Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

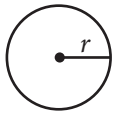
DIRECTIONS

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.

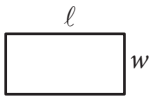
NOTES

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.

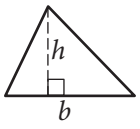
REFERENCE



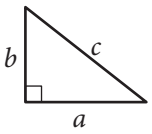
$A = \pi r^2$
$C = 2\pi r$



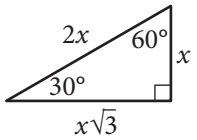
$A = \ell w$

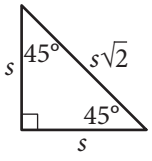


$A = \frac{1}{2}bh$

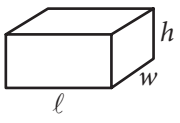


$c^2 = a^2 + b^2$

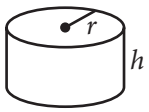




Special Right Triangles

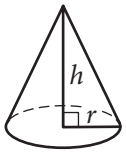


$V = \ell wh$

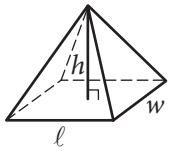


$V = \pi r^2 h$

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



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



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

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

1

One pound of grapes costs $2. At this rate, how many dollars will c pounds of grapes cost?

A) $2c$

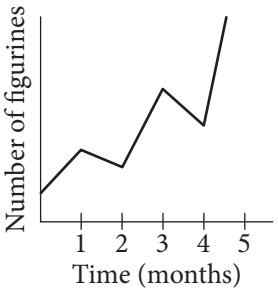
B) $2 + c$

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

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

2

Tracy collects, sells, and trades figurines, and she tracks the number of figurines in her collection on the graph below.



On what interval did the number of figurines decrease the fastest?

A) Between 1 and 2 months

B) Between 2 and 3 months

C) Between 3 and 4 months

D) Between 4 and 5 months

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CONTINUE

3

In a random sample of 200 cars of a particular model, 3 have a manufacturing defect. At this rate, how many of 10,000 cars of the same model will have a manufacturing defect?

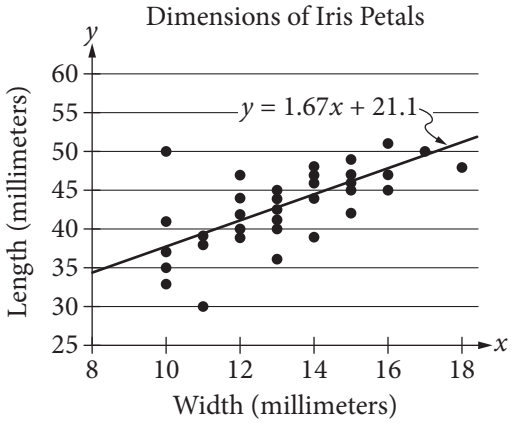
A) 150

B) 200

C) 250

D) 300

4



The scatterplot above shows data collected on the lengths and widths of *Iris setosa* petals. A line of best fit for the data is also shown. Based on the line of best fit, if the width of an *Iris setosa* petal is 19 millimeters, what is the predicted length, in millimeters, of the petal?

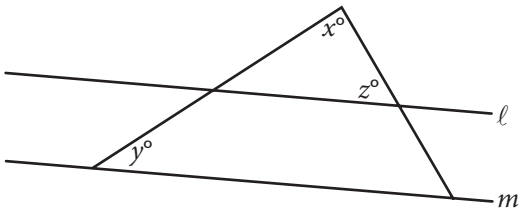
A) 21.10

B) 31.73

C) 52.83

D) 55.27

5



Note: Figure not drawn to scale.

In the figure above, lines ℓ and m are parallel, $y = 20$, and $z = 60$. What is the value of x ?

A) 120

B) 100

C) 90

D) 80

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CONTINUE

6

Two types of tickets were sold for a concert held at an amphitheater. Tickets to sit on a bench during the concert cost $75 each, and tickets to sit on the lawn during the concert cost $40 each. Organizers of the concert announced that 350 tickets had been sold and that $19,250 had been raised through ticket sales alone. Which of the following systems of equations could be used to find the number of tickets for bench seats, B, and the number of tickets for lawn seats, L, that were sold for the concert?

