Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

Turn to Section 3 of your answer sheet to answer the questions in this section.

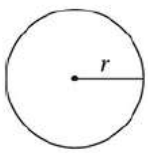
DIRECTIONS

For questions 1–15, solve each problem, choose the best answer from the choices provided, and fill in the corresponding circle on your answer sheet. **For questions 16–20,** solve the problem and enter your answer in the grid on the answer sheet. Please refer to the directions before question 16 on how to enter you answers in the grid. You may use any available space in your test booklet for scratch work.

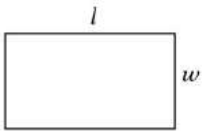
NOTES

1. The use of a calculator is NOT permitted.
2. All variables and expressions used represent real numbers unless otherwise indicated.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated, the domain of a given function f is the set of all real numbers for which $f(x)$ is a real number.

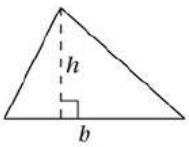
REFERENCE



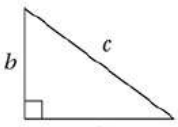
$A = \pi r^2$
$C = 2\pi r$



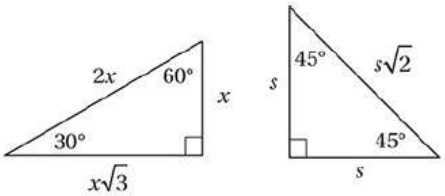
$A = lw$



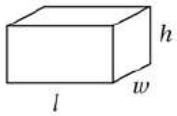
$A = \frac{1}{2}bh$



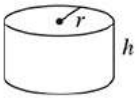
$c^2 = a^2 + b^2$



Special Right Triangles

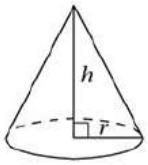


$V = lwh$

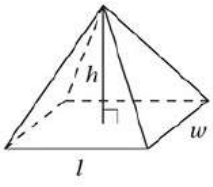


$V = \pi r^2 h$

$V = \frac{4}{3}\pi r^3$



$V = \frac{1}{3}\pi r^2 h$



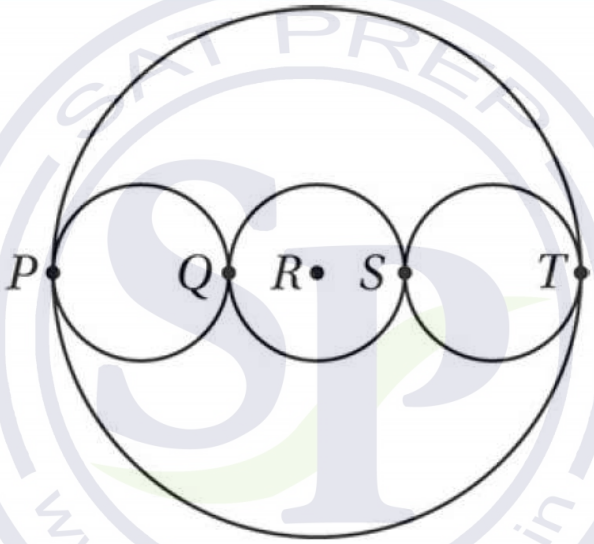
$V = \frac{1}{3}lwh$

1

If $2b - 1 = 5$, what is the value of $2b^2 - 1$?

A) 15
B) 17
C) 24
D) 25

2



In the figure above, points P, Q, R, S, and T lie on the same line, and R is the center of the large circle. If the three smaller circles are congruent and the radius of the large circle is 6, what is the radius of one of the smaller circles?

A) 1
B) 2
C) 3
D) 4

3

Jeri has edited $\frac{1}{5}$ of her term paper. If she has edited

15 pages, how many pages does she have left to edit?

A) 45
B) 50
C) 60
D) 75

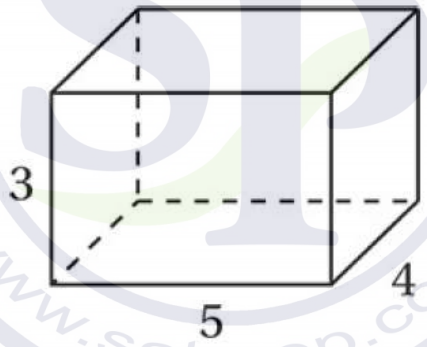
4

7, 12, 22, 42, 82

Which of the following gives a rule for finding each term in the sequence after the first?

A) Add 5 to the preceding number.
B) Add 5 to the sum of all of the preceding terms.
C) Double the preceding term and then subtract 2 from the result.
D) Add 14 to the preceding term and divide that result by 2.

5



The figure above shows a rectangular box. What is the longest length of a diagonal of one of the faces of this box?

A) $\sqrt{24}$
B) $\sqrt{41}$
C) $\sqrt{50}$
D) $\sqrt{60}$

6

Which of the following points is NOT on the graph of the line $-2x - 3y = 36$ in the xy-plane?

A) $(-9, 6)$
B) $(-24, 4)$

C) (6, −16)

D) (12, −20)

7

During a coyote repopulation study, researchers determine that the equation $P = 250(1.32)^t$ describes the population P of coyotes t years after their introduction into a new region. Which of the following gives the values of I, the initial population of coyotes, and r, the annual percent increase in this population?

