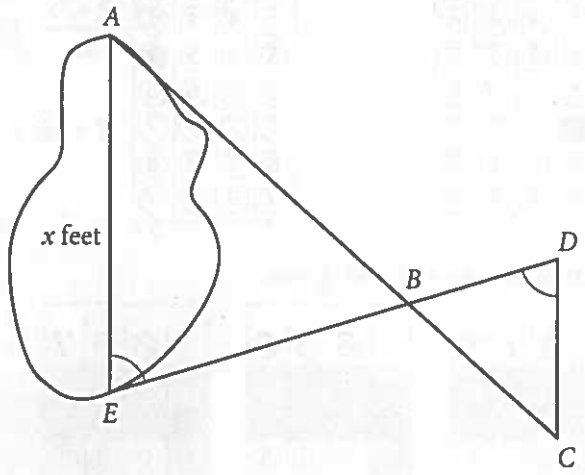
16

If $t > 0$ and $t^2 - 4 = 0$, what is the value of t ?

17



A summer camp counselor wants to find a length, x, in feet, across a lake as represented in the sketch above. The lengths represented by AB, EB, BD, and CD on the sketch were determined to be 1800 feet, 1400 feet, 700 feet, and 800 feet, respectively. Segments AC and DE intersect at B, and $\angle AEB$ and $\angle CDB$ have the same measure. What is the value of x ?

18

$$x + y = -9$$
$$x + 2y = -25$$

According to the system of equations above, what is the value of x ?

19

In a right triangle, one angle measures $x°$, where $\sin x° = \frac{4}{5}$. What is $\cos(90° - x°)$?

20

If $a = 5\sqrt{2}$ and $2a = \sqrt{2x}$, what is the value of x ?

STOP

If you finish before time is called, you may check your work on this section only. Do not turn to any other section.

25

If $\sin x° = a$, which of the following must be true for all values of x ?

A) $\cos x° = a$

B) $\sin(90° - x°) = a$

C) $\cos(90° - x°) = a$

D) $\sin(x^2)° = a^2$

26

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

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

27

In the xy-plane, the graph of the polynomial function f crosses the x-axis at exactly two points, $(a, 0)$ and $(b, 0)$, where a and b are both positive. Which of the following could define f ?

A) $f(x) = (x - a)(x - b)$

B) $f(x) = (x + a)(x + b)$

C) $f(x) = (x - a)(x + b)$

D) $f(x) = x(x - a)(x - b)$

28

If $y = 3x^2 + 6x + 2$ is graphed in the xy-plane, which of the following characteristics of the graph is displayed as a constant or coefficient in the equation?

A) y-coordinate of the vertex

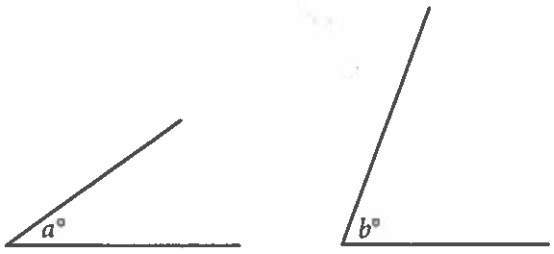
B) x-intercept(s)

C) y-intercept

D) x-intercept of the line of symmetry

CONTINUE

23



Note: Figures not drawn to scale.

The angles shown above are acute and $\sin(a°) = \cos(b°)$. If $a = 4k - 22$ and $b = 6k - 13$, what is the value of k ?

A) 4.5

B) 5.5

C) 12.5

D) 21.5

24

Mr. Kohl has a beaker containing n milliliters of solution to distribute to the students in his chemistry class. If he gives each student 3 milliliters of solution, he will have 5 milliliters left over. In order to give each student 4 milliliters of solution, he will need an additional 21 milliliters. How many students are in the class?

