Nonlinear Functions

CollegeBoard Question Bank

Abstract

This exercise sheet contains

- an **Easy** category with 25 questions;
- a **Medium** category with 35 questions;
- a **Hard** category with 40 questions

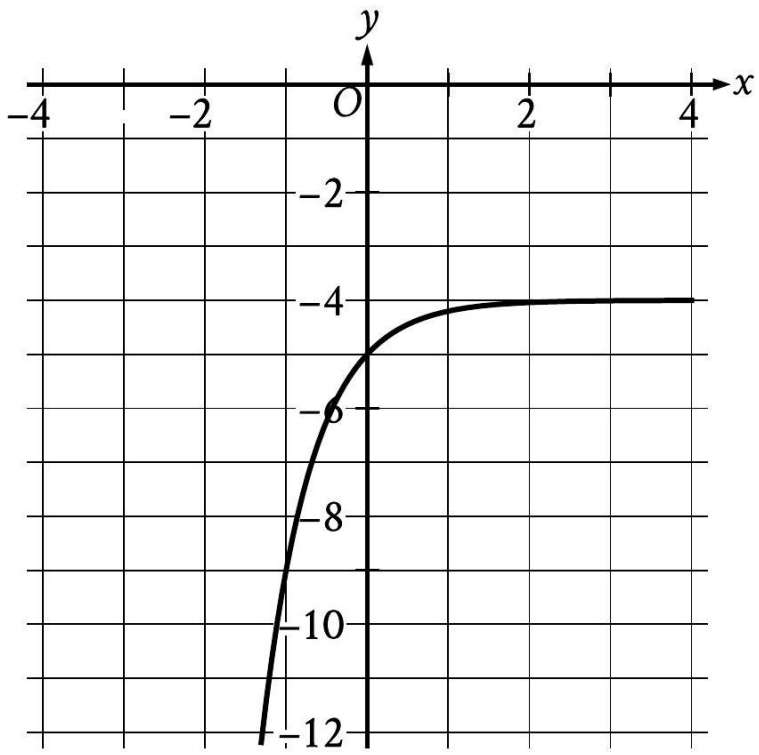
for you to attempt. A digital copy of this sheet is available for you on moodle. Feel free to utilize the **Question Space** on Teams to ask for guidance.

Best,
Omar :)

Nonlinear Functions

Easy

(1) **6abec9a8** MULTIPLE CHOICE One answer only



What is the y-intercept of the graph shown?

a. $(0, -4)$
b. $(0, -5)$
c. $(0, 0)$
d. $(-1, -9)$

(2) **07bcecac** MULTIPLE CHOICE One answer only

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

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

a. 8 years after 1984 , the predicted population of this country was approximately 32.91 million.
b. In 1984, the predicted population of this country was approximately 8 million.
c. 32.91 years after 1984 , the predicted population of this country was approximately 8 million.
d. In 1984, the predicted population of this country was approximately 32.91 million.

(3) **788bfd56** MULTIPLE CHOICE One answer only

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

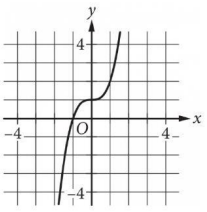
a. 40
b. 0
c. 16
d. 76

(4) **b39d74a0** MULTIPLE CHOICE One answer only

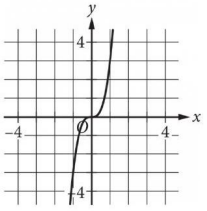
x	y
0	0
1	1
2	8
3	27

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

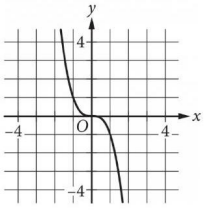
a.



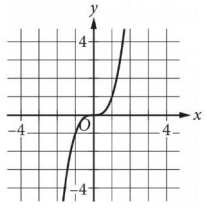
b.



c.



d.



(5) **2fec8bf4** MULTIPLE CHOICE One answer only

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

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

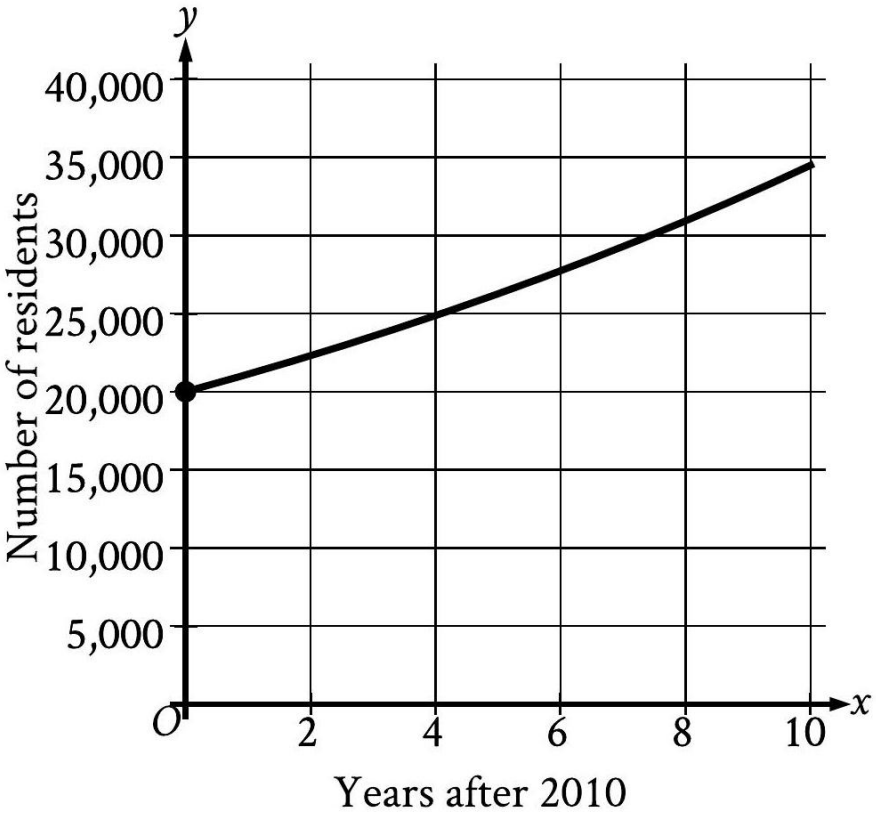
a. The estimated number of marine mammals in the area increased by 102 each year during the study.
b. The estimated number of marine mammals in the area was 102 when the study began.
c. The estimated number of marine mammals in the area was 1,800 when the study began.
d. The estimated number of marine mammals in the area increased by 1,800 each year during the study.