A) $I = 250$, $r = 32\%$

B) $I = 250$, $r = 132\%$

C) $I = 330$, $r = 32\%$

D) $I = 330$, $r = 132\%$

8

Which of the following is equal to $\frac{1}{\sqrt{3}+1}$?

A) $\frac{\sqrt{3}}{2} - \frac{1}{2}$

B) $\frac{\sqrt{3}}{2} + \frac{1}{2}$

C) $\frac{\sqrt{3}}{4} - \frac{1}{4}$

D) $\frac{\sqrt{3}}{4} + \frac{1}{4}$

9

Which of the following could be the x-intercept and y-intercept of a line that is perpendicular to the line $3x + 6y = 0$?

A) (−6, 0) and (0, 3)

B) (3, 0) and (0, −6)

C) (3, 0) and (0, 6)

D) (6, 0) and (0, 3)

10

The function f is defined by the equation $f(x) = x - x^2$. Which of the following represents a quadratic with no real zeros?

A) $f(x) + \frac{1}{2}$

B) $f(x) - \frac{1}{2}$

C) $f\left(\frac{x}{2}\right)$

D) $f\left(x - \frac{1}{2}\right)$

11

In the xy-plane, the graph of the line $y = \frac{15}{4}$ intersects the graph of the equation $y = x^2 + x$ at two points. What is the distance between these two points?

A) $\frac{3}{2}$

B) $\frac{5}{2}$

C) $\frac{15}{4}$

D) 4

12

If $i^{2k} = 1$, and $i = \sqrt{-1}$, which of the following must be true about k?

A) k is a multiple of 4.

B) k is a positive integer.

C) When $2k$ is divided by 4, the remainder is 1.

D) $\frac{k}{2}$ is an integer.

13

For all numbers x and y, let z be defined by the equation $z = |2^2 - x^2 - y^2| + 2^2$. What is the smallest possible value of z?

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

14

If the polynomial $P(x)$ has factors of 12, $(x - 5)$, and $(x + 4)$, which of the following must also be a factor of $P(x)$?

A) $2x^2 + 8$
B) $4x^2 - 20$
C) $6x^2 - 6x - 120$
D) $x^2 - 10x + 25$

15

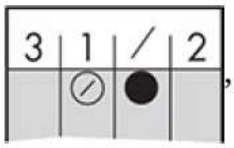
If $f(x) = -x + 7$ and $g(f(x)) = 2x + 1$, what is the value of $g(2)$?

A) −11
B) −5
C) 5
D) 11

DIRECTIONS

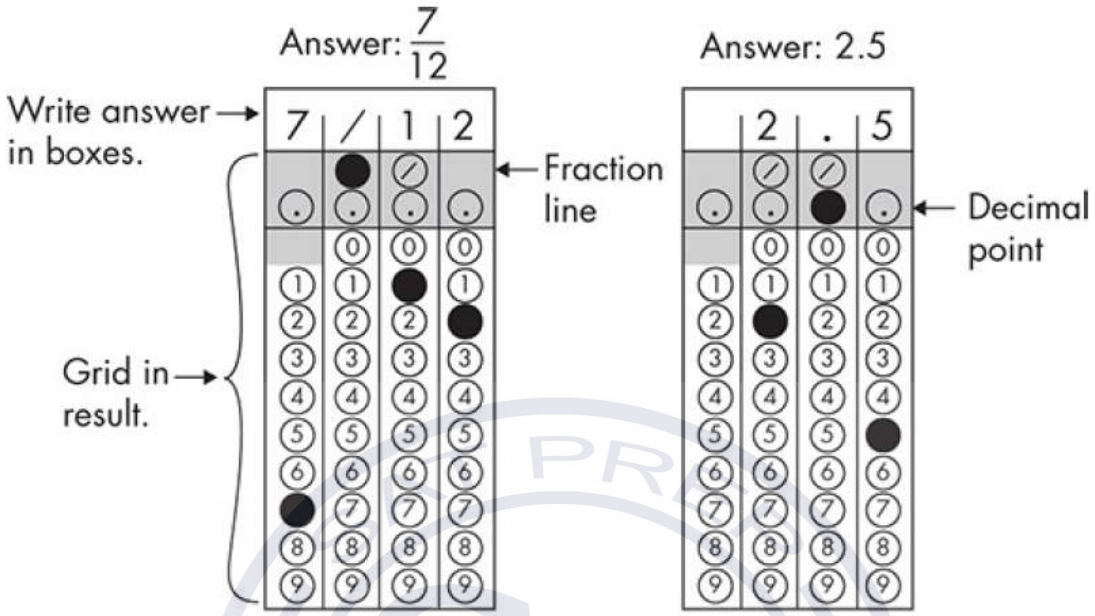
For questions 16–20, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

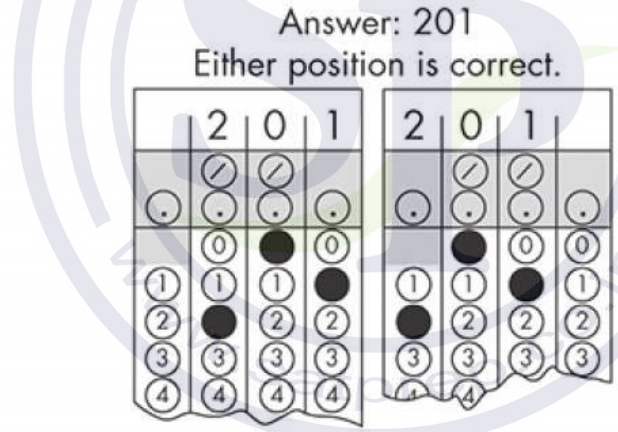
1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.
4. Some problems may have more than one correct answer. In such cases, grid only one answer.
5. **Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or $\frac{7}{2}$.

