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SAT® November 2016

IMPORTANT REMINDERS:

1

A No. 2 pencil is required for the test. Do not use a mechanical pencil or pen.

2

Sharing any questions with anyone is a violation of the SAT® Program's Test Security and Fairness policies and may result in your scores being canceled.

3

Requests to cancel scores must be received in writing by the Wednesday following the test date.

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.

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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.
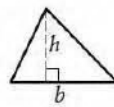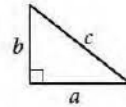
REFERENCE
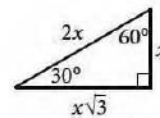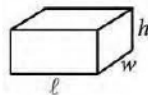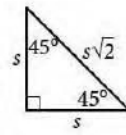

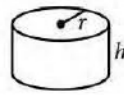$A = \pi r^2$
$C = 2\pi r$

$A = \ell w$

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

$c^2 = a^2 + b^2$
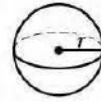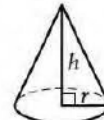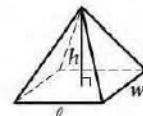
Special Right Triangles

$V = \ell w h$
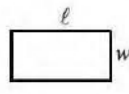
$V = \pi r^2 h$

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

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

$V = \frac{1}{3}\ell w h$

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.

1

A snack stand sells bags of popcorn for $1 each and bags of peanuts for $2 each. If no more than $30 worth of bags of popcorn and bags of peanuts were sold one evening, and at least 8 of the bags sold were popcorn, what is the maximum number of bags of peanuts that could have been sold that evening?

A) 7

B) 11

C) 14

D) 16

2

$$d = 35w + 250$$

The number of dollars, d, in Vonn's holiday savings account w weeks after he opened the account is modeled by the equation above. Which of the following best describes the meaning of the number 250 in the equation?

A) The number of dollars Vonn deposited into the account each week

B) The number of dollars Vonn initially deposited into the account

C) The total number of dollars in the account after w weeks

D) The number of weeks since the account was opened

3

If $\dfrac{3}{4}x + 1 = k + \dfrac{1}{4}x$, what is the value of k when $x = 0$?

A) -2

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

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

D) 1

4

Which of the following is equivalent to $a^{\frac{8}{7}}$?

A) $\sqrt[8]{a^7}$

B) $\sqrt[7]{a^8}$

C) $a\sqrt[8]{a}$

D) $a^2\sqrt[7]{a^4}$

5

Which of the following is equivalent to the expression $4(x+1)^2 - 3(x+1)^2$?

A) 1

B) $x + 1$

C) $x^2 + 2x + 1$

D) $x^2 + 2x + 7$

6

At a Mexican restaurant, tacos cost $3 and burritos cost $6. If a group of students spends at least $30 but at most $45 on 5 tacos and n burritos, which of the following is true about n ?

A) $33 \le n \le 45$

B) $18 \le n \le 30$

C) $12 \le n \le 15$

D) $3 \le n \le 5$

7

A home-improvement store sells indoor paint for $20 a can and outdoor paint for $30 a can. A customer spends $260 on cans of indoor and outdoor paint. If the customer buys 2 fewer cans of indoor paint than cans of outdoor paint, how many cans of indoor paint did the customer buy?

A) 4

B) 5

C) 6

D) 7

8

If $4(h - 1) = 3(t + 2)$, what is h in terms of t ?

A) $h = \dfrac{3t + 3}{4}$

B) $h = \dfrac{3t + 6}{4}$

C) $h = \dfrac{3t + 10}{4}$

D) $h = \dfrac{4t + 11}{3}$

9
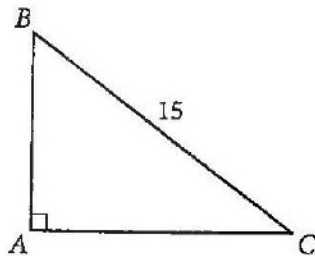
In right triangle ABC above, the tangent of $\angle C$ is $\dfrac{3}{4}$.