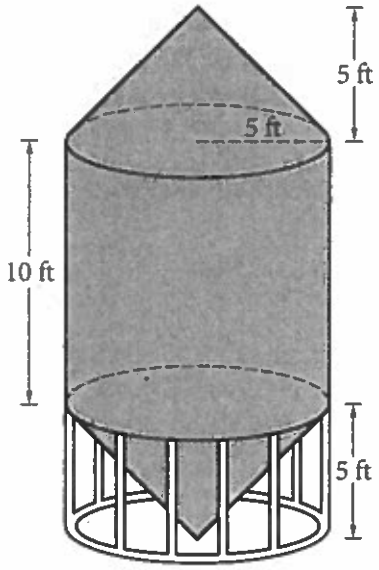
A) 16

B) 21

C) 23

D) 26

25



A grain silo is built from two right circular cones and a right circular cylinder with internal measurements represented by the figure above. Of the following, which is closest to the volume of the grain silo, in cubic feet?

A) 261.8

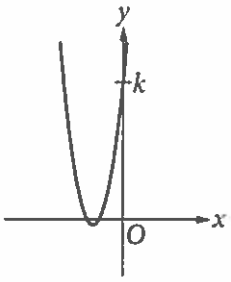
B) 785.4

C) 916.3

D) 1,047.2

CONTINUE

10



The graph of $y = 2x^2 + 10x + 12$ is shown. If the graph crosses the y-axis at the point $(0, k)$, what is the value of k ?

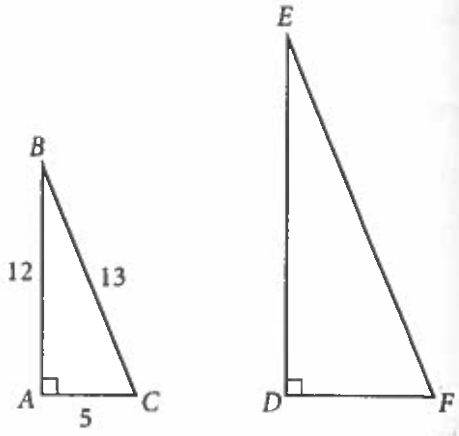
A) 2
B) 6
C) 10
D) 12

11

A circle in the xy-plane has center $(5, 7)$ and radius 2. Which of the following is an equation of the circle?

A) $(x-5)^2 + (y-7)^2 = 4$
B) $(x+5)^2 + (y+7)^2 = 4$
C) $(x-5)^2 + (y-7)^2 = 2$
D) $(x+5)^2 + (y+7)^2 = 2$

12



In the figure above, triangle ABC is similar to triangle DEF. What is the value of $\cos(E)$?

A) $\frac{12}{5}$
B) $\frac{12}{13}$
C) $\frac{5}{12}$
D) $\frac{5}{13}$

CONTINUE

24

Which of the following is an equation of a circle in the xy-plane with center $(0, 4)$ and a radius with endpoint $\left(\frac{4}{3}, 5\right)$?

A) $x^2 + (y-4)^2 = \frac{25}{9}$

B) $x^2 + (y+4)^2 = \frac{25}{9}$

C) $x^2 + (y-4)^2 = \frac{5}{3}$

D) $x^2 + (y+4)^2 = \frac{3}{5}$

25

$$h = -4.9t^2 + 25t$$

The equation above expresses the approximate height h, in meters, of a ball t seconds after it is launched vertically upward from the ground with an initial velocity of 25 meters per second. After approximately how many seconds will the ball hit the ground?

A) 3.5

B) 4.0

C) 4.5

D) 5.0

26

Katarina is a botanist studying the production of pears by two types of pear trees. She noticed that Type A trees produced 20 percent more pears than Type B trees did. Based on Katarina's observation, if the Type A trees produced 144 pears, how many pears did the Type B trees produce?

A) 115

B) 120

C) 124

D) 173

27

A square field measures 10 meters by 10 meters. Ten students each mark off a randomly selected region of the field; each region is square and has side lengths of 1 meter, and no two regions overlap. The students count the earthworms contained in the soil to a depth of 5 centimeters beneath the ground's surface in each region. The results are shown in the table below.

Region	Number of earthworms	Region	Number of earthworms
A	107	F	141
B	147	G	150
C	146	H	154
D	135	I	176
E	149	J	166

Which of the following is a reasonable approximation of the number of earthworms to a depth of 5 centimeters beneath the ground's surface in the entire field?

A) 150

B) 1,500

C) 15,000

D) 150,000

CONTINUE

29

A circle in the xy-plane has equation $(x+3)^2 + (y-1)^2 = 25$. Which of the following points does NOT lie in the interior of the circle?

