Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

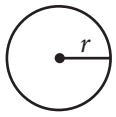
DIRECTIONS

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.

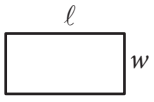
NOTES

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.

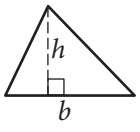
REFERENCE



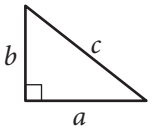
$A = \pi r^2$
$C = 2\pi r$



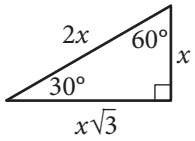
$A = \ell w$

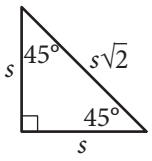


$A = \frac{1}{2}bh$

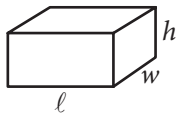


$c^2 = a^2 + b^2$

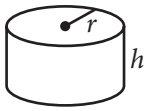




Special Right Triangles

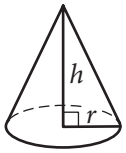


$V = \ell wh$

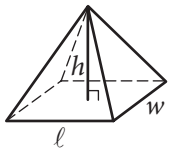


$V = \pi r^2 h$

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



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

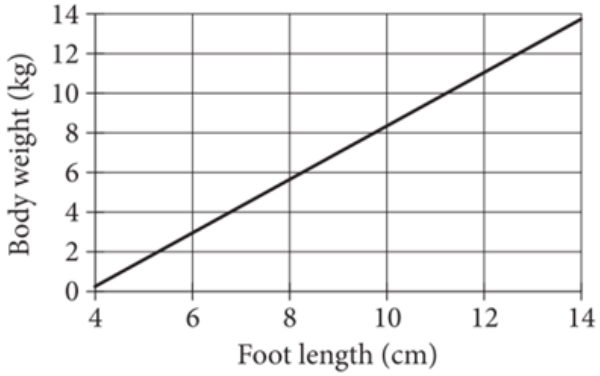


$V = \frac{1}{3}\ell wh$

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

CONTINUE

1



The line models the relationship between body weight and foot length for a group of infants. Based on the model, what is the predicted weight, in kilograms (kg), of an infant with a foot length of 9 centimeters (cm)?

A) 5

B) 7

C) 9

D) 11

2

Line segment AC has a length of 120 and contains point B. If $AB = 5x + 20$ and $BC = 6x - 10$, which equation shows the relationship between the lengths of line segments AB, BC, and AC?

A) $5x + 20 = 120$

B) $6x - 10 = 120$

C) $(5x + 20) - (6x - 10) = 120$

D) $(5x + 20) + (6x - 10) = 120$

3

$$x = 4$$

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

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

A) (4,6)

B) (4,3)

C) (4,2)

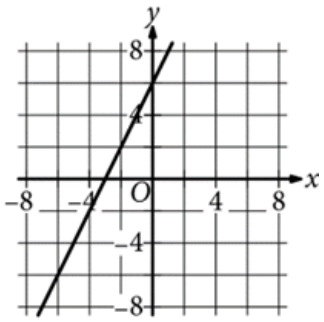
D) (4,1)

CONTINUE

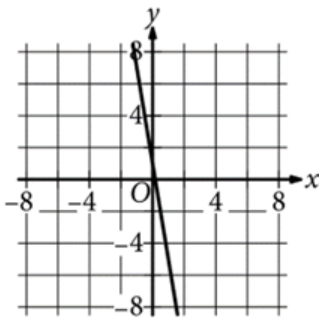
4

The function f is defined by $f(x) = 2x + 6$. What is the graph of $y = f(x)$?

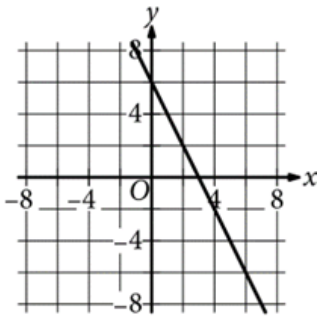
A)



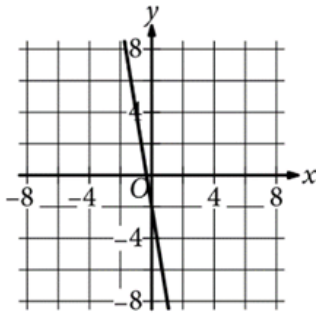
B)



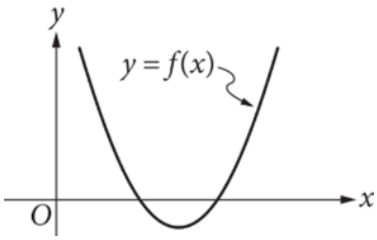
C)



D)