(If $3\frac{1}{2}$ is entered into the grid as 

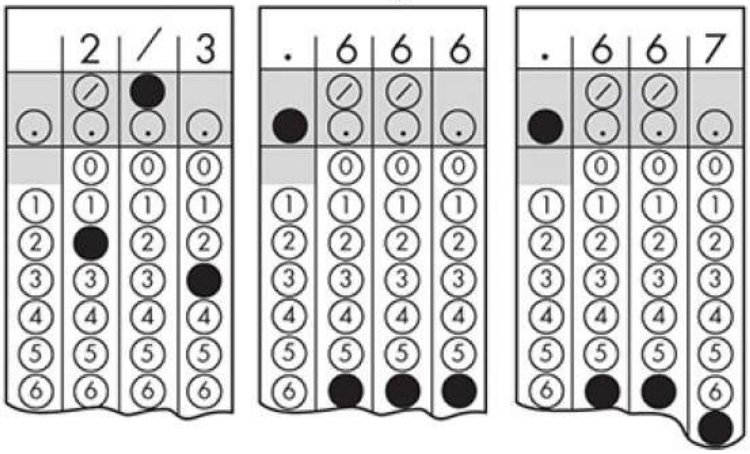
, it will be interpreted as $3\frac{1}{2}$, not $3\frac{1}{2}$.)

6. **Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.





Acceptable ways to grid $\frac{2}{3}$ are:



16

In a writer's workshop, there are half as many men as women. If there are 24 total men and women in the writer's workshop, how many men are there?

17

If $3-\frac{1}{b}=\frac{3}{2}$ what is the value of b?

18

The square of a positive number is 0.24 greater than the number itself. What is the number?

19

The function f is a quadratic function with zeros at $x = 1$ and $x = 5$. The graph of $y = f(x)$ in the xy-plane is a parabola with a vertex at $(3, -2)$. What is the y-intercept of this graph?

20

When graphed in the xy-plane, the line $y = mx - 4$ intersects the x-axis at an angle of θ. If $m > 0$, $0° < \theta < 90°$, and $\theta = \frac{3}{\sqrt{58}}$, what is the value of m?

STOP

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

Math Test – Calculator

55 MINUTES, 38 QUESTIONS

Turn to Section 4 of your answer sheet to answer the questions in this section.

DIRECTIONS

For questions 1–30, solve each problem, choose the best answer from the choices provided, and fill in the corresponding circle on your answer sheet. **For questions 31–38,** solve the problem and enter your answer in the grid on the answer sheet. Please refer to the directions before question 31 on how to enter you answers in the grid. You may use any available space in your test booklet for scratch work.

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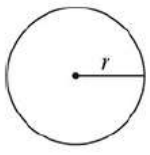
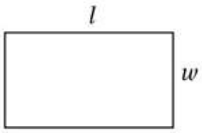
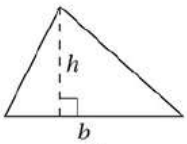
REFERENCE



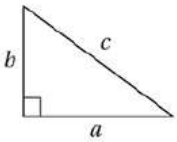
$A = \pi r^2$
$C = 2\pi r$



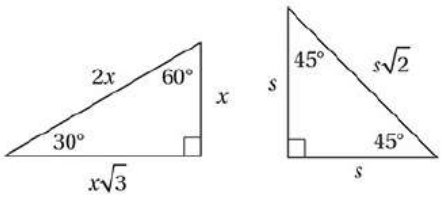
$A = lw$



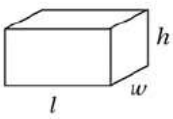
$A = \frac{1}{2}bh$



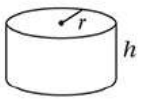
$c^2 = a^2 + b^2$



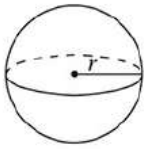
Special Right Triangles



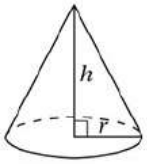
$V = lwh$



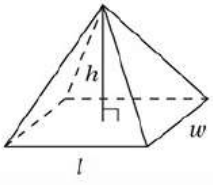
$V = \pi r^2 h$



$V = \frac{4}{3}\pi r^3$



$V = \frac{1}{3}\pi r^2 h$



$V = \frac{1}{3}lwh$

1

If $a = \frac{1}{2}b$ and $2a + 4b = 20$, what is the value of b?

A) 2.5

B) 4

C) 5

D) 15

2

Spin	Frequency
1	3
2	4
3	3
4	0
5	1
6	1
7	1
8	3
9	1
10	3

The spinner for a board game has 10 sectors, numbered 1 through 10. It is spun 20 times and the results summarized in the table above. What is the median value of these 20 spins?