A) $(-7, 3)$

B) $(-3, 1)$

C) $(0, 0)$

D) $(3, 2)$

30

Year	Subscriptions sold
2012	5,600
2013	5,880

The manager of an online news service received the report above on the number of subscriptions sold by the service. The manager estimated that the percent increase from 2012 to 2013 would be double the percent increase from 2013 to 2014. How many subscriptions did the manager expect would be sold in 2014?

A) 6,020

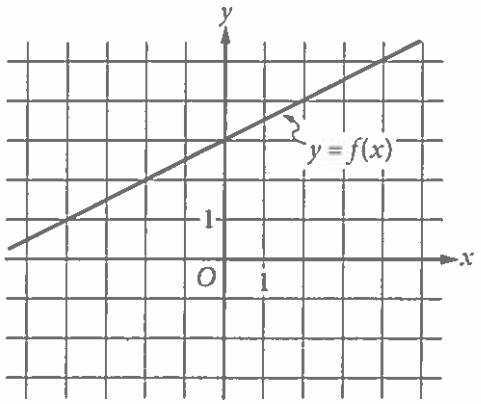
B) 6,027

C) 6,440

D) 6,468

CONTINUE

28



The graph of the linear function f is shown in the xy-plane above. The slope of the graph of the linear function g is 4 times the slope of the graph of f. If the graph of g passes through the point $(0, -4)$, what is the value of $g(9)$?

A) 5

B) 9

C) 14

D) 18

29

$$x^2 + 20x + y^2 + 16y = -20$$

The equation above defines a circle in the xy-plane. What are the coordinates of the center of the circle?

A) $(-20, -16)$

B) $(-10, -8)$

C) $(10, 8)$

D) $(20, 16)$

30

$$y = x^2 - a$$

In the equation above, a is a positive constant and the graph of the equation in the xy-plane is a parabola. Which of the following is an equivalent form of the equation?

A) $y = (x + a)(x - a)$

B) $y = (x + \sqrt{a})(x - \sqrt{a})$

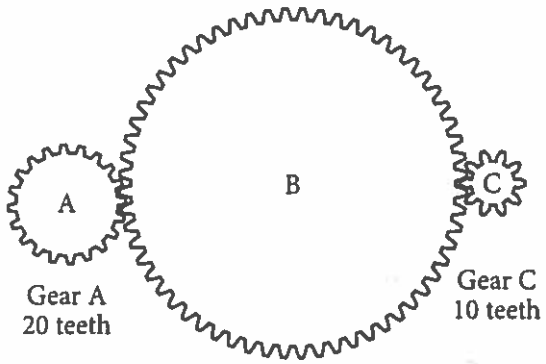
C) $y = \left(x + \frac{a}{2}\right)\left(x - \frac{a}{2}\right)$

D) $y = (x + a)^2$

CONTINUE

26

A gear ratio $r:s$ is the ratio of the number of teeth of two connected gears. The ratio of the number of revolutions per minute (rpm) of two gear wheels is $s:r$. In the diagram below, Gear A is turned by a motor. The turning of Gear A causes Gears B and C to turn as well.



If Gear A is rotated by the motor at a rate of 100 rpm, what is the number of revolutions per minute for Gear C?

A) 50

B) 110

C) 200

D) 1,000

27

In the xy-plane, the graph of $2x^2 - 6x + 2y^2 + 2y = 45$ is a circle. What is the radius of the circle?

A) 5

B) 6.5

C) $\sqrt{40}$

D) $\sqrt{50}$

28

Two different points on a number line are both 3 units from the point with coordinate -4. The solution to which of the following equations gives the coordinates of both points?

A) $|x + 4| = 3$

B) $|x - 4| = 3$

C) $|x + 3| = 4$

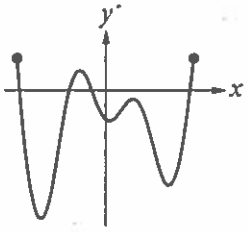
D) $|x - 3| = 4$

CONTINUE

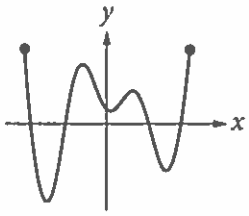
12

If the function f has five distinct zeros, which of the following could represent the complete graph of f in the xy-plane?