What is the length of $\overline{AB}$?

A) 9

B) $\dfrac{105}{16}$

C) $\dfrac{45}{4}$

D) 12

10

$$\frac{5}{x} + 3 = \frac{4}{x-1}$$

What are the two solutions to the equation above?

A) 1 and $\dfrac{3}{5}$

B) 1 and $\dfrac{5}{3}$

C) -1 and $\dfrac{3}{5}$

D) -1 and $\dfrac{5}{3}$

11

If $9x^2y^2 = 25$ and $xy > 0$, what is the value of $18xy$?

A) 6

B) 30

C) 50

D) 150

12

Emmary makes and sells ceramics. It costs her $12 to make a ceramic piece. If she sells each piece for $33, which of the following equations gives the amount of profit p, in dollars, Emmary will receive for selling n pieces? (profit = revenue – expenses)

A) $p = 21n$

B) $p = 33n$

C) $p = 33n - 12$

D) $p = 33n + 12$

13

$$x^2 + y^2 = 104$$
$$y - 5x = 0$$

If the ordered pair (x, y) is a solution to the system of equations above, and $x < 0$, what is the value of y ?

A) -20

B) -10

C) -5

D) -2

14

$$f(x) = (x - 3)(x^2 - 4x + 3)$$

How many <u>distinct</u> zeros does the function f, defined above, have?

A) None

B) One

C) Two

D) Three

15

The function f is defined by $f(x) = (x + 2)^2$.
If $f(x + a) = x^2 - 6x + 9$, where a is a constant, what is the value of a ?

A) -5

B) -3

C) 1

D) 3

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 $3\ 1\ /\ 2$ 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.

Answer: $\frac{7}{12}$

Write answer in boxes. ← Fraction line

Answer: 2.5

← Decimal point

Grid in result.

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.

16

A bamboo plant has a height of 11 feet and grows at a constant rate of 2 feet per day. At this rate, how many days from now will the height of the bamboo plant be 27 feet?

17
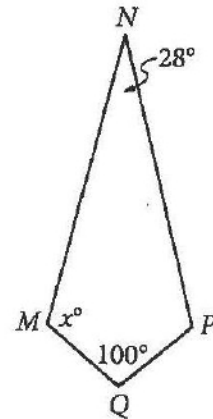
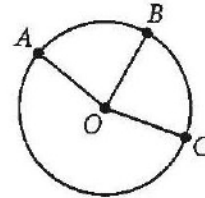In the figure above, $MN = NP$ and $MQ = QP$. What is the value of x ?

18

If x is positive and $x + (x+1) + (x+2) = x^2 - 1$, what is the value of x ?

19

$$2x + 3y = 26$$
$$x + 3y = 19$$

If (x, y) satisfies the system of equations above, what is the value of x ?

20

In the circle above, radius $\overline{OB}$ has length 1. The measure of $\angle AOB$ is equal to the measure of $\angle BOC$, and the length of arc $\overarc{ABC}$ is $\dfrac{8\pi}{9}$. What is the measure, in degrees, of $\angle AOB$? (Disregard the degree symbol when gridding your answer.)

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.
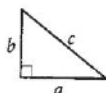
REFERENCE

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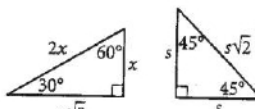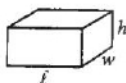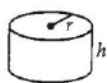
$A = \ell w$

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

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

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.

1

On Tuesday, Dianna's store sold 5 pairs of running shoes for every 9 pairs of sandals sold. If Dianna's store sold 27 pairs of sandals on Tuesday, how many pairs of running shoes did Dianna's store sell on that day?

A) 10

B) 15

C) 20

D) 25

2

A bag containing 12 marbles includes 3 red marbles, 6 blue marbles, and 3 white marbles. What percent of the marbles in the bag are blue?

A) 6%

B) 25%

C) 50%

D) 75%

3

If 3 times k is equal to 15, what is 4 more than k ?