A) $(75B)(40L) = 1{,}950$
$B + L = 350$

B) $40B + 75L = 19{,}250$
$B + L = 350$

C) $75B + 40L = 350$
$B + L = 19{,}250$

D) $75B + 40L = 19{,}250$
$B + L = 350$

7

In the xy-plane, the graph of which of the following equations is a line with a slope of 3 ?

A) $y = \frac{1}{3}x$

B) $y = x - 3$

C) $y = 3x + 2$

D) $y = 6x + 3$

8

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

In the equation above, which of the following is a possible value of $x + 1$?

A) $1 - \sqrt{2}$

B) $\sqrt{2}$

C) 2

D) 4

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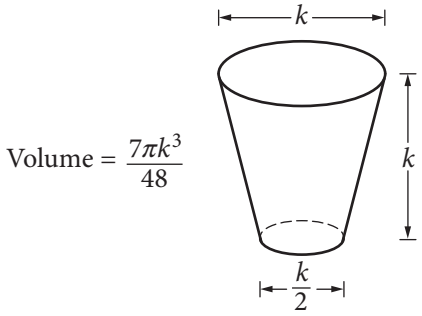
CONTINUE

Questions 9-11 refer to the following information.



The glass pictured above can hold a maximum volume of 473 cubic centimeters, which is approximately 16 fluid ounces.

9

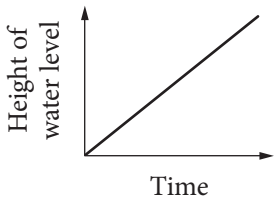
What is the value of k, in centimeters?

A) 2.52
B) 7.67
C) 7.79
D) 10.11

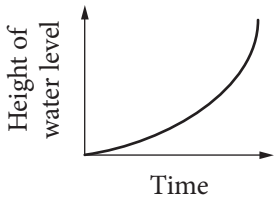
10

Water pours into the glass slowly and at a constant rate. Which of the following graphs best illustrates the height of the water level in the glass as it fills?

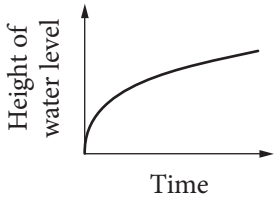
A)



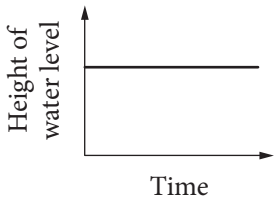
B)



C)



D)



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11

Jenny has a pitcher that contains 1 gallon of water. How many times could Jenny completely fill the glass with 1 gallon of water? (1 gallon = 128 fluid ounces)

A) 16

B) 8

C) 4

D) 3

12

Roberto is an insurance agent who sells two types of policies: a $50,000 policy and a $100,000 policy. Last month, his goal was to sell at least 57 insurance policies. While he did not meet his goal, the total value of the policies he sold was over $3,000,000. Which of the following systems of inequalities describes x, the possible number of $50,000 policies, and y, the possible number of $100,000 policies, that Roberto sold last month?

A) $x + y < 57$
$50{,}000x + 100{,}000y < 3{,}000{,}000$

B) $x + y > 57$
$50{,}000x + 100{,}000y > 3{,}000{,}000$

C) $x + y < 57$
$50{,}000x + 100{,}000y > 3{,}000{,}000$

D) $x + y > 57$
$50{,}000x + 100{,}000y < 3{,}000{,}000$

13

If $a^{-\frac{1}{2}} = x$, where $a > 0$, what is a in terms of x ?

A) $\sqrt{x}$

B) $-\sqrt{x}$

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

D) $-\frac{1}{x^2}$

14

Which of the following is a value of x for which the expression $\frac{-3}{x^2 + 3x - 10}$ is undefined?

A) -3

B) -2

C) 0

D) 2

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CONTINUE

15

A granite block in the shape of a right rectangular prism has dimensions 30 centimeters by 40 centimeters by 50 centimeters. The block has a density of 2.8 grams per cubic centimeter. What is the mass of the block, in grams? (Density is mass per unit volume.)

A) 336

B) 3,360

C) 16,800

D) 168,000

16

Number of Adults Contracting Colds

	Cold	No cold	Total
Vitamin C	21	129	150
Sugar pill	33	117	150
Total	54	246	300

The table shows the results of a research study that investigated the therapeutic value of vitamin C in preventing colds. A random sample of 300 adults received either a vitamin C pill or a sugar pill each day during a 2-week period, and the adults reported whether they contracted a cold during that time period. What proportion of adults who received a sugar pill reported contracting a cold?

