



Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

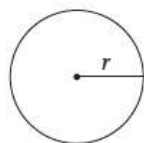
DIRECTIONS

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

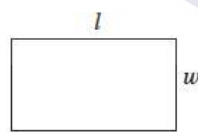
- The use of a calculator is NOT permitted.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated, the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

REFERENCE

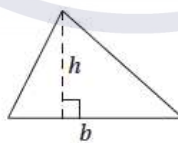


$$A = \pi r^2$$

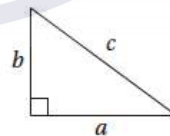
$$C = 2\pi r$$



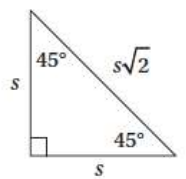
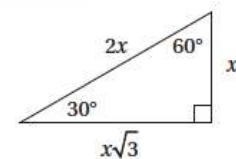
$$A = lw$$



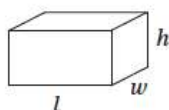
$$A = \frac{1}{2}bh$$



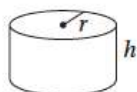
$$c^2 = a^2 + b^2$$



Special Right Triangles



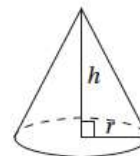
$$V = lwh$$



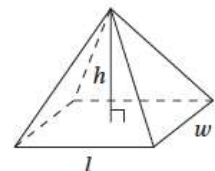
$$V = \pi r^2 h$$



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



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



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

The number of degrees of arc in a circle is 360.

The number of radians of arc in a circle is 2π .

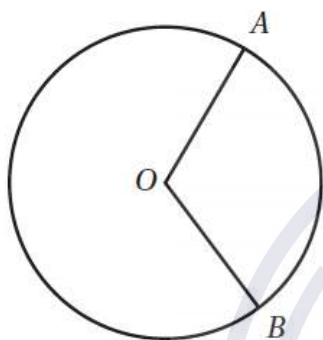
The sum of the measures in degrees of the angles of a triangle is 180.

1

If $-3x = 18$, what is the value of $4x + 6$?

- A) -30
- B) -18
- C) -6
- D) 30

2



The circle above with center O has a circumference of 30. If angle AOB measures 120° . What is the length of minor arc AB ?

- A) 5
- B) 6
- C) 10
- D) 20

3

A textile manufacturer receives two shipments of raw materials. Shipment A contains 30% polyester by weight, and shipment B contains 50% polyester by weight. Together, the two shipments contain 130 pounds of polyester. If x represents the total weight of the materials in shipment A and y represents the total weight of the materials shipment B, which equation models this relationship?

- A) $0.3x + 0.5y = 130$
- B) $0.5x + 0.3y = 130$
- C) $30x + 50y = 130$
- D) $50x + 30y = 13$

4

A roofing company estimates the price of a job, in dollars, using the expression $M + 15nh$, where M is the total cost of the materials, n is the number of roofers who will be working on the job, and h is the number of hours the job will take using n roofers. What is the best interpretation of the number 15 in this expression?

- A) The company generally has 15 roofers working on a job.
- B) The company charges \$15 per hour for each roofer on the job.
- C) Each roofer is expected to work on the job for 15 hours.
- D) The cost of the materials is expected to be a multiple of \$15.

5

$$(-5x^2y + 3xy - 7y^2) - (5x^2y - 7y^2 + 5xy)$$

Which of the following is equivalent to the expression above?

- A) $-14y^2 - 2xy$
- B) $-10x^2y + 8xy$
- C) $-10x^2y - 14y^2 - 2xy$
- D) $-10x^2y - 2xy$

6

$$\sqrt{3k+3} - x = 0$$

In the equation above, if $x = 6$, what is the value of k ?

- A) 3
- B) 9
- C) 11
- D) 36

7

A shipping company uses the formula $c = \frac{1}{3}wl$ to estimate how many shipping containers, c , can fit on a barge whose deck is w yards wide and l long.

Which of the following correctly expresses w in terms of c and l ?

