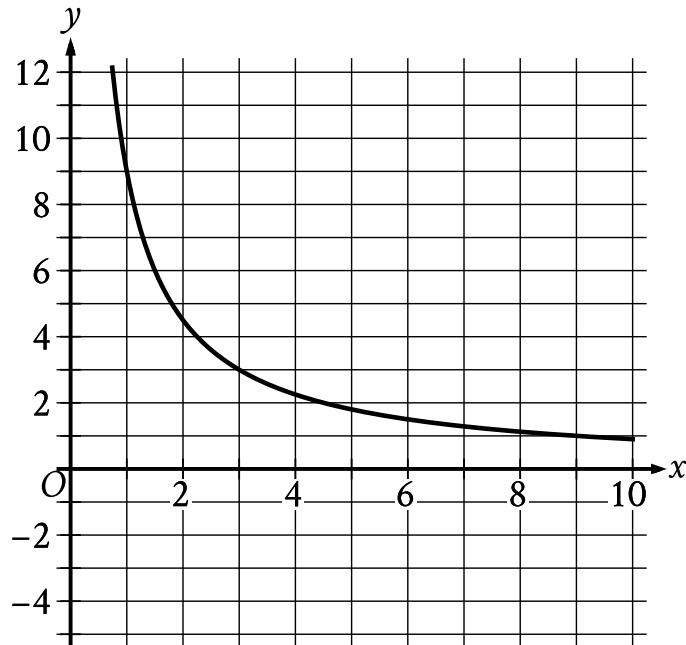
The correct answer is 11,875. It's given that the exponential function  $g$  is defined by  $g(x) = 19 \cdot a^x$ , where  $a$  is a positive constant, and  $g(3) = 2,375$ . It follows that when  $x = 3$ ,  $g(x) = 2,375$ . Substituting 3 for  $x$  and 2,375 for  $g(x)$  in the given equation yields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