A) 7

B) 9

C) 19

D) 49

4

If $12ax - 6 = 36$, what is the value of $ax - \frac{1}{2}$?

A) 3

B) 6

C) 12

D) 24

5

Type of particle	Size range
Clay	less than 0.002 mm
Silt	0.002 mm up to 0.061 mm
Sand (fine)	0.061 mm up to 0.124 mm
Sand (medium)	0.124 mm up to 0.49 mm
Sand (coarse)	0.49 mm up to 2.00 mm

The table above shows the size of several types of particles found in soil. In which of the following inequalities does p represent the size range, in millimeters (mm), of the three types of sand particles listed in the table?

A) $0.061 \le p < 2.00$

B) $0.002 \le p < 0.49$

C) $p < 0.061$

D) $p < 2.00$

6

Temperature Inside Alicia's Home
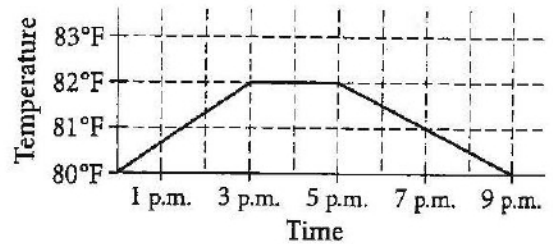
The graph above represents the temperature inside Alicia's home on a certain day. From 5 p.m. to 9 p.m., how many degrees Fahrenheit (°F), did the temperature decrease each hour?

A) 2

B) 1

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

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

7

If $a = 2(x+1)^2$ and $b = (x+1)$, which of the following is equivalent to ab ?

A) $2(x+1)^3$

B) $2(x+1)^2$

C) $2(x+2)^3$

D) $2(x+2)^2$

8

Majors	Career				
	Law	Medicine	Teaching	Other	Total
English	23	5	32	30	90
Biology	2	78	20	10	110
Political Science	54	1	9	16	80
Economics	13	10	17	80	120
Total	92	94	78	136	400

The table above shows the number of students who were enrolled in one of four majors when they were in college and the careers that each student chose directly after college. Based on the table, what proportion of students who majored in political science did <u>not</u> have a career in law, medicine, or teaching directly after college?

A) 0.04

B) 0.12

C) 0.16

D) 0.20

9

It is often possible to donate money to a charity by mail or by cell phone. The amounts of 5 mail donations and 5 cell phone donations are given in the table below. What is the positive difference, in dollars, in the mean donation amount for mail donations and for cell phone donations?

Donation Amounts in Dollars

Donation method	Amount (in dollars)				
Mail	10	50	25	5	10
Cell phone	5	10	10	20	5

A) 0

B) 10

C) 25

D) 50

10

A bucket contains 5 gallons of water. The water in the bucket weighs 42 pounds. One gallon of diluted bleach is mixed with the water, and then the total weight of the liquid in the bucket is 50.52 pounds. What is the weight per gallon of the liquid in the bucket after the diluted bleach is added?

A) 0.10 pounds/gallon

B) 0.12 pounds/gallon

C) 8.42 pounds/gallon

D) 8.50 pounds/gallon

11

Researchers in Australia carried out an experiment to determine if the color of a coffee mug affects how people rate the flavor intensity of the coffee. Volunteers were randomly assigned to taste coffee in mugs that differed only by color: some white and some clear. The same type of coffee was used in both mugs. The researchers concluded that the mean flavor intensity rating was significantly higher for those who drank coffee in a white mug than for those who drank coffee in a clear mug. Based on this study, which of the following statements is correct?

A) The color of the mug was the cause of the difference in mean intensity rating for these volunteers, and this conclusion can be generalized to all coffee drinkers.

B) The color of the mug was the cause of the difference in mean intensity rating for these volunteers, but it is not reasonable to generalize this conclusion to all coffee drinkers.

C) It is not reasonable to conclude that the color of the mug was the cause of the difference in mean intensity rating for these volunteers.

