



Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

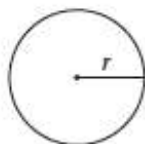
DIRECTIONS

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

- The use of a calculator is NOT permitted.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated, the domain of a given function f is the set of all real numbers for which $f(x)$ is a real number.

REFERENCE

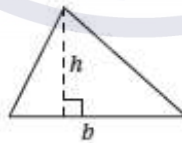


$$A = \pi r^2$$

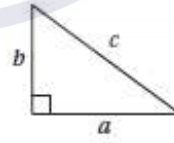
$$C = 2\pi r$$



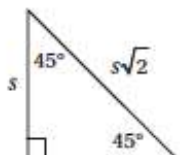
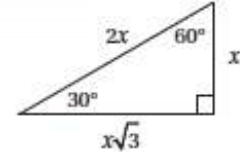
$$A = lw$$



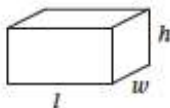
$$A = \frac{1}{2}bh$$



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



Special Right Triangles



$$V = lwh$$



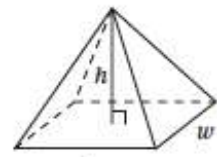
$$V = \pi r^2 h$$



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



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



$$V = \frac{1}{3}lwh$$

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

If $2x - 3y = 9$ and $y = 3$, then what is the value of x ?

- A) 0
- B) 3
- C) 6
- D) 9

2

$$x - y = -4$$

$$x - 2y = -6$$

Which of the following ordered pairs (x, y) satisfies the system of equations above?

- A) $(-2, 2)$
- B) $(-2, 4)$
- C) $(4, 8)$
- D) $(4, -8)$

3

An information technology company estimates the cost of a project, in dollars, using the expression $240 + 3nt$, where n is the number of computer servers working on the project and t is the total time, in hours, the project will take using n servers. Which of the following is the best interpretation of the number 3 in the expression?

- A) Each server costs the company \$3 per hour to run.
- B) A minimum of 3 servers will work on the project.
- C) The price of the project increases by \$3 every hour.
- D) Each server can work 3 hours per day.

4

If $\frac{5}{8}x = -\frac{1}{16}$, what is the value of x ?

- A) $-\frac{11}{16}$
- B) $-\frac{1}{10}$
- C) $-\frac{5}{128}$
- D) $\frac{9}{16}$

5

$$a^4 - 6a^2 + 10$$

Which of the following is equivalent to the expression shown above?

- A) $(a^2 - 2)(a^2 - 5)$
- B) $(a^2 - 1)(a^2 - 10)$
- C) $(a^2 + 3)^2 + 1$
- D) $(a^2 - 3)^2 + 1$

6

In triangle ABC , angle C has a measure of 90° . If $\sin A = 0.6$, what is the value of $\cos B$?

- A) 0.3
- B) 0.4
- C) 0.6
- D) 0.8



7

$$\sqrt{m^2 - 13} - x = 0$$

If $m < 0$ and $x = 6$ in the equation above, what is the value of m ?

- A) -13
- B) -10
- C) -7
- D) -3

8

If $\frac{x^b}{x^a} = 16$ and $x^{-2} = \frac{1}{16}$, what is the value of $b - a$?

- A) -2
- B) 2
- C) 4
- D) 8

9

b	2	4	6	8
$f(b)$	1	25	65	121

The table above shows ordered pairs that satisfy the function f . Which of the following could define f ?

- A) $f(b) = 3b^2 - 2$
- B) $f(b) = 3b^2 - 4$
- C) $f(b) = 2b^2 - 7$
- D) $f(b) = 2b^2$

10

The equation $y = kx - 1$, where k is a constant, describes a line in the xy -plane. If the graph of this line contains the point (a, b) , where a and b are nonzero, what is the value of k in terms of a and b ?

- A) $\frac{b+1}{a}$
- B) $\frac{b-1}{a}$
- C) $\frac{a}{b+1}$
- D) $\frac{a}{b-1}$

11

The equation $\frac{12x^2 + 6x - 23}{bx - 3} = -2x - \frac{23}{bx - 3}$

is true for all values of $x \neq \frac{3}{b}$, where b is a constant.

What is the value of b ?

- A) -12
- B) -6
- C) 4
- D) 6

12

If h and k are functions such that $h(x) = x + 3$ and $h(g(2)) = 9$, which of the following could describe $g(x)$?

