# Math Test – No Calculator

## 25 MINUTES, 20 QUESTIONS

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

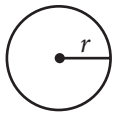
### DIRECTIONS

**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 your answers in the grid. You may use any available space in your test booklet for scratch work.

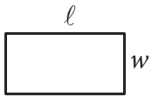
### NOTES

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.

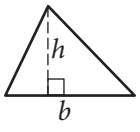
### REFERENCE



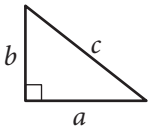

$A = \pi r^2$
$C = 2\pi r$



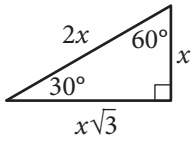

$A = \ell w$

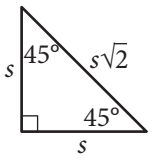



$A = \frac{1}{2}bh$

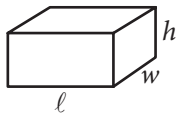



$c^2 = a^2 + b^2$

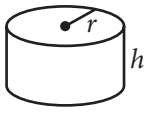



Special Right Triangles

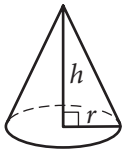



$V = \ell wh$

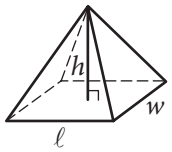



$V = \pi r^2 h$


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




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




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

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





CONTINUE

**1**

In the 1884 US presidential election, candidates James Blaine and Grover Cleveland received a total of 401 electoral college votes. The number of electoral college votes Blaine received, $b$, was 37 fewer than the number of electoral college votes Cleveland received, $c$. Which system of equations represents this situation?

A) $b + c = 438$
$b = c - 37$

B) $b + c = 438$
$b = c + 37$

C) $b + c = 401$
$b = c - 37$

D) $b + c = 401$
$b = c + 37$

**2**

$$2p + 6 = 8 + 7p$$

What value of $p$ satisfies the given equation?

A) $-\frac{2}{9}$

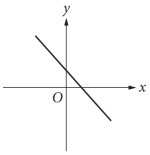
B) $-\frac{2}{5}$

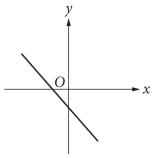
C) $\frac{14}{15}$

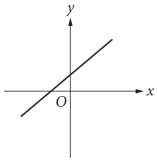
D) $\frac{14}{9}$

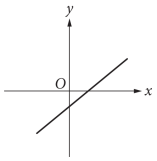
**3**

Which of the following could represent the graph of the linear equation $y = mx + 3$, where $m$ is a positive constant?

A)



B)



C)



D)



**4**

The equation $y = \sqrt{\frac{hg}{x}}$ relates to the positive numbers $g$, $h$, $x$, and $y$. Which equation correctly expresses $h$ in terms of $g$, $x$, and $y$?

A) $h = gxy$

B) $h = gxy^2$

C) $h = \frac{gy^2}{x}$

D) $h = \frac{xy^2}{g}$





CONTINUE

5

$$|x-1|=8$$

If $x$ is a solution to the given equation, what is a possible value of $x$ - 1?

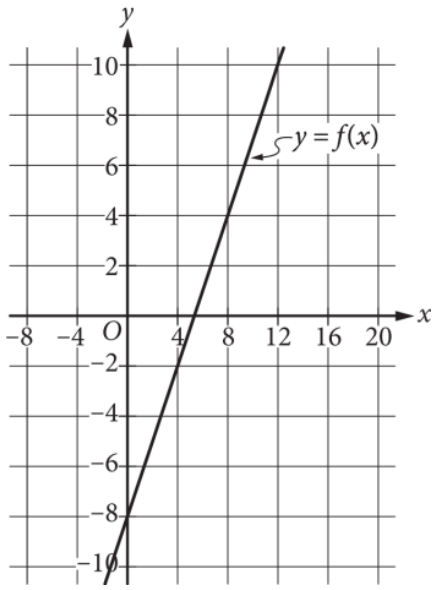
A) −8

B) −6

C) 6

D) 7

6




The graph of the linear function $f$ is shown. Which equation defines $f$?

