

$$h(x) = 2(x - 4)^2 - 32$$

The quadratic function h is defined as shown. In the xy -plane, the graph of $y = h(x)$ intersects the x -axis at the points $(0, 0)$ and $(t, 0)$, where t is a constant.

What is the value of t ?

- A. 1
- B. 2
- C. 4
- D. 8

$$f(x) = 9,000(0.66)^x$$

The given function f models the number of advertisements a company sent to its clients each year, where x represents the number of years since **1997**, and $0 \leq x \leq 5$. If $y = f(x)$ is graphed in the xy -plane, which of the following is the best interpretation of the y -intercept of the graph in this context?

- A. The minimum estimated number of advertisements the company sent to its clients during the **5** years was **1,708**.
- B. The minimum estimated number of advertisements the company sent to its clients during the **5** years was **9,000**.
- C. The estimated number of advertisements the company sent to its clients in **1997** was **1,708**.
- D. The estimated number of advertisements the company sent to its clients in **1997** was **9,000**.

Function f is defined by $f(x) = -a^x + b$, where a and b are constants. In the xy -plane, the graph of $y = f(x) - 12$ has a y -intercept at $(0, -\frac{75}{7})$. The product of a and b is $\frac{320}{7}$. What is the value of a ?

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

A. $h = -t^2 + 3.6$

B. $h = -t^2 + 51.84$

C. $h = -16t^{\text{sup}} - 3.6$

D. $h = -16t^{\text{sup}} + 51.84$

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

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

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

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

Growth of a Culture of Bacteria

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

A culture of bacteria is growing at an exponential rate, as shown in the table above.

At this rate, on which day would the number of bacteria per milliliter reach 5.12×10^8

?

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

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

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

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

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

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

A. -266

B. -19

C. $-\frac{33}{2}$

D. $-\frac{5}{2}$

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

A. $n = 72^{t+1}$

B. $n = 72^{t+5}$

C. $n = 180^{t+1}$

D. $n = 180^{t+5}$

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

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

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

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

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

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

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

$$f(t) = 8,000(0.65)^t$$

The given function f models the number of coupons a company sent to their customers at the end of each year, where t represents the number of years since the end of **1998**, and $0 \leq t \leq 5$. If $y = f(t)$ is graphed in the ty -plane, which of the following is the best interpretation of the y -intercept of the graph in this context?

- A. The minimum estimated number of coupons the company sent to their customers during the **5** years was **1,428**.
- B. The minimum estimated number of coupons the company sent to their customers during the **5** years was **8,000**.
- C. The estimated number of coupons the company sent to their customers at the end of **1998** was **1,428**.
- D. The estimated number of coupons the company sent to their customers at the end of **1998** was **8,000**.

x	$p(x)$
-2	5
-1	0
0	-3
1	-1
2	0

The table above gives selected values of a polynomial function p . Based on the values in the table, which of the following must be a factor of p ?

- A. $(x - 3)$
- B. $(x + 3)$
- C. $(x - 1)(x + 2)$
- D. $(x + 1)(x - 2)$

The function f is defined by $f(x) = (x+3)(x+1)$. The graph of f in the xy -plane is a parabola. Which of the following intervals contains the x -coordinate of the vertex of the graph of f ?

- A. $-4 < x < -3$
- B. $-3 < x < 1$
- C. $1 < x < 3$
- D. $3 < x < 4$

A landscaper is designing a rectangular garden. The length of the garden is to be 5 feet longer than the width. If the area of the garden will be 104 square feet, what will be the length, in feet, of the garden?

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

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

The equation above models the number of members, M , of a gym t years after the gym opens. Of the following, which equation models the number of members of the gym q quarter years after the gym opens?

A. $M = 1,800(1.02)^{\frac{q}{4}}$

B. $M = 1,800(1.02)^{4q}$

C. $M = 1,800(1.005)^{4q}$

D. $M = 1,800(1.082)^q$

The functions f and g are defined by the given equations, where $x \geq 0$. Which of the following equations displays, as a constant or coefficient, the maximum value of the function it defines, where $x \geq 0$?

I. $f(x) = 33(0.4)^{x+3}$

II. $g(x) = 33(0.16)(0.4)^{x-2}$

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

Square P has a side length of x inches. Square Q has a perimeter that is **176** inches greater than the perimeter of square P. The function f gives the area of square Q, in square inches. Which of the following defines f ?

A. $f(x) = (x + 44)^2$

B. $f(x) = (x + 176)^2$

C. $f(x) = (176x + 44)^2$

D. $f(x) = (176x + 176)^2$

The surface area of a cube is $6\left(\frac{a}{4}\right)^2$, where a is a positive constant. Which of the following gives the perimeter of one face of the cube?