- A) $w = \frac{1}{3}cl$
 B) $w = 3cl$
 C) $w = \frac{l}{3c}$
 D) $w = \frac{3c}{l}$

8

Which of the following equations represents a line that is parallel to the line with the equation $y = -2x + 4$?

- A) $2x + 4y = 0$
 B) $-4x + y = -2$
 C) $-6x - 3y = 9$
 D) $8x - 4y = 4$

9

The population, P , of a certain village from 1960 to 1980 can be calculated using the function $P(t) = 1,200 + 60t$, where t represents the number of years since 1960. Which of the following statements is the best interpretation of the number 1,200 in this context?

- A) From 1960 to 1980, the population of the town increased by 1,200 people.
 B) Between 1960 and 1980, the population of the town increased 1,200 people each year.
 C) The population of the town was 1,200 at the beginning of 1960.
 D) Between 1960 and 1980, the population of the town increased by $\frac{1200}{60}$ people each year.

10

$$3x + 2y = 4$$

$$-4x - 6y = -2$$

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

- A) $\left(\frac{14}{13}, -7\right)$
 B) $(4, 1)$
 C) $(2, -1)$
 D) $\left(\frac{3}{2}, -\frac{3}{2}\right)$

11

Which of the following is equivalent to $\frac{6+2i}{5-3i}$?
 (Note: $i = \sqrt{-1}$)

- A) $\frac{6}{5} - \frac{2i}{3}$
 B) $\frac{6}{5} + \frac{2i}{3}$
 C) $\frac{12}{17} - \frac{14i}{17}$
 D) $\frac{12}{17} + \frac{14i}{17}$

12

The graph of the equation $y = x^2 + k$ in the xy -plane is a parabola with a vertex that is below the x -axis. Which of the following is true of the parabola represented by the equation $y = k(x - b)^2 - c$?

- A) The vertex is $(b, -c)$, and the parabola opens downward.
- B) The vertex is $(b, -c)$, and the parabola opens upward.
- C) The vertex is $(-b, c)$, and the parabola opens downward.
- D) The vertex is $(-b, c)$, and the parabola opens upward.

13

Which of the following is equivalent to $8^{\frac{3}{2}}$?

- A) $\sqrt{64}$
- B) $\sqrt[3]{8^2}$
- C) 4^3
- D) $16\sqrt{2}$

14

What is the sum of all values that satisfy the equation $3x^2 + 30x + 15 = 0$?

- A) -10
- B) $-4\sqrt{5}$
- C) $4\sqrt{5}$
- D) 10

15

If $4x - 2y = 20$, what is the value of $\frac{16^x}{4^y}$?

- A) 4^5
- B) 4^{10}
- C) 16^2
- D) It cannot be determined from the given information.

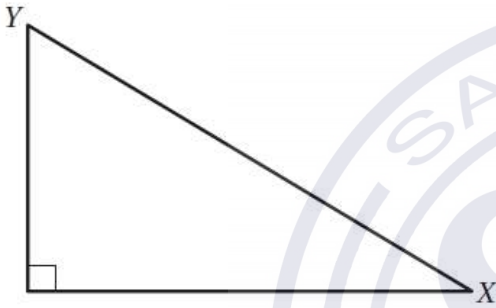
16

$$ax + 3y = c$$

$$6x + 9y = 15$$

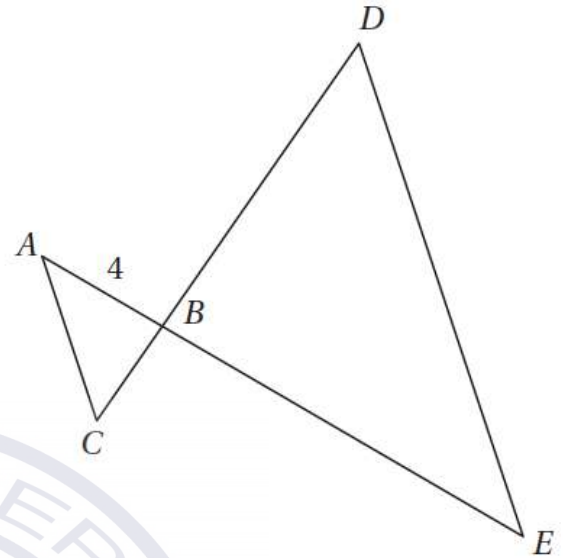
In the system of equations above, a and c are constants. If this system has infinitely many solutions, what is the value of $\frac{a}{c}$?