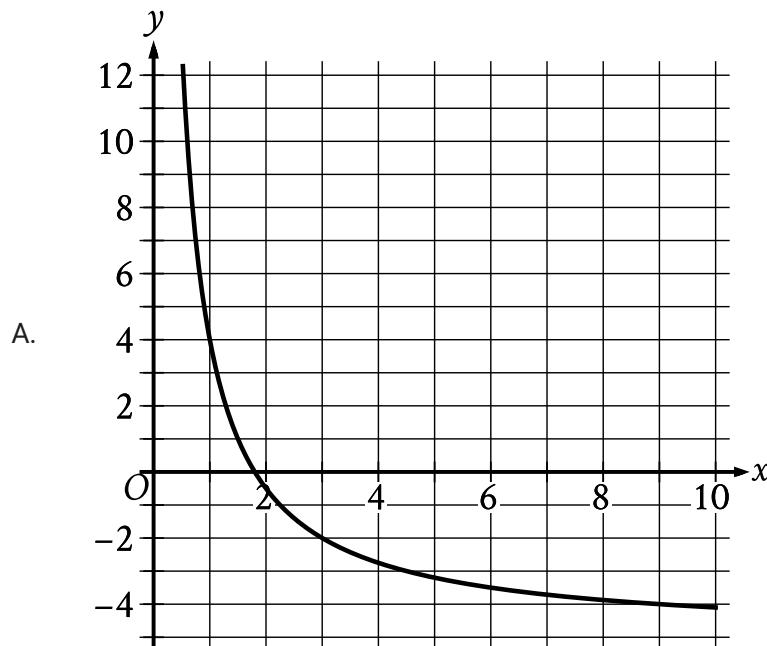
# Question ID 36f0ebb0

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

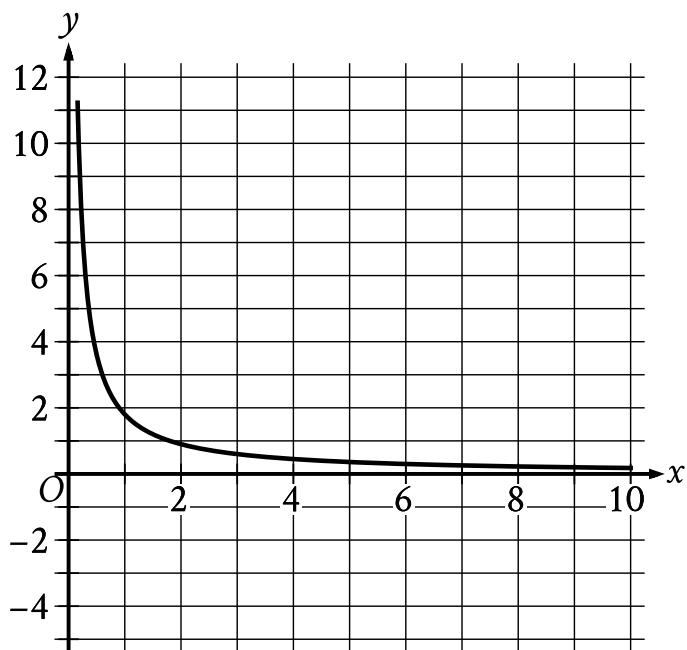
ID: 36f0ebb0



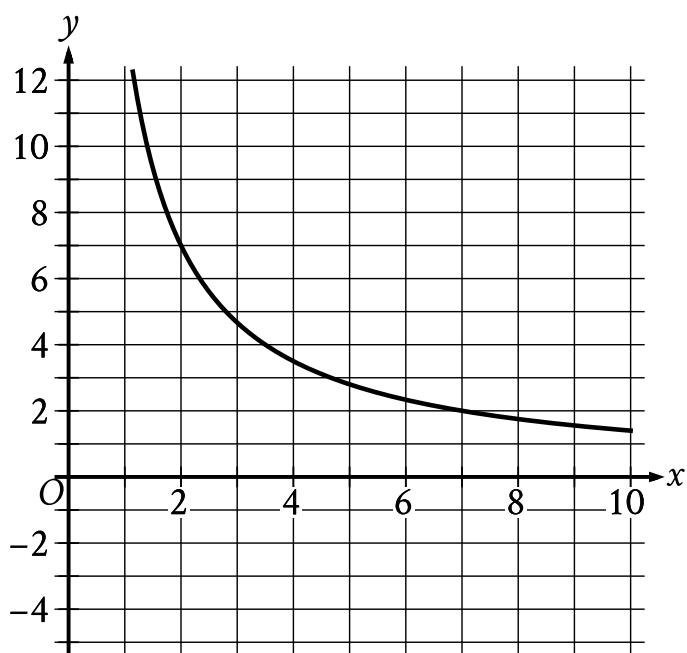
The graph of the rational function  $f$  is shown, where  $y = f(x)$  and  $x \geq 0$ . Which of the following is the graph of  $y = f(x) + 5$ , where  $x \geq 0$ ?

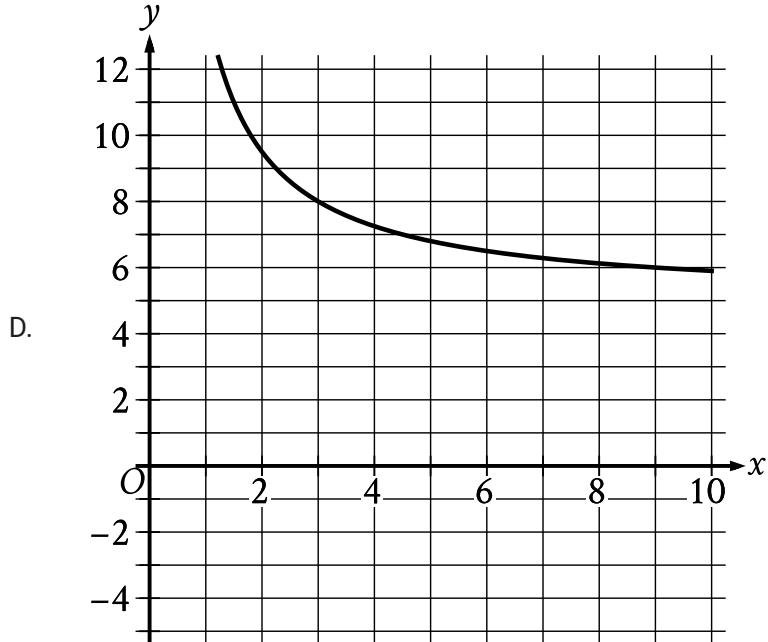


B.



C.





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.

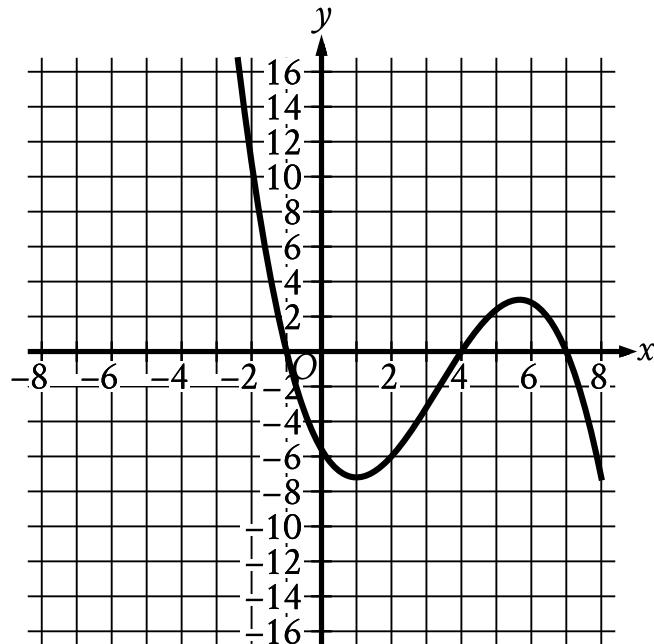
Choice C is incorrect and may result from conceptual errors.