(6) **bd4d0e0c** MULTIPLE CHOICE One answer only

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

a. 10
b. 0
c. -152
d. -32

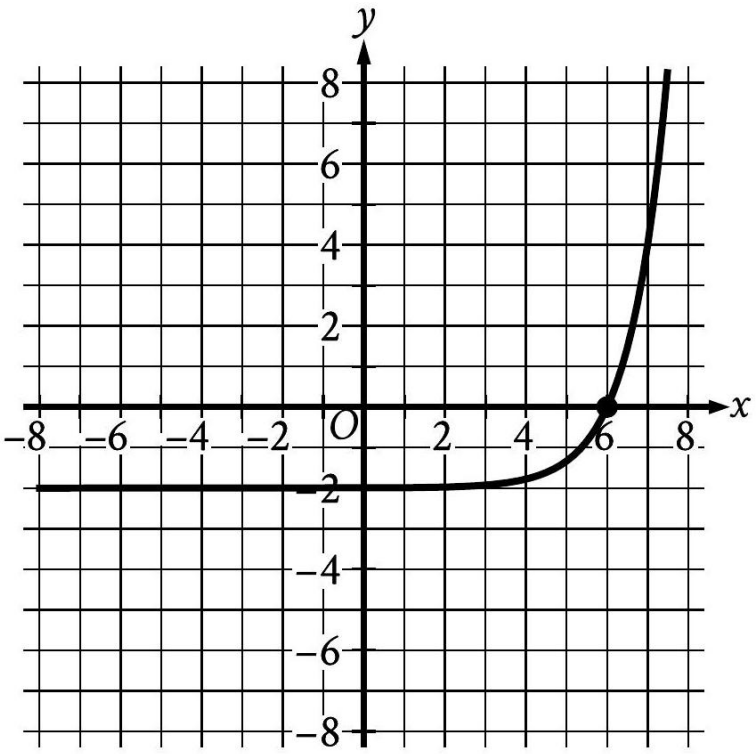
(7) **2d394c28** MULTIPLE CHOICE One answer only



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

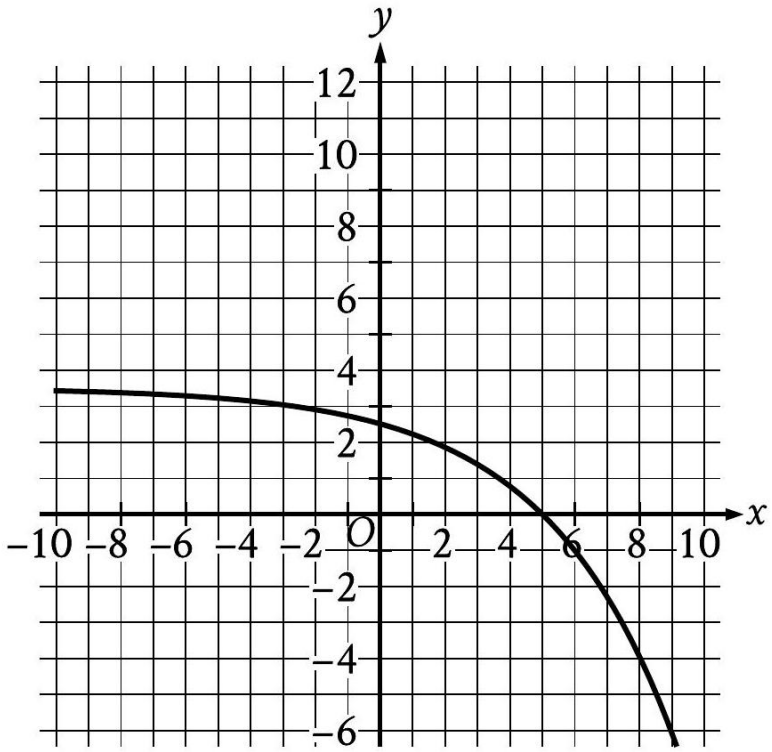
a. 25,000
b. 20,000
c. 2,000
d. 0

(8) **2b6c12eb** SHORT ANSWER Case-Insensitive



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

(9) **79e6ec70** MULTIPLE CHOICE One answer only



What is the x-intercept of the graph shown?

a. $(5, 0)$
b. $(-2, 0)$
c. $(-5, 0)$
d. $(2, 0)$

(10) **5377d9cf** MULTIPLE CHOICE One answer only

If $f(x) = \frac{x^2-6x+3}{x-1}$, what is $f(-1)$?

a. 5
b. 2
c. -5
d. -2

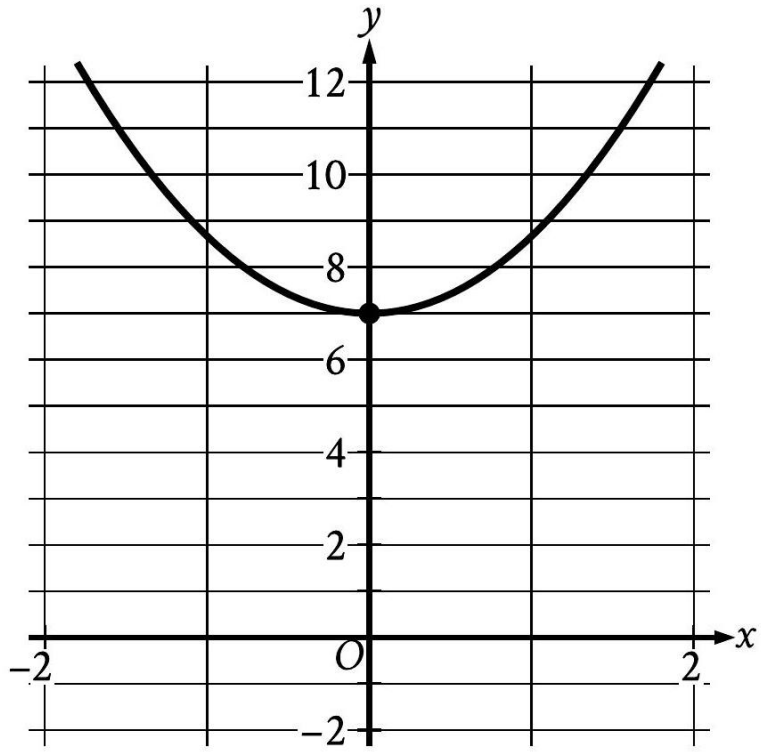
(11) **75915e3c** MULTIPLE CHOICE One answer only

$$f(x) = 2\,(3^x)$$

For the function f defined above, what is the value of $f(2)$?

a. 9
b. 36
c. 18
d. 12

(12) **2f4eafcc** SHORT ANSWER Case-Insensitive

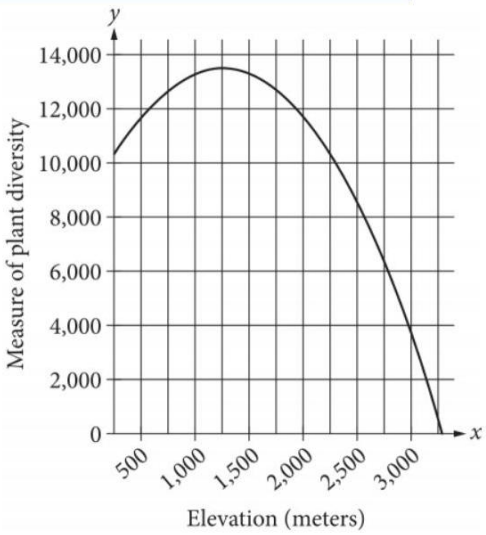


The parabola shown intersects the y-axis at the point (x, y). What is the value of y ?

