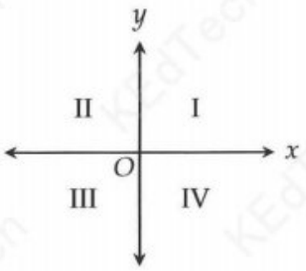
7



In the xy-plane, the quadrants are labeled as shown. The graph of the equation $y = 3(x + a)^2 + b$, where a and b are positive constants, has a vertex in which quadrant?

A) Quadrant I
B) Quadrant II
C) Quadrant III
D) Quadrant IV

8

$$-6(3x^2 - 8x) = q$$

In the given equation, q is an integer constant. If the equation has exactly two distinct real solutions, what is the greatest possible value of q?

9

$$f(x) = m\left[(x - m)^2 - 1\right]$$

In the given quadratic function, m is a positive constant. The graph of $y = f(x)$ in the xy-plane is a parabola. Which of the following statements about the parabola is true?

A) Its minimum is reached at $(m, -1)$.
B) Its minimum is reached at $(m, -m)$.
C) Its maximum is reached at $(m, -1)$.
D) Its maximum is reached at $(m, -m)$.

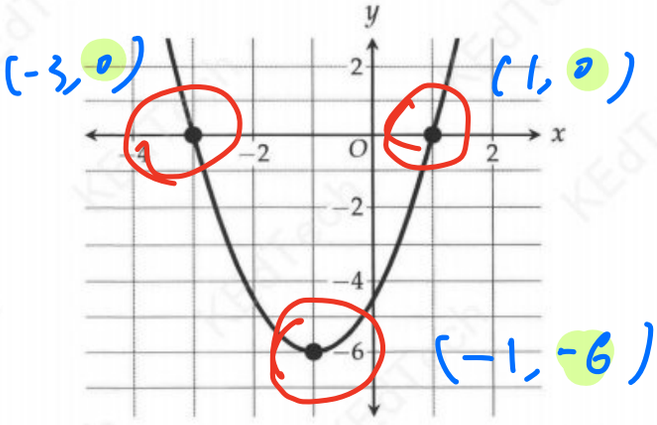
10

$$g(x) = -3x^2 + 18x$$

The function g gives the download speed, in megabytes per second, of a file x minutes after a download of the file was started. The graph of $y = g(x)$ in the xy-plane has x-intercepts at $(0, 0)$ and $(c, 0)$, where c is a constant. Which of the following is the best interpretation of the value of $\frac{c}{2}$ in this context?

A) At the start of the download, the download speed was $\frac{c}{2}$ megabytes per second.
B) During the download, the download speed reached a maximum of $\frac{c}{2}$ megabytes per second.
C) The download speed was at its highest $\frac{c}{2}$ minutes after the download was started.
D) The download was completed $\frac{c}{2}$ minutes after it was started.

11



The graph of $y = ax^2 + 3x + c$ is shown, where a and c are constants. What is the value of $a + c$?

12

The function f is defined by $f(x) = -6x^2 + 48x - 95$, and the function g is defined by $g(x) = f(x-3)$. For what value of x does $g(x)$ reach its maximum?

A) -2
B) 1
C) 4
D) 7

13

In the xy-plane, the line $y = 5.5$ intersects the graph of the equation $y = -x^2 + 16x - a$ at exactly one point. What is the value of a?

A) $-\frac{139}{2}$
B) $\frac{128}{11}$
C) $\frac{27}{2}$
D) $\frac{117}{2}$

14

$$y = 4x$$
$$y = 3x^2 + bx + 3$$

In the given system of equations, b is a positive constant. The system has exactly one distinct real solution. What is the value of b?

15

$$f(x) = a(x-3)(x-k)$$

In the given quadratic function, a and k are constants. The graph of $y = f(x)$ in the xy-plane is a parabola with vertex $(5, -32)$. What is the value of a?

A) 2
B) 5
C) 6
D) 8

16

$$y = 2x^2 + 15x + 57$$
$$y = -9x + p$$

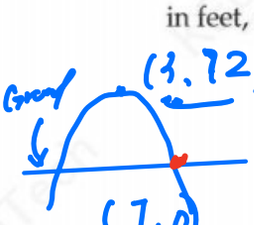
In the given system of equations, p is a constant. The system has exactly one distinct real solution, (x, y). What is the value of y?

17

The function g is defined by $g(x) = ax^2 + bx + c$, where a, b, and c are constants. The graph of $y = g(x)$ in the xy-plane passes through the points $(-4, 0)$ and $(8, 0)$. If the sum of b and c is equal to 14, what is the value of a?

18

A golf ball was struck from a certain height above the ground. The ball reached its maximum height of 72 feet above the ground 3 seconds after it was struck, and the ball hit the ground 7 seconds after it was struck. A quadratic function can be used to model the height, in feet, of the ball above the ground in terms of the time, in seconds, after the ball was struck. Based on the model, what was the height, in feet, of the ball 5 seconds after it was struck?



$y = a(x-h)^2 + k$

$y = a(x-3)^2 + 72$

$0 = a(7-3)^2 + 72$

$y = 54$

19

x	y	$f(x)$
6	28	30
10	−20	−18
14	28	30

The table gives three values of x and their corresponding values of y, where $y = f(x) - 2$ and f is a quadratic function. What is the value of $f(20)$?

$y = f(x) - 2$ $\quad f(x) = y + 2$

(6, 30)
(14, 30)

$x_{midpoint} = 10$

(10, −18)

✓

282

20

$$g(x) = ax^2 + 8x + c$$

The quadratic function g is defined by the given equation, where a and c are constants. The graph of $y = g(x)$ in the xy-plane has x-intercepts at $(0, 0)$ and $(n, 0)$, where n is a nonzero constant. If the maximum value of $g(x)$ is 25, which of the following must be true?

I. $a < 0$
II. $c = 0$
III. $n > 0$

A) I only
B) II only
C) I and II only
D) I, II, and III

21

In the xy-plane, a parabola with equation $y = ax^2 + bx + c$, where a, b, and c are constants, has a vertex at the point $(-5, -100)$. If $c > 0$, which of the following is a possible value of b?

A) −60
B) −40
C) 40
D) 60

22

$$f(x) = 3x^2 + bx + c$$

In the given quadratic function, b and c are constants. The graph of $y = f(x)$ in the xy-plane does not intersect the x-axis. If $f(-7) = f(9)$, which of the following could be the value of $b + c$?

A) −1
B) −3
C) −5
D) −7

$b = -6$ $\quad x = -\frac{b}{2a}$

$x = 1$ $\quad f(x) = 3(x-1)^2 + k$

$3(x^2 - 2x + 1) + k$

$3x^2 - 6x + 3 + k$ $\quad 3 + k = c$

$b + c = -6 + 3 + k = k - 3$

$k > 0$ $\quad k - 3 > -3$