A) $f(x)=\frac{3}{2}x-8$

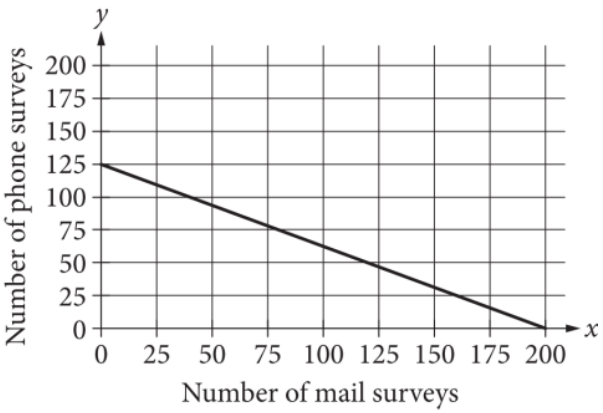
B) $f(x)=\frac{3}{2}x+5$

C) $f(x)=\frac{1}{3}x-8$

D) $f(x)=\frac{1}{3}x+5$

7

A research institute conducted phone and mail surveys. The total cost of conducting these surveys was $5,000. The line shown models the possible combinations of phone and mail surveys that the institute could have conducted.




According to the model, what was the cost for each phone survey conducted?

A) $200

B) $125

C) $40

D) $25

8

Which expression is equivalent to $(5x^3 - 2x + 1) - (2x^3 + 2x + 1)$?

A) $3x^3$

B) $3x^3 + 2$

C) $3x^3 - 4x$

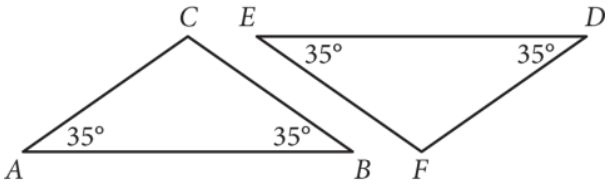
D) $3x^3 - 4x + 2$





CONTINUE

9




Triangle ABC and triangle DEF each have two angles measuring 35°, as shown. Which of the following additional pieces of information is sufficient to prove that triangle ABC is congruent to triangle DEF ?

A) the measures of $\angle ACB$ and $\angle DFE$ are equal.

B) The lengths of $\overline{BC}$ and $\overline{EF}$ are equal.

C) The lengths of $\overline{AC}$ and $\overline{DE}$ are equal.

D) No additional information is necessary to prove that the two triangles are congruent.

10

Which expression is equivalent to $y^{\frac{1}{8}\left(y^{\frac{3}{4}}\right)^{\frac{3}{2}}}$, where $y > 0$ ?

A) $\sqrt[4]{y^5}$

B) $\sqrt[3]{y^4}$

C) $\sqrt[8]{y^5}$

D) $\sqrt[8]{y^7}$





CONTINUE

11

What is the value of $\sin\left(\frac{3\pi}{4}\right)$?

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

B) $-\frac{\sqrt{3}}{2}$

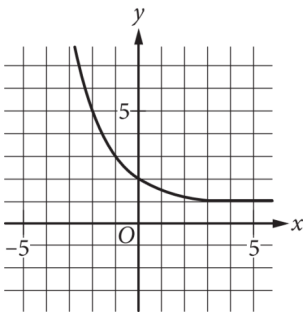
C) $\frac{\sqrt{2}}{2}$

D) $\frac{\sqrt{3}}{2}$

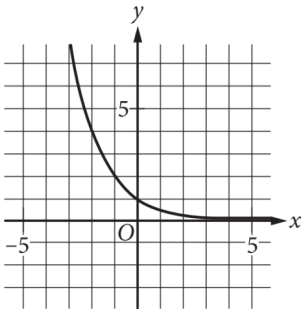
12

What is the graph of the equation $y = 2^{-x} + 1$?

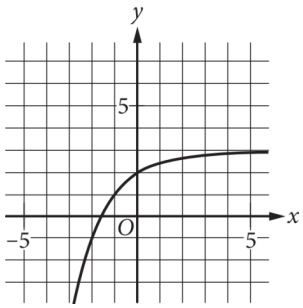
A)



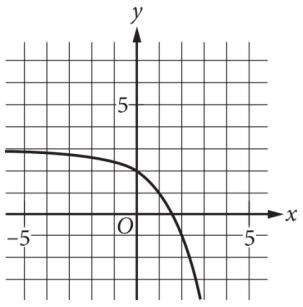

B)




C)




D)








CONTINUE

13

In 2005, 10 phlox plants were planted in a garden. The number of phlox plants increased by 140% each year. Which of the following equations best models the estimated number of plants, $P$, in the garden $t$ years after 2005?