(13) **94ff3e2d** SHORT ANSWER Case-Insensitive

The function h is defined by $h(x) = \frac{8}{5x+6}$. What is the value of $h(2)$?

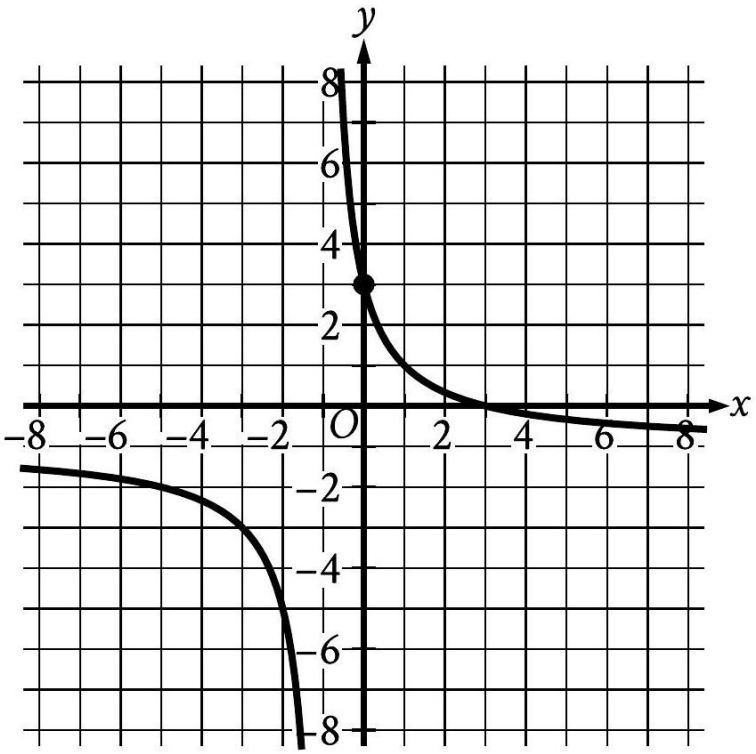
(14) **ebe4bde0** MULTIPLE CHOICE One answer only



The quadratic function graphed above models a particular measure of plant diversity as a function of the elevation in a region of Switzerland. According to the model, which of the following is closest to the elevation, in meters, at which plant diversity is greatest?

a. 13,500
b. 1,250
c. 3,000
d. 250

(15) **c99d154a** SHORT ANSWER Case-Insensitive

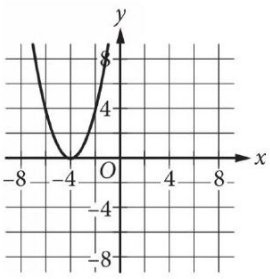


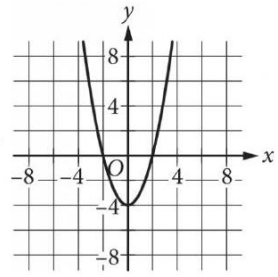
What is the y-coordinate of the y-intercept of the graph shown?

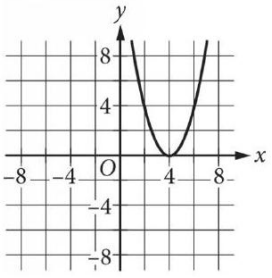
(16) **d46da42c** MULTIPLE CHOICE One answer only

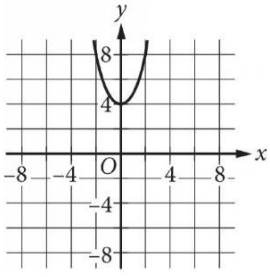
$$f(x) = x^2 + 4$$

The function f is defined as shown. Which of the following graphs in the xy plane could be the graph of $y = f(x)$?

a. 

b. 

c. 

d. 

(17) **1863e3be** SHORT ANSWER Case-Insensitive

The y-intercept of the graph of $y = x^2 + 31$ in the xy-plane is $(0, y)$. What is the value of y ?

(18) **ca4ee54e** MULTIPLE CHOICE One answer only

The graph shows the predicted value y, in dollars, of a certain sport utility vehicle x years after it is first purchased.

Which of the following is closest to the predicted value of the sport utility vehicle 3 years after it is first purchased?

a. $\$23,000$
b. $\$9,619$
c. $\$13,632$
d. $\$19,320$

(19) **c1eead73** MULTIPLE CHOICE One answer only

The function g is defined by $g(x) = |x + 18|$. What is the value of $g(4)$?

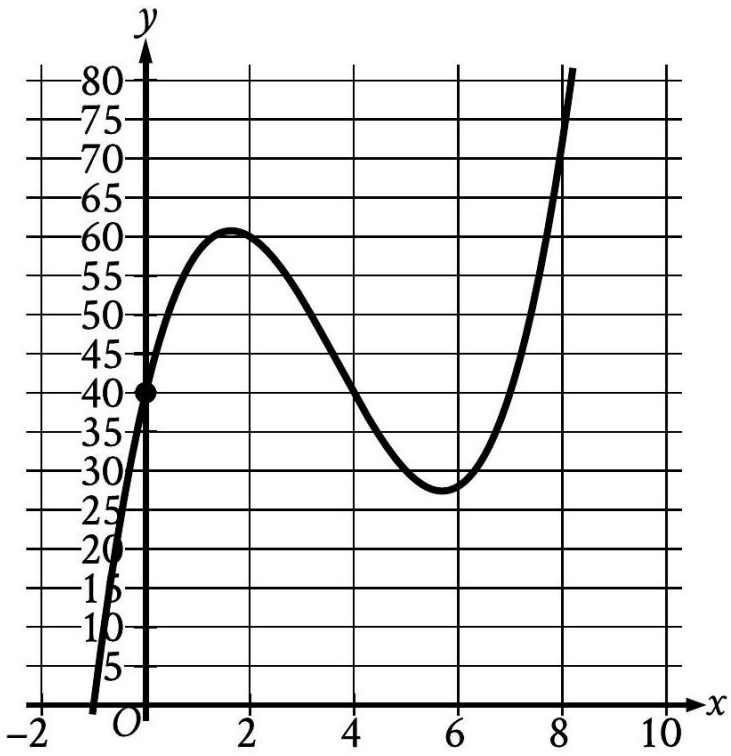
a. -4
b. 14
c. 22
d. -18

(20) **04b985e6** MULTIPLE CHOICE One answer only

The kinetic energy, in joules, of an object with mass 9 kilograms traveling at a speed of v meters per second is given by the function K, where $K(v) = \frac{9}{2}v^2$. Which of the following is the best interpretation of $K(34) = 5,202$ in this context?

