3

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 bubble 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 your 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 x for which $f(x)$ is a real number.

REFERENCE

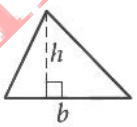


$A = \pi r^2$

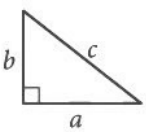
$C = 2\pi r$



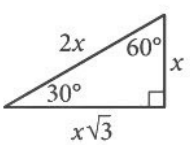
$A = \ell w$

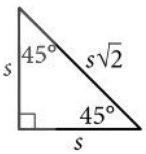


$A = \frac{1}{2}bh$

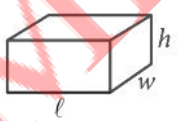


$c^2 = a^2 + b^2$

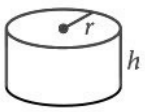




Special Right Triangles



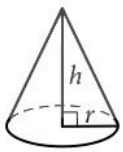
$V = \ell wh$



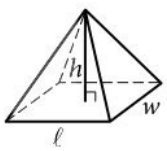
$V = \pi r^2 h$



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



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



$V = \frac{1}{3}\ell wh$

The number of degrees of arc in a circle is 360.
The number of radians of arc in a circle is 2π.
The sum of the measures in degrees of the angles of a triangle is 180.

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CONTINUE

3

1

Sarah purchased equipment for $6500. She estimated that the value of the equipment decreased by $220 each year for five years after it was purchased. Which function defines the estimated value of the equipment $v(t)$, in dollars, t years after it was purchased, where $0 \le t \le 5$?

A) $v(t) = 6{,}500 + 220t$

B) $v(t) = 6{,}500 - 220t$

C) $v(t) = 220 + 6{,}500t$

D) $v(t) = 220 - 6{,}500t$

2

If $4x + 6 = 2(x + 7)$, what is the value of $3x$?

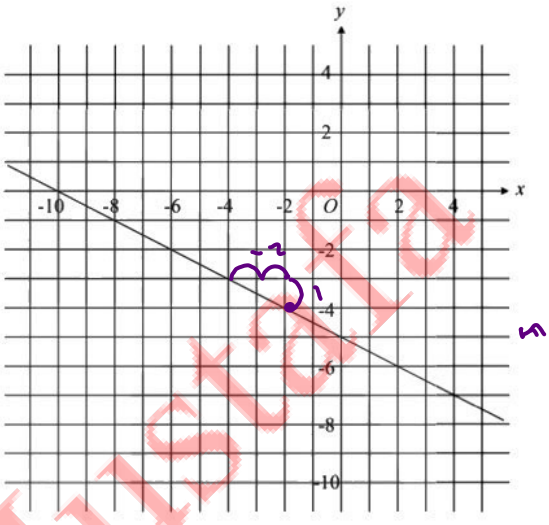
A) 10

B) 12

C) 18

D) 30

3



What is the slope of the line graphed?

A) -2

B) $-\frac{1}{2}$

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

D) 2

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CONTINUE

3

4

$$3a = c^2 - 7b$$

The given equation relates the variables a, b, and c, where a, b, and c are distinct, positive real numbers. Which equation correctly expresses c in terms of a and b?

A) $c = 2(3a + 7b)$

B) $c = 2(3a + 7b)^2$

C) $c = \sqrt{3a + 7b}$

D) $c = \dfrac{3a + 7b}{2}$

5

A sphere has a radius of 3 centimeters. What is the volume, in cubic centimeters, of the sphere?

$\left(\text{volume} = \frac{4}{3}\pi \times (\text{radius})^3\right)$

A) 8π

B) 12π

C) 36π

D) 108π

6

$$g(x) = 0.2x + 1.0$$

The given function models the average price $g(x)$, in dollars, of one gallon of gasoline in the United States from 2000 to 2008. In the function, x represents the number of years after 2000. Based on the model, what is the best interpretation of $g(5) = 2.0$?

A) The average price of 1 gallon of gasoline in 2004 was \$2.00.

B) The average price of 1 gallon of gasoline in 2005 was \$2.00.

C) The average price of 5 gallons of gasoline in 2000 was \$2.00.

D) The average price of 5 gallons of gasoline in 2008 was \$2.00.

7

$$|-x + 4| = 5$$

What is one of the solutions to the given equation?