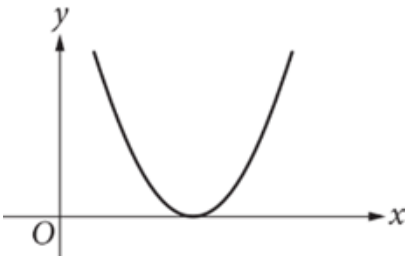


5

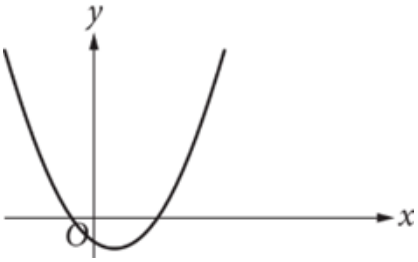


The graph of the quadratic function f is shown, where $y = f(x)$. Which of the following could be the graph of $y = f(x) + 2$?

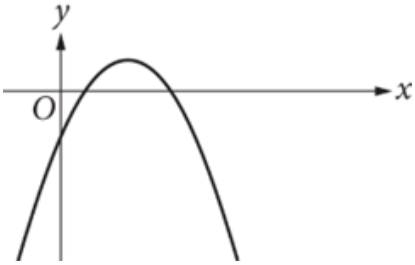
A)



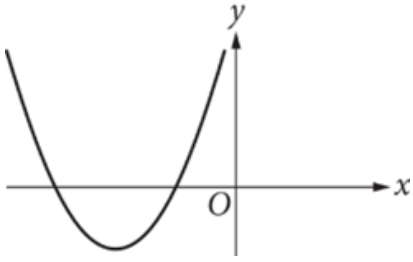
B)



C)



D)



CONTINUE

6

The function q is defined by $q(x) = 5(-1)^x$, where x is an integer. What is the value of $q(6)$?

A) -30

B) -5

C) 5

D) 30

7

$$\frac{(x-4)(x+2)}{(x-4)} = 0$$

Which value is a solution to the given equation?

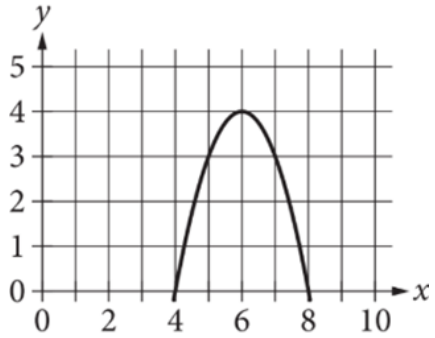
A) 4

B) 2

C) 0

D) -2

8



What is an equation of the graph shown?

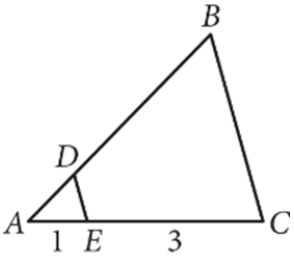
A) $y = -(x - 4)^2 + 8$

B) $y = (x + 4)^2 - 8$

C) $y = -(x - 6)^2 + 4$

D) $y = (x + 6)^2 - 4$

9



In the figure shown, triangle ABC is similar to triangle ADE such that B corresponds to D and C corresponds to E. The measure of angle ABC is 60°. What is the measure of angle ADE?

A) 15°

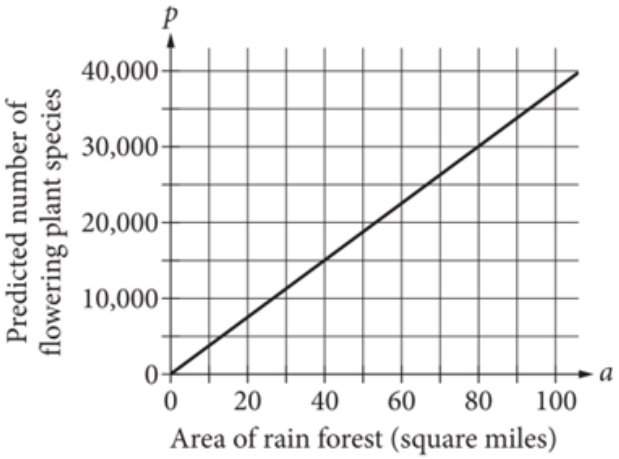
B) 20°

C) 45°

D) 60°

CONTINUE

10



The graph models the relationship between the area of a rain forest a, in square miles, and the predicted number of flowering plant species, p, found in that area. What equation represents this relationship?

A) $p = 200a$

B) $p = 375a$

C) $p = 500a$

D) $p = 750a$

11

$$p = \frac{2}{n} + 3$$

The given equation relates the numbers p and n, where n is not equal to 0 and $p > 3$. Which equation correctly expresses n in terms of p?

A) $n = \frac{p}{2} - 3$

B) $n = \frac{p}{2} + 3$

C) $n = \frac{2}{p-3}$

D) $n = -\frac{2}{p+3}$

12

$$y = 3x + 5$$
$$y = px + 8$$

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

A) -3

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

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

D) 3

CONTINUE

13

$$\sqrt{x}(\sqrt{x}+\sqrt{y})$$

Which of the following expressions is equal to the given expression, where $x \geq 0$ and $y \geq 0$?