17



In the triangle above, if the sine of angle X is 0.3, what is the cosine of angle Y ?

18



In the figure above, $\overline{AC} \parallel \overline{DE}$, and \overline{AE} intersects \overline{CD} at point B . If $AE = 16$, how many times greater is the area of $\triangle DBE$ than the area of $\triangle ABC$?

19

$$\frac{4x^2 + 1}{4x^2 - 1} + \frac{16x}{16x^2 - 4}$$

The expression above is equivalent to $\frac{ax + b}{ax - b}$ where a and b are constants and $x \neq \frac{1}{2}$. What is the value of $a + b$?

20

$$x^3 - 4x^2 + 2x - 8 = 0$$

For what real value of x is the equation above true?

Math Test – Calculator

55 MINUTES, 38 QUESTIONS

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

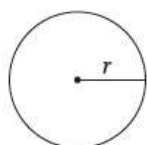
DIRECTIONS

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 for which $f(x)$ is a real number.

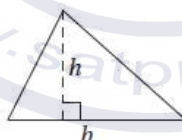
REFERENCE



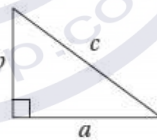
$$A = \pi r^2$$
$$C = 2\pi r$$



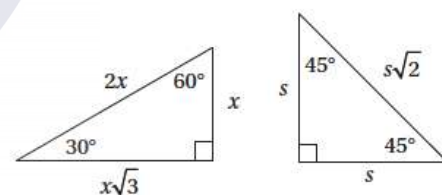
$$A = lw$$



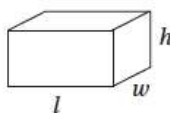
$$A = \frac{1}{2}bh$$



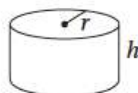
$$c^2 = a^2 + b^2$$



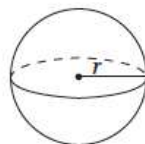
Special Right Triangles



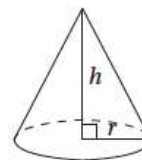
$$V = lwh$$



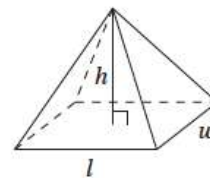
$$V = \pi r^2 h$$



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



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



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

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.

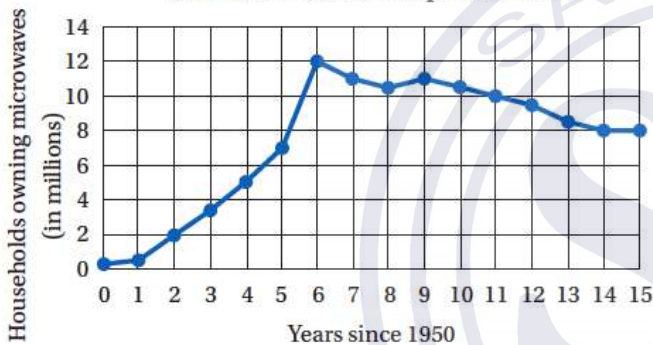
1

If $\frac{4}{3}z = \frac{2}{5}$, what is the value of z ?

- A) $\frac{3}{10}$
 B) $\frac{8}{15}$
 C) 2
 D) $\frac{10}{3}$

2

Microwave Ownership 1950–1965



The graph above shows the number of households owning microwaves each year from 1950 to 1965. Which of the following best describes the general trend in microwave ownership from 1950 to 1965?

- A) Ownership decreased slowly until 1956, then increased quickly from 1956 to 1965.
 B) Ownership decreased quickly until 1956, then increased slowly from 1956 to 1965.
 C) Ownership increased slowly until 1956, then decreased quickly from 1956 to 1965.
 D) Ownership increased quickly until 1956, then decreased slowly from 1956 to 1965.