A) 1

B) 4

C) 5

D) 9

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CONTINUE

3

8

$$y < -\frac{3}{2}x + 2$$

$$y > \frac{3}{2}x + 2$$

Which point (x, y) is a solution to the given system of inequalities in the xy-plane?

A) (-6, 0)
B) (0, -4)
C) (0, 6)
D) (4, 0)

Plug in

9

The function g is defined by $g(x) = 2x^{-1}$. What is the value of $g(3)$?

A) -6
B) $\frac{1}{6}$
C) $\frac{2}{3}$
D) $\frac{3}{2}$

$2(3)^{-1}$

$2 \times \frac{1}{3} = \frac{2}{3}$

10

A jet flies at a steady altitude of 9,200 meters above sea level. At $t = 0$, the jet begins increasing altitude for 11 seconds to an altitude of 9,805 meters. The jet then decreases altitude for another 11 seconds, reaching 9,200 meters above sea level again. If there is a quadratic relationship between the jet's altitude y, in meters above sea level, and the time t, in seconds, after the jet started to climb, which of the following equations could model that relationship?

A) $y = -5(t - 11)^2 + 9{,}805$
B) $y = -5(t - 9{,}805)^2 + 11$
C) $y = -5(t - 22)^2 + 9{,}805$
D) $y = -5(t - 9{,}805)^2 + 22$

(11, 9805)
(22, 9200)

11

The function f is defined by $f(x) = (-6)(2)^x + 4$. What is the y-intercept of the graph of $y = f(x)$ in the xy-plane?

A) (0, -8)
B) (0, -6)
C) (0, -2)
D) (0, 2)

y-int

$y\text{-int} = -6 + 4 = -2$

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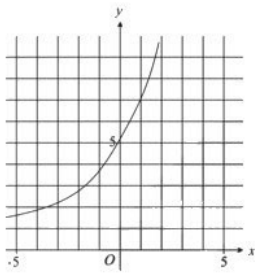
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3

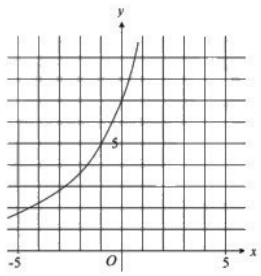
12

What is the graph of the equation $y = 4\left(\frac{3}{2}\right)^{x+1}$?

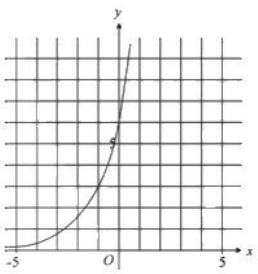
A)



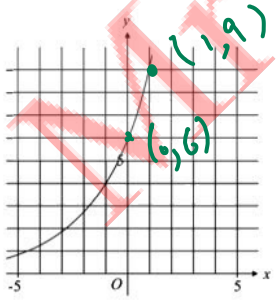
B)



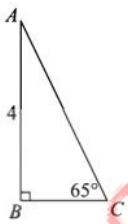
C)



D)



13



Which expression is equivalent to the length of $\overline{BC}$ shown?

A) $\frac{\tan 65°}{4}$

B) $\tan\left(\frac{65°}{4}\right)$

C) $4 \tan 65°$

D) $\frac{4}{\tan 65°}$

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CONTINUE

3

14

If $x>0$ and $\left(\sqrt{x\sqrt{x}}\right)^2=(x^a)^2$, what is the value of a ?

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

B) $\frac{3}{4}$

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

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

15

$$2x + 5y = 9$$
$$30x + ay = 50$$

In the given system of equations, a is a constant. The system has no solution. What is the value of a?

A) 75

B) 46

C) 33

D) 15

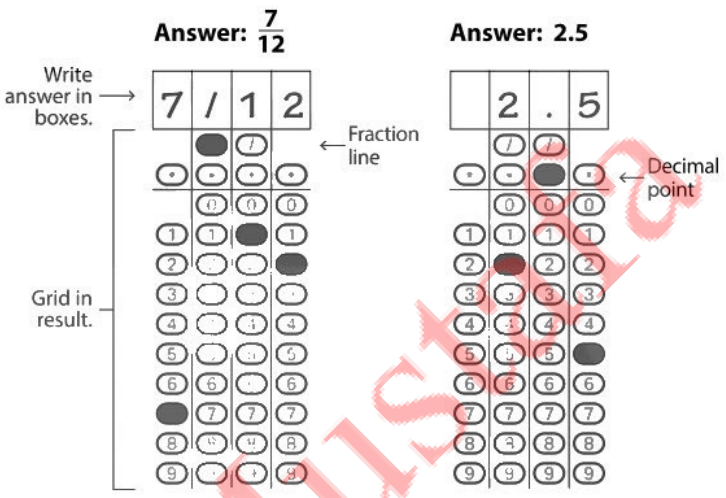
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CONTINUE