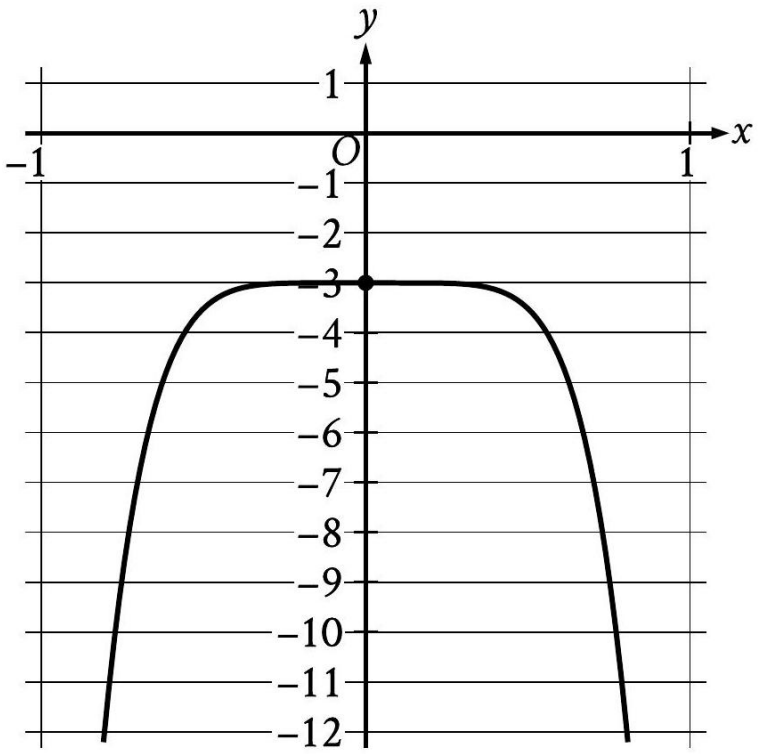
a. The object traveling at 34 meters per second has a kinetic energy of 5,202 joules.
b. The object traveling at 23,409 meters per second has a kinetic energy of 34 joules.
c. The object traveling at 340 meters per second has a kinetic energy of 5,202 joules.
d. The object traveling at 5,202 meters per second has a kinetic energy of 34 joules.

(21) **26f5269a** SHORT ANSWER Case-Insensitive



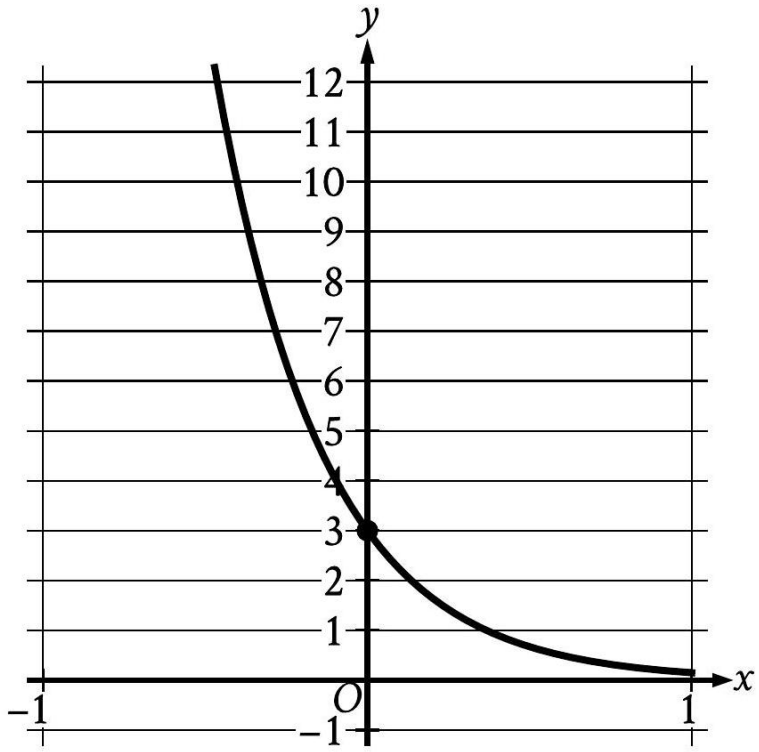
The y-intercept of the graph shown is (x, y). What is the value of y ?

(22) **50418728** SHORT ANSWER Case-Insensitive



The graph of the polynomial function f, where $y = f(x)$, is shown. The y-intercept of the graph is $(0, y)$. What is the value of y ?

(23) **02c67921** SHORT ANSWER Case-Insensitive



The graph of the exponential function f is shown, where $y = f(x)$. The y-intercept of the graph is $(0, y)$. What is the value of y ?

(24) **39652e93** MULTIPLE CHOICE One answer only

The function f is defined by $f(x) = \frac{16}{x}$. What is the value of $f(x)$ when $x = 17$?

a. $\frac{17}{16}$
b. $\frac{16}{17}$
c. 17
d. 16

(25) **ee05c84e** MULTIPLE CHOICE One answer only

$$f(x) = (x + 0.25x)(50 - x)$$

The function f is defined above. What is the value of $f(20)$?

a. 2,000
b. 500
c. 750
d. 250

Medium

(1) **39714777** MULTIPLE CHOICE One answer only

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

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. $-3,249$
c. 57
d. -57

(2) **02add2d2** MULTIPLE CHOICE One answer only

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. $c = 1,300\text{msup}$
b. $c = 1,300\text{msup}$
c. $c = 1,300\text{ msup}$
d. $c = 1,300\text{msup}$

(3) **f89af023** MULTIPLE CHOICE One answer only

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

a. 18
b. 27
c. 54
d. 9

(4) **e53add44** MULTIPLE CHOICE One answer only

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

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

a. 0.04
b. 1.04
c. 0.4
d. 1.4

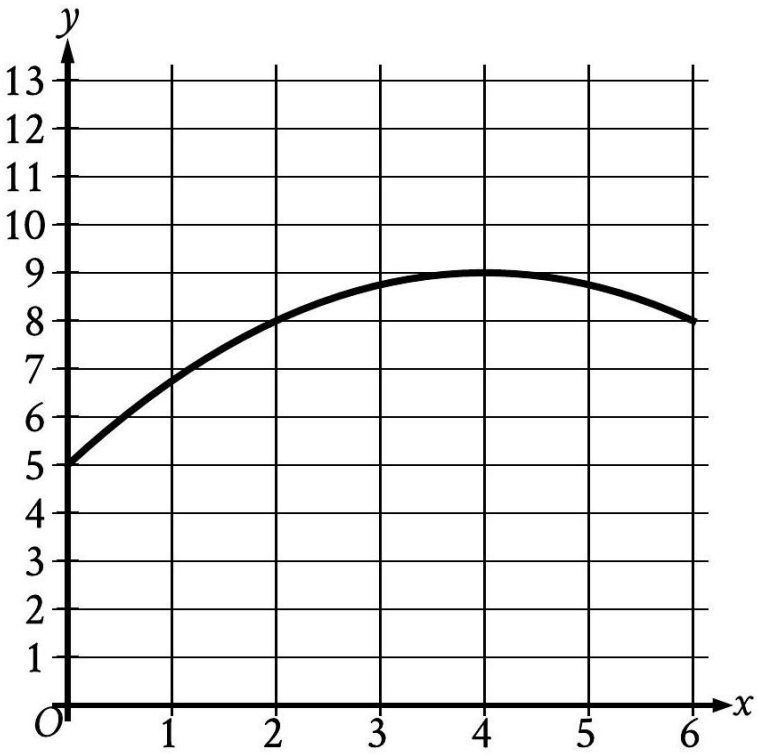
(5) **926c246b** MULTIPLE CHOICE One answer only

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

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

a. The estimated data traffic, in terabytes, for the year that is t years after 2010
b. The estimated percent increase in the data traffic, in terabytes, each year
c. The estimated amount of increase of data traffic, in terabytes, each year
d. The estimated data traffic, in terabytes, in 2010

(6) **95d1c344** MULTIPLE CHOICE One answer only



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. 9
b. 8
c. 5
d. 0

(7) **15c364bf** MULTIPLE CHOICE One answer only

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.