- A) $x^2 + 2$
- B) $x^2 + 3$
- C) $x^2 + 4$
- D) $x^2 + 5$



13

$$y = a(x + 3)(x - 1)$$

In the quadratic function above, a is a nonzero constant. The graph of the equation in the xy -plane is a parabola with vertex (m, n) . Which of the following is equal to n ?

- A) 0
- B) $-a$
- C) $-2a$
- D) $-4a$

14

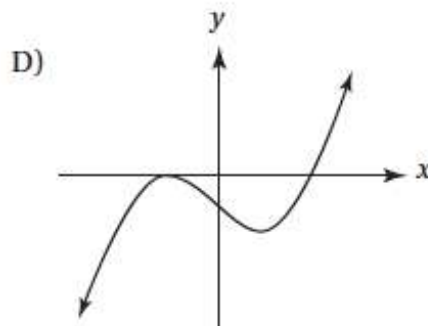
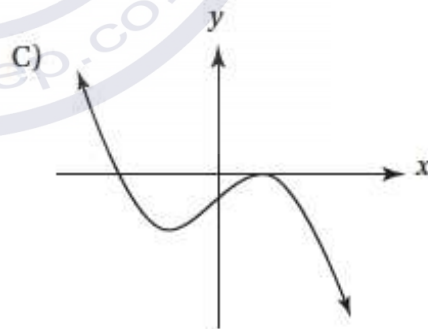
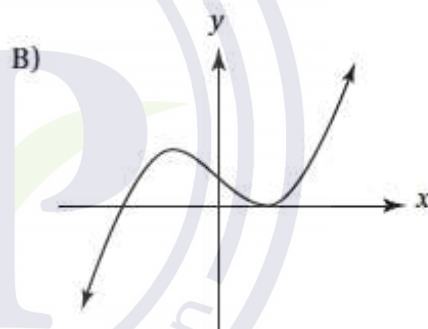
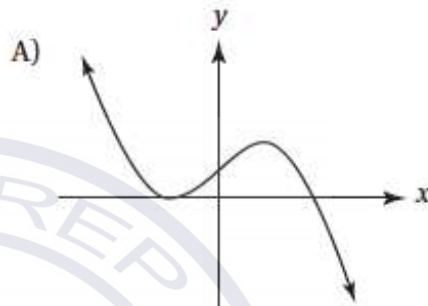
$$x^2 - 2ax + b = 0$$

In the equation above, a and b are constants. If this equation is solved for x , there are two solutions. What is the sum of these two solutions?

- A) $2a$
- B) $-2a$
- C) b
- D) $-b$

15

Which of the following can represent the graph in the xy -plane of $y = a(x - b)(x + c)^2$, where a , b , and c are all positive constants?





DIRECTIONS

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

- 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.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or $\frac{7}{2}$.

(If $3\frac{1}{2}$ is entered into the grid as

3	1	/	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

, it will be interpreted as $\frac{31}{2}$, not $3\frac{1}{2}$.)

- 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.

Write answer in boxes. →

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

7	/	1	2
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

← Fraction line

Grid In result. →

Answer: 2.5

2	.	5
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6
7	7	7
8	8	8
9	9	9

← Decimal point

Answer: 201
Either position is correct.

2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4

2	0	1
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4

Acceptable ways to grid $\frac{2}{3}$ are:

2	/	3
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0
1	1	1
2	2	2
3	3	3
4	4	4
5	5	5
6	6	6

.	6	6	6
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6

.	6	6	7
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6



16

At a restaurant, each large order of fries has 350 more calories than one large soda. If 2 large orders of fries and 3 large sodas have a total of 1,500 calories, how many calories does one large order of fries have?

17

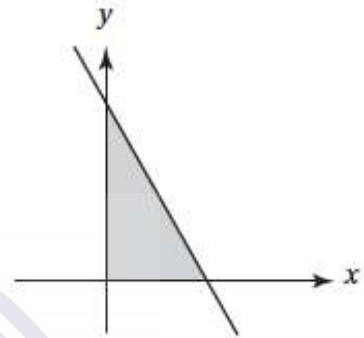
If $a = 4\sqrt{2}$ and $2a = \sqrt{2b}$, what is the value of b ?

18

$$x + \frac{36}{x} = 12$$

If $x > 0$, what is the solution to the equation above?

19



Note: Figure not drawn to scale.

