SAT Math
Nonlinear Functions 3

Question #	ID
3.1	91e7ea5e

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

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

A. 1

B. 2

C. 4

D. 8

3.2   a9084ca4

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

The given function f models the number of advertisements a company sent to its clients each year, where x represents the number of years since 1997, and $0 \le x \le 5$. 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 $9{,}000$.

3.3   b8f13a3a

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

3.4   7902bed0

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

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

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

C. $h = -16(t + 51.84)^2 - 3.6$

D. $h = -16(t - 1.8)^2 + 51.84$

Question #	ID
3.5	4a0d0399

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

3.6   9654add7

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

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

A. The revenue, in dollars, when the unit price of the product is $0

B. The unit price, in dollars, of the product that will result in maximum revenue

C. The unit price, in dollars, of the product that will result in a revenue of $0

D. The maximum revenue, in dollars, that the company can make

3.7   263f9937

Growth of a Culture of Bacteria

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

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

A. Day 5

B. Day 9

C. Day 11

D. Day 12

Question #	ID
3.8	18e35375

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

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

A. -266

B. -19

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

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

3.9	9afe2370

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

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

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

A. $r < -1$

B. $-1 < r < 0$

C. $0 < r < 1$

D. $r > 1$

3.10	0121a235

x	p(x)
−2	5
−1	0
0	−3
1	−1
2	0

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

A. $(x - 3)$

B. $(x + 3)$

C. $(x - 1)(x + 2)$

D. $(x + 1)(x - 2)$

Question #	ID
3.11	70753f99

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

A. $-4 < x < -3$

B. $-3 < x < 1$

C. $1 < x < 3$

D. $3 < x < 4$

3.12	58dcc59f

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

3.13	84dd43f8

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

3.14	59d1f4b5

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

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

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

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

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

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

Question #	ID
3.15	01668cd6

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

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

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

A. I only

B. II only

C. I and II

D. Neither I nor II

3.16	635f54ee

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

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

B. a

C. $4a$

D. $6a$

3.17	de39858a

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

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

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

C. 54

D. 60

3.18	1178f2df

x	y
21	−8
23	8
25	−8

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

Question #	ID
3.19	84e8cc72

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

A. 234

B. 778

C. 970

D. $1{,}014$

3.20	4b642eef

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?

3.21	9f2ecade

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

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

Question #	ID
3.22	6f5540a5

Kao measured the temperature of a cup of hot chocolate placed in a room with a constant temperature of 70 degrees Fahrenheit (°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. $T(m) = 70 + 115(0.75)^{\frac{m}{5}}$

3.23	b73ee6cf

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

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

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

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

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

3.24	7eed640d	$h(x) = -16x^2 + 100x + 10$

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

A. The initial height of the projectile

B. The maximum height of the projectile

C. The time at which the projectile reaches its maximum height

D. The time at which the projectile hits the ground

Question #	ID
3.25	43926bd9

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

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

3.26   a7711fe8

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

A. -4

B. -2

C. 2

D. 4

3.27   1a722d7d

Let the function p be defined as $p(x) = \dfrac{(x-c)^2 + 160}{2c}$, 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

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3.28   70fb357b

$$y = 576^{(2x+2)}$$

The graph of the given equation in the *xy*-plane has a *y*-intercept of (r, s). Which of the following equivalent equations displays the value of s as a constant, a coefficient, or the base?

A. $y = 331,776^{x+1}$

B. $y = 24^{4x+4}$

C. $y = \frac{1}{24}(13,824)(576)^{2x}$

D. $y = \frac{1}{576}576^{(2x+3)}$

3.29   ce508fb0

The functions f and g are defined by the given equations. $f(x) = 3 + \left| -2x - x^2 \right|$ $g(w) = \left| \frac{-w}{w-1} \right| - w + 5$

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

3.30   1fe10d97

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

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

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

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

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

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

3.31   ce579859

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

A. $n = 72(1.5)^t$

B. $n = 72(2.5)^t$

C. $n = 180(1.5)^t$

D. $n = 180(2.5)^t$

Question #	ID
3.32	6d9e01a2

$$f(x) = 4x^2 - 50x + 126$$

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

3.33 bba18ecb

When the quadratic function f is graphed in the *xy*-plane, where $y = f(x)$, its vertex is $(-3, 6)$. One of the *x*-intercepts of this graph is $\left(-\frac{17}{4}, 0\right)$. What is the other *x*-intercept of the graph?