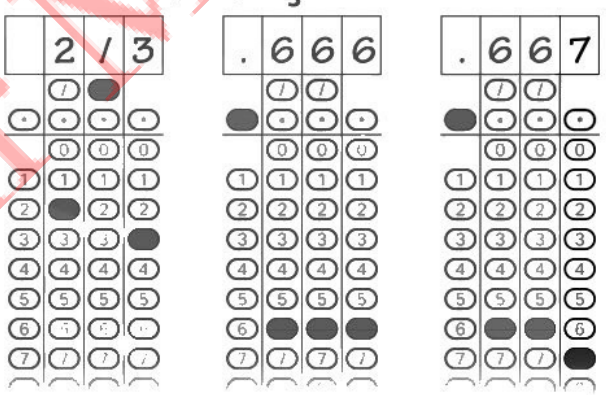
DIRECTIONS

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

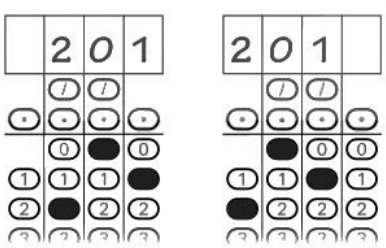
1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the bubbles accurately. You will receive credit only if the bubbles are filled in correctly.
2. Mark no more than one bubble in any column.
3. No question has a negative answer.
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 7/2. (If  is entered into the grid, it will be interpreted as $\frac{31}{2}$, 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:



Answer: 201 – either position is correct



NOTE:
You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.

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CONTINUE

3

16

$18x^2 + 9x - 9 = 0$

What is the value of the positive solution of the quadratic equation above?

17

A bookseller ordered 5 cases of a new best-selling novel. Each case held 16 copies of the novel. The bookseller paid shipping charges of $8.95 on each case. The total cost the bookseller paid for the 5 cases was $1644.75, including the shipping charges. What is the cost, in dollars, for each copy of the novel, not including the shipping charges? (Disregard the $ sign when entering your answer. For example, if your answer is $4.97, enter 4.97)

18

$-40 = 3.2(10 - 5x)$

What is the value of x that satisfies the equation above?

19

$21x^3+13x^2+2x$

The given expression is equivalent to $x(ax + 1)(bx + 2)$, where a and b are positive integers. What is the value of $a+b$?

20

$x(x-6)+y(y+4)=3$

The equation of a circle in the xy-plane is shown above. What is the radius of the circle?

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STOP

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

4

Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

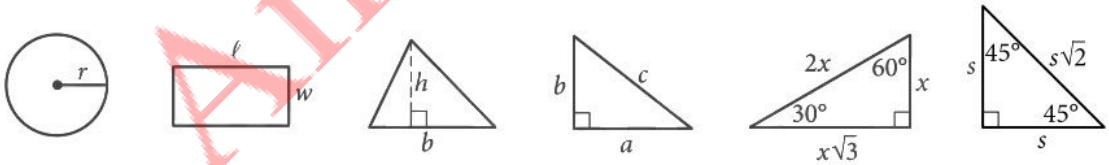
DIRECTIONS

For questions 1-30, solve each problem, choose the best answer from the choices provided, and fill in the corresponding bubble 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 your 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 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 x for which $f(x)$ is a real number.