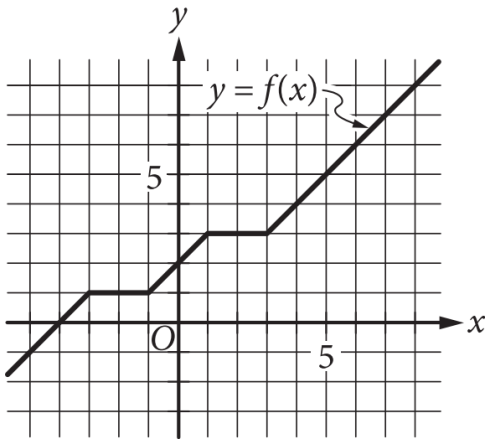
A) $P = 1.14(10)^t$

B) $P = 2.4(10)^t$

C) $P = 10(1.14)^t$

D) $P = 10(2.4)^t$

14




The complete graph of the function $f$ is shown in the $xy$-plane. What is the $y$-intercept of the graph of $y = f(x + 2)$ ?

A) (0 , 3)

B) (0 , 2)

C) (0 , 1)

D) (0 , 0)

15

One of the two equations in a linear system is $2x + 2y = 2$. The system has no solution. Which equation could be the other equation in the system?

A) $3x - 3y = 3$

B) $3x + 3y = 3$

C) $2x - 2y = 2$

D) $2x + 2y = 3$

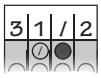


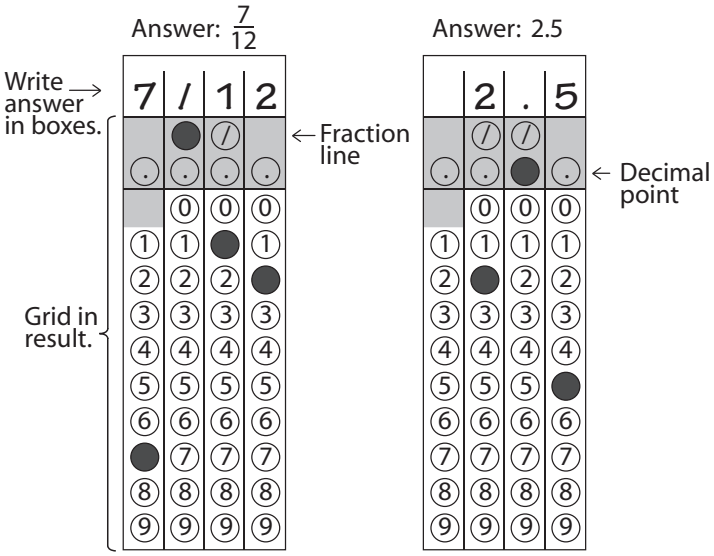


CONTINUE

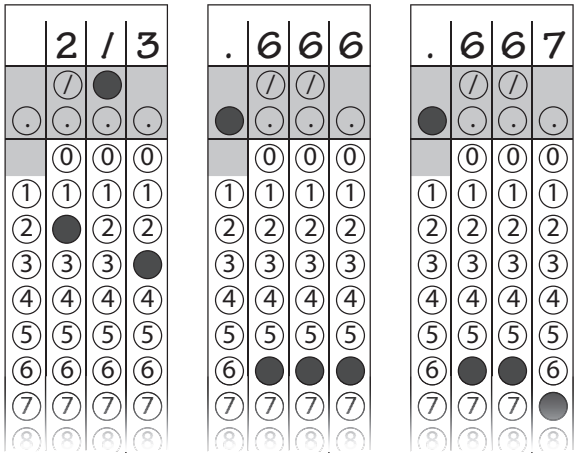
**DIRECTIONS**

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

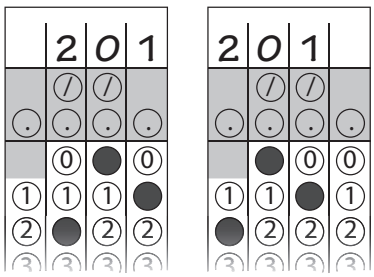
1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.
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 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.





CONTINUE

16

$$g(x) = \frac{(2+x)}{x}$$

For the given function $g$, what is the value of $g(8)$ ?