(8) **f28944ff** MULTIPLE CHOICE One answer only

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

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

a.

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

b.

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

c.

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

d.

x	-1	0	1
$q(x)$	-64	0	64

(9) **50e40f08** SHORT ANSWER Case-Insensitive

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

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?

(10) **c4259674** MULTIPLE CHOICE One answer only

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

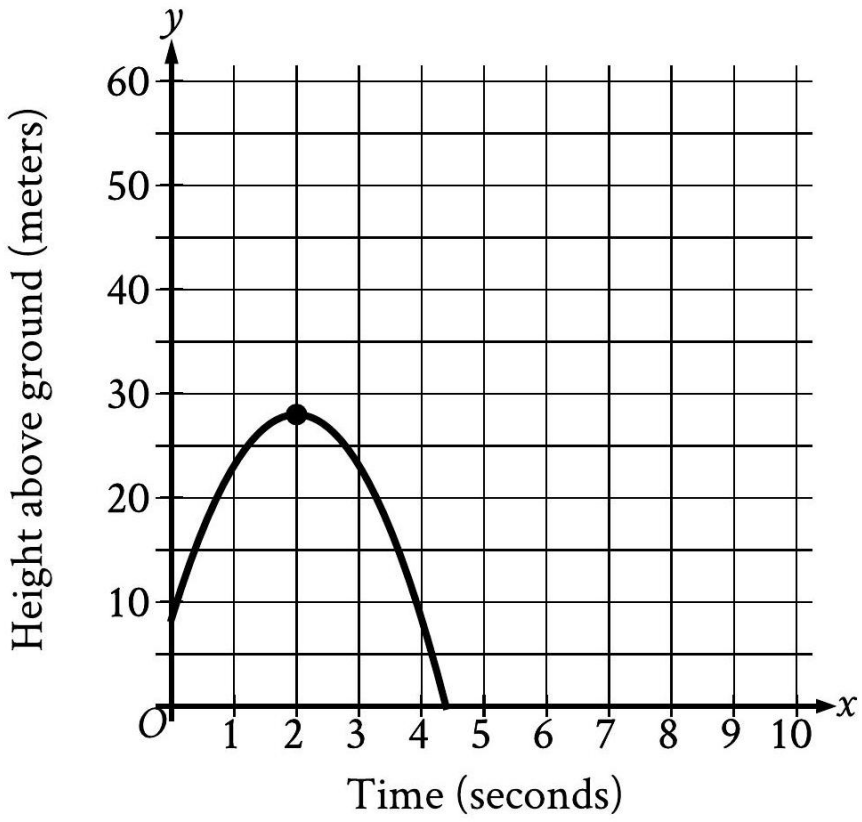
a. -84
b. $\frac{21}{4}$
c. $\frac{1}{84}$
d. $\frac{4}{21}$

(11) **a31417d1** MULTIPLE CHOICE One answer only

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

a. $C = 600(0.15)^t$
b. $C = 600(0.85)^t$
c. $C = 600(1.85)^t$
d. $C = 600(1.15)^t$

(12) **197bed38** MULTIPLE CHOICE One answer only



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 $x = 2$ to $x = 3$
b. From $x = 0$ to $x = 4$
c. From $x = 0$ to $x = 2$
d. From $x = 3$ to $x = 4$

(13) **c4cd5bcc** MULTIPLE CHOICE One answer only

In the xy-plane, the y-coordinate of the y-intercept of the graph of the function f is c. Which of the following must be equal to c ?

a. $f(1)$
b. $f(3)$
c. $f(0)$
d. $f(2)$

(14) **dc77e0dc** MULTIPLE CHOICE One answer only

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

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. 5
b. 12
c. 500
d. 2

(15) **78d5f91a** MULTIPLE CHOICE One answer only

$$f(x) = x^3 + 3x^2 - 6x - 1$$

For the function f defined above, what is the value of $f(-1)$?

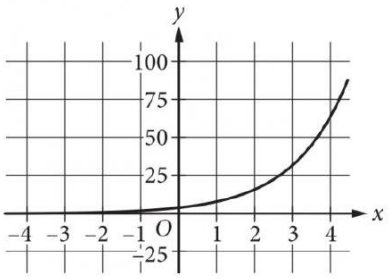
a. 11
b. -7
c. -11
d. 7

(16) **d675744f** MULTIPLE CHOICE One answer only

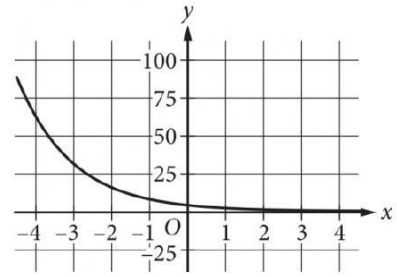
$$y = 4\,(2^x)$$

Which of the following is the graph in the xy plane of the given equation?

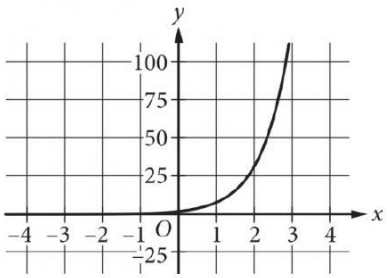
a.



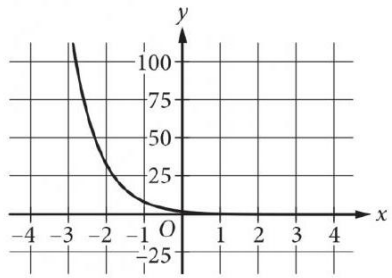
b.



c.



d.



(17) **f44a29a8** MULTIPLE CHOICE One answer only

An object's kinetic energy, in joules, is equal to the product of one-half the object's mass, in kilograms, and the square of the object's speed, in meters per second. What is the speed, in meters per second, of an object with a mass of 4 kilograms and kinetic energy of 18 joules?

a. 36
b. 9
c. 6
d. 3

(18) **d71f6dbf** MULTIPLE CHOICE One answer only

The height, in feet, of an object x seconds after it is thrown straight up in the air can be modeled by the function $h(x) = -16x^2 + 20x + 5$. Based on the model, which of the following statements best interprets the equation $h(1.4) = 1.64$?

a. its initial height.
b. The speed of the object 1.4 seconds after being thrown straight up in the air is approximately 1.64 feet per second.
c. The height of the object 1.4 seconds after being thrown straight up in the air is 1.64 feet.
d. The height of the object 1.64 seconds after being thrown straight up in the air is 1.4 feet. The height of the object 1.64 seconds after being thrown straight up in the air is approximately 1.4 times as great as