A) 2

B) 4

C) 5

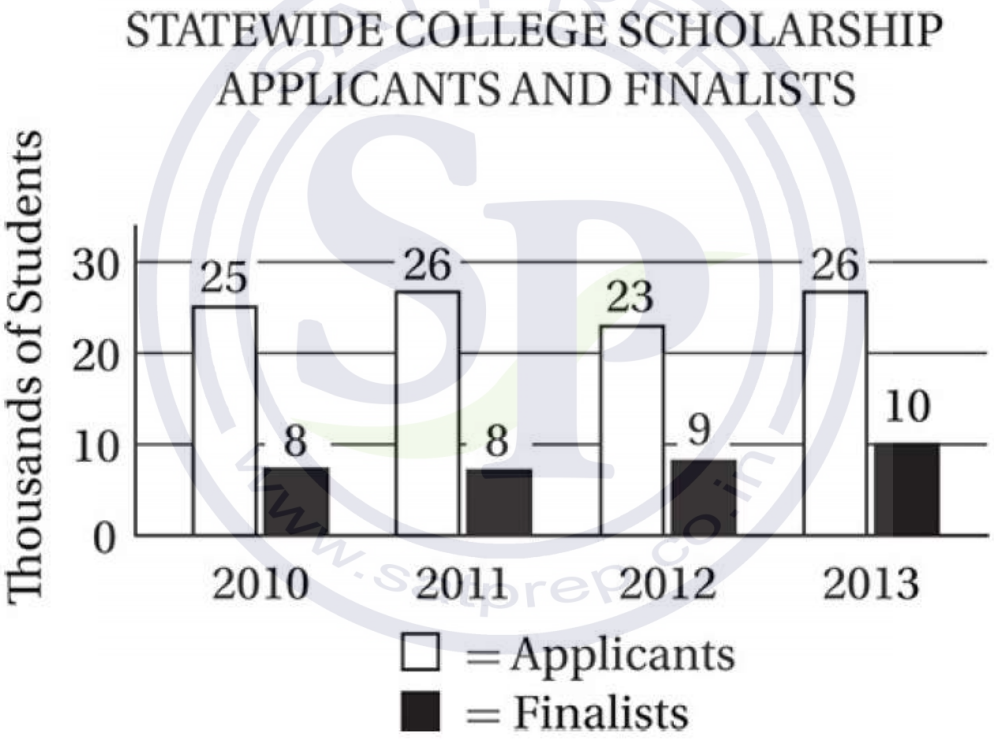
D) 6

3

A 48-gram serving of breakfast cereal contains 8 grams of sugar. How many grams of sugar are there in a 57-gram serving of the same cereal?

A) 9.5
B) 10.5
C) 11.5
D) 12.5

4



The graph above shows the number of applicants and finalists for a statewide college scholarship program over four consecutive years. For which year was the ratio of finalists to applicants the greatest?

A) 2010
B) 2011
C) 2012
D) 2013

5

If $y^3 = 20$ and $z^2 = 10$, what is the value of $(yz)^6$?

A) 2×10^5

B) 4×10^4

C) 2×10^5

D) 4×10^5

6

If the sum of a, b, and c is three times the sum of a and b, which of the following expresses the value of a in terms of b and c?

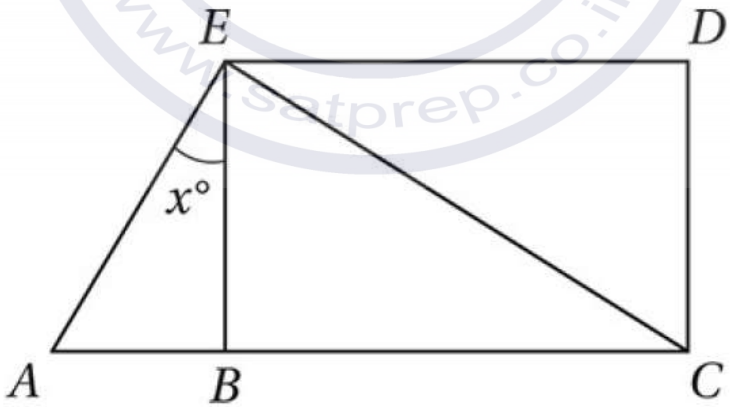
A) $\frac{c - 2b}{2}$

B) $\frac{2b - c}{2}$

C) $\frac{c - 3b}{3}$

D) $\frac{3b - c}{3}$

7



Note: Figure not drawn to scale.

In the figure above, $BCDE$ is a rectangle, $AC = 14$, $BC = 12$, and $EC = 13$. What is the value of $\tan x$?

A) 0.4

B) 0.6

C) 1.3

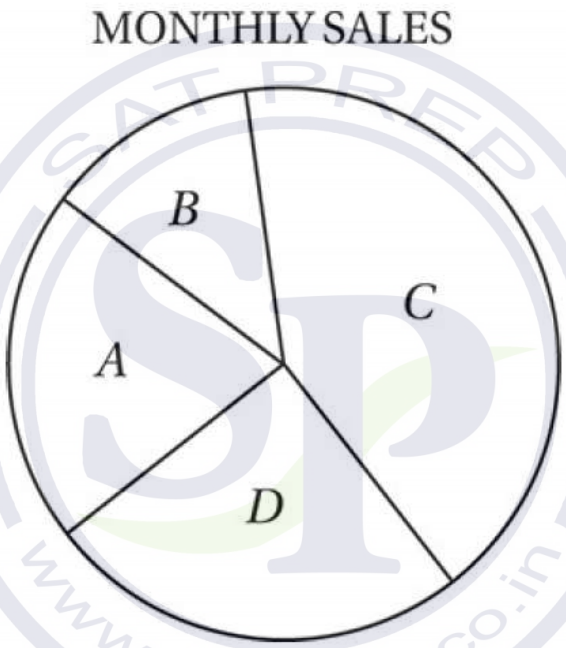
D) 2.5

8

Which of the following binomials is a factor of $x^2 - 6x + 8$?