REFERENCE



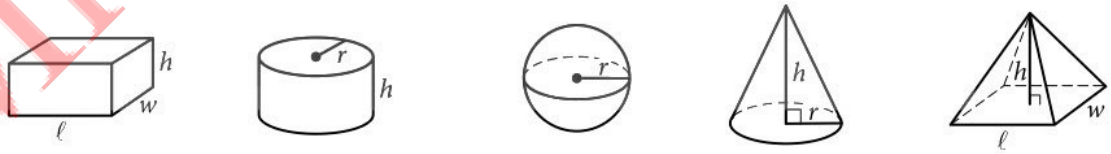
$A = \pi r^2$
$C = 2\pi r$

$A = \ell w$

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

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

Special Right Triangles



$V = \ell wh$

$V = \pi r^2 h$

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

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

$V = \frac{1}{3}\ell wh$

The number of degrees of arc in a circle is 360.
The number of radians of arc in a circle is 2π.
The sum of the measures in degrees of the angles of a triangle is 180.

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CONTINUE

4

1

The table shows the number of days with and without rain in Rio de Janeiro, Brazil, during two months in 2017.

	October	November	Total
With rain	9	11	20
Without rain	22	19	41
Total	31	30	61

What is the fraction of days in October and November of 2017 with rain?

A) $\frac{9}{61}$

B) $\frac{11}{61}$

C) $\frac{20}{61}$

D) $\frac{41}{61}$

2

The function f is defined $f(x) = x^2 - 3x + 2$.
What is the value of $f(2)$?

A) -4

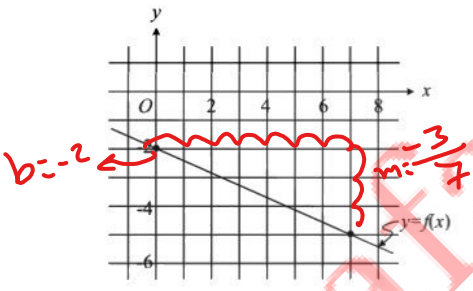
B) -2

C) 0

D) 4

3

The graph of the linear function f is shown.



Which equation defines f?

A) $f(x) = -\frac{3}{7}x - 2$

B) $f(x) = -\frac{7}{3}x - 2$

C) $f(x) = \frac{3}{7}x - 2$

D) $f(x) = \frac{7}{3}x - 2$

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CONTINUE

4

4

$f(x) = 2x + 1$

For the given linear function f, which table consists of three values of x and their corresponding values of $f(x)$?

A)

x	$f(x)$
-2	-4
0	-3
2	2

B)

x	$f(x)$
-2	1
0	2
2	3

C)

x	$f(x)$
-2	-5
0	0
2	5

D)

x	$f(x)$
-2	-3
0	1
2	5

5

3, 3, 3, 4, 5, 5, 5

Which statement best compares the mean and the median of the 7 data values shown in the list?

A) The mean is less than the median.

B) The mean is equal to the median.

C) The mean is greater than the median.

D) There is not enough inforwne tion to determine the relationship between the inean and the median.

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CONTINUE

4

6

$4x + 1 = 2x - 3$

Which equation has the same solution as the given equation?

A) $2x = -2$

B) $2x = -4$

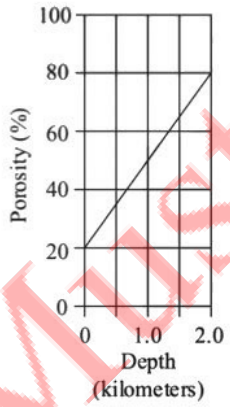
C) $6x = -2$

D) $6x = -4$

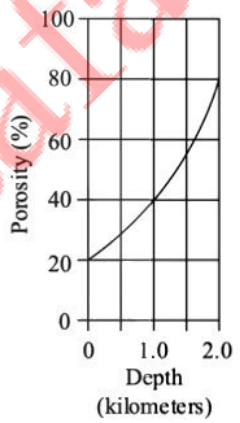
7

Porosity is the amount of space inside of a rock as a percentage of the total volume of the rock. As the depth below Earth's surface increases, the porosity of a certain type of rick decreases exponentially. Which of the following graphs could show this decreasing exponential relationship?

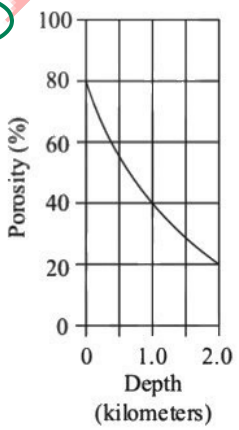
A)



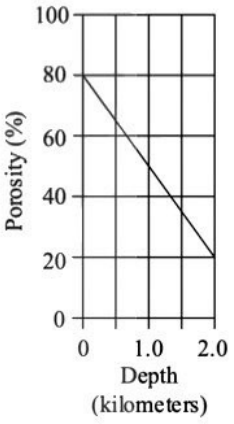
B)



C)



D)



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CONTINUE

4

8

$$y > 3x + 2$$

For which of the following tables are all the values of x and their corresponding values of y solutions to the given inequality?