17

Line $h$ is defined by $y = -8x + 7$. What is the slope of a line that is perpendicular to line $h$ in the xy-plane?

18

$$x + 2y = 11$$
$$3x + 3y = 24$$

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





CONTINUE

19

| | volume ($m^3$) |
|---|---|
| Rectangular prism A | 96 |
| Rectangular prism B | 12 |

Rectangular prism A is similar to rectangular prism B, where the longest side of rectangular prism A corresponds to the longest side of rectangular prism B. The table gives the volumes, in cubic meters ($m^3$), of the two prisms. The length of the longest side of rectangular prism A is 6 meters. What is the length, in meters, of the longest side of rectangular prism B?

20

$$x^2 - 10x + 14 = 0$$

One solution to the given equation can be written as $x = 5 + \sqrt{n}$, where $n$ is a constant. What is the value of $n$?

# STOP

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

# 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 your answers in the grid. You may use any available space in your test booklet for scratch work.

### NOTES

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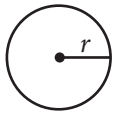


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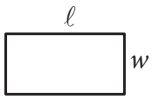
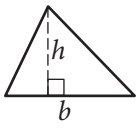
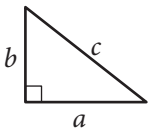


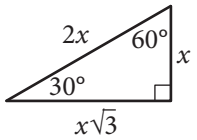

$A = \ell w$

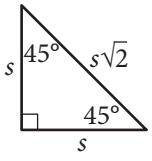



$A = \frac{1}{2}bh$

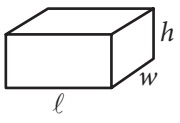



$c^2 = a^2 + b^2$

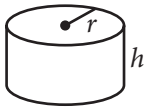



Special Right Triangles

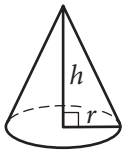



$V = \ell wh$

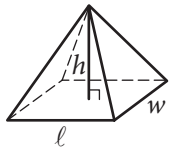



$V = \pi r^2 h$


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




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




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

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





CONTINUE

**1**

It is estimated that humans begin REM sleep 90 minutes after falling asleep. Based on this estimate, how many seconds after falling asleep do humans begin REM sleep?

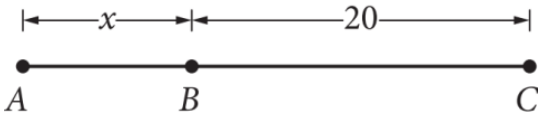
A) 3,600
B) 5,400
C) 8,100
D) 9,000

**2**

The function $g$ is defined by $g(x) = 4x - 2$. What is the value of $g(-3)$ ?

A) $-\frac{1}{4}$
B) $-\frac{5}{4}$
C) $-10$
D) $-14$

**3**




For line segment $\overline{AC}$ shown, the length of line segment $\overline{BC}$ is 2 times the length of line segment $\overline{AB}$. Which equation represents this situation?

A) $x + 2 = 20$
B) $x + 20 = 2$
C) $x - 2(20)$
D) $2x = 20$

**4**

Two people sweep the floor. The table gives their sweeping rates, in square yards per minute ($yd^2$/min).

| Person | Rate |
|---|---|
| Jeremy | 12 |
| Eric | 16 |

If each person sweeps the floor for 5 minutes, how much greater of an area, in square yards, does Eric sweep than Jeremy?

A) 20
B) 60
C) 80
D) 140

**5**

Which expression is equivalent to $x^4(3x^2 + 9x - 8)$ ?

A) $x^4 + 3x^2 + 9x - 8$
B) $3x^6 + 9x^5 - 8x^4$
C) $3x^8 + 9x^5 - 8x^4$
D) $12x^2 + 36x - 32$





CONTINUE

6

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

A) $(0, 4)$
B) $(0, 2)$
C) $(0, -2)$
D) $(0, -4)$

7

The table summarizes the number of public schools in two California counties in 2017.

| | County | | |
|---|---|---|---|
| **School** | Los Angeles | San Diego | Total |
| Elementary | 1,395 | 498 | 1,893 |
| Middle | 422 | 165 | 587 |
| High | 570 | 191 | 761 |
| Total | 2,387 | 854 | 3,241 |

A public middle school will be selected at random from the two counties. What is the probability, to the nearest hundredth, of selecting a school in San Diego County?