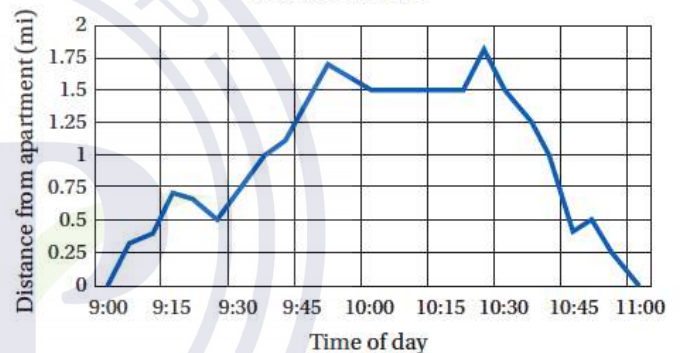
3

The amount of money a yoga teacher earns is directly proportional to the number of students who attend his class. He earns \$90 if 12 students attend his class. How much money will he earn if 30 students attend his class?

- A) \$36
 B) \$200
 C) \$225
 D) \$360

4

Darrell's Walk



The graph above shows Darrell's distance from his apartment during a 2-hour walk around the city. He stopped for 20 minutes to rest on a park bench during his walk. Based on the graph, around what time did he begin his rest?

- A) 9:15
 B) 10:00
 C) 10:25
 D) 11:00

5

The population density of a region is equal to the population of the region divided by the area of the region. What is the area, in km^2 , of a region with a population density of 70 people per km^2 and a population of 3,850 people?

- A) $.018 \text{ km}^2$
- B) 36 km^2
- C) 55 km^2
- D) 70 km^2

6

The speed of light is approximately 3×10^8 meters per second. Based on this information, approximately how long will it take for light from a star to reach a planet that is 10 million kilometers away?

- A) $.0\bar{3}$ seconds
- B) $33.\bar{3}$ seconds
- C) 3×10^5 seconds
- D) 3×10^{15} seconds

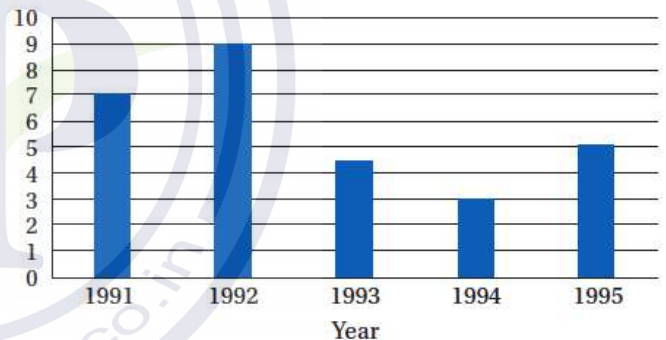
7

The planners in a town of 3,000 people are considering a plan to build an apartment complex on the site of a local park. A team went to the park site and asked 300 town voters who were using the park whether or not they supported the plan. Ten of those surveyed had no opinion. Which of the following is the most significant potential flaw in the design of this survey?

- A) the small sample size
- B) the small size of the town
- C) the fact that some respondents did not have an opinion
- D) the location of the survey

8

Oil Consumption in Country X (1991–1995)

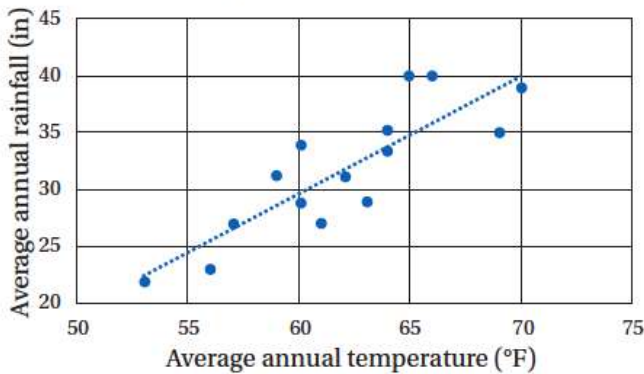


The number of barrels of oil consumed by country X each year from 1991 to 1995 is shown in the graph above. If the total amount of oil consumed in those five years was 285,000 barrels, what is an appropriate label for the vertical axis of the graph?