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.

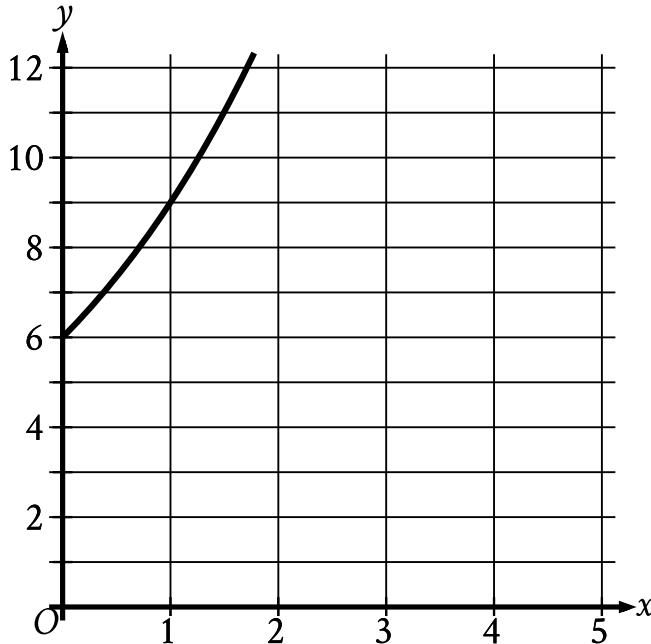
Choice C is incorrect. This is the value of  $f(1)$ , not  $f(0)$ .

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 ( $\text{ft}^2$ ), 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  $\text{ft}^2$ .
- 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  $\text{ft}^2$ .

ID: a2a2a711 Answer

Correct Answer: A

Rationale

Choice A is correct. The function  $f$  gives the area of the rectangle, in  $\text{ft}^2$ , 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  $\text{ft}^2$ .

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  $\text{ft}$ , of the rectangle if its area is  $w \text{ ft}^2$ , rather than as the area, in  $\text{ft}^2$ , 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.  $n = \text{msup}$
- B.  $n = \text{msup}$
- C.  $n = 604\text{msup}$
- D.  $n = 0.004\text{msup}$

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 Difficulty: Medium

# 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 **0th** 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.

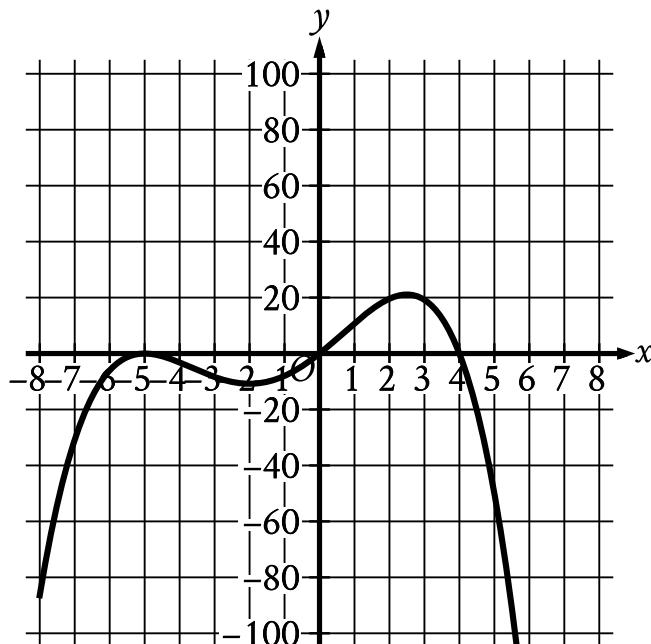
Choice D is incorrect and may result from conceptual or calculation errors.

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

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  $x = 4$ .