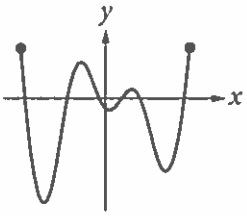
A)



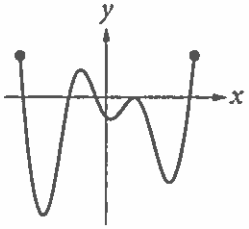
B)



C)



D)



13

$$h = -16t^2 + vt + k$$

The equation above gives the height h, in feet, of a ball t seconds after it is thrown straight up with an initial speed of v feet per second from a height of k feet. Which of the following gives v in terms of h, t, and k ?

A) $v = h + k - 16t$

B) $v = \dfrac{h - k + 16}{t}$

C) $v = \dfrac{h + k}{t} - 16t$

D) $v = \dfrac{h - k}{t} + 16t$

14

The cost of using a telephone in a hotel meeting room is \$0.20 per minute. Which of the following equations represents the total cost c, in dollars, for h hours of phone use?

A) $c = 0.20(60h)$

B) $c = 0.20h + 60$

C) $c = \dfrac{60h}{0.20}$

D) $c = \dfrac{0.20h}{60}$

CONTINUE

11

The expression $\dfrac{x^{-2}y^{\frac{1}{2}}}{x^{\frac{1}{3}}y^{-1}}$, where $x > 1$ and $y > 1$, is

equivalent to which of the following?

A) $\dfrac{\sqrt{y}}{\sqrt[3]{x^2}}$

B) $\dfrac{y\sqrt{y}}{\sqrt[3]{x^2}}$

C) $\dfrac{y\sqrt{y}}{x\sqrt{x}}$

D) $\dfrac{y\sqrt{y}}{x^2\sqrt[3]{x}}$

12

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) $3 < x < 4$

CONTINUE

13

In the xy-plane, the graph of the function $f(x) = x^2 + 5x + 4$ has two x-intercepts. What is the distance between the x-intercepts?

A) 1

B) 2

C) 3

D) 4

14

$$\sqrt{4x} = x - 3$$

What are all values of x that satisfy the given equation?

I. 1

II. 9

A) I only

B) II only

C) I and II

D) Neither I nor II

15

$$-3x + y = 6$$

$$ax + 2y = 4$$

In the system of equations above, a is a constant. For which of the following values of a does the system have no solution?

A) -6

B) -3

C) 3

D) 6

9

$$kx - 3y = 4$$

$$4x - 5y = 7$$

In the system of equations above, k is a constant and x and y are variables. For what value of k will the system of equations have no solution?

A) $\frac{12}{5}$

B) $\frac{16}{7}$

C) $-\frac{16}{7}$

D) $-\frac{12}{5}$

10

In the xy-plane, the parabola with equation $y = (x - 11)^2$ intersects the line with equation $y = 25$ at two points, A and B. What is the length of $\overline{AB}$?

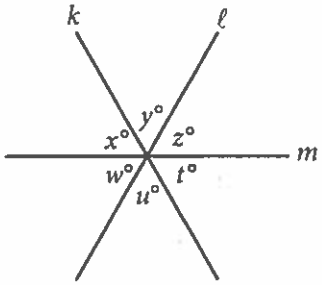
A) 10

B) 12

C) 14

D) 16

11



Note: Figure not drawn to scale.

In the figure above, lines k, ℓ, and m intersect at a point. If $x + y = u + w$, which of the following must be true?

I. $x = z$

II. $y = w$

III. $z = t$

A) I and II only

B) I and III only

C) II and III only

D) I, II, and III

12

$$y = a(x - 2)(x + 4)$$

In the quadratic equation above, a is a nonzero constant. The graph of the equation in the xy-plane is a parabola with vertex (c, d). Which of the following is equal to d ?