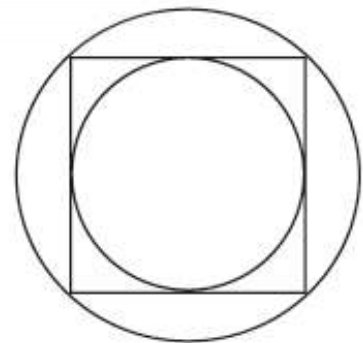
$$x \geq 0$$

$$y \geq 0$$

$$3x + y \leq k$$

In the figure above, the shaded region represents the solution set for the system of inequalities shown. If the area of this shaded region is 24 square units, what is the value of k ?

20



In the figure above, a circle is inscribed in a square that is inscribed in a larger circle. If the area of the larger circle is 16.5 square units, what is the area of the smaller circle?



Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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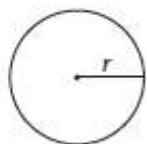
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NOTES

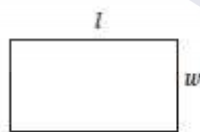
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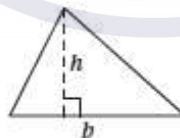


$$A = \pi r^2$$

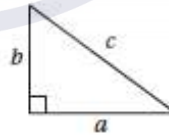
$$C = 2\pi r$$



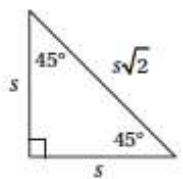
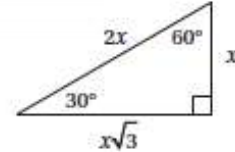
$$A = lw$$



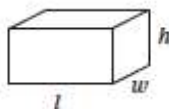
$$A = \frac{1}{2}bh$$



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



Special Right Triangles



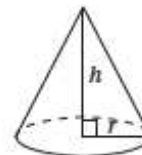
$$V = lwh$$



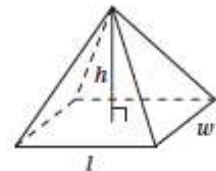
$$V = \pi r^2 h$$



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



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



$$V = \frac{1}{3}lwh$$

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 multiple-choice math test consists of 50 questions. Every student earns 2 points for each correct answer, -0.25 points for each incorrect answer, and 0 points for each question left unanswered. If a student answers 40 questions and gets 32 of them correct, how many points does the student earn?

- A) 61.5
- B) 62.0
- C) 62.5
- D) 64.0

2

If the average of 3, 5, and m is 10, what is the value of m ?

- A) 2
- B) 6
- C) 12
- D) 22

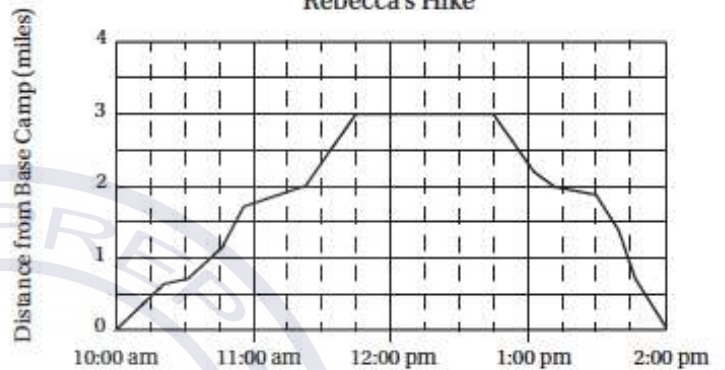
3

If $3b + 4 = -1$, what is the value of $9b + 12$?

- A) -8
- B) -4
- C) -3
- D) -2

4

Rebecca's Hike



The graph above shows Rebecca's distance from her base camp as she hiked to a mountaintop, took a 1-hour break for lunch, and returned back to base camp. According to the graph, approximately how much longer was her hike to the mountaintop than her hike from the mountaintop back to base camp?

- A) 20 minutes
- B) 30 minutes
- C) 45 minutes
- D) 60 minutes

5

In the 2014 season, the Bombers baseball team had a win-to-loss ratio of 5:3, with no game ending in a tie. If the Bombers played 120 total games in 2014, how many games did they lose?

- A) 24
- B) 36
- C) 45
- D) 72



6

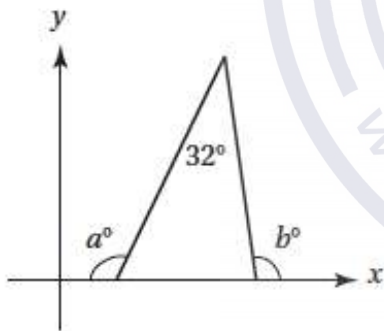
$$3x^3 - 2x^2 + 5$$

$$5x^2 + x - 10$$

Which of the following is the sum of the two polynomials shown above?