A) $x - 4$
B) $x + 4$
C) $x + 2$
D) $x - 8$

Questions 9–11 are based on the graph below.



The pie graph above represents the monthly ad sales for four salespeople—Maria, Eli, Georgia, and Zoe—at a social media website. For the month, Maria's sales accounted for 25% of the total, Eli had $3,000 in sales, Georgia had $5,000 in sales, and Zoe had $10,000 in sales.

9

Which sector represents Georgia's sales for the month?

A) Sector *A*
B) Sector *B*
C) Sector *C*
D) Sector *D*

10

What is the sum of the monthly sales for all four salespeople?

A) $22,500
B) $24,000
C) $25,000
D) $27,000

11

If Eli and Georgia both earn 10% commission on their sales, and Maria and Zoe both earn 15% commission on their sales, how much more did Maria earn in monthly commissions than Georgia?

A) $300
B) $360
C) $375
D) $400

12

Let the function f be defined by $f(x) = 2 - |x - 4|$ for all real values of x. What is the greatest value of f?

A) −2
B) 2
C) 4
D) 6

13

If $\frac{3}{b} - \frac{2}{5} = 1$, what is the value of b?

A) $\frac{5}{7}$
B) $\frac{6}{5}$
C) $\frac{15}{7}$
D) 5

14

For the function f, $f(1) = 4$ and $f(2) = 13$. Which of the following equations could describe f?

A) $f(x) = x^2 + 3$

B) $f(x) = x^2 + 9$

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

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

15

Which of the following is NOT equivalent to $12b^2$?

A) $(6b)(6b)$

B) $12b(b)$

C) $\left(b\sqrt{12}\right)^2$

D) $6b^2 + 6b^2$

16

If m is a number chosen randomly from the set $\{2, 3, 4, 6\}$ and n is a number chosen randomly from the set $\{1, 2, 3, 4\}$, what is the probability that mn is a multiple of 12?

A) $\frac{1}{16}$

B) $\frac{1}{8}$

C) $\frac{1}{4}$

D) $\frac{1}{2}$

17

If $y = 3x + 4$ and $x < 3$, which of the following represents all the possible values of y?

A) $y > 7$

B) $y < 13$

C) $7 < y < 13$

D) $y > 13$

18

If $g(x + 1) = x^2 + 2x + 4$ for all values of x, which of the following is equal to $g(x)$?

A) $x^2 + 4$

B) $x^2 + 3$

C) $(x - 1)^2 + 4$

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

19

A: 2, 7, 12, 17, 22, . . .

B: 5, 15, 25, 35, 45, . . .

Two sequences, A and B, follow the patterns shown above. If the nth term of sequence A is 72, what is the nth term of sequence B?

A) 125

B) 135

C) 145

D) 155

20

A website received 2,100 visitors in July from both subscribers and nonsubscribers. If the ratio of subscribers to nonsubscribers among this group was 2:5, how many more nonsubscribers visited the site in July than subscribers?

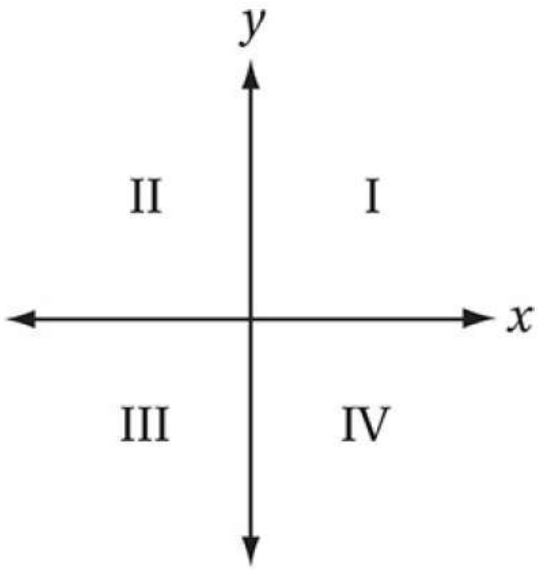
A) 126

B) 630

C) 900

D) 1,260

21



The figure above shows the locations of quadrants I–IV in the *xy*-plane. Which of the following represents a pair of linear equations that do NOT intersect in quadrant I?