D) It is not possible to draw any conclusions from this experiment because volunteers were used.

12

The average net primary production in tropical rain forests each year is 8,900 kilocalories per square meter. If the total net primary production of a selected portion of a tropical rain forest in a given year is 1.8×10^8 kilocalories, what is the approximate total area, in square meters, of the selected portion?

A) 4.9×10^3

B) 1.6×10^4
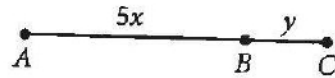
C) 2.0×10^4

D) 1.6×10^{12}

13

$$a^2 + 6a + 9 = 16$$

Based on the equation above, which of the following could be the value of $a + 3$?

A) 8

B) 4

C) 2

D) 1

14

Note: Figure not drawn to scale.

In the figure above, $AC = 42$. If $y = 2x$, what is the length of line segment BC ?
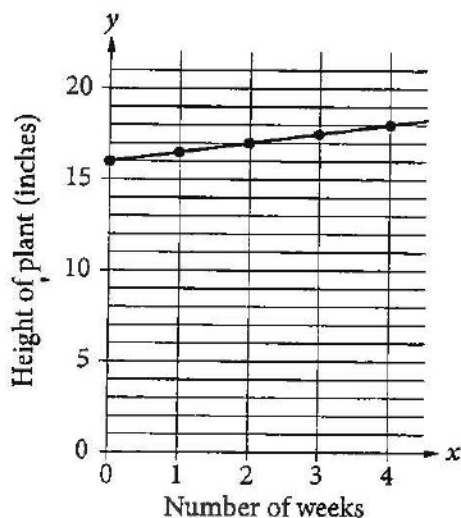
A) 6

B) 7

C) 12

D) 14

15

If a and b are positive integers, which of the following is NOT equivalent to $\frac{-a}{-b}$?

A) $\frac{a}{b}$

B) $\frac{-(-a)}{b}$

C) $\frac{1}{\frac{-b}{-a}}$

D) $\frac{-(-a)}{-b}$

16

Milagros recorded the height of a plant, in inches, each week as it grew. The results are graphed below, and the line of best fit is also shown.

What is the meaning of the y-intercept of the graph?

A) The plant measured 16 inches one week after Milagros started measuring its height.

B) The plant grew 16 inches each week after Milagros started measuring its height.

C) The plant increased in height $\frac{1}{2}$ inch each week.

D) The plant measured 16 inches when Milagros started measuring its height.

17

Distribution of 250 History Books

Book type	US	British
Paperbacks	40	45
Hardcovers	90	75

A historian has a collection of 250 books about US and British history. The distribution of the books is shown in the table above. If a hardcover book is to be selected at random, what is the probability that the book will be a US history book?

A) $\frac{6}{11}$

B) $\frac{13}{25}$

C) $\frac{4}{9}$

D) $\frac{9}{25}$

18

Pilar is a salesperson at a car dealership. Each car at the dealership costs at least $15,000. For each car Pilar sells, she receives a commission of 6% of the amount by which the selling price exceeds $10,000. If Pilar sells a car at a price of d dollars, which of the following functions gives her commission $C(d)$, in dollars, on the sale?

A) $C(d) = 0.06(d - 10,000)$

B) $C(d) = 0.06(d - 15,000)$

C) $C(d) = 0.06(10,000 - d)$

D) $C(d) = 0.06(15,000 - d)$

19

The point $(5, -3)$ lies on both line j and line k in the xy-plane. The equations of lines j and k are $y = cx + 2$ and $y = 3x + b$, respectively. What is the value of $c + b$?