- A) $8x^3 - 2x - 5$
- B) $3x^3 - x^2 - 5$
- C) $3x^3 + 3x^2 + x - 5$
- D) $8x^5 - x^3 - 5$

7



In the figure above, what is the value of $a + b$?

- A) 212
- B) 238
- C) 296
- D) 328

8

If $\frac{K+i}{i} = 1 - 2i$, where $i = \sqrt{-1}$, what is the value of K ?

- A) 2
- B) -2
- C) $2 + i$
- D) $-2 + i$

9

x	y
2	10
4	5
10	2

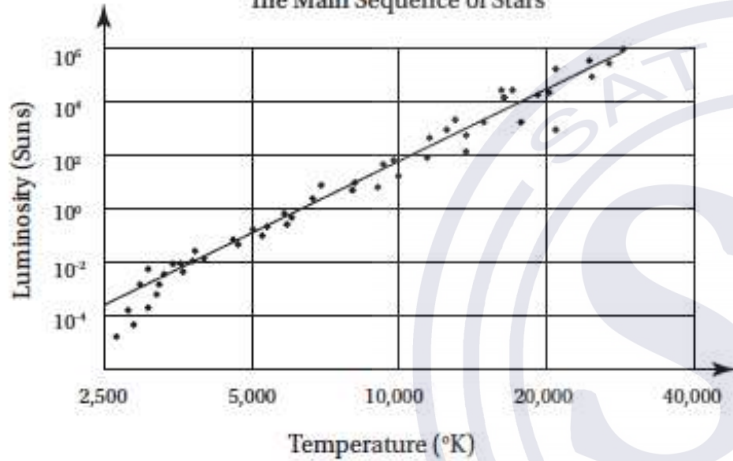
Based on the ordered pairs in the table above, which of the following could express the relationship between the variables x and y ?

- A) y varies linearly with, but not directly as, x .
- B) y varies directly as x .
- C) y varies inversely as x .
- D) y varies exponentially as x .



Questions 10–12 refer to the following information.

The Main Sequence of Stars



The scatterplot above charts the temperature (in degrees Kelvin) and luminosity (in Suns) for 50 stars, including our own sun, that fall under the category of “Main Sequence” stars.

10

The vertical axis indicates the luminosity of the stars in units called “Suns.” (A Sun unit equals the luminosity of our own sun.) According to the scatterplot, which of the following is the best estimate for the temperature of our sun?

- A) 2,600°K
- B) 5,800°K
- C) 10,100°K
- D) 12,400°K

11

According to the line of best fit shown on the scatterplot, a Main Sequence star with a temperature of 10,000°K is approximately how many times as luminous as a Main Sequence star with a temperature of 5,000°K?

- A) 9 times as luminous
- B) 90 times as luminous
- C) 900 times as luminous
- D) 900,000 times as luminous

12

What percent of the stars represented in the scatterplot have a luminosity less than 0.0001 Sun?

- A) 0.2%
- B) 0.4%
- C) 2%
- D) 4%



13

$$\frac{a+k}{b+k} = -2$$

Given the formula above, which of the following expresses k in terms of a and b ?

- A) $\frac{-a-2b}{3}$
 B) $\frac{a-2b}{3}$
 C) $\frac{-a+2b}{2}$
 D) $\frac{a-2b}{2}$

14

Which of the following functions, when graphed in the xy -plane, will intersect the x -axis exactly 3 times?

- A) $f(x) = (x^2 + 1)(x^2 + 1)$
 B) $f(x) = (x^2 - 1)(x^2 + 1)$
 C) $f(x) = x^2(x^2 - 1)$
 D) $f(x) = x^2(x^2 + 1)$

15

For how many distinct integer values of n is $(n+2)(n+8)$ negative?

- A) Four
 B) Five
 C) Six
 D) Seven

16

Lauren's car can travel d miles per gallon of gasoline. If she travels at a constant speed of s miles per hour, which of the following represents the number of hours she can travel on 6 gallons of gasoline?

- A) $\frac{6d}{s}$
 B) $\frac{6s}{d}$
 C) $\frac{d}{6s}$
 D) $\frac{s}{6d}$

17

$$\frac{2x+1}{2y} = \frac{a}{b}$$

If a and b are non-zero constants in the linear equation above, what is the slope of this line when it is graphed in the xy -plane?