A. $\left(-\frac{29}{4}, 0\right)$

B. $\left(-\frac{7}{4}, 0\right)$

C. $\left(\frac{5}{4}, 0\right)$

D. $\left(\frac{17}{4}, 0\right)$

3.34 abcd0003

For the function f, for each increase in the value of x by c, where c is a positive constant, the value of $f(x)$ increases by a factor of 27. Which of the following equivalent forms of the function f displays $\frac{1}{c}$ as a coefficient of x?

Ⓐ $f(x) = 48(3)^{\frac{1}{2}x}$

Ⓑ $f(x) = 48(3^3)^{\frac{1}{6}x}$

Ⓒ $f(x) = 48(9)^{\frac{1}{4}x}$

Ⓓ $f(x) = 48\left(27^{\frac{1}{3}x}\right)^{\frac{1}{2}}$

3.35 f2d60b99

The function $f(x) = \frac{1}{9}(x-7)^2 + 3$ gives a metal ball's height above the ground $f(x)$, in inches, x seconds after it started moving on a track, where $0 \le x \le 10$. Which of the following is the best interpretation of the vertex of the graph of $y = f(x)$ in the *xy*-plane?

A. The metal ball's minimum height was 3 inches above the ground.

B. The metal ball's minimum height was 7 inches above the ground.

C. The metal ball's height was 3 inches above the ground when it started moving.

D. The metal ball's height was 7 inches above the ground when it started moving.

Question #	ID
3.36	4dd4efcf

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

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

    I. $c < 0$

    II. $a \geq 1$

A. I only

B. II only

C. I and II

D. Neither I nor II

3.37	b7c74b73

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

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

A. 4

B. 5

C. 36

D. 64

3.38	a58232b7

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

    I. $g(x) = 18(1.16)(1.4)^{x+2}$

    II. $h(x) = 18(1.4)^{x+4}$

A. I only

B. II only

C. I and II

D. Neither I nor II

3.39	f25a34aa

The area of a triangle is equal to x^2 square centimeters. The length of the base of the triangle is $2x + 22$ centimeters, and the height of the triangle is $x - 10$ centimeters. What is the value of x?
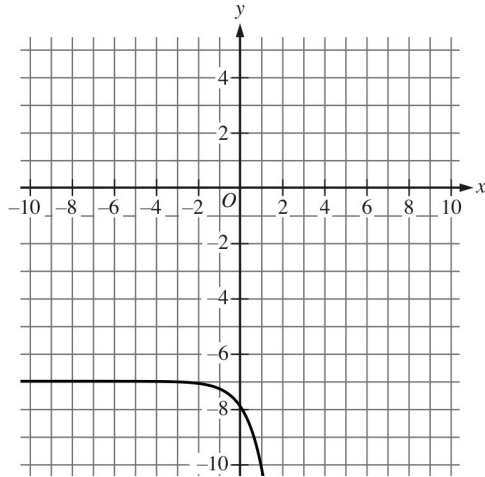
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Question #	ID
3.40	668f1863

Function f is a quadratic function where $f(-20) = 0$ and $f(-4) = 0$. The graph of $y = f(x)$ in the xy-plane has a vertex at $(r, -64)$. What is the value of r?

3.41   df71424b

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

A. Three

B. Two

C. One

D. Zero

3.42   d139cf4b

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

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

A. $3 + \left(\dfrac{55}{4}\right)^2$

B. $3 + 2\left(\dfrac{55}{4}\right)^2$

C. $3 - 2\left(\dfrac{55}{4}\right)^2$

D. $3 - \left(\dfrac{55}{4}\right)^2$

Question #	ID
3.43	8462b105

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

A. $f(x) = x^2 + x + 91$

B. $f(x) = x^2 + 91$

C. $f(x) = x^2 + 91x$

D. $f(x) = x^2 + 91x + 91$

3.44	35e05e19

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

A. $V(x) = 11x(x - 1)$

B. $V(x) = 11x(x + 1)$

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

D. $V(x) = x(x + 11)(x + 1)$

3.45	ebed7dc6

An auditorium has seats for $1,800$ people. Tickets to attend a show at the auditorium currently cost $\$4.00$. For each $\$1.00$ increase to the ticket price, 100 fewer tickets will be sold. This situation can be modeled by the equation $y = -100x^2 + 1,400x + 7,200$, where x represents the increase in ticket price, in dollars, and y represents the revenue, in dollars, from ticket sales. If this equation is graphed in the *xy*-plane, at what value of x is the maximum of the graph?

A. 4

B. 7

C. 14

D. 18

3.46	128c75e2

The function g is defined by $g(x) = \frac{|x|}{a} - 14$, where $a < 0$. What is the product of $g(15a)$ and $g(7a)$?