A) 0.05
B) 0.19
C) 0.28
D) 0.69

8

A museum built a scale model of the solar system throughout its city where 1 mile in the model represents an actual distance of 400,000,000 miles. The model of the Sun is $x$ miles away from the model of Earth. Which expression represents the actual distance, in miles, between Earth and the Sun?

A) $400{,}000{,}000x$
B) $1{,}000{,}000x$
C) $400x$
D) $\frac{x}{400}$

9

The list shown gives the heights, in inches, for the 6 ten-year-old children in a group.

52, 53, 54, 54, 55, 56

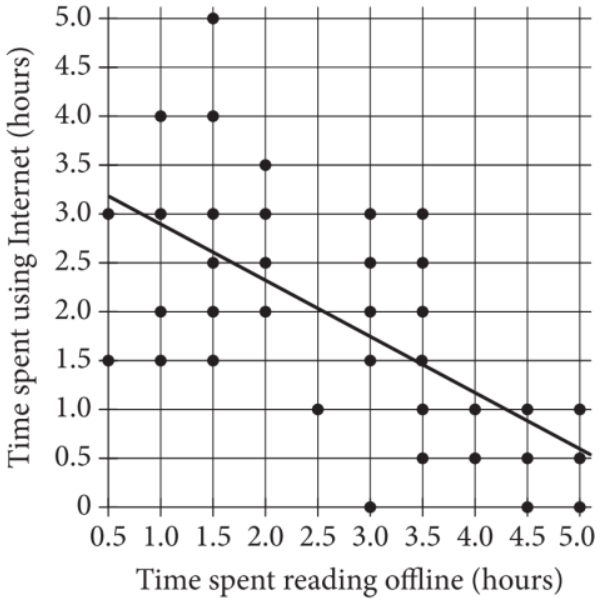
A seventh child with a height of 60 inches will be added to the group. Which of the following correctly describes how the mean and the median of the group will change when the seventh child is added?

A) The mean and the median will increase.
B) The mean and the median will decrease.
C) The mean will increase, and the median will remain the same.
D) The mean will decrease, and the median will remain the same.



CONTINUE

**Questions 10 and 11 refer to the following information.**




In a certain school district, 36 high school students were selected at random for a study on Internet use and offline reading habits. During October, each student reported the average amount of time, to the nearest half hour, spent reading offline on Saturdays and the average amount of time, to the nearest half hour, spent using the Internet on Saturdays. The scatterplot above shows the times recorded by the students. A line of best fit is also shown.

10

The line of best fit underestimates one student's reported average time spent using the Internet on Saturdays by more than 2 hours. For how many hours did this student report reading offline?

A) 0.5
B) 1.5
C) 3.5
D) 5.0

11

According to the line of best fit, if a student spends an average of 1.25 hours reading offline on Saturdays, which of the following is the best estimate of time the student would be expected to spend using the Internet on Saturdays?

A) Between 3.5 and 4.0 hours
B) Between 3.0 and 3.5 hours
C) Between 2.5 and 3.0 hours
D) Between 2.0 and 2.5 hours





CONTINUE

12

Line $k$ is defined by $y = -x + 5$. Line $j$ is parallel to line $k$ on the xy-plane. What is the slope of line $j$?

A) $-1$

B) $-\frac{1}{5}$

C) $1$

D) $5$

13

For a survey, students were assigned to either group R or group V. Combined, the students in both groups answered a total of 17 questions. Of these, a total of 9 questions were answered by the students in group V. The equation $4r + 9 = 17$ describes this situation, where $r$ represents the number of questions answered by each student in group R. Which of the following is the best interpretation of $4r$ in this context?

A) The number of students in group R

B) The number of students in group V

C) The total number of questions answered by students in group R

D) The total number of questions answered by students in group V

14

How many solutions does the equation $5(x + 1) = 5x + 5$ have?

A) zero

B) Exactly one

C) Exactly two

D) Infinitely many

15

| Age | Average amount of money |
|---|---|
| 25 | \$42 |
| 28 | \$36 |
| 33 | \$26 |
| 35 | \$22 |
| 42 | \$8 |

The table shows the results of a survey on the average amount of money $d$, in dollars, consumers would be willing to spend on a product and their corresponding age $a$, in years. Which equation could represent this linear relationship?

A) $d = -2a + 92$

B) $d = -\frac{1}{2}a + 92$

C) $d = 2a - 8$

D) $d = 2a - 40$





CONTINUE

16

$$4(x + 1) = 6 + 2(x + 1)$$

If x is the solution to the given equation, what is the value of $x + 1$ ?