A)

x	y
2	4
4	10
6	18

Plug in

B)

x	y
2	6
4	4
6	12

C)

x	y
2	8
4	14
6	20

D)

x	y
2	10
4	18
6	26

9

The mass of a mouse is 23 grams. The mass of the mouse's brain is 0.4 grams. The brain makes up what percent, by mass, of the mouse?

A) 1.7%

B) 4%

C) 9.2%

D) 30%

$\frac{0.4}{23} \times 100$

10



Angel works part time at an electronics store. His total weekly pay consists of a base salary and a commission that is equal to $\frac{1}{10}$ of his weekly sales. The graph shown gives his total weekly pay based on his total weekly sales, in dollars. Which statement is true about Angel's total weekly pay?

A) Angel's base salary is $225.

B) Angel's total weekly pay increases by $50 for each increase of $5 in sales.

C) If Angel's total weekly sales are $1,000, then his total pay will be $100.

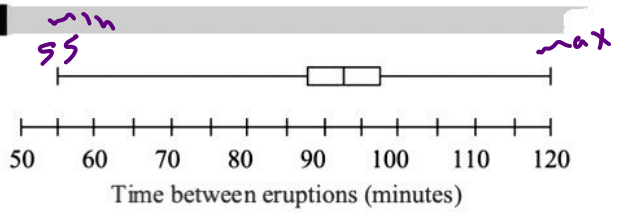
D) If Angel's total weekly pay is $250, then his total weekly sales were $500.

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CONTINUE

4

11



A natural geyser was observed over a 10-day period. The box plot summarizes the time, in minutes, between eruptions of the geyser. Which of the following is the minimum time, in minutes, between eruptions during those 10 days?

A) 55
B) 89
C) 94
D) 120

12

For a linear function f, the graph of $y = f(x)$ in the xy-plane passes through the points $(0, 3)$ and $(1,6)$. Which equation defines f?

A) $f(x) = 3x + 6$
B) $f(x) = 3x + 3$
C) $f(x) = \frac{1}{3}x + 3$
D) $f(x) = \frac{1}{3}x + 6$

13

In March 2016, a video streaming company had a monthly revenue from US memberships of 0.39 million dollars. The company had a monthly revenue from US memberships of 0.61 million dollars 24 months later. Which equation can be used to find x, the average increase in monthly revenue, in millions of dollars, during this 24-month period?

A) $0.39x = 0.61$
B) $24 + 0.39x = 0.61$
C) $24x = 0.61$
D) $0.39 + 24x = 0.61$

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CONTINUE

4

Questions 14 and 15 refer to the following information.

The table gives the approximate number of students enrolled in postsecondary programs in 3 countries in 2015. Each student was enrolled in only one program.

	Bachelor's	Master's	Doctoral	Total
Norway	188,800	62,100	7,500	258,400
Sweden	246,400	135,600	21,400	403,400
Finland	219,400	63,200	19,900	302,500
Total	654,600	260,900	48,800	964,300

14

Of the students enrolled in postsecondary programs in Finland in 2015, what fraction were enrolled in master's program?

A) $\frac{63,200}{302,500}$

B) $\frac{63,200}{260,900}$

C) $\frac{302,500}{964,300}$

D) $\frac{260,900}{302,500}$

15

For students enrolled in a doctoral program in Sweden in 2015, the ratio of students who worked full time to students who did not work full time is approximately 5 to 6. Which of the following is the approximate number of students enrolled in a doctoral program in Sweden in 2015 who worked full time?

A) 713

B) 9,727

C) 11,673

D) 17,833

16

$$6 - 3y = x$$
$$8 + 3y = x$$

The solution to the given system of equations is (x, y). What is the value of x?