A) $3x + 5y = 15y = 4$
B) $5x + 3y = 15y = 4$
C) $5x - 3y = 15y = 4$
D) $3x - 5y = 15y = 4$

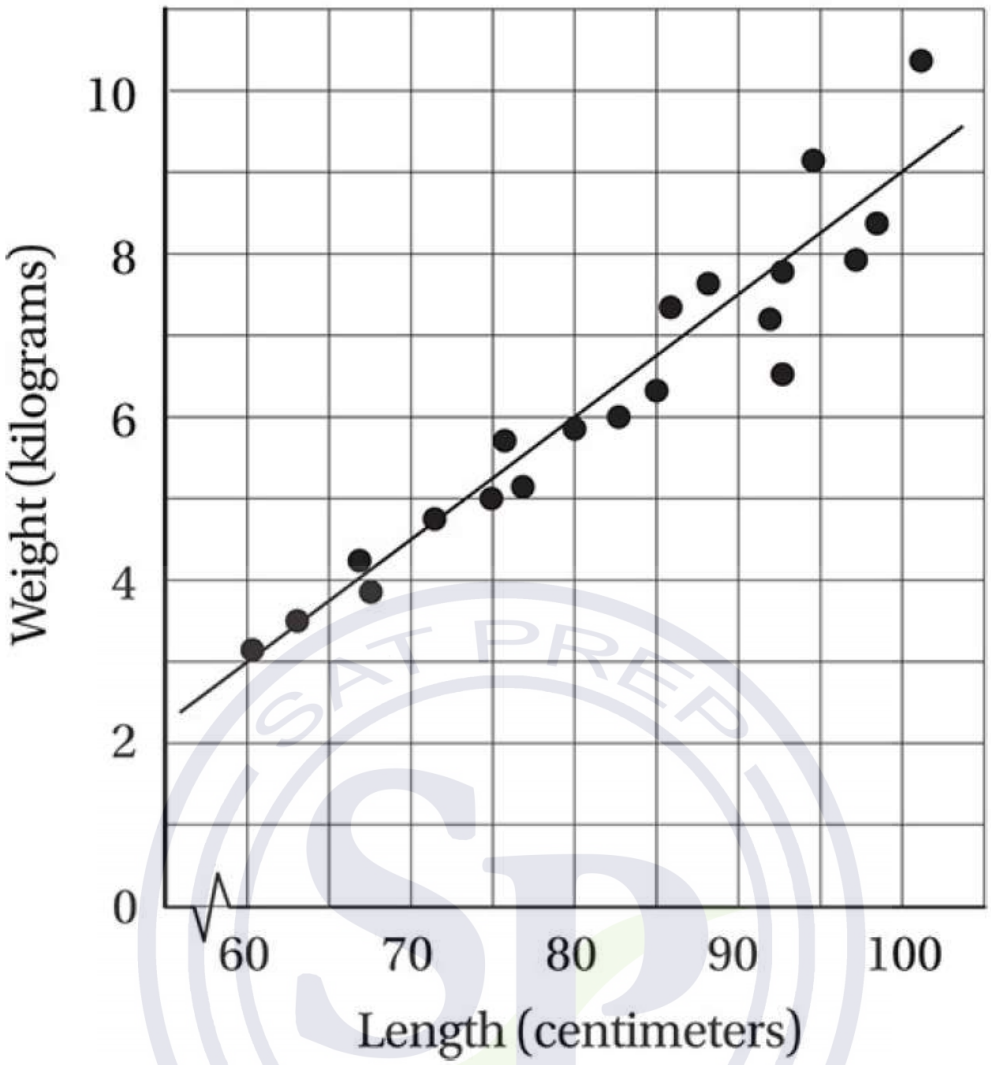
22

During a 40-minute session at a 220 volt charging station, the charge on an electric car battery increases from an initial charge of 50 power units to a final charge of 106 power units. If this charge increases linearly with time, which of the following best describes the charge, q, in power units, on this same battery after charging for t hours from an initial charge of 20 power units? (1 hour = 60 minutes)

A) $q = 55t + 50$
B) $q = 84t + 50$
C) $q = 55t + 20$
D) $q = 84t + 20$

Questions 23 and 24 are based on the graph below.

LENGTH AND WEIGHT OF SALMON



23

The scatterplot above shows the length and weight of a group of 20 salmon and the line of best fit for the data. According to this line of best fit, which of the following best approximates the weight, in kilograms, of a salmon that is 95 centimeters long?

A) 7.6
B) 7.8
C) 8.3
D) 8.8

24

Which of the following equations best describes the relationship between w, the weight in kilograms of each salmon, and l, its length in centimeters?

A) $w = \frac{3}{20}l + 2$

B) $w = \frac{20}{3}l + 2$

C) $w = \frac{3}{40}l - 6$

D) $w = \frac{3}{20}l - 6$

25

The average size of a compressed image file is 750 kB. If Ronika's data plan allows her to send 2 GB of data each month before she pays any overage charges, but she plans to use 85% of that data for texting, approximately how many compressed images can she send each month before she incurs any overage charges? (1 GB = 1,000 MB; 1 MB = 1,000 kB)

A) 227

B) 400

C) 2,267

D) 4,000

26

Perfectioner's Chocolate Company makes two varieties of truffles: dark chocolate and milk chocolate. Each dark chocolate truffle requires 0.65 ounces of cocoa powder, and each milk chocolate truffle requires 0.45 ounces of cocoa powder. If cocoa powder costs c dollars per pound, and Perfectioner's Chocolate Company has budgeted $200 per week for cocoa powder, which of the following inequalities indicates the restrictions on the number of dark chocolate truffles, d, and the number of milk chocolate truffles, m, the company can make in one week? (1 pound = 16 ounces)

A) $\frac{200}{c} \geq 0.65d + 0.45m$

B) $\frac{200}{16c} \geq 0.65d + 0.45m$

C) $\frac{3{,}200}{c} \geq 0.65d + 0.45m$

D) $3{,}200c \geq \frac{0.65}{d} + \frac{0.45}{m}$

27

If n is a positive integer and $m = 2^{n+2} + 2^n$, what is 2^{n+3} in terms of m?