A) $x+\sqrt{xy}$

B) $x+\sqrt{x+y}$

C) $\sqrt{x^2+xy}$

D) $\sqrt{x^2+x+y}$

14

Joe was asked to memorize a list of 200 vocabulary words, and he was assessed on his memorization of the words over 3 days. On day 1, he remembered all 200 words. On each of the next two days, Joe remembered 10% fewer words than he did the preceding day. How many words did Joe remember on day 3 ?

A) 160

B) 162

C) 172

D) 180

15

$$x^2+y^2-16x-4y+32=0$$

In the *xy*-plane, the graph of the given equation is a circle. What is the length of the radius of this circle?

A) 2

B) 6

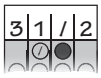
C) 8

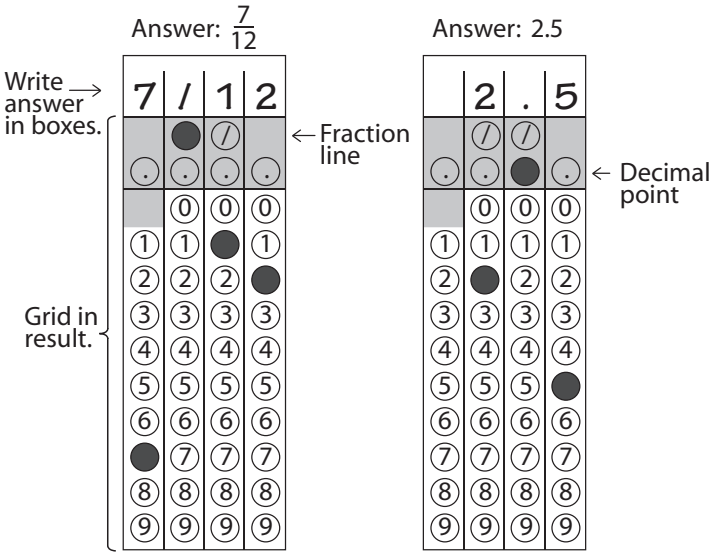
D) 36

CONTINUE

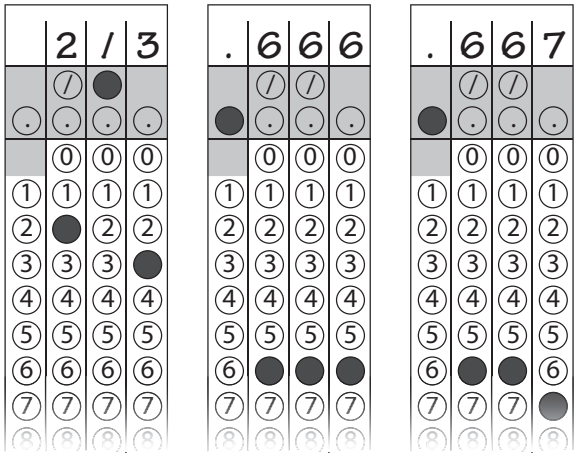
DIRECTIONS

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

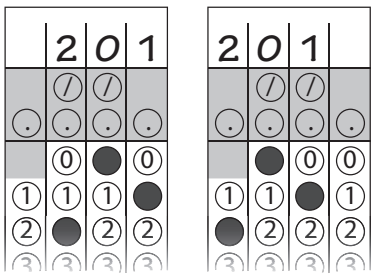
1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.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

$$|2x| = 64$$

What positive value of x satisfies the given equation?

17

The equation of line k is $y = 7x + 2$. What is the slope of a line that is parallel to line k in the xy-plane?

18

If $\frac{2}{3}p + 4 = 10$, what is the value of $3p$?

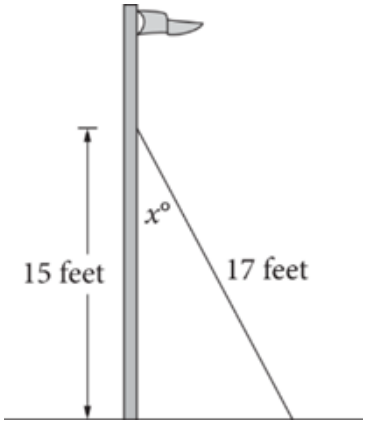
CONTINUE

19

$$(x^3 - 6x + 5)(3x^2 + x)$$

If the given expression is rewritten in the form $ax^5 + bx^4 + cx^3 + dx^2 + ex$, where a, b, c, d, and e are constants, what is the value of d?

20



The figure shows the mast of a boat that is installed perpendicular to the deck of the boat. The mast is secured by a rope that is anchored to the deck. The rope measures 17 feet long and makes an angle of $x°$ with the mast. The point where the rope is attached to the mast is 15 feet above the deck. What is the value of $\tan(x°)$?