A) 1

B) 3

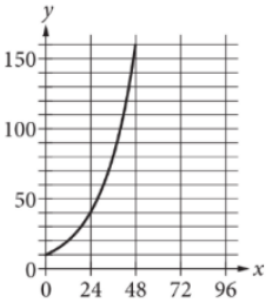
C) 4

D) 6

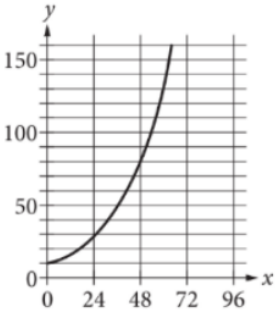
17

The initial number of bacteria in a population is 10 thousand. The bacteria in the population are observed to double in number every 12 hours. Which graph represents the number of bacteria y, in thousands, $x$ hours after the initial observation?

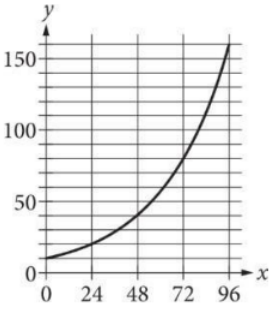
A)



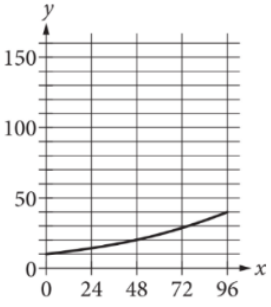

B)




C)




D)

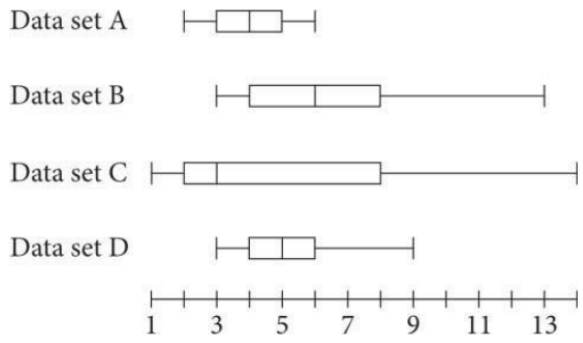







CONTINUE

18




The box plots shown summarize the data in each of four data sets. Which of the four data sets has a range of 6 ?

A) Data set A
B) Data set B
C) Data set C
D) Data set D

19

A forest contains different species of trees. Let $t$ represent the total number of trees in the forest, let $h$ represent the number of hickory trees, and let $k$ represent the number of oak trees. If a tree is selected at random from the forest,which expression represents the probability of selecting a tree that is neither hickory nor oak?

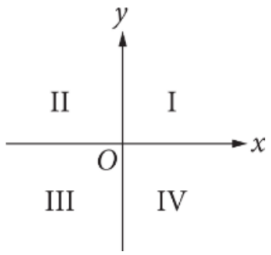
A) $\frac{h+k}{t}$

B) $\frac{t-h-k}{t}$

C) $\frac{h+k-t}{t}$

D) $\frac{t+h+k}{t}$

20




In the xy-plane shown, the quadrants are labeled I, II, III, and IV. The graph of $y = -(x + h)^2 + k$ , where $h$ and $k$ are positive constants, is a parabola. In which quadrant is the vertex of this parabola?

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





CONTINUE

21

At the beginning of the day, there were 500 items for sale in a store. The number of items for sale at the end of the day was $r$% less than the number at the beginning of the day. Which expression represents the number of items for sale at the end of the day?

A) $\left(\frac{100 - r}{100}\right)500$

B) $\left(\frac{100 + r}{100}\right)500$

C) $\left(\frac{r}{100}\right)500$

D) $(100 - r)500$

22

The area, in square inches, of a certain right triangle is given by the equation $A = \frac{1}{2}b(2b)$, where $b$ is the length, in inches, of one of the legs of the triangle. Which expression represents the length, in inches, of the shortest leg of the triangle?