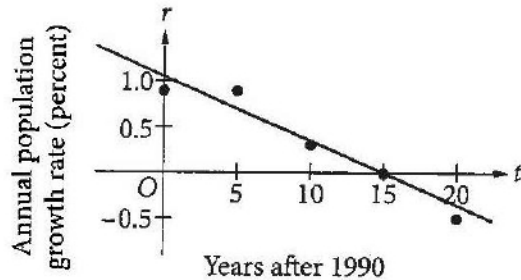A) -19

B) -17

C) 2

D) 17

20

Employee Absences

Number of days	Number of employees
0	8
1	4
2	3
4	4
5	5
13	1

The frequency table above shows the distribution of the number of days each of the 25 employees of a company was absent last month. What is the median number of days absent for the 25 employees last month?

A) 1

B) 2

C) 4

D) 5

Questions 21-23 refer to the following information.

Years after 1990

The graph above shows the percent of annual population growth rate, r, in a certain country for the number of years after 1990, t, at 5-year intervals. A linear model fitting the plotted points is also shown. The equation for the linear model is $r = -0.07t + 1.06$.

21

Which of the following statements is the best interpretation of the coefficient of t in the model?

A) The predicted annual population growth rate of the country increases by 1 every 0.07 years.

B) The predicted annual population growth rate of the country decreases by 0.07 every five years.

C) The predicted annual population growth rate of the country decreases by 0.07 every year.

D) The predicted annual population growth rate of the country increases by 0.07 every year.

22

Based on the model, which of the following is closest to the year in which the predicted annual population growth rate of the country is –1% ?

A) 2010

B) 2015

C) 2020

D) 2025

23

The actual annual population growth rate in the country in 1995 was 0.9%. For the year 1995, what is the actual annual population growth rate minus the annual population growth rate predicted by the model?

A) –0.07%

B) 0.19%

C) 0.67%

D) 1.06%

24

Which of the following examples would exhibit linear growth over time?

A) The height of a plant that doubles in height every two months

B) The value of a home that is increasing in value by 5% every year

C) The number of books read by someone who reads 3 books every month

D) The number of birds in an area where the population of birds is decreasing by 30% every year

25

A book publishing company pays the author of a certain book $2.50 per book for the first 500 books sold. After the first 500 books are sold, the payment increases to $3.25 per book sold. Which of the following functions gives the author's total payment $P(b)$, in dollars, in terms of the number of books sold, b, where $b > 500$?

A) $P(b) = 2.50(500) + 3.25b$

B) $P(b) = 2.50b + 3.25b$

C) $P(b) = 2.50b + 3.25(b - 500)$

D) $P(b) = 2.50(500) + 3.25(b - 500)$

26
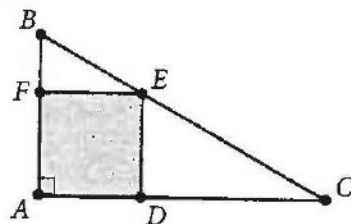
Note: Figure not drawn to scale.

In the figure above, ABC is a right triangle and $AC = \dfrac{3}{2} AB$. If the quadrilateral $AFED$ is a square, the area of the shaded region is what fraction of the area of triangle ABC ?

A) $\dfrac{3}{4}$

B) $\dfrac{2}{3}$

C) $\dfrac{13}{20}$

D) $\dfrac{12}{25}$

27

$$(x-3)^2 + (y-5)^2 = 18$$

The graph of the equation above is a circle in the xy-plane. What is the area of the circle?

A) 6π

B) 9π

C) 12π

D) 18π

28

Which of the following is equivalent to $\dfrac{3x^2 + 7x - 6}{9 - x^2}$

for $x \neq -3$ and $x \neq 3$?

A) $-3 + \dfrac{7}{3 - x}$

B) $3 - \dfrac{7}{3 - x}$

C) $-3 + \dfrac{7}{3 + x}$

D) $3 - \dfrac{7}{3 + x}$

Questions 29 and 30 refer to the following information.

$$S = 2Cr$$

The formula above can be used to approximate the surface area S of a planet using its average radius r and average circumference C.

29

The surface area of Neptune is approximately 2.94×10^9 square miles. Of the following, which best approximates the average radius, in miles, of Neptune?