A) $-9a$

B) $-8a$

C) $-5a$

D) $-2a$

CONTINUE

15

In order to determine if treatment X is successful in improving eyesight, a research study was conducted. From a large population of people with poor eyesight, 300 participants were selected at random. Half of the participants were randomly assigned to receive treatment X, and the other half did not receive treatment X. The resulting data showed that participants who received treatment X had significantly improved eyesight as compared to those who did not receive treatment X. Based on the design and results of the study, which of the following is an appropriate conclusion?

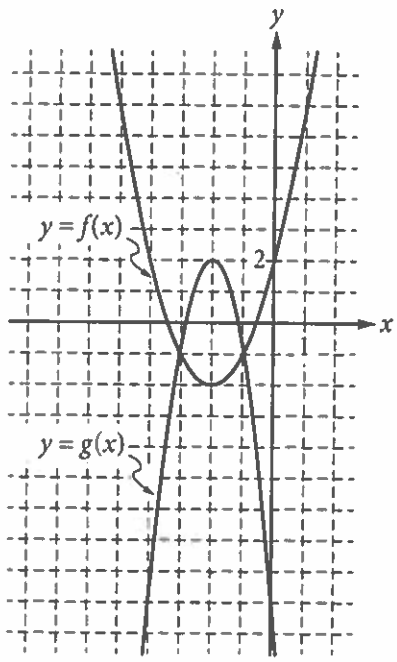
A) Treatment X is likely to improve the eyesight of people who have poor eyesight.

B) Treatment X improves eyesight better than all other available treatments.

C) Treatment X will improve the eyesight of anyone who takes it.

D) Treatment X will cause a substantial improvement in eyesight.

16



Graphs of the functions f and g are shown in the xy-plane above. For which of the following values of x does $f(x) + g(x) = 0$?

A) -3

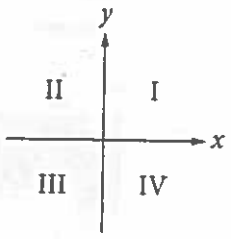
B) -2

C) -1

D) 0

CONTINUE

28



If the system of inequalities $y \geq 2x + 1$ and $y > \frac{1}{2}x - 1$ is graphed in the xy-plane above, which quadrant contains no solutions to the system?

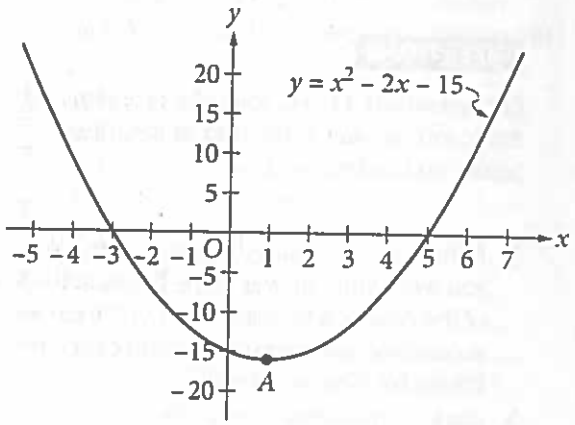
A) Quadrant II
B) Quadrant III
C) Quadrant IV
D) There are solutions in all four quadrants.

29

For a polynomial $p(x)$, the value of $p(3)$ is -2. Which of the following must be true about $p(x)$?

A) $x - 5$ is a factor of $p(x)$.
B) $x - 2$ is a factor of $p(x)$.
C) $x + 2$ is a factor of $p(x)$.
D) The remainder when $p(x)$ is divided by $x - 3$ is -2.

30



Which of the following is an equivalent form of the equation of the graph shown in the xy-plane above, from which the coordinates of vertex A can be identified as constants in the equation?

A) $y = (x + 3)(x - 5)$
B) $y = (x - 3)(x + 5)$
C) $y = x(x - 2) - 15$
D) $y = (x - 1)^2 - 16$

CONTINUE

13

Which of the following expressions is equivalent to $\frac{x^2-2x-5}{x-3}$?

A) $x-5-\frac{20}{x-3}$

B) $x-5-\frac{10}{x-3}$

C) $x+1-\frac{8}{x-3}$

D) $x+1-\frac{2}{x-3}$

14

A shipping service restricts the dimensions of the boxes it will ship for a certain type of service. The restriction states that for boxes shaped like rectangular prisms, the sum of the perimeter of the base of the box and the height of the box cannot exceed 130 inches. The perimeter of the base is determined using the width and length of the box. If a box has a height of 60 inches and its length is 2.5 times the width, which inequality shows the allowable width x, in inches, of the box?