A) 1

B) 2

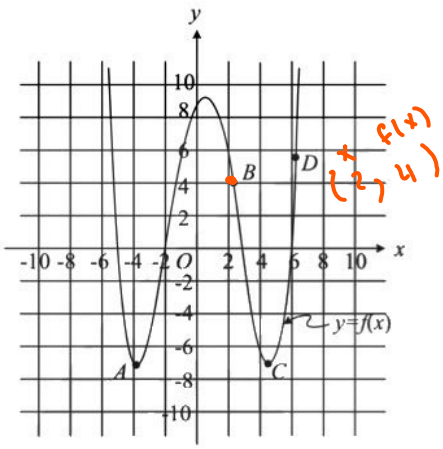
C) 7

D) 14

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4

17



The graph of $y = f(x)$ is shown. At which point is $f(x) > x$?

A) A

B) B

C) C

D) D

18

$$2(x + 1)^2 = x^2 + 6x - 8$$

How many distinct real solutions does the given equation have?

A) zero

B) Exactly one

C) Exactly two

D) Infinitely many

19

On a certain day, there were 80 items in a vending machine. One week later, there were 50 items in the vending machine. By what percentage did the number of items in the vending machine decrease during this time?

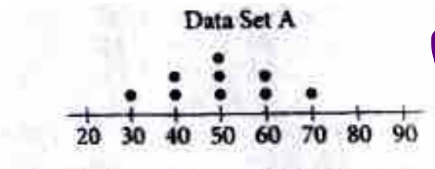
A) 30%

B) 37.5%

C) 60%

D) 62.5%

20



The dot plot shows data set A. Which of the following data sets has the same range as data set A?

A) 40, 40, 50, 50, 50, 70, 70

B) 20, 30, 40, 50, 60, 70, 80, 90

C) 20, 30, 40, 50, 50, 50, 60, 70, 80

D) 40, 50, 50, 60, 60, 60, 70, 70, 70, 70, 80, 80, 80, 80, 80

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CONTINUE

4

21

When 40 is increased to 50, the percent increase is the same as when the number n is increased to 25. What is the value of n?

A) 10
B) 15
C) 20
D) 22

$\frac{50-40}{40} \times 100 = \frac{25-n}{n} \times 100$

$\frac{1}{4} = \frac{25-n}{n}$

$n = 20$

22

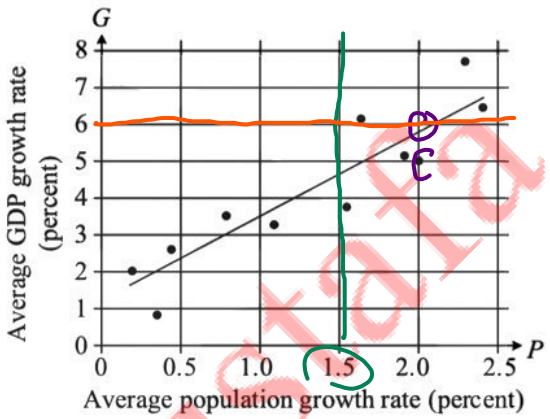
The volume of a sphere with a radius of x inches is p times as large as the volume of a sphere with a diameter of x inches. What is the value of p?

$r_2 = \frac{x}{2}$

A) 16
B) 8
C) 3
D) $\frac{4}{3}$

$p = \frac{2^3}{1^3} = 8$

Questions 23 and 24 refer to the following information.



The scatterplot shows the annual average population growth rate, in percent, and the annual average gross domestic product (GDP) growth rate, in percent, for 11 years for a given country. A line of best fit for the data is also shown.

23

For the year in which the average population growth rate was 2%, what is the predicted value minus the actual value for the average GDP growth rate?

A) 0.2%
B) 0.4%
C) 0.7%
D) 1.0%

$5.7 - 5 = 0.7$

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CONTINUE

4

24

Of the years in which the average population growth rate was greater than 1.5%, what fraction had an average GDP growth rate greater than 6%?

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

B) $\frac{1}{3}$

C) $\frac{1}{5}$

D) $\frac{1}{6}$

25

Which of the following is a factor of the polynomial $(x^2-4)(x+5)$?

A) $x - 9$

B) $x + 2$

C) $x - 1$

D) $x + 1$

26

$$\frac{3}{4}x + \frac{1}{2}y = \frac{2}{3}$$

$$9x + 6y = 8$$

How many solutions does the given system of equations have ?