STOP

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

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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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.

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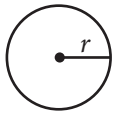

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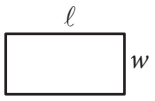

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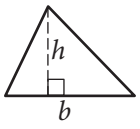
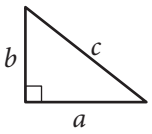
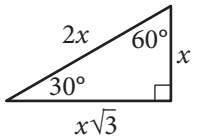
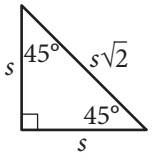


$A = \frac{1}{2}bh$

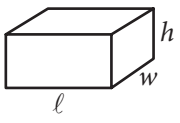


$c^2 = a^2 + b^2$

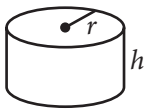




Special Right Triangles

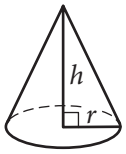


$V = \ell wh$

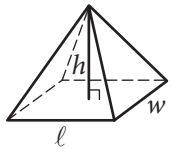


$V = \pi r^2 h$

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



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



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

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.

CONTINUE

1

The function f is defined by $f(x) = 17x + 13$. What is the value of $f(8)$?

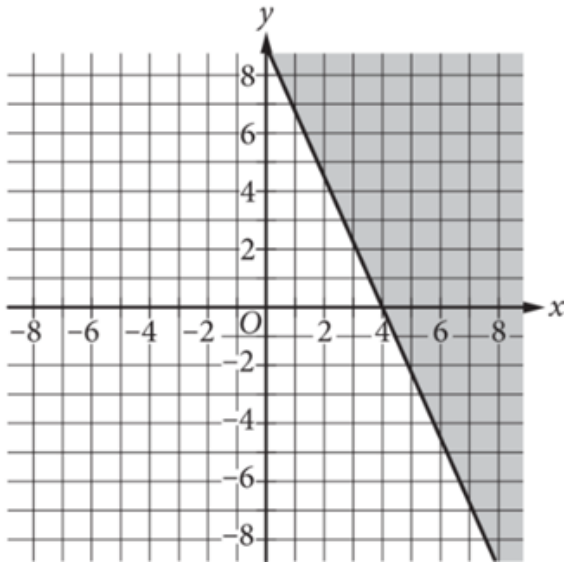
A) 38

B) 121

C) 136

D) 149

2



The shaded region shown represents all solutions to an inequality. Which ordered pair (x,y) is a solution to this inequality?

A) (5,0)

B) (0,5)

C) (−5,0)

D) (0,−5)

3

Leonardo da Vinci's rectangular painting *Mona Lisa* measures 21 inches wide and 30 inches long. An artist is creating a larger-scale replica of *Mona Lisa*, where the equation $A = (21x)(30x)$ gives the area of the replica, in square inches. Which of the following is the best interpretation of x in this context?

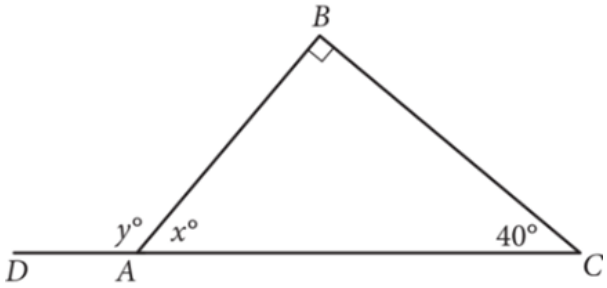
A) The width of the replica is x inches greater than the width of the original *Mona Lisa*.

B) The length of the replica is x inches greater than the length of the original *Mona Lisa*.

C) The measure of each side of the replica is x times as great as the measure of the corresponding side of the original *Mona Lisa*.

D) The area of the replica is x times as great as the area of the original *Mona Lisa*.

4



In triangle ABC, $\overline{CA}$ is extended to point D. What is the value of y ?

A) 50

B) 115

C) 130

D) 140

CONTINUE

Questions 5 and 6 refer to the following information.

Dakota and Alex work as babysitters. For each babysitting job, Dakota charges $10 per hour plus a flat fee of $5 for travel expenses. Alex charges $8 per hour plus an additional fee of $4 per child.

5

Dakota and Alex have different babysitting jobs where each will be babysitting 4 children for the same amount of time. If they charge the same total amount, in dollars, for their respective jobs, how many hours will each spend babysitting?