(19) **6676f055** MULTIPLE CHOICE One answer only

$$f(\theta) = -0.28(\theta - 27)^2 + 880$$

An engineer wanted to identify the best angle for a cooling fan in an engine in order to get the greatest airflow. The engineer discovered that the function above models the airflow $f(\theta)$, in cubic feet per minute, as a function of the angle of the fan θ, in degrees. According to the model, what angle, in degrees, gives the greatest airflow?

a. 27
b. -0.28
c. 0.28
d. 880

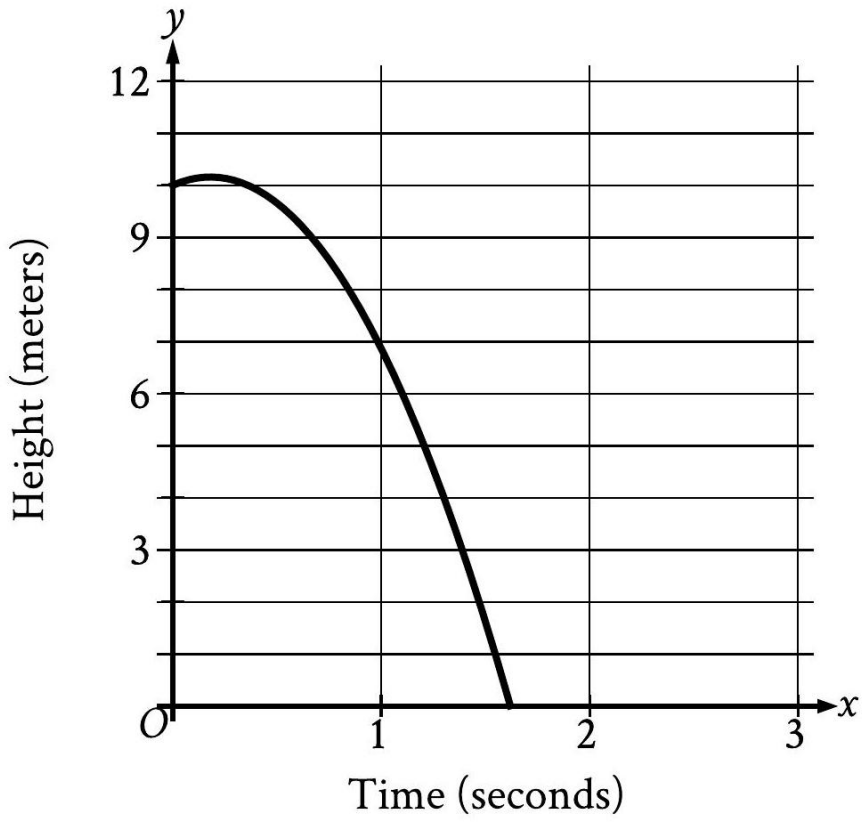
(20) **dd8ac009** MULTIPLE CHOICE One answer only

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. $d =$ msup
c. $d =$ msup
d. $d = 670$ msup

(21) **9ff88bb5** MULTIPLE CHOICE One answer only



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 hits the water at 1.6 seconds.
b. The diver reaches a maximum height above the water at 0.2 seconds.
c. The diver hits the water at 0.2 seconds.
d. The diver reaches a maximum height above the water at 1.6 seconds.

(22) **281a4f3b** MULTIPLE CHOICE One answer only

A certain college had 3,000 students enrolled in 2015. The college predicts that after 2015, the number of students enrolled each year will be 2% less than the number of students enrolled the year before. Which of the following functions models the relationship between the number of students enrolled, $f(x)$, and the number of years after 2015, x?

a. $f(x) = 0.02(3,000)^x$
b. $f(x) = 3,000(0.02)^x$
c. $f(x) = 3,000(0.98)^x$
d. $f(x) = 0.98(3,000)^x$

(23) **100030d9** SHORT ANSWER Case-Insensitive

A rubber ball bounces upward one-half the height that it falls each time it hits the ground. If the ball was originally dropped from a distance of 20.0 feet above the ground, what was its maximum height above the ground, in feet, between the third and fourth time it hit the ground?

(24) **c7a187a7** MULTIPLE CHOICE One answer only

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

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

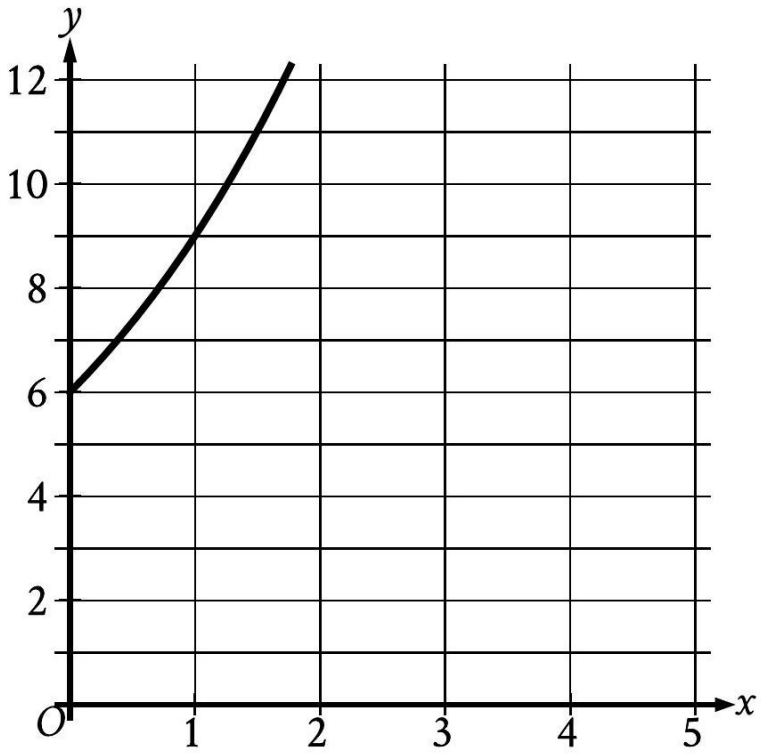
a. $(12, 0)$
b. $(-30, 0)$
c. $(-360, 0)$
d. $(-12, 0)$

(25) **e1391dd6** MULTIPLE CHOICE One answer only

According to Moore's law, the number of transistors included on microprocessors doubles every 2 years. In 1985, a microprocessor was introduced that had 275,000 transistors. Based on this information, in which of the following years does Moore's law estimate the number of transistors to reach 1.1 million?

a. 1994
b. 1987
c. 1989
d. 1991

(26) **f1fa0821** MULTIPLE CHOICE One answer only



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 2.5 times the estimated population at $x = 0$.
c. The estimated population at $x = 1$ is 1.5 times the estimated population at $x = 0$.
d. The estimated population at $x = 1$ is 3.5 times the estimated population at $x = 0$.