A) $0 < x \leq 10$

B) $0 < x \leq 11\frac{2}{3}$

C) $0 < x \leq 17\frac{1}{2}$

D) $0 < x \leq 20$

15

The expression $\frac{1}{3}x^2-2$ can be rewritten as $\frac{1}{3}(x-k)(x+k)$, where k is a positive constant.

What is the value of k ?

A) 2

B) 6

C) $\sqrt{2}$

D) $\sqrt{6}$

CONTINUE

12

$$\frac{1}{2x+1}+5$$

Which of the following is equivalent to the expression above for $x > 0$?

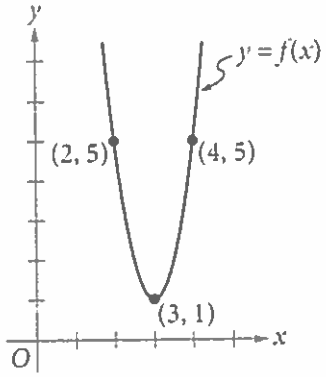
A) $\frac{2x+5}{2x+1}$

B) $\frac{2x+6}{2x+1}$

C) $\frac{10x+5}{2x+1}$

D) $\frac{10x+6}{2x+1}$

13



The graph of the function f in the xy-plane above is a parabola. Which of the following defines f ?

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

B) $f(x) = 4(x+3)^2 + 1$

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

D) $f(x) = 3(x+3)^2 + 1$

CONTINUE

19

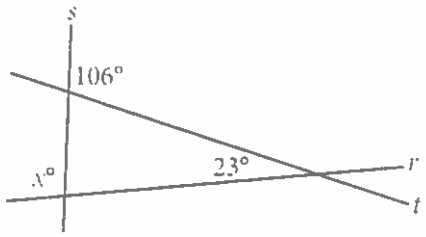
$$\frac{2x+6}{(x+2)^2}-\frac{2}{x+2}$$

The expression above is equivalent to $\frac{a}{(x+2)^2}$, where a is a positive constant and $x \neq -2$.

What is the value of a ?

20

Intersecting lines r, s, and t are shown below.



What is the value of x ?

STOP

If you finish before time is called, you may check your work on this section only.
Do not turn to any other section.

3

13

The equation $\frac{24x^2 + 25x - 47}{ax - 2} = -8x - 3 - \frac{53}{ax - 2}$ is true for all values of $x \neq \frac{2}{a}$, where a is a constant.

What is the value of a ?

A) -16

B) -3

C) 3

D) 16

14

What are the solutions to $3x^2 + 12x + 6 = 0$?

A) $x = -2 \pm \sqrt{2}$

B) $x = -2 \pm \frac{\sqrt{30}}{3}$

C) $x = -6 \pm \sqrt{2}$

D) $x = -6 \pm 6\sqrt{2}$

15

$$C = \frac{5}{9}(F - 32)$$

The equation above shows how a temperature F, measured in degrees Fahrenheit, relates to a temperature C, measured in degrees Celsius. Based on the equation, which of the following must be true?

I. A temperature increase of 1 degree Fahrenheit is equivalent to a temperature increase of $\frac{5}{9}$ degree Celsius.

II. A temperature increase of 1 degree Celsius is equivalent to a temperature increase of 1.8 degrees Fahrenheit.

III. A temperature increase of $\frac{5}{9}$ degree Fahrenheit is equivalent to a temperature increase of 1 degree Celsius.

A) I only

B) II only

C) III only

D) I and II only

CONTINUE

8

$$2ax - 15 = 3(x + 5) + 5(x - 1)$$

In the equation above, a is a constant. If no value of x satisfies the equation, what is the value of a ?