A) 2.0

B) 3.0

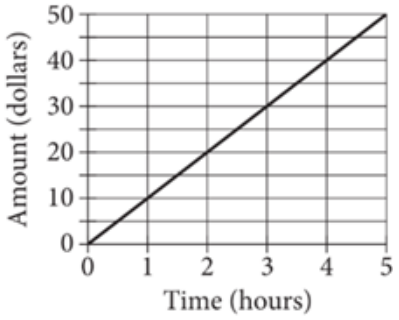
C) 5.5

D) 10.5

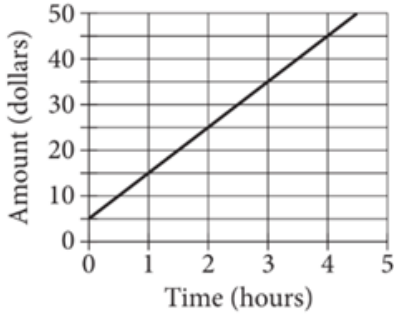
6

Which graph shows the relationship between the time, in hours, that Dakota spends babysitting and the amount, in dollars, Dakota charges for each babysitting job?

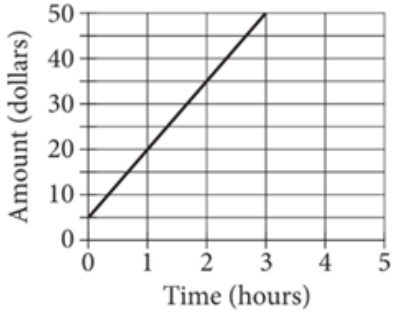
A)



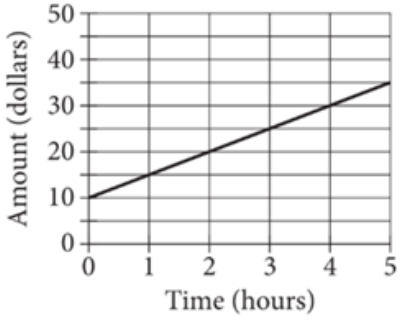
B)



C)



D)



CONTINUE

7

Line l has a slope of -3 and an x-intercept of $(\frac{9}{2}, 0)$. What is the y-intercept of line l?

A) $\left(\frac{9}{2}, 0\right)$

B) $\left(0, \frac{9}{2}\right)$

C) $\left(\frac{27}{2}, 0\right)$

D) $\left(0, \frac{27}{2}\right)$

Questions 8 and 9 refer to the following information.

The table shows the approximate land areas, in thousands of acres, of four national parks in West Virginia.

National park	Area (in thousands of acres)
Bluestone National Scenic River	4.3
Gauley River National Recreation Area	11.6
Harpers Ferry National Historical Park	3.7
New River Gorge National River	72.2

8

What is the range of the land areas, in thousands of acres, of the four parks in the table?

A) 91.8

B) 72.2

C) 68.5

D) 36.1

9

A new data set with three values is formed by removing the data for New River Gorge National River. How does the mean area for the new data set compare to the mean area for the original data set?

A) The mean area for the new data set is larger.

B) The mean area for the new data set is smaller.

C) The mean area for the new data set is the same.

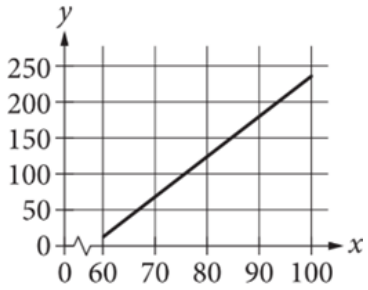
D) There is not enough information to compare the mean areas.

CONTINUE

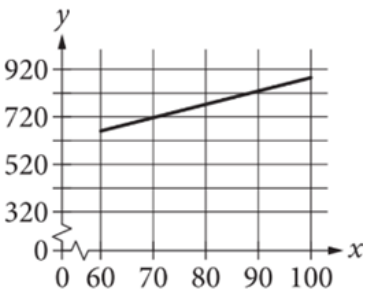
10

The mass y, in grams, of juvenile cobia fish x days after hatching can be modeled by the equation $y = -324 + 5.6x$, where $60 \le x \le 100$. Which graph represents this relationship?

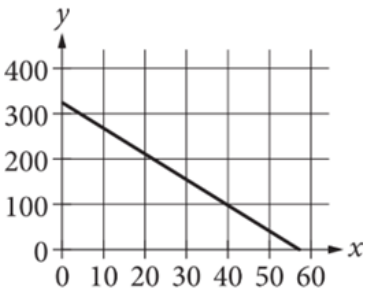
A)



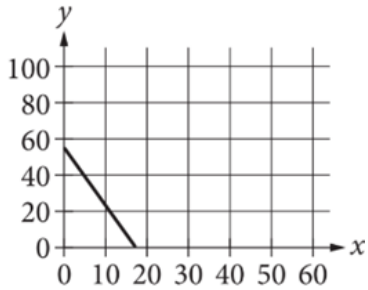
B)



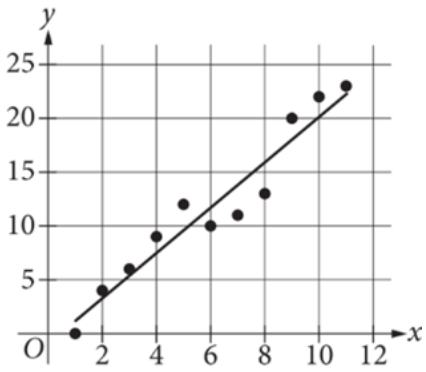
C)



D)



11



The scatterplot shows the relationship between two variables, x and y. A line of best fit is also shown. For how many of the data points does the line of best fit predict a greater y-value than the actual y-value?