A) m

B) $\frac{2m}{5}$

C) $\frac{8m}{5}$

D) $3m^2$

28

For how many values of x between 0 and 2π does $\sin 3x = \frac{1}{2}$?

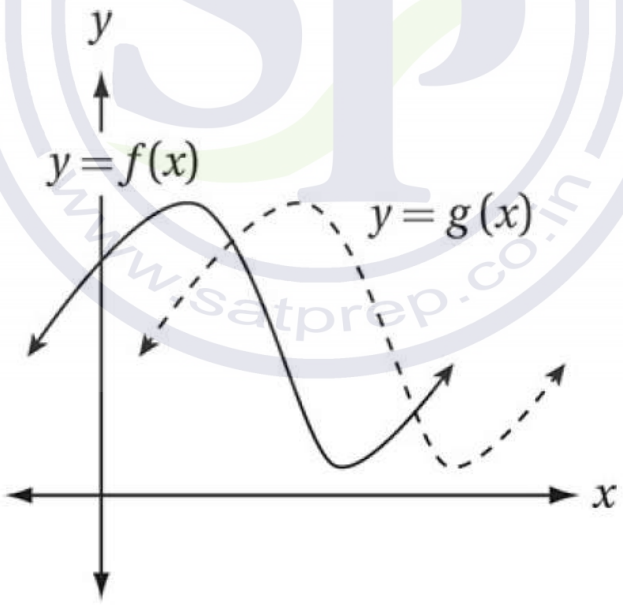
A) Two

B) Three

C) Four

D) Six

29



The figure above shows the graphs of functions f and g in the xy-plane. Which of the following equations could express the relationship between f and g?

A) $f(x) = g(x - 2)$

B) $f(x) = g(x + 2)$

C) $f(x) = g(x) + 2$

D) $f(x) = g(x) - 2$

30

A researcher is trying to estimate the daily amount of time undergraduate computer science majors spend on nonrecreational computer activities. She surveys 120 students from among the computer science majors at a large state university and asks them, "How much time do you spend in nonrecreational computer activities each day?" The mean of these responses is 210 minutes per day, with a standard deviation of 16.5 minutes. If another researcher wishes to present the same question to a new set of subjects at the same university, which of the following subject groups would most likely yield a data set with a smaller margin of error for the estimated daily amount of time undergraduate computer science majors spend on nonrecreational computer activities?

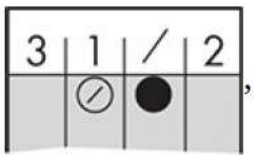
A) 240 randomly selected computer science majors
B) 240 randomly selected liberal arts majors
C) 80 randomly selected computer science majors
D) 80 randomly selected liberal art majors