A) 2,643
B) 15,300
C) 96,120
D) 192,200

30

The volume V of a planet can be expressed in terms of its surface area S and its average radius r by the formula $V = \dfrac{1}{3} Sr$. Which of the following expresses the planet's average circumference, C, in terms of its volume and its average radius?

A) $C = \dfrac{2r^2}{3V}$

B) $C = \dfrac{3r^2}{2V}$

C) $C = \dfrac{2V}{3r^2}$

D) $C = \dfrac{3V}{2r^2}$

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 $\boxed{3\,|\,1\,/\,2}$ 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.

Answer: $\frac{7}{12}$ Answer: 2.5

Write answer in boxes. →   ← Fraction line   ← Decimal point

Grid in result.

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.

31

Lab Experiment
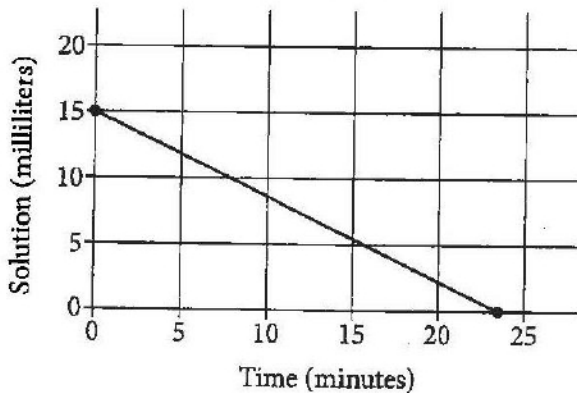
The graph above gives the number of milliliters of solution in a beaker from the start to the end of an experiment. According to the graph, how many milliliters of solution were in the beaker at the start of the experiment?

32

Kim purchased a shirt that cost $23.00 before a 6% sales tax was added. How much sales tax, in dollars, did Kim pay for this shirt? (Disregard the $ sign when gridding your answer. For example, if your answer is $4.97, grid 4.97)
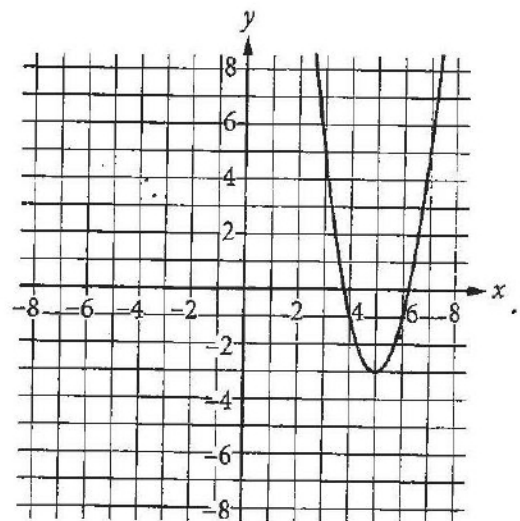
33

$$3r - 4s = 8$$
$$\frac{1}{2}r - s = 2$$

What is the value of r in the system of linear equations above?

34

The function f is defined by $f(x) = 2x^2 - 8x + 5$. The graph of $y = f(x - h)$ is shown in the xy-plane below.

What is the value of h ?

35

A can in the shape of a right circular cylinder has a height of 4 inches and is $\frac{1}{2}$ full of water. If the amount of water in the can is 32π cubic inches, what is the diameter, in inches, of the can?

36

At a theater, adult tickets for a play cost $15 each and child tickets cost $10 each. If 300 tickets were sold, and the sale of the tickets generated between $3575 and $3600, inclusive, what is a possible number of child tickets that were sold?

Questions 37 and 38 refer to the following information.

In a typical elk herd in Yellowstone National Park, the ratio of males to females is 14 to 46.

37

A biologist spots a herd of 150 elk in the park. The biologist uses the ratio of males to females in a typical herd to estimate the number of males in this herd. How many males would the biologist expect to be in this herd?

38

If p percent of a typical herd of elk is female, what is the value of p, rounded to the nearest whole number?

STOP

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