A) $\frac{11}{18}$

B) $\frac{11}{50}$

C) $\frac{9}{50}$

D) $\frac{11}{100}$

17

Ages of 20 Students Enrolled in a College Class

Age	Frequency
18	6
19	5
20	4
21	2
22	1
23	1
30	1

The table above shows the distribution of ages of the 20 students enrolled in a college class. Which of the following gives the correct order of the mean, median, and mode of the ages?

A) mode < median < mean

B) mode < mean < median

C) median < mode < mean

D) mean < mode < median

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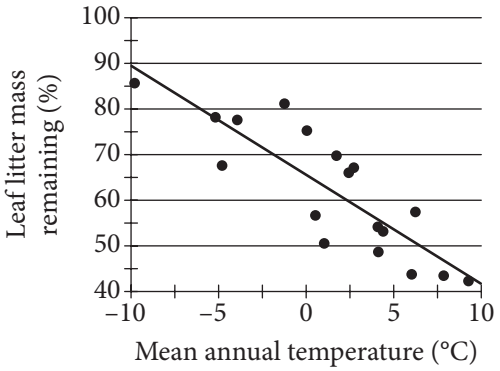
CONTINUE

18

The figure below shows the relationship between the percent of leaf litter mass remaining after decomposing for 3 years and the mean annual temperature, in degrees Celsius (°C), in 18 forests in Canada. A line of best fit is also shown.



A particular forest in Canada, whose data is not included in the figure, had a mean annual temperature of −2°C. Based on the line of best fit, which of the following is closest to the predicted percent of leaf litter mass remaining in this particular forest after decomposing for 3 years?

A) 50%

B) 63%

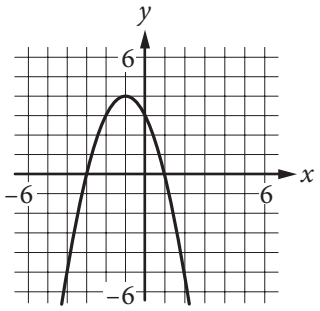
C) 70%

D) 82%

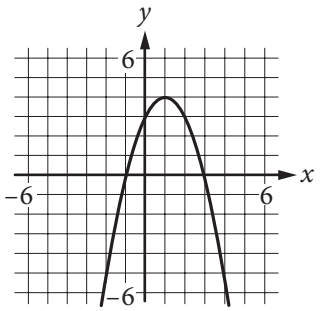
19

The range of the polynomial function f is the set of real numbers less than or equal to 4. If the zeros of f are -3 and 1, which of the following could be the graph of $y = f(x)$ in the xy-plane?

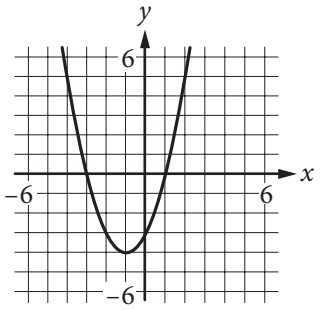
A)



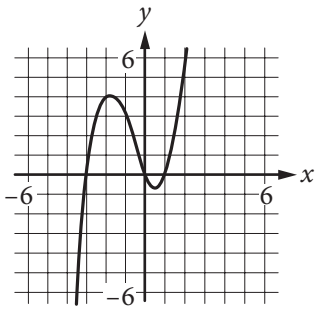
B)



C)



D)



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20

The average annual energy cost for a certain home is $4,334. The homeowner plans to spend $25,000 to install a geothermal heating system. The homeowner estimates that the average annual energy cost will then be $2,712. Which of the following inequalities can be solved to find t, the number of years after installation at which the total amount of energy cost savings will exceed the installation cost?

A) $25{,}000 > (4{,}334 - 2{,}712)\,t$

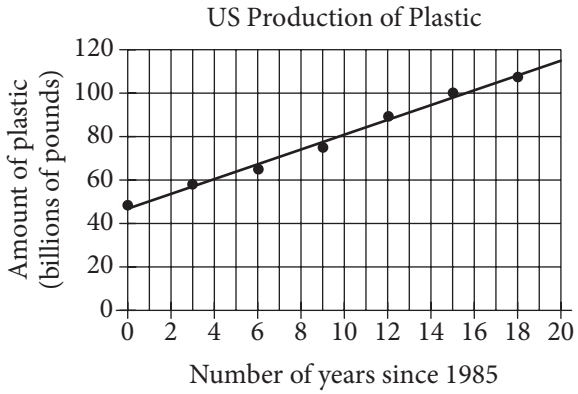
B) $25{,}000 < (4{,}334 - 2{,}712)\,t$

C) $25{,}000 - 4{,}334 > 2{,}712t$

D) $25{,}000 > \dfrac{4{,}332}{2{,}712}\,t$

Questions 21 and 22 refer to the following information.