Student-Produced Response Questions

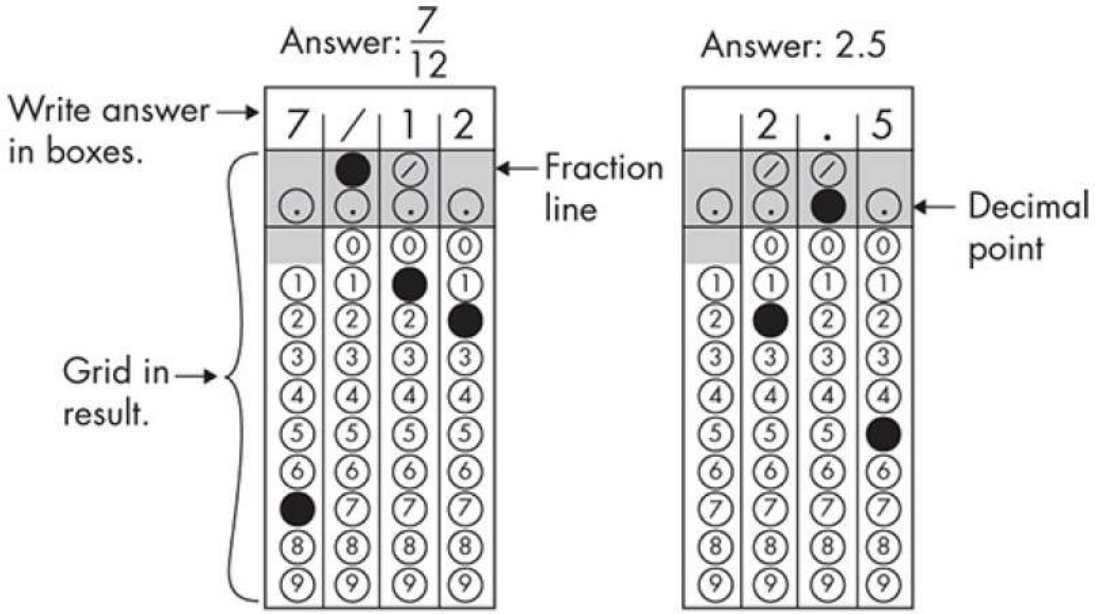
DIRECTIONS

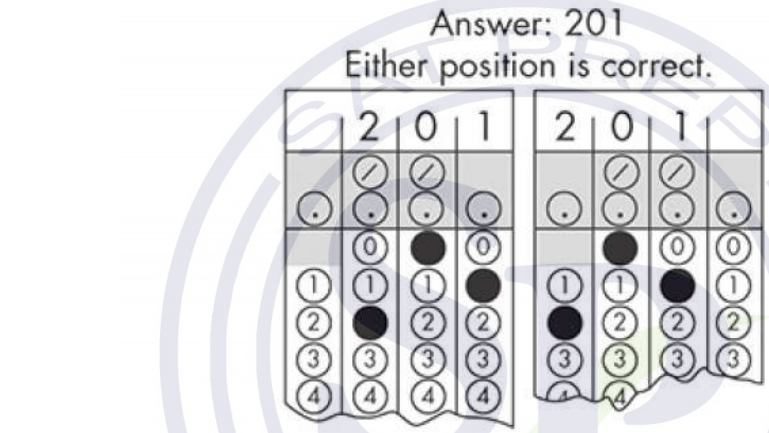
For questions 31–38, solve the problem and enter your answer in the grid, as described below, on the answer sheet.

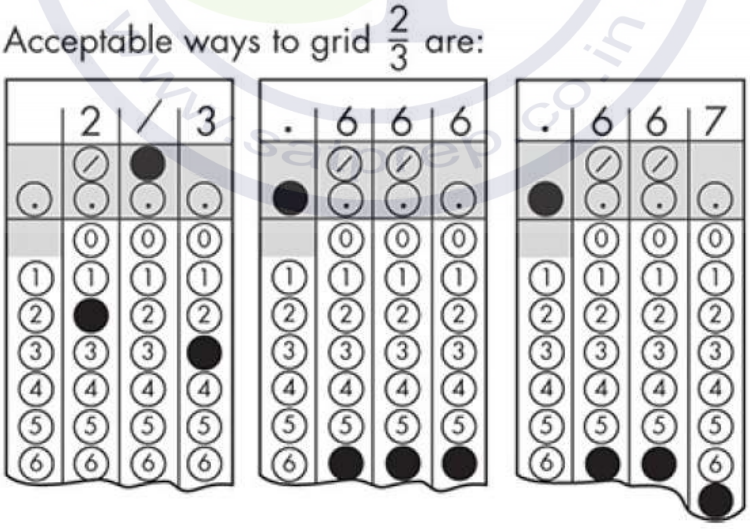
1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.
4. Some problems may have more than one correct answer. In such cases, grid only one answer.
5. **Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or $\frac{7}{2}$.

   (If $3\frac{1}{2}$ is entered into the grid as 

, it will be interpreted as $3\frac{1}{2}$, not $3\frac{1}{2}$.)
6. **Decimal answers:** If you obtain a decimal answer with more digits than the grid can accommodate, it may be either rounded or truncated, but it must fill the entire grid.







31

What number is 40% greater than the sum of 40 and 80?

32

x	$h(x)$
3	6
5	14

The table above shows a set of ordered pairs that correspond to the function $h(x) = \frac{x^2}{2} + k$.

What is the value of k?

33

$$hx + 4y = -3$$

The equation above is the equation of a line in the xy-plane, and h is a constant. If the slope of this line is −13, what is the value of h?

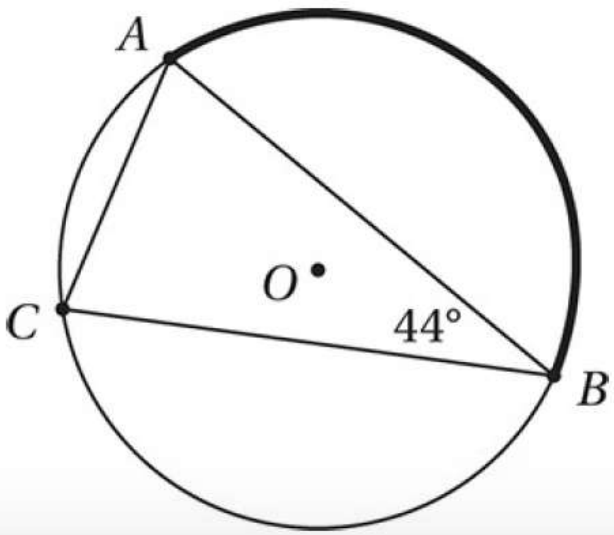
34

The sum of two numbers is four times their difference. The smaller of these numbers is 15. What is the greater number?

35

If $0 < x < 2\pi$ and $5\cos x = \sqrt{5}$, what is the value of $\left(\frac{\sin x}{3}\right)^2$?

36



Note: Figure not drawn to scale.

In the figure above, the circle with center O has a circumference of 50, and $AB = BC$. What is the length of arc AB?

Questions 37 and 38 are based on the scenario described below.

An Internet service provider offers three different plans for residential users. Plan A charges users $500 for the first year of service, and $80 per month thereafter. Plan B charges users $68 per month. Plan C is a "high speed" plan that offers 200% higher speeds for $92 per month.

37

Isabelle has been using Plan A for over a year. She recently reviewed her plan and realized that if she had been using Plan B for same amount of time, she would have saved $104 for Internet service over the entire period. At the time of her review, how many months had Isabelle been on Plan A?

38

Isabelle is now considering switching to either Plan B or Plan C for her home business, but she calculates that having the "high speed" plan will save her only approximately 45 minutes of work each month. At what minimum hourly rate, in dollars per hour, would she have to value her work (that is, how much more would she have to value one hour of free time over one hour of work time) for Plan C to be worth the extra cost over Plan B?

STOP

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