A) 11

B) 7

C) 4

D) 1

12

Line k is defined by $y = 2x + 14$. Line j is perpendicular to line k in the xy-plane. What is the slope of line j?

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

B) $\frac{1}{14}$

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

D) 2

CONTINUE

Questions 13 and 14 refer to the following information.

In 2015, a certain country had an adult population of 250 million people, of which 160 million were internet users and 90 million were not internet users. Of the adult population that used the internet, 52.8 million people had accessed two or more social media websites.

13

The adult population of this country in 2015 was 77% of the total population. Which of the following was the approximate total population of this country in 2015?

A) 140 million
B) 190 million
C) 320 million
D) 440 million

14

In 2015, what fraction of the adult internet users in this country had accessed two or more social media websites?

A) $\frac{21}{100}$
B) $\frac{33}{100}$
C) $\frac{53}{100}$
D) $\frac{59}{100}$

15

If $10(x + 9) = 9(x + 9) + 25$, what is the value of $x + 9$?

A) –9
B) 16
C) 25
D) 34

16

A biologist selected a sample of adult female Karner blue butterflies at random from a local population. The mean forewing length of the butterflies in the sample is 1.5 centimeters. The margin of error associated with this estimate for the population mean is 1 centimeter. If the biologist wants an estimate that has a smaller margin of error associated with it and can be generalized to the entire local population, which of the following changes should be made when the study is repeated?

A) Using a different tool to measure the butterflies
B) Measuring the butterflies at two different times of the day and comparing the results
C) Selecting and measuring only the butterflies that look the smallest
D) Selecting and measuring a larger random sample of the butterflies

CONTINUE

17

The ratio of the diameter of a circle to its circumference is 1 to π. If the diameter of the circle is multiplied by 3, how will the circumference of the circle change?

A) It will be multiplied by $\frac{1}{3}$.

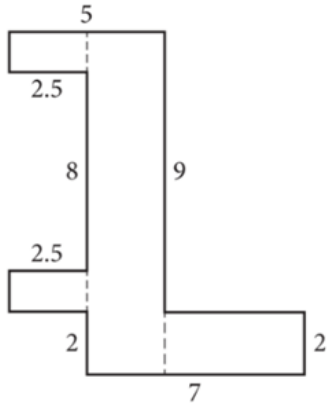
B) It will be multiplied by $\frac{\pi}{3}$.

C) It will be multiplied by 3.

D) It will be multiplied by 3π.

18

In the figure shown, all angles formed by adjacent sides are right angles.



Note: Figure not drawn to scale.

What is the perimeter of the figure?

A) 25

B) 39

C) 42

D) 46

19

The tables show the frequencies of data values for two data sets.

Data Set P

Value	Frequency
0	1
1	1
2	2
3	3
4	6
5	5
6	4
7	3
8	3
9	2

Data Set Q

Value	Frequency
4	1
5	1
6	2
7	3
8	6
9	5
10	4
11	3
12	3
13	2

Which statement best compares the mean a and standard deviation b of data set P with the mean c and standard deviation d of data set Q?

A) $a < c$; $b < d$

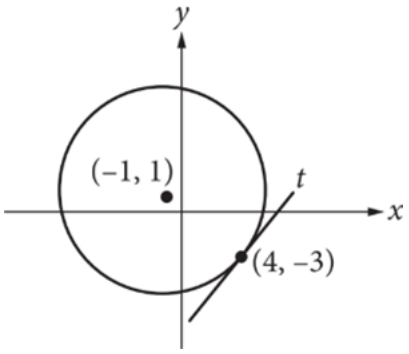
B) $a < c$; $b = d$

C) $a > c$; $b = d$

D) $a > c$; $b > d$

CONTINUE

20



The circle shown has center $(-1,1)$. Line t is tangent to this circle at point $(4,-3)$. Which of the following points also lies on line t?

A) $(0, \frac{5}{4})$

B) (3,6)

C) (8,2)

D) (9,1)

21

$$y = 3x + 6$$
$$y = -3x + 9$$

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

A) 15

B) 7.5

C) 1.5

D) 0.5

22

A researcher estimates that there is a population of 618 gray wolves in the Upper Peninsula of Michigan, which covers an area of approximately 16,452 square miles. Which of the following is closest to the estimated population density, in gray wolves per square mile, in this area?