Between 1985 and 2003, data were collected every three years on the amount of plastic produced annually in the United States, in billions of pounds. The graph below shows the data and a line of best fit. The equation of the line of best fit is $y = 3.39x + 46.89$, where x is the number of years since 1985 and y is the amount of plastic produced annually, in billions of pounds.



21

Which of the following is the best interpretation of the number 3.39 in the context of the problem?

A) The amount of plastic, in billions of pounds, produced in the United States during the year 1985

B) The number of years it took the United States to produce 1 billion pounds of plastic

C) The average annual plastic production, in billions of pounds, in the United States from 1985 to 2003

D) The average annual increase, in billions of pounds, of plastic produced per year in the United States from 1985 to 2003

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CONTINUE

22

Which of the following is closest to the percent increase in the billions of pounds of plastic produced in the United States from 2000 to 2003?

A) 10%

B) 44%

C) 77%

D) 110%

23

$$M = 1{,}800(1.02)^{t}$$

The equation above models the number of members, M, of a gym t years after the gym opens. Of the following, which equation models the number of members of the gym q quarter years after the gym opens?

A) $M = 1{,}800(1.02)^{\frac{q}{4}}$

B) $M = 1{,}800(1.02)^{4q}$

C) $M = 1{,}800(1.005)^{4q}$

D) $M = 1{,}800(1.082)^{q}$

24

For the finale of a TV show, viewers could use either social media or a text message to vote for their favorite of two contestants. The contestant receiving more than 50% of the vote won. An estimated 10% of the viewers voted, and 30% of the votes were cast on social media. Contestant 2 earned 70% of the votes cast using social media and 40% of the votes cast using a text message. Based on this information, which of the following is an accurate conclusion?

A) If all viewers had voted, Contestant 2 would have won.

B) Viewers voting by social media were likely to be younger than viewers voting by text message.

C) If all viewers who voted had voted by social media instead of by text message, Contestant 2 would have won.

D) Viewers voting by social media were more likely to prefer Contestant 2 than were viewers voting by text message.

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CONTINUE

25

Population of Greenleaf, Idaho

Year	Population
2000	862
2010	846

The table above shows the population of Greenleaf, Idaho, for the years 2000 and 2010. If the relationship between population and year is linear, which of the following functions P models the population of Greenleaf t years after 2000?

A) $P(t) = 862 - 1.6t$

B) $P(t) = 862 - 16t$

C) $P(t) = 862 + 16(t - 2{,}000)$

D) $P(t) = 862 - 1.6(t - 2{,}000)$

26

To determine the mean number of children per household in a community, Tabitha surveyed 20 families at a playground. For the 20 families surveyed, the mean number of children per household was 2.4. Which of the following statements must be true?

A) The mean number of children per household in the community is 2.4.

B) A determination about the mean number of children per household in the community should not be made because the sample size is too small.

C) The sampling method is flawed and may produce a biased estimate of the mean number of children per household in the community.

D) The sampling method is not flawed and is likely to produce an unbiased estimate of the mean number of children per household in the community.

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CONTINUE

27

In the xy-plane, the point (p, r) lies on the line with equation $y = x + b$, where b is a constant. The point with coordinates $(2p, 5r)$ lies on the line with equation $y = 2x + b$. If $p \neq 0$, what is the value of $\frac{r}{p}$?

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

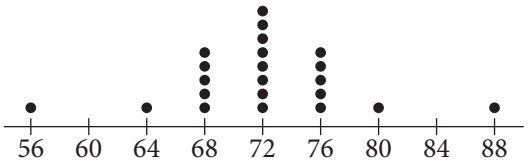
B) $\frac{3}{4}$

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

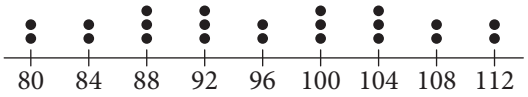
D) $\frac{5}{2}$

28

The 22 students in a health class conducted an experiment in which they each recorded their pulse rates, in beats per minute, before and after completing a light exercise routine. The dot plots below display the results.