- A) $\frac{b}{a}$
 B) $\frac{b}{2a}$
 C) $\frac{b+a}{2a}$
 D) $\frac{b-a}{2a}$



Questions 18 and 19 refer to the following information.

$$P(t) = 250(2.4)^t$$

The formula above shows the relationship between the population, P , of a certain mushroom species on a one-acre plot of land as a function of t , the number of weeks that have passed since the mushrooms were first introduced on the plot.

18

What is the meaning of the number 250 in the formula above?

- A) The plot initially contained 250 mushrooms.
- B) The population of mushrooms increases by 250 mushrooms per week.
- C) The population of mushrooms increases by 250% each week.
- D) It will take 250 weeks for the population of mushrooms to double.

19

By what percent should we expect the mushroom population to increase between the start of week 6 and the start of week 7?

- A) 40%
- B) 140%
- C) 240%
- D) 480%

20

If $\frac{x^2 + 1}{2} + \frac{x}{p} = 1$, which of the following expressions gives both possible values of x , in terms of p ?

- A) $\frac{-p \pm \sqrt{p^2 - 8p}}{2p}$
- B) $\frac{-p \pm \sqrt{p^2 - 4p}}{2p}$
- C) $\frac{-2 \pm \sqrt{4 + 4p^2}}{2p}$
- D) $\frac{-2 \pm \sqrt{4 - 4p^2}}{2p}$

21

If the variable a varies inversely as b , which of the following statements must be true?

- A) $a + b$ is a constant.
- B) $a - b$ is a constant.
- C) $\frac{a}{b}$ is a constant.
- D) ab is a constant.



22

	Test positive for antibody	Test negative for antibody	Total
Antibody present	480	20	500
No antibody	5	495	500
Total	485	515	1,000

A researcher is studying the effectiveness of a method for testing the presence of an antibody in a patient's bloodstream. The table above shows the results of 1,000 patient trials. According to these data, what is the probability that a patient who has the antibody will nevertheless have a negative test result?

- A) 0.01
- B) 0.04
- C) 0.05
- D) 0.20

23

Class A: 68, 79, 88, 91, 97, 98, 99

Class B: 85, 85, 85, 88, 88, 90, 90

The lists above indicate the tests scores, in increasing order, for two of Mr. Pearlman's classes, each of which has 6 students. Which of the following correctly compares the standard deviation of the scores for each class?

- A) The standard deviation of the scores in Class A is smaller.
- B) The standard deviation of the scores in Class B is smaller.
- C) The standard deviations of the scores in Class A and Class B are equal.
- D) The relationship cannot be determined from the information given.

24

Mrs. Black has a bag of candy bars to hand out to the students in her class before they take their AP calculus BC exam. If she gives each student 3 candy bars, she will have 6 left over. In order to give each student 5 candy bars, she will need 50 more candy bars. How many students are in Mrs. Black's class?

- A) 18
- B) 27
- C) 28
- D) 44

25

The sum of three numbers is 240. If the greatest of these numbers is 50% more than the sum of the other two, what is the value of the greatest of these numbers?

- A) 96
- B) 120
- C) 140
- D) 144

26

In the xy -plane, points $A(2, 5)$ and $B(-12, k)$ lie on a line that has a slope of $-\frac{4}{7}$. What is the value of k ?

- A) 13
- B) 16.5
- C) 18
- D) 29.5

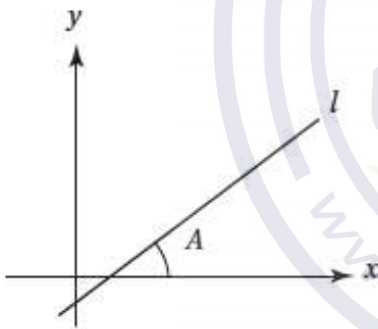


27

The original price of an outboard motor was marked down by 30% for a week-long sale. Since the motor was not sold in the first week, it was marked down an additional p percent. If the total markdown from the original price was then 58%, what is the value of p ?

- A) 12
- B) 28
- C) 40
- D) 42

28



In the figure above, if $\cos A = 0.8$, what is the slope of line l ?

- A) 0.60
- B) 0.75
- C) 0.90
- D) 1.10

Questions 29 and 30 refer to the following information.