A) 0.04

B) 3.76

C) 26.62

D) 53.24

CONTINUE

23

In the xy-plane, exactly how many x-intercepts does the graph of $f(x) = x(x - 4)^2(x - 5)^3$ have?

A) 2

B) 3

C) 5

D) 6

24

The effectiveness of a mineral supplement in the soil on the growth of a particular species of plant is being studied. A botanist planted 1,000 seeds in a greenhouse so that the growing conditions for all seeds would be as identical as possible. The seeds were obtained from two 500-seed packages. The seeds from one package were planted in soil that had the supplement added, and the seeds from the second package were planted in soil that did not have the supplement added. How should the experiment be changed to allow the researcher to conclude whether the supplement has an effect on plant growth?

A) One of the packages of seeds should be planted outdoors rather than in a greenhouse.

B) Half of the seeds from each package should be randomly assigned to each soil type.

C) All 1,000 seeds should receive the supplement.

D) No changes to the experiment are needed.

25

Researchers estimated that 0.07%, by mass, of a 12-gram sample of an orchid plant consists of the fatty acid eicosadienoic acid. Based on this estimate, what is the mass of eicosadienoic acid, in grams, in this orchid sample?

A) 0.0084

B) 0.084

C) 0.84

D) 8.4

CONTINUE

26

The population, in millions, of Suzhou, China, can be modeled by the function $p(t) = 1.1(1.066)^t$, where t represents the number of years after 1990, and $0 \le t \le 25$. Which of the following equations best models the population, in millions, of Suzhou, where n represents the number of years after 1995, and $0 \le n \le 25$?

A) $r(n) = 1.1(1.066)^{5n}$

B) $r(n) = 1.1(1.066)^{n-5}$

C) $r(n) = 1.1(1.066)^5(1.066)^n$

D) $r(n) = (1.1)^5(1.066)^5(1.066)^n$

27

$$x^2 + 6x + c = 0$$

In the given equation, c is a constant. The equation has exactly two distinct real solutions. Which statement about the value of c must be true?

A) $c = 6$

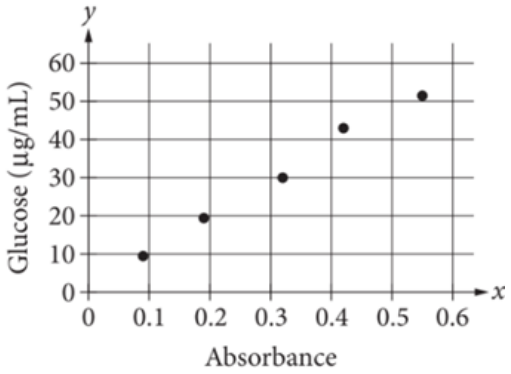
B) $c > 9$

C) $c = 9$

D) $c < 9$

28

A procedure allows a researcher to determine the concentration of glucose y, in micrograms per milliliter (μg/mL), in a soil sample by measuring the absorbance, x, at a specific wavelength of light. The scatterplot shows this relationship for 5 soil samples.



Which equation is the most appropriate linear model for the data?

A) $y = 1.5 + 90x$

B) $y = 1.5 + 10x$

C) $y = 10 + 1.5x$

D) $y = 90 + 1.5x$

CONTINUE

29

A piece of paper is cut two times, resulting in three smaller pieces of paper of the same shape and size. Then, the three smaller pieces are stacked and cut two times to form nine even smaller pieces, each with the same shape and size. This process continues until the pieces of paper are too small to cut. Which of the following functions gives the number of pieces of paper, $F(c)$, that result after c cuts, where c is an even number?

A) $F(c) = 3^{\frac{c}{2}}$

B) $F(c) = 3^{\frac{c}{2}+1}$

C) $F(c) = 3^{2c}$

D) $F(c) = 3^{2c+1}$

30

There are 640 acres in 1 square mile. The area of a forest is increasing at a rate of 1 acre per decade. Which of the following is closest to the rate at which the area of the forest is increasing, in square kilometers per decade? (Use 1 kilometer = 0.62 mile.)