Beats per minute before exercise



Beats per minute after exercise

Let s_1 and r_1 be the standard deviation and range, respectively, of the data before exercise, and let s_2 and r_2 be the standard deviation and range, respectively, of the data after exercise. Which of the following is true?

A) $s_1 = s_2$ and $r_1 = r_2$

B) $s_1 < s_2$ and $r_1 < r_2$

C) $s_1 > s_2$ and $r_1 > r_2$

D) $s_1 \neq s_2$ and $r_1 = r_2$

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CONTINUE

29

A photocopy machine is initially loaded with 5,000 sheets of paper. The machine starts a large job and copies at a constant rate. After 20 minutes, it has used 30% of the paper. Which of the following equations models the number of sheets of paper, p, remaining in the machine m minutes after the machine started printing?

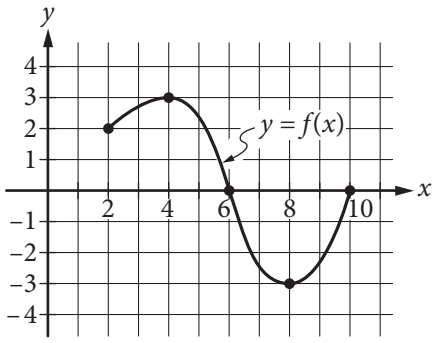
A) $p = 5{,}000 - 20m$

B) $p = 5{,}000 - 75m$

C) $p = 5{,}000(0.3)^{\frac{m}{20}}$

D) $p = 5{,}000(0.7)^{\frac{m}{20}}$

30



x	$g(x)$
−2	1
−1	2
0	3
1	4
2	5
3	6
4	7

The complete graph of the function f and a table of values for the function g are shown above. The maximum value of f is k. What is the value of $g(k)$?

A) 7

B) 6

C) 3

D) 0

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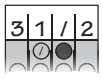
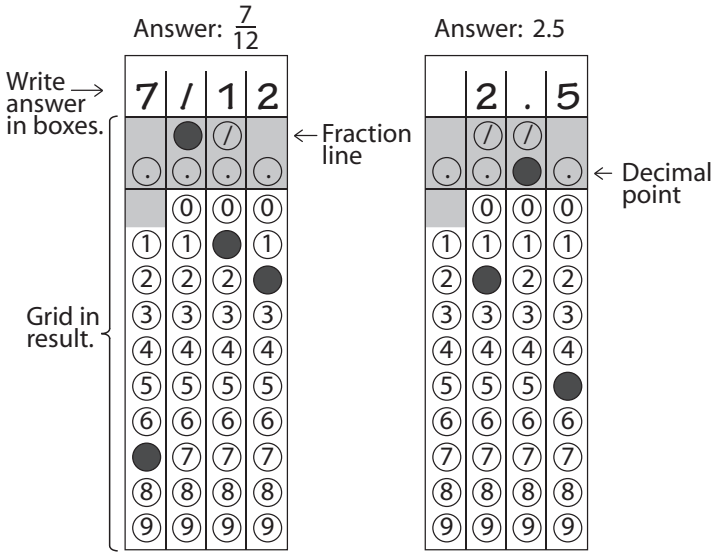
CONTINUE

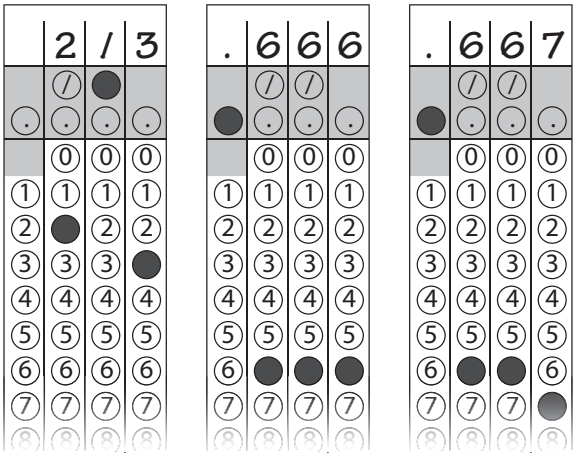
DIRECTIONS

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

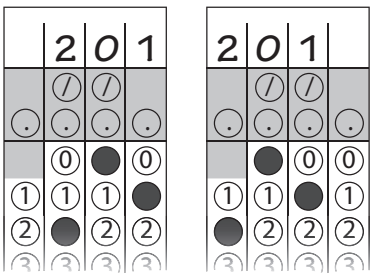
1. Although not required, it is suggested that you write your answer in the boxes at the top of the columns to help you fill in the circles accurately. You will receive credit only if the circles are filled in correctly.
2. Mark no more than one circle in any column.
3. No question has a negative answer.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