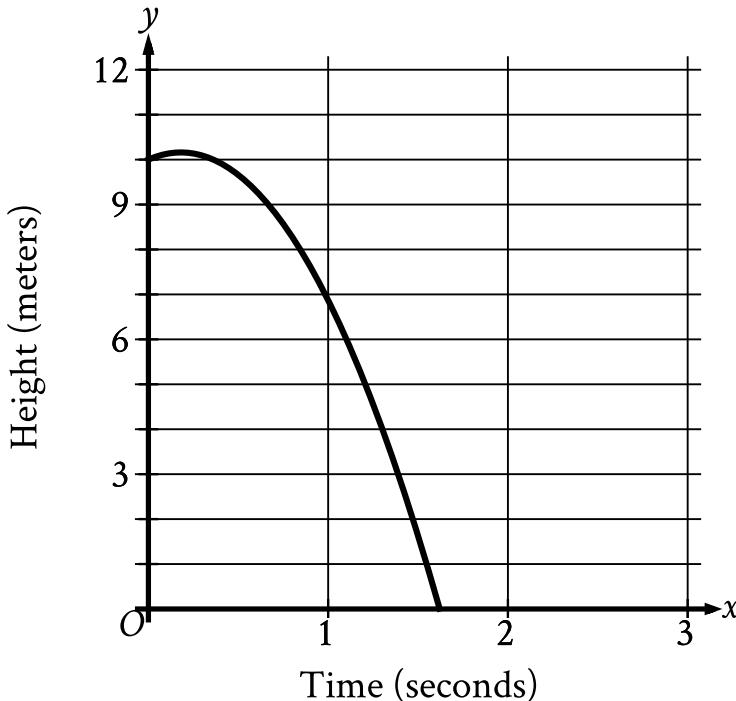
Choice D is incorrect. The graph of this equation has  $x$ -intercepts at  $x = -4$ ,  $x = 0$ , and  $x = 5$ , rather than  $x$ -intercepts at  $x = -5$ ,  $x = 0$ , and  $x = 4$ .

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.  $p = 0.96^{msup}$
- B.  $p = 1.04^{msup}$
- C.  $p = 15,000^{msup}$
- D.  $p = 15,000^{msup}$

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 Difficulty: Medium

# 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.

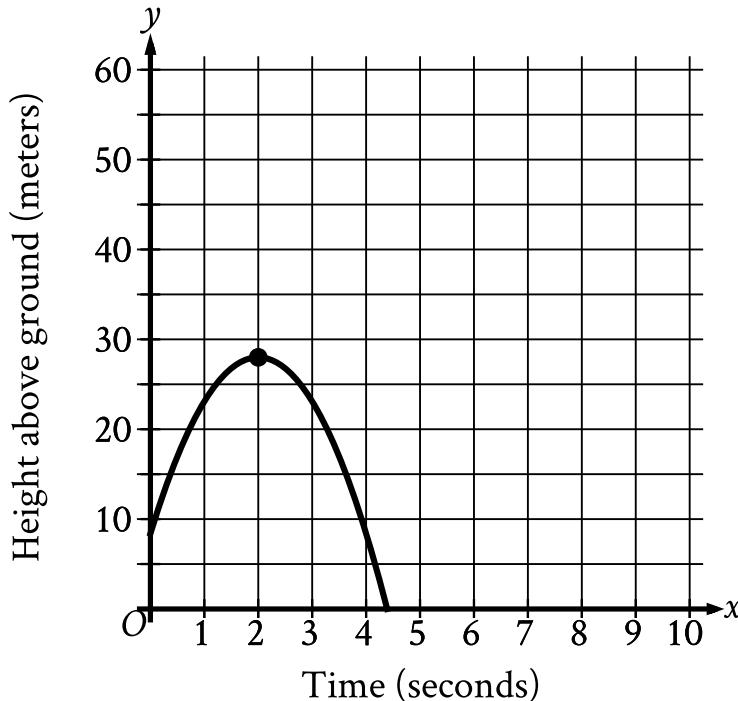
Choice D is incorrect and may result from conceptual or calculation errors.

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 13th root of both sides of this equation yields  $r = \sqrt[13]{\frac{68,071.93}{36,100.00}}$ , or  $r$  is approximately equal to **1.05**. Substituting **1.05** for  $r$  in the equation  $A(t) = 36,100.00r^t$  yields  $A(t) = 36,100.00(1.05)^t$ , so the equation  $A(t) = 36,100.00(1.05)^t$  could define  $A$ .

Choice B is incorrect. Substituting **0** for  $t$  in this function indicates an initial balance of **\$31,971.93**, rather than **\$36,100.00**.

Choice C is incorrect. Substituting **0** for  $t$  in this function indicates an initial balance of **\$31,971.93**, rather than **\$36,100.00**. Additionally, this function indicates the account balance is decreasing, rather than increasing, over time.

Choice D is incorrect. This function indicates the account balance is decreasing, rather than increasing, over time.

Question Difficulty: Medium

# Question ID 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  $y = -16(x - 5.6)^2 + 502$ .

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