	Yes	No	Total
Males	150	90	240
Females	107	173	280
Total	255	265	520

The table above shows the results of a survey of 520 adults who were asked whether they approved of a recent state budget proposal.

29

If n of the females had voted yes instead of no, the ratio of yes votes to no votes would have been exactly the same for the females as for the males. What is the value of n ?

- A) 62
- B) 66
- C) 68
- D) 70

30

If this survey is representative of the entire voting population of a state in which 32,760 people are expected to vote on this budget referendum, how many males are expected to vote yes?

- A) 9,450
- B) 15,120
- C) 19,270
- D) 20,475



Student-Produced Response Questions

DIRECTIONS

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

- 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.
- Mark no more than one circle in any column.
- No question has a negative answer.
- Some problems may have more than one correct answer. In such cases, grid only one answer.
- Mixed numbers** such as $3\frac{1}{2}$ must be gridded as 3.5 or $\frac{7}{2}$.

(If $3\frac{1}{2}$ is entered into the grid as

3	1	/	2
<input type="radio"/>	<input checked="" type="radio"/>		<input checked="" type="radio"/>

, it will be interpreted as $\frac{31}{2}$, not $3\frac{1}{2}$.)

- 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. →

7	/	1	2
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
0		0	0
1		0	0
2		0	0
3		0	0
4		0	0
5		0	0
6		0	0
7		0	0
8		0	0
9		0	0

← Fraction line

Grid in result. →

Answer: 2.5

	2	.	5
<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
0		0	0
1		0	0
2		0	0
3		0	0
4		0	0
5		0	0
6		0	0
7		0	0
8		0	0
9		0	0

← Decimal point

Answer: 201
Either position is correct.

	2	0	1
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>
0		0	0
1		0	0
2		0	0
3		0	0
4		0	0

	2	0	1
<input type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>
0		0	0
1		0	0
2		0	0
3		0	0
4		0	0

Acceptable ways to grid $\frac{2}{3}$ are:

	2	/	3
<input type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>	<input checked="" type="radio"/>
0		0	0
1		0	0
2		0	0
3		0	0
4		0	0
5		0	0
6		0	0

.	6	6	6
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
0		0	0
1		0	0
2		0	0
3		0	0
4		0	0
5		0	0
6		0	0

.	6	6	7
<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input checked="" type="radio"/>	<input type="radio"/>
0		0	0
1		0	0
2		0	0
3		0	0
4		0	0
5		0	0
6		0	0



31

If a shipment of fruit contains 6 tons of bananas, 4 tons of grapes, 2 tons of apples, and 3 tons of oranges, what fraction of the shipment, by weight, is oranges?

32

A state environmental study determines that the coastal regions of the state lose 24.5 acres of wetlands per month. At this rate, how many months will it take these coastal regions to lose a total of 343 acres?

33

$$d_n = 13n + 200$$

The formula above represents the number of donuts, d_n , that a bakery sold on the n th day of a festival. If the festival lasted 3 days, what was the total number of donuts that the bakery sold during the festival?

34

Connor and Joachim collaborated to write a computer program that consisted of 3,500 lines of code. If Joachim wrote 600 more lines of code than Connor did, how many lines of code did Connor write?

35

$$V(t) = 1000(1 + k)^m$$

An analyst wants to use the formula above to estimate the value, in dollars, of a \$1,000 initial investment in a mutual fund after m quarters have passed. If a \$1,000 initial investment in this fund is worth \$1,102.50 after 2 quarters, what number should the analyst choose for k ?



36



The figure above shows a hemispherical bowl made of glass. The bowl is 9 centimeters high and the glass is 3 centimeter thick. A second bowl is to be constructed to scale with the original bowl, but with one-half the height and diameter. The smaller bowl can hold a maximum of $k\pi$ cubic centimeters of water. What is the value of k ? (The volume of a sphere with radius r is given by the formula $V = \frac{4}{3}\pi r^3$.)

Questions 37 and 38 refer to the following information.

$$I = \frac{FV}{(1+r)^n}$$

The formula above indicates the initial investment, I , that must be made in an account with an annual interest rate of r to ensure a future value of FV after a period of n years.

37

To the nearest dollar, what initial investment should be made in an account that earns 20% annually ($r = 0.20$) in order to ensure a future value of \$432 in two years? (Ignore the \$ sign when gridding your answer. That is, enter \$125 as 125.)

38

What value of r , to the nearest thousandth, would ensure that the value of an investment would increase by 69% in 2 years?