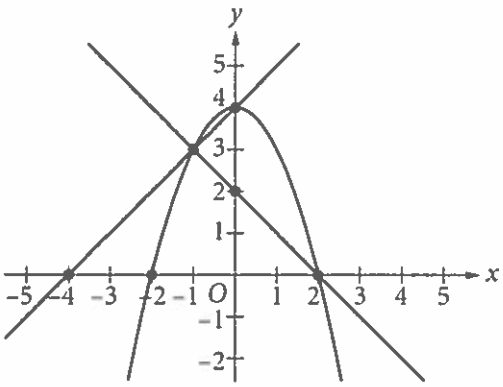
A) 1

B) 2

C) 4

D) 8

9



A system of three equations is graphed in the xy-plane above. How many solutions does the system have?

A) None

B) One

C) Two

D) Three

10

$$(ax + 3)(5x^2 - bx + 4) = 20x^3 - 9x^2 - 2x + 12$$

The equation above is true for all x, where a and b are constants. What is the value of ab ?

A) 18

B) 20

C) 24

D) 40

11

$$\frac{x}{x - 3} = \frac{2x}{2}$$

Which of the following represents all the possible values of x that satisfy the equation above?

A) 0 and 2

B) 0 and 4

C) −4 and 4

D) 4

CONTINUE

29

Gender	Handedness	
	Left	Right
Female		
Male		
Total	18	122

The incomplete table above summarizes the number of left-handed students and right-handed students by gender for the eighth-grade students at Keisel Middle School. There are 5 times as many right-handed female students as there are left-handed female students, and there are 9 times as many right-handed male students as there are left-handed male students. If there is a total of 18 left-handed students and 122 right-handed students in the school, which of the following is closest to the probability that a right-handed student selected at random is female? (Note: Assume that none of the eighth-grade students are both right-handed and left-handed.)

A) 0.410

B) 0.357

C) 0.333

D) 0.250

30

$$3x + b = 5x - 7$$
$$3y + c = 5y - 7$$

In the equations above, b and c are constants.

If b is c minus $\frac{1}{2}$, which of the following is true?

A) x is y minus $\frac{1}{4}$.

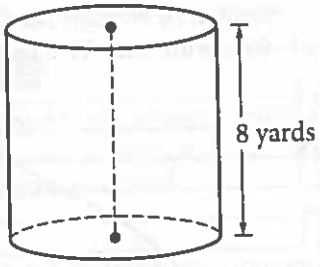
B) x is y minus $\frac{1}{2}$.

C) x is y minus 1.

D) x is y plus $\frac{1}{2}$.

CONTINUE

35



A dairy farmer uses a storage silo that is in the shape of the right circular cylinder above. If the volume of the silo is 72π cubic yards, what is the diameter of the base of the cylinder, in yards?

36

$$h(x) = \frac{1}{(x-5)^2 + 4(x-5) + 4}$$

For what value of x is the function h above undefined?

Questions 37 and 38 refer to the following information.

Jessica opened a bank account that earns 2 percent interest compounded annually. Her initial deposit was \$100, and she uses the expression $\$100(x)^t$ to find the value of the account after t years.

37

What is the value of x in the expression?

38

Jessica's friend Tyshaun found an account that earns 2.5 percent interest compounded annually. Tyshaun made an initial deposit of \$100 into this account at the same time Jessica made a deposit of \$100 into her account. After 10 years, how much more money will Tyshaun's initial deposit have earned than Jessica's initial deposit? (Round your answer to the nearest cent and ignore the dollar sign when gridding your response.)

STOP

If you finish before time is called, you may check your work on this section only. Do not turn to any other section.

26

In the xy-plane, the line determined by the points $(2, k)$ and $(k, 32)$ passes through the origin. Which of the following could be the value of k ?

A) 0
B) 4
C) 8
D) 16

27

A rectangle was altered by increasing its length by 10 percent and decreasing its width by p percent. If these alterations decreased the area of the rectangle by 12 percent, what is the value of p ?

A) 12
B) 15
C) 20
D) 22

28

In planning maintenance for a city's infrastructure, a civil engineer estimates that, starting from the present, the population of the city will decrease by 10 percent every 20 years. If the present population of the city is 50,000, which of the following expressions represents the engineer's estimate of the population of the city t years from now?

A) $50{,}000(0.1)^{20t}$
B) $50{,}000(0.1)^{\frac{t}{20}}$
C) $50{,}000(0.9)^{20t}$
D) $50{,}000(0.9)^{\frac{t}{20}}$

CONTINUE