A. $\frac{a}{4}$

B. a

C. $4a$

D. $6a$

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

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

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

C. 54

D. 60

x	y
21	−8
23	8
25	−8

The table shows three values of x and their corresponding values of y , where $y = f(x) + 4$ and f is a quadratic function. What is the y -coordinate of the y -intercept of the graph of $y = f(x)$ in the xy -plane?

A quadratic function models the height, in feet, of an object above the ground in terms of the time, in seconds, after the object is launched off an elevated surface. The model indicates the object has an initial height of **10** feet above the ground and reaches its maximum height of **1,034** feet above the ground **8** seconds after being launched. Based on the model, what is the height, in feet, of the object above the ground **10** seconds after being launched?

- A. **234**
- B. **778**
- C. **970**
- D. **1,014**

The total distance d , in meters, traveled by an object moving in a straight line can be modeled by a quadratic function that is defined in terms of t , where t is the time in seconds. At a time of 10.0 seconds, the total distance traveled by the object is 50.0 meters, and at a time of 20.0 seconds, the total distance traveled by the object is 200.0 meters. If the object was at a distance of 0 meters when $t = 0$, then what is the total distance traveled, in meters, by the object after 30.0 seconds?

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$$h(x) = x^3 + ax^2 + bx + c$$

The function h is defined above, where a , b , and c are integer constants. If the zeros of the function are -5 , 6 , and 7 , what is the value of c ?

$$f(x) = (x + 7)^2 + 4$$

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

Kao measured the temperature of a cup of hot chocolate placed in a room with a constant temperature of 70 degrees Fahrenheit ($^{\circ}\text{F}$). The temperature of the hot chocolate was 185°F at 6:00 p.m. when it started cooling. The temperature of the hot chocolate was 156°F at 6:05 p.m. and 135°F at 6:10 p.m. The hot chocolate's temperature continued to decrease. Of the following functions, which best models the temperature $T(m)$, in degrees Fahrenheit, of Kao's hot chocolate m minutes after it started cooling?

A. $T(m) = 185(1.25)^m$

B. $T(m) = 185(0.85)^m$

C. $T(m) = (185 - 70)(0.75)^{\frac{m}{5}}$

D. $T(m) = 70 + 115(0.75)^{\frac{m}{5}}$

$$p(t) = 90,000(1.06)^t$$

The given function p models the population of Lowell t years after a census. Which of the following functions best models the population of Lowell m months after the census?

A. $r(m) = \frac{90,000}{12}(1.06)^m$

B. $r(m) = 90,000\left(\frac{1.06}{12}\right)^m$

C. $r(m) = 90,000\left(\frac{1.06}{12}\right)^{\frac{m}{12}}$

D. $r(m) = 90,000(1.06)^{\frac{m}{12}}$

The population of a town is currently 50,000, and the population is estimated to increase each year by 3% from the previous year. Which of the following equations can be used to estimate the number of years, t , it will take for the population of the town to reach 60,000 ?

A. $50,000 = 60,000(0.03)^t$

B. $50,000 = 60,000(3)^t$

C. $60,000 = 50,000(0.03)^t$

D. $60,000 = 50,000(1.03)^t$

For the exponential function f , the value of $f(1)$ is k , where k is a constant. Which of the following equivalent forms of the function f shows the value of k as the coefficient or the base?

A. $f(x) = 50(2)^{x+1}$

B. $f(x) = 80(2)^x$

C. $f(x) = 128(2)^{x-1}$

D. $f(x) = 205(2)^{x-2}$

$$h(x) = -16x^2 + 100x + 10$$

The quadratic function above models the height above the ground h , in feet, of a projectile x seconds after it had been launched vertically. If $y = h(x)$ is graphed in the xy -plane, which of the following represents the real-life meaning of the positive x -intercept of the graph?

- A. The initial height of the projectile
- B. The maximum height of the projectile
- C. The time at which the projectile reaches its maximum height
- D. The time at which the projectile hits the ground

x	$f(x)$
1	a
2	a^5
3	a^9

For the exponential function f , the table above shows several values of x and their corresponding values of $f(x)$, where a is a constant greater than 1. If k is a constant and $f(k) = a^{29}$, what is the value of k ?

$$f(x) = (x - 10)(x + 13)$$

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

A. -130

B. -13

C. $-\frac{23}{2}$

D. $-\frac{3}{2}$

Two variables, x and y , are related such that for each increase of 1 in the value of x , the value of y increases by a factor of 4 . When $x = 0$, $y = 200$. Which equation represents this relationship?

A. $y = 4^{x+200}$

B. $y = 4^{200x}$

C. $y = 200^{4x}$

D. $y = 200^{4x+1}$

What is the minimum value of the function f defined by $f(x) = (x - 2)^2 - 4$?

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

Let the function p be defined as $p(x) = \frac{(x-c)^2 + 160}{2c}$, where c is a constant. If $p(c) = 10$, what is the value of $p(12)$?

- A. 10.00
- B. 10.25
- C. 10.75
- D. 11.00