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

B) $b$

C) $2b$

D) $2b^2$





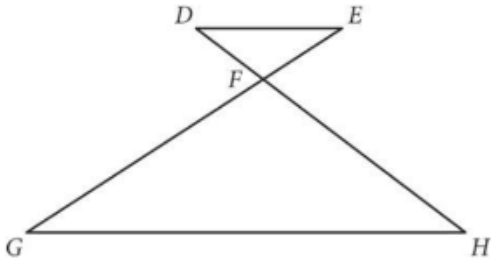
CONTINUE

23

Scientists took 94 ice core sections from a glacier. Each section was in the shape of a right circular cylinder and had a length of 1 meter and a diameter of 0.1 meter. Which of the following is closest to the total volume, in cubic meters, of the 94 sections?

A) 30
B) 7
C) 3
D) 0.7

24



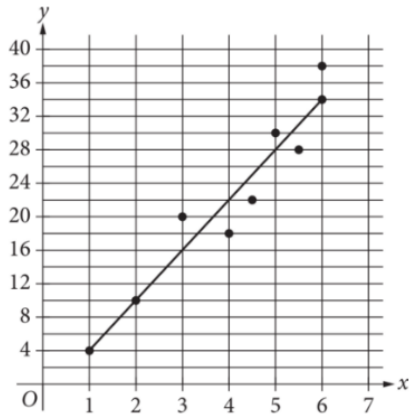

In the figure shown, $\overline{GE}$ and $\overline{DH}$ intersect at point F. Which of the following additional statements is (are) sufficient to prove that triangle DEF is similar to triangle HGF?

I. The length of $\overline{DE}$ is $\frac{1}{3}$ the length of $\overline{HG}$
II. DE is parallel to HG

A) I is sufficient, but II is not.
B) II is sufficient, but I is not.
C) I is sufficient, and II is sufficient.
D) Neither I nor II is sufficient.

25

The scatterplot shows the relationship between two variables, $x$ and $y$. A line of best fit for the data is also shown.




Which data point has an actual $y$-value that is 2 more than the $y$-value predicted by the line of best fit for the corresponding $x$-value?

A) (2, 10)
B) (3, 20)
C) (4, 18)
D) (5, 30)



CONTINUE

26

A plant's height is 1.25 times its height from last week. What was the percentage increase in the plant's height from last week?

A ) 1.25%

B ) 2.5%

C ) 12.5%

D ) 25%

27

In a forest, white pine trees between 15 and 45 years old grew 36 to 48 inches in height each year. A 15-year-old white pine tree growing in the forest was 240 inches tall. Which of the following inequalities gives all possible values for the tree's height $h$, in inches, at the end of its 45th year?

A) $h \leq 540$

B) $h \leq 2{,}160$

C) $240 \leq h \leq 1{,}080$

D) $1{,}320 \leq h \leq 1{,}680$

28

$p$% of $x$ is 3. Which expression represents $x$ in terms of $p$ ?

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

B) $\frac{3p}{100}$

C) $\frac{(100)(3)}{p}$

D) $\frac{p}{(100)(3)}$





CONTINUE

29

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

Which of the following equivalent forms of the given function $f$ displays, as the base or the coefficient, the $y$-coordinate of the $y$-intercept of the graph of $y = f(x)$ in the $xy$-plane?

A) $f(x) = \left(\frac{1}{3}\right)^{(2x+2)}$

B) $f(x) = \frac{1}{9}\left(\frac{1}{3}\right)^{2x}$

C) $f(x) = 81^{\left(-\frac{1}{2}x-\frac{1}{2}\right)}$

D) $f(x) = 3^{(-2x-2)}$

30

Two different store owners in a shopping center estimated the percentage of all visitors who wear eyeglasses. They each selected a random sample of the shopping center visitors and recorded whether the visitors were wearing eyeglasses. The results from each sample are shown in the table below.

| | Percentage of visitors wearing eyeglasses | Margin of error |
|---|---|---|
| Sample A | 21% | 3% |
| Sample B | 21% | 2% |

If the associated margin of error was calculated the same way for both samples, which of the following is the most likely reason that the result for Sample A has a larger margin of error?

A) Sample A included more visitors than Sample B.

B) Sample B included more visitors than Sample A.

C) Sample A included a greater percentage of visitors who were wearing eyeglasses than Sample B.

D) Sample B included a greater percentage of visitors who were wearing eyeglasses than Sample A.