A) Zero

B) Exactly one

C) Exactly two

D) Infinitely many

27

Two companies used the same sampling method to conduct polls to determine the proportion of residents in favor of the construction of a new parking garage in the town. Both companies surveyed participants selected at random from the same population. Company A used a sample of 560 residents, and Company B used a sample of 220 residents. Which of the following statements is most likely true?

A) The proportion of residents in favor of the construction will be smaller in Company A's survey than in Company B's survey.

B) The proportion of residents in favor of the construction will be larger in Company A's survey than in Company B's survey.

C) The margin of error associated with the proportion in Company A's survey will be smaller than the margin of error associated with the proportion in Company B's survey.

D) The margin of error associated with the proportion in Company A's survey will be larger than the margin of error associated with the proportion in Company B's survey.

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CONTINUE

4

28



On a 60-mile road there are 7 rest stops placed at equal intervals, including one at each end of the road, as shown above. What is the distance, in feet, between two consecutive rest stops?
(Note: 1 mile = 5,280 feet)

A) 31,680
B) 36,960
C) 45,257
D) 52,800

$\frac{60}{6} \times 5280$

29

After every period of 2.62 years, the mass of promethium-147 in a sample will be half the mass it was at the beginning of the period. The function m gives the mass, in grams, of promethium-147 that remains from an initial 40-gram sample after t years. Which equation defines m?

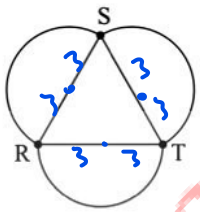
A) $m(t) = 40(\frac{1}{2.62})^{0.5t}$

B) $m(t) = 40(2.62)^{0.5t}$

C) $m(t) = 40(0.5)^{2.62t}$

D) $m(t) = 40(0.5)^{\frac{t}{2.62}}$

30



In the figure above, ΔRST is equilateral and each side of ΔRST is the diameter of a semicircle. If the total length of the three semicircles is 9π, what is the perimeter of ΔRST?

A) 6
B) 9
C) 12
D) 18

$6+6+6$

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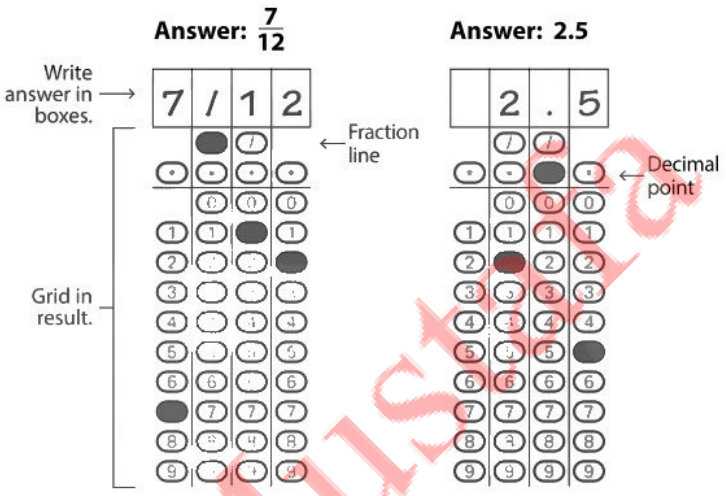
CONTINUE

4

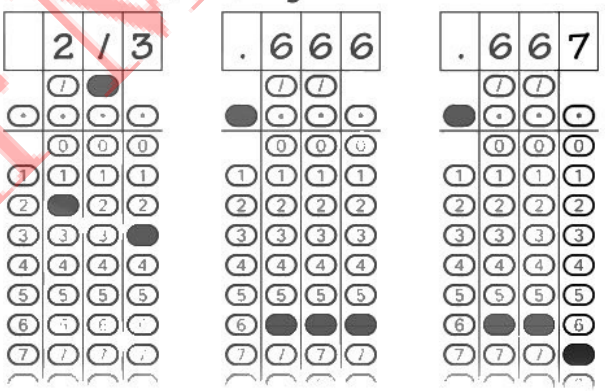
DIRECTIONS

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

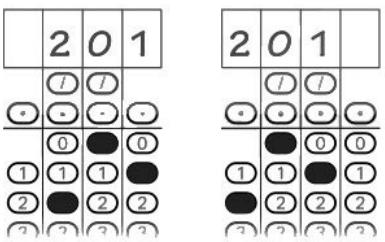
1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the bubbles accurately. You will receive credit only if the bubbles are filled in correctly.
2. Mark no more than one bubble in any column.
3. No question has a negative answer.
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 7/2. (If  is entered into the grid, it will be interpreted as $\frac{31}{2}$, 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:



Answer: 201 – either position is correct



NOTE:
You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.