(27) **5bf0f84a** MULTIPLE CHOICE One answer only

$$h(t) = -16t^2 + 110t + 72$$

The function above models the height h, in feet, of an object above ground t seconds after being launched straight up in the air. What does the number 72 represent in the function?

a. The maximum height, in feet, of the object
b. The maximum speed, in feet per second, of the object
c. The initial speed, in feet per second, of the object
d. The initial height, in feet, of the object

(28) **70ebd3d0** MULTIPLE CHOICE One answer only

$$N(d) = 115(0.90)^d$$

The function N defined above can be used to model the number of species of brachiopods at various ocean depths d, where d is in hundreds of meters. Which of the following does the model predict?

a. For every increase in depth by 100 meters, the number of brachiopod species decreases by 10%.
b. For every increase in depth by 1 meter, the number of brachiopod species decreases by 10%.
c. For every increase in depth by 100 meters, the number of brachiopod species decreases by 115 .
d. For every increase in depth by 1 meter, the number of brachiopod species decreases by 115.

(29) **97158b3a** MULTIPLE CHOICE One answer only

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. 29
b. w
c. $(w + 29)$
d. $w(w + 29)$

(30) **dba7432e** MULTIPLE CHOICE One answer only

x	$f(x)$
0	5
1	$\frac{5}{2}$
2	$\frac{5}{4}$
3	$\frac{5}{8}$

The table above gives the values of the function f for some values of x. Which of the following equations could define f ?

a. $f(x) = 5\left(2^{-(x+1)}\right)$
b. $f(x) = 5\left(2^{x}\right)$
c. $f(x) = 5\left(2^{x+1}\right)$
d. $f(x) = 5\left(2^{-x}\right)$

(31) **c19d1fb0** SHORT ANSWER Case-Insensitive

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?

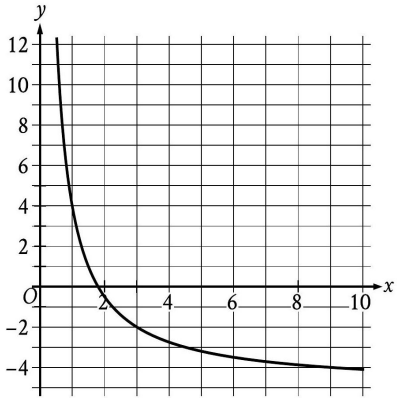
(32) **f5e8ccf1** MULTIPLE CHOICE One answer only

$$f(x) = (x + 4)(x - 1)(2x - 3)$$

The function f is defined above. Which of the following is NOT an x-intercept of the graph of the function in the xy-plane?

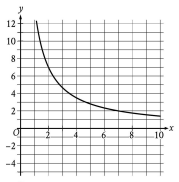
a. $(-4, 0)$
b. $\left(-\frac{2}{3}, 0\right)$
c. $\left(\frac{3}{2}, 0\right)$
d. $(1, 0)$

(33) **aa95fb33** MULTIPLE CHOICE One answer only

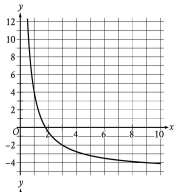


The graph of the rational function f is shown, where $y = f(x)$ and $x \geq 0$. Which of the following is the graph of $y = f(x) + 5$, where $x \geq 0$?

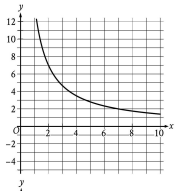
a.



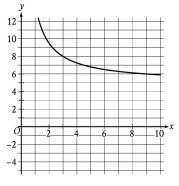
b.



c.



d.



(34) **7a4475df** MULTIPLE CHOICE One answer only

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. $p(x) = 2,000(0.97)^x$
d. $p(x) = 2,000(1.03)^x$

(35) **5c00c2c1** MULTIPLE CHOICE One answer only

There were no jackrabbits in Australia before 1788 when 24 jackrabbits were introduced. By 1920 the population of jackrabbits had reached 10 billion. If the population had grown exponentially, this would correspond to a 16.2% increase, on average, in the population each year. Which of the following functions best models the population $p(t)$ of jackrabbits t years after 1788?

a. $p(t) = (24 \cdot 1.162)^t$
b. $p(t) = 24(1.162)^t$
c. $p(t) = 24(2)^{1.162t}$
d. $p(t) = 1.162(24)^t$

Hard

(1) **301faf80** SHORT ANSWER Case-Insensitive

The product of two positive integers is 462 . If the first integer is 5 greater than twice the second integer, what is the smaller of the two integers?

(2) **02060533** MULTIPLE CHOICE One answer only

x	$g(x)$
-27	3
-9	0
21	5

The table shows three values of x and their corresponding values of $g(x)$, where $g(x) = \frac{f(x)}{x+3}$ and f is a linear function. What is the y-intercept of the graph of $y = f(x)$ in the xy-plane?

a. $(0, -9)$
b. $(0, 12)$
c. $(0, 36)$
d. $(0, 4)$

(3) **91e7ea5e** MULTIPLE CHOICE One answer only

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

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. 4
c. 8
d. 2

(4) **358f18bc** SHORT ANSWER Case-Insensitive

$$f(x) = x^2 - 48x + 2,304$$

What is the minimum value of the given function?

(5) **a9084ca4** MULTIPLE CHOICE One answer only

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

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 estimated number of advertisements the company sent to its clients in 1997 was 9,000 .
b. The minimum estimated number of advertisements the company sent to its clients during the 5 years was 1,708 .
c. The minimum estimated number of advertisements the company sent to its clients during the 5 years was 9,000 .
d. The estimated number of advertisements the company sent to its clients in 1997 was 1,708.

(6) **40491607** SHORT ANSWER Case-Insensitive

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

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

(7) **9654add7** MULTIPLE CHOICE One answer only

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

a. The unit price, in dollars, of the product that will result in a revenue of \$0
b. The unit price, in dollars, of the product that will result in maximum revenue
c. The revenue, in dollars, when the unit price of the product is \$0
d. The maximum revenue, in dollars, that the company can make

(8) **263f9937** MULTIPLE CHOICE One answer only

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

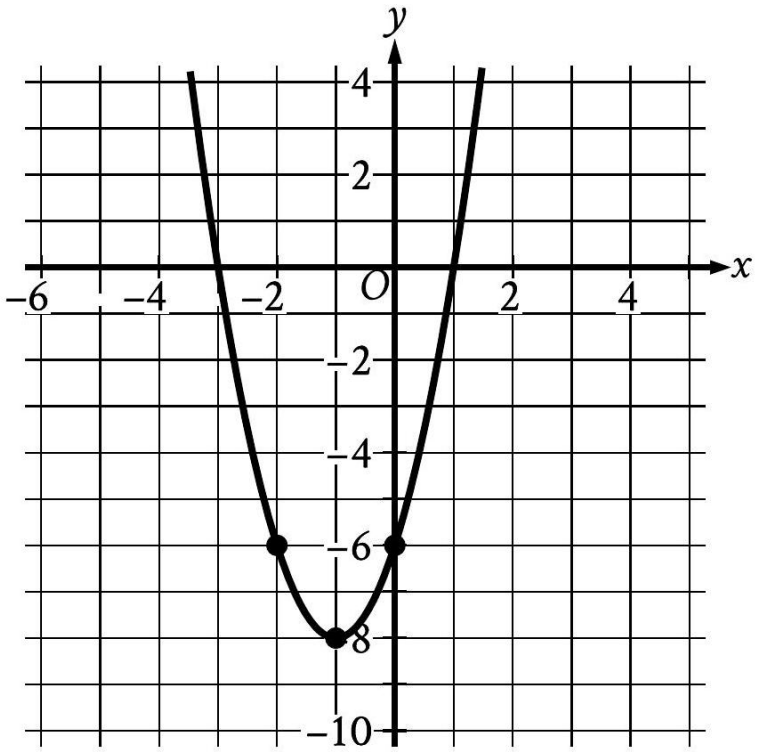
(9) **2992ac30** MULTIPLE CHOICE One answer only