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CONTINUE

31

There are two atoms of hydrogen and one atom of oxygen in one molecule of water. How many atoms of hydrogen are there in 51 molecules of water?

32

$$x - \frac{1}{2}a = 0$$

If $x = 1$ in the equation above, what is the value of a ?

33

In the xy-plane, the equations $x + 2y = 10$ and $3x + 6y = c$ represent the same line for some constant c. What is the value of c ?

34

On April 18, 1775, Paul Revere set off on his midnight ride from Charlestown to Lexington. If he had ridden straight to Lexington without stopping, he would have traveled 11 miles in 26 minutes. In such a ride, what would the average speed of his horse have been, to the nearest tenth of a mile per hour?

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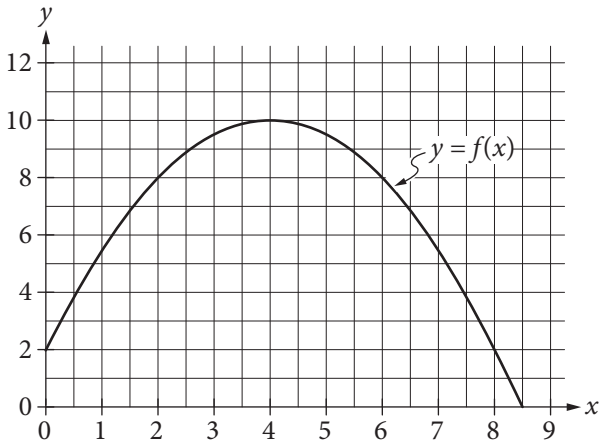
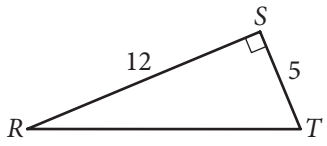
CONTINUE

35



The graph of the function f, defined by $f(x) = -\frac{1}{2}(x-4)^2 + 10$, is shown in the xy-plane above. If the function g (not shown) is defined by $g(x) = -x + 10$, what is one possible value of a such that $f(a) = g(a)$?

36



In triangle RST above, point W (not shown) lies on $\overline{RT}$. What is the value of $\cos(\angle RSW) - \sin(\angle WST)$?

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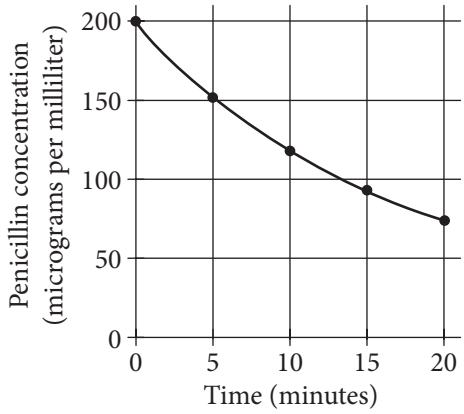
CONTINUE

Questions 37 and 38 refer to the following information.

Minutes after injection	Penicillin concentration (micrograms per milliliter)
0	200
5	152
10	118
15	93
20	74



When a patient receives a penicillin injection, the kidneys begin removing the penicillin from the body. The table and graph above show the penicillin concentration in a patient's bloodstream at 5-minute intervals for the 20 minutes immediately following a one-time penicillin injection.

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CONTINUE

37

According to the table, how many more micrograms of penicillin are present in 10 milliliters of blood drawn from the patient 5 minutes after the injection than are present in 8 milliliters of blood drawn 10 minutes after the injection?

38

The penicillin concentration, in micrograms per milliliter, in the patient's bloodstream t minutes after the penicillin injection is modeled by the function P defined by $P(t) = 200b^{\frac{t}{5}}$. If P approximates the values in the table to within 10 micrograms per milliliter, what is the value of b, rounded to the nearest tenth?

STOP

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

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No Test Material On This Page