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CONTINUE

4

31

$x^2 - 8x = 0$

What is one of the solutions to the given equation?

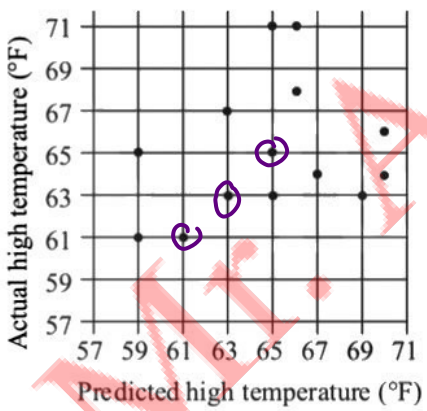
$x(x-8)=0$ $x=8$ $x=0$

32

An infographic (not shown) displaying the numbers of speakers of various languages uses 1 symbol to represent 10 million speakers of a language. The infographic uses 14.5 symbols to represent speakers of Russian. How many speakers of Russian, in millions, are represented in the infographic?

1 : 10
14.5 : —
145

33



The scatterplot shows the relationship between the predicted high temperature, in degrees Fahrenheit (°F), and the actual high temperature, in °F, for 14 days in a certain city. For how many of the 14 days was the predicted high temperature equal to the actual high temperature?

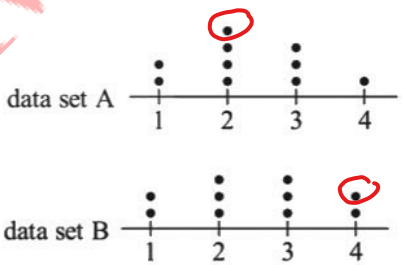
3

34

The equation $F = 10a$ gives the net force F, in newtons, required to accelerate a 10-kilogram object, where a is the acceleration, in meters per second squared $\left(\frac{m}{s^2}\right)$. What net force, in newtons, is required for the object's acceleration to be 4 $\frac{m}{s^2}$?

$10(4) = 40$

35



$\frac{2}{10} = .2$

The dot plots show the values for data set A and data set B. The mean of data set B is how much greater than the mean of data set A?

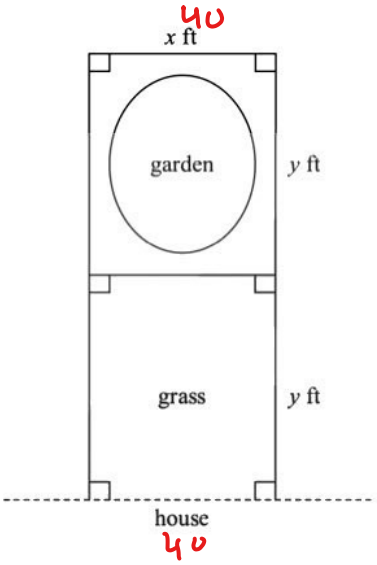
or $\Rightarrow 2.5 - 2.3 = .2$

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CONTINUE

4

36



Note: Figure not drawn to scale

The figure above represents Omari's backyard. He plans to build a fence on the three sides of his backyard that do not border the house and to build an additional fence to divide the backyard into the two rectangular regions shown. If Omari uses 300 feet (ft) of fencing and $x = 40$, what is the value of y ?

$y = \frac{300 - (40 + 40)}{4} = 55$

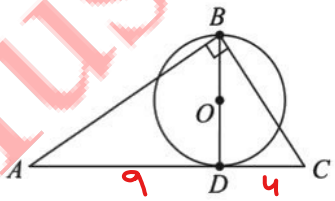
37

$g(x)=(15-2x)(5+2x)$

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

$x = \frac{7.5 - 7.5}{2} = 2.5$

38



In the figure above, $\overline{BD}$ is a diameter of the circle and ΔABC is right triangle. The circle is tangent to $\overline{AC}$ at point D. If $AD = 9$ and $CD = 4$, what is the length of $\overline{BD}$?

$BD^2 = 4 \times 9$

$BD = 6$

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STOP

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