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

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

a. 12
b. 18
c. 72
d. 8

(10) **09d21d79** SHORT ANSWER Case-Insensitive



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

(11) **821e724e** SHORT ANSWER Case-Insensitive

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

(12) **ce508fb0** SHORT ANSWER Case-Insensitive

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

$$f(x) = 3 + \left|-2x - x^2\right| \qquad g(w) = \left|\frac{-w}{w-1}\right| - w + 5$$

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

(13) **9afe2370** MULTIPLE CHOICE One answer only

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. $0 < r < 1$
c. $-1 < r < 0$
d. $r < -1$

(14) **270cf326** MULTIPLE CHOICE One answer only

Which of the following functions has(have) a minimum value at -3 ?

$$f(x) = -6(3)^x - 3 \qquad g(x) = -3(6)^x$$

a. Neither I nor II
b. II only
c. I only
d. I and II

(15) **0121a235** MULTIPLE CHOICE One answer only

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. $(x-1)(x+2)$
c. $(x+3)$
d. $(x+1)(x-2)$

(16) **70753f99** MULTIPLE CHOICE One answer only

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. $1 < x < 3$
b. $-3 < x < 1$
c. $-4 < x < -3$
d. $3 < x < 4$

(17) **58dcc59f** SHORT ANSWER Case-Insensitive

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?

(18) **84dd43f8** SHORT ANSWER Case-Insensitive

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 $f(2)$?

(19) **59d1f4b5** MULTIPLE CHOICE One answer only

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

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

a. $M = 1,800(1.082)^q$
b.
c. $M = 1,800(1.005)^{4q}$
d. $M = 1,800(1.02)^{4q}$

(20) **95eeeb5b** MULTIPLE CHOICE One answer only

The function f is defined by $f(x) = ax^2 + bx + c$, where a, b, and c are constants. The graph of $y = f(x)$ in the $xy-$ plane passes through the points $(7, 0)$ and $(-3, 0)$. If a is an integer greater than 1 , which of the following could be the value of $a + b$?

a. -3
b. -6
c. 5
d. 4

(21) **635f54ee** MULTIPLE CHOICE One answer only

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. a
b. $4a$
c. $6a$
d. $\frac{a}{4}$

(22) **70fb357b** MULTIPLE CHOICE One answer only

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

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. $y = \text{msup}$
b. $y = \frac{1}{576}\ \text{msup}$
c. $y = \text{msup}$
d. $y = \frac{1}{24}\text{msup}$

(23) **de39858a** MULTIPLE CHOICE One answer only

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 $\left(-2, \frac{325}{36}\right)$. What is the value of ab ?

a. $\frac{1}{4}$
b. $\frac{1}{2}$
c. 60
d. 54

(24) **d41cf4d3** MULTIPLE CHOICE One answer only

The function f is defined by $f(x) = a\sqrt{x+b}$, where a and b are constants. In the xy-plane, the graph of $y = f(x)$ passes through the point $(-24, 0)$, and $f(24) < 0$. Which of the following must be true?

a. $a > b$
b. $a < b$
c. $f(0) = 24$
d. $f(0) = -24$

(25) **1178f2df** SHORT ANSWER Case-Insensitive

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?

(26) **84e8cc72** MULTIPLE CHOICE One answer only

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. 1,014
b. 970
c. 778
d. 234

(27) **4b642eef** SHORT ANSWER Case-Insensitive

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?

(28) **9f2ecade** SHORT ANSWER Case-Insensitive

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

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 ?

(29) **7a6d06bf** SHORT ANSWER Case-Insensitive

A rectangle has an area of 155 square inches. The length of the rectangle is 4 inches less than 7 times the width of the rectangle. What is the width of the rectangle, in inches?

(30) **dcf63c94** MULTIPLE CHOICE One answer only

$$f(x) = 272(2)^x$$

The function f is defined by the given equation. If $h(x) = f(x - 4)$, which of the following equations defines function h ?

a. $h(x) = 272(16)^x$
b. $h(x) = 68(2)^x$
c. $h(x) = 17(2)^x$
d. $h(x) = 272(8)^x$

(31) **6f5540a5** MULTIPLE CHOICE One answer only

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. $185(0.85)^m$
b. $T(m) = 70 + 115(0.75)^{\frac{m}{5}}$
c. $T(m) = (185 - 70)(0.75)^{\frac{m}{5}}$
d. $T(m) = 185(1.25)^m$

(32) **1073d70c** MULTIPLE CHOICE One answer only

At the time that an article was first featured on the home page of a news website, there were 40 comments on the article. An exponential model estimates that at the end of each hour after the article was first featured on the home page, the number of comments on the article had increased by 190% of the number of comments on the article at the end of the previous hour. Which of the following equations best represents this model, where C is the estimated number of comments on the article t hours after the article was first featured on the home page and $t \leq 4$?

a. $C = 40\text{msup}$
b. $C = 40\text{msup}$
c. $C = 40\text{msup}$
d. $C = 40\text{msup}$

(33) **b73ee6cf** MULTIPLE CHOICE One answer only

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. $60,000 = 50,000(0.03)^t$
c. $60,000 = 50,000(1.03)^t$
d. $50,000 = 60,000(3)^t$

(34) **7eed640d** MULTIPLE CHOICE One answer only

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

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

(35) **43926bd9** SHORT ANSWER Case-Insensitive

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 ?

(36) **161126cf** MULTIPLE CHOICE One answer only

$$f(x) = (1.84)^{\frac{x}{4}}$$

The function f is defined by the given equation. The equation can be rewritten as $f(x) = \left(1 + \frac{p}{100}\right)^x$, where p is a constant. Which of the following is closest to the value of p ?

a. 46
b. 96
c. 21
d. 16

(37) **a7711fe8** MULTIPLE CHOICE One answer only

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

a. -2
b. 4
c. -4
d. 2

(38) **1a722d7d** MULTIPLE CHOICE One answer only

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. 11.00
b. 10.75
c. 10.25
d. 10.00

(39) **6e7ae9fc** SHORT ANSWER Case-Insensitive

The function g is defined by $g(x) = x(x-2)(x+6)^2$. The value of $g(7-w)$ is 0 , where w is a constant. What is the sum of all possible values of w ?

(40) **48f83c34** MULTIPLE CHOICE One answer only

A right rectangular prism has a height of 9 inches. The length of the prism's base is x inches, which is 7 inches more than the width of the prism's base. Which function V gives the volume of the prism, in cubic inches, in terms of the length of the prism's base?

a. $V(x) = 9x(x - 7)$
b. $V(x) = x(x + 9)(x - 7)$
c. $V(x) = 9x(x + 7)$
d. $V(x) = x(x + 9)(x + 7)$

Total of marks: 100