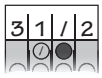


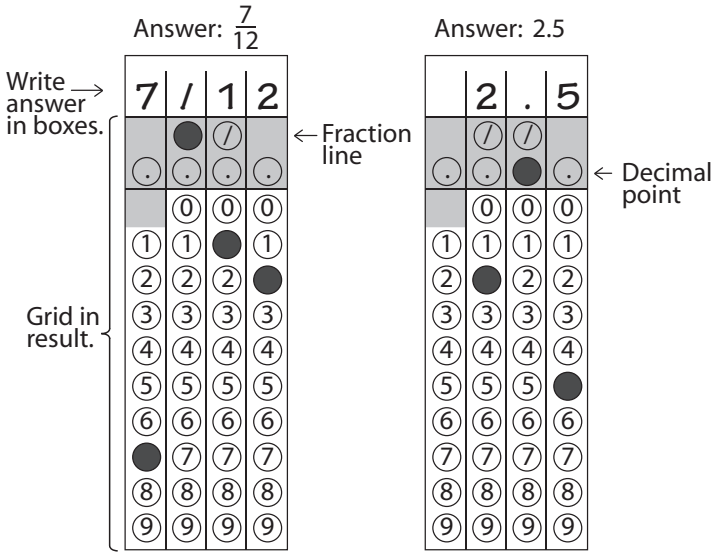


CONTINUE

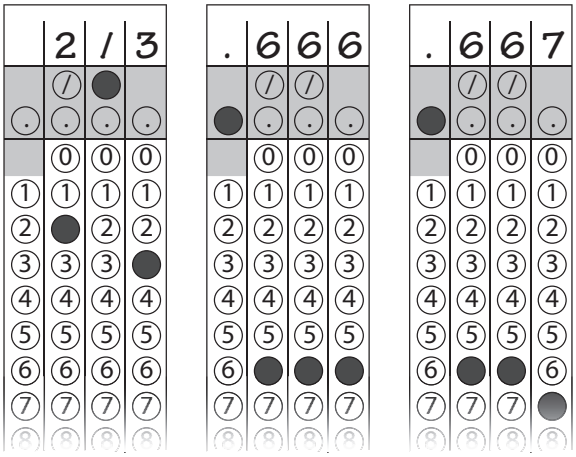
**DIRECTIONS**

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

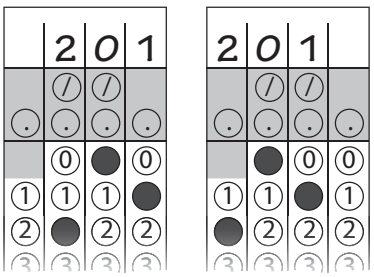
1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.
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 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.





CONTINUE

31

A limestone stalactite grew in length at a rate of $\frac{1}{8}$ of a millimeter per year. At this rate, how many years would it take for this stalactite to grow a total of 4.0 millimeters?

32

$$x + y = 10$$
$$x - y = 4$$

The solution to the given system of equations is $(x, y)$. What is the value of $2x$?





CONTINUE

33

If $3\sqrt{x-3}+10=22$, what is the value of $x-3$ ?

34

| Average speed (mph) | Number of laps |
|---|---|
| $0 \leq s < 140$ | 4 |
| $140 \leq s < 145$ | 20 |
| $145 \leq s < 150$ | 32 |
| $150 \leq s < 155$ | 57 |
| $155 \leq s < 160$ | 52 |
| $160 \leq s < 165$ | 35 |

The table gives the average speed $s$, in miles per hour (mph), of each lap around the track for one racing team. For how many laps was the average speed greater than or equal to 150 mph?





CONTINUE

35

Long jump distances (meters)

| | | | | | |
|---|---|---|---|---|---|
| Aditi | 4.2 | 3.8 | 3.2 | 4.0 | 4.3 |
| Bella | $x$ | 4.4 | 3.7 | 3.8 | 4.6 |

Aditi and Bella each attempted the long jump five times during a track meet, and their distances are shown in the table. The mean distance for Bella's attempts was 0.3 meter greater than the mean distance for Aditi's attempts. What is the value of $x$?

36

What is the $x$-coordinate of the $x$-intercept of the line with equation $\frac{5}{4}x + \frac{2}{3}y = 1$ when it is graphed in the $xy$-plane?





CONTINUE

37

What is the perimeter of an equilateral triangle with a height of $5\sqrt{3}$ ?

38

$$y = -3$$
$$y = x^2 + 10x + a$$

In the system of equations shown, $a$ is a positive constant. For which value of $a$ does the system have exactly one distinct real solution?

# STOP

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