A) 0.0006

B) 0.0010

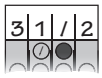
C) 0.0025

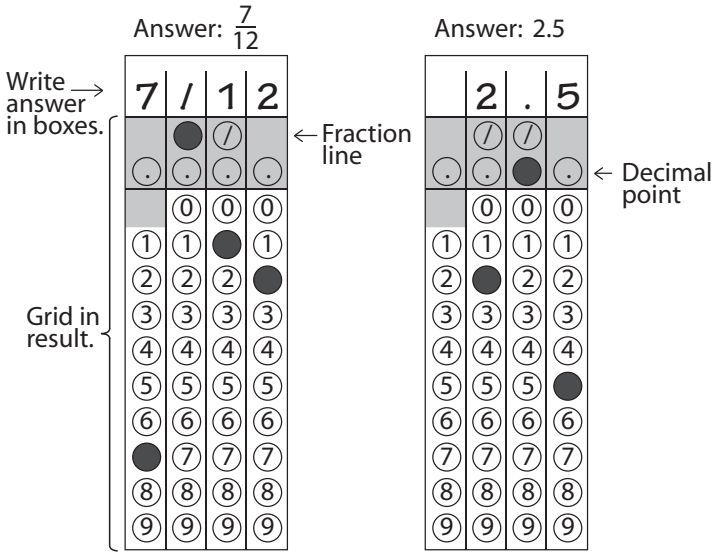
D) 0.0041

CONTINUE

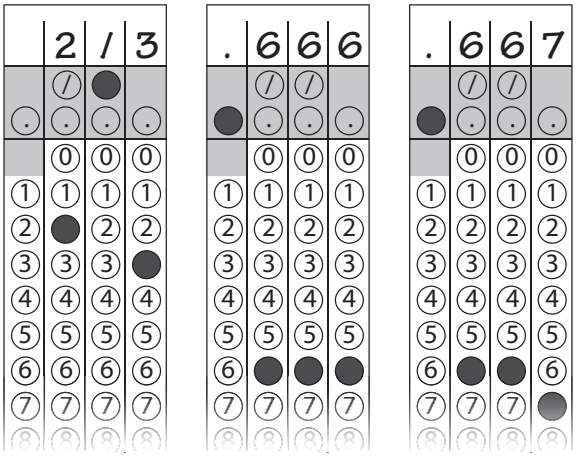
DIRECTIONS

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

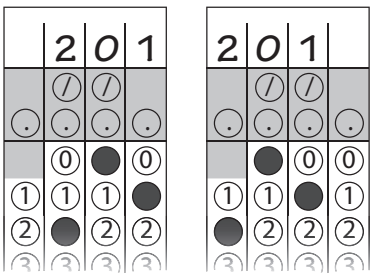
1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.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

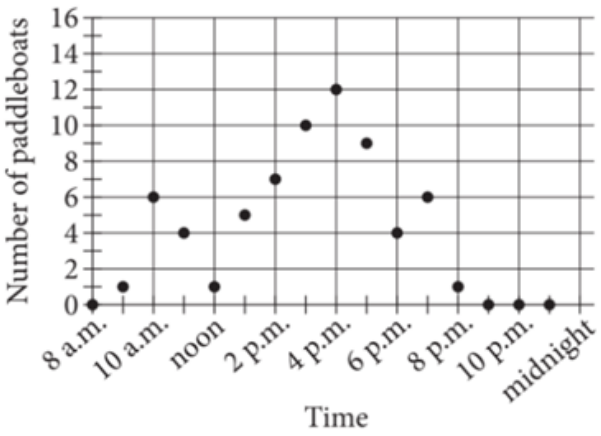


NOTE: You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.

CONTINUE

31

An observer counted the number of paddleboats on a lake each hour beginning at 8 a.m. The scatterplot shows these data.



How many paddleboats were counted on the lake at 2 p.m.?

32

A company spent a total of $9000 on digital and print ads. The ratio of the money spent on digital ads to the money spent on print ads was 1 to 3. How much money, in dollars, did the company spend on digital ads? (Disregard the $ sign when entering your answer. For example, if your answer is $4.97, enter 4.97)

CONTINUE

33

$$x^2 + 2x - 1 = 0$$

A solution to the given equation is $\sqrt{k} - 1$. What is the value of k?

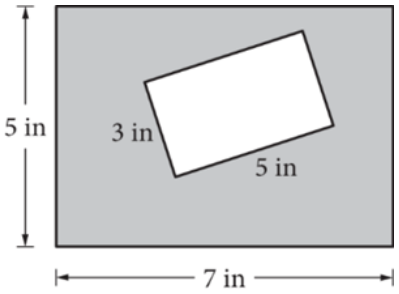
34

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

The function C gives the temperature, in degrees Celsius, that corresponds to a temperature of x degrees Fahrenheit. If a temperature increased by 19.8 degrees Fahrenheit, how much did the temperature increase in degrees Celsius? (Disregard the degree symbol when entering your answer.)

CONTINUE

35



Note: Figure not drawn to scale.

The figure shows two rectangles. If a point within the figure is selected at random, what is the probability that the point is within the shaded region? (Express your answer as a decimal or fraction, not as a percent.)

36

$$-9x + 24qx = 36$$

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

CONTINUE

37

The value of r is $\frac{20}{21}$ times the value of t, where $t > 0$. The value of t is what percent greater than the value of r? (Disregard the % sign when entering your answer. For example, if your answer is 39%, enter 39)

38

Two numbers, a and b, are each greater than zero, and 4 times the square root of a is equal to 9 times the cube root of b. If $a = \frac{2}{3}$, for what value of x is a^x equal to 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.