- A) Barrels of oil consumed (in hundreds)
- B) Barrels of oil consumed (in thousands)
- C) Barrels of oil consumed (in tens of thousands)
- D) Barrels of oil consumed (in hundreds of thousands)

9

Temperature vs. Rainfall



A meteorologist recorded the average annual temperature and average annual rainfall for 15 different villages and recorded his results on the scatterplot above. The line of best fit for the data is also shown. For the village with an average annual temperature of 65°F , the actual average annual rainfall is approximately how many inches greater than the average annual rainfall predicted by the line of best fit?

- A) 1
- B) 3
- C) 5
- D) 35

10

Which of the following sets represents all the values of n for which the expression $|n - 3| - 3$ is negative?

- A) $\{n | n < 3\}$
- B) $\{n | n > 3\}$
- C) $\{n | n < 0 \text{ or } n > 6\}$
- D) $\{n | 0 < n < 6\}$

11

$$f(x) = \frac{x^2 - 36}{\frac{x}{3} - 6}$$

For which value of x is the function f above undefined?

- A) -6
- B) 0
- C) 3
- D) 18

12

	Lives on campus	Lives off campus
Eats in dining hall	160	56
Does not eat in dining hall	63	121

The table above shows the results of a survey of 400 students on a college campus, in which they were asked whether they live on campus and whether they eat in a dining hall. If a student who lives on campus is chosen at random, what is the probability that he or she does NOT eat in the dining hall?

- A) $\frac{2}{5}$
- B) $\frac{63}{160}$
- C) $\frac{63}{184}$
- D) $\frac{63}{223}$

13

The Glenville PTA is sponsoring a bake sale that sells cookies and brownies. Each cookie cost \$1.50, and each brownie costs \$2.25. The PTA's goals for the day are to sell at least 55 items and to bring in at least \$100 of revenue. Let x be the number of cookies sold, and let y be the number of brownies sold. Which of the following systems of inequalities represents the PTA's goals?

- A) $x + y \leq 100$
 $1.5x + 2.25y \leq 55$
- B) $x + y \geq 100$
 $1.5x + 2.25y \geq 55$
- C) $x + y \geq 55$
 $1.5x + 2.25y \leq 100$
- D) $x + y \geq 55$
 $1.5x + 2.25y \geq 100$

14

The graph of the function f in the xy -plane crosses the x -axis at -4 , 2 , and 5 . Which of the following could define f ?

- A) $f(x) = (x - 2)^2(x - 5)$
- B) $f(x) = (x^2 + 2x - 8)(3x - 15)$
- C) $f(x) = (x^2 - 7x + 10)(x - 4)$
- D) $f(x) = (x - 4)(x + 2)(x + 5)$

Questions 15 and 16 refer to the following information.

An anthropologist surveyed 400 households at random from each of two villages, Village A and Village B, and recorded the number of children in each household. Village A has a total of 2,000 households, and Village B has a total of 3,200 households. The results of the survey are shown in the table below.

Number of children	Village A	Village B
0	60	40
1	150	140
2	110	130
3	70	70
4	10	20

15

What is the median number of children per household for all the households surveyed?

- A) 2.0
- B) 2.5
- C) 3.5
- D) 4.0

16

If each of these two samples is representative of its respective village, approximately how many households altogether (in both villages) have no children?

- A) 620
- B) 640
- C) 650
- D) 680

17

Table A		Table B	
x	$f(x)$	x	$g(x)$
-1	2	3	-1
3	6	5	3
5	5	6	2

Table A above shows values that satisfy the function $f(x)$, and Table B shows values that satisfy the function $g(x)$. What is the value of $f(g(3))$?

- A) -1
- B) 2
- C) 3
- D) 5

18

Which choice best approximates the percent increase in yield of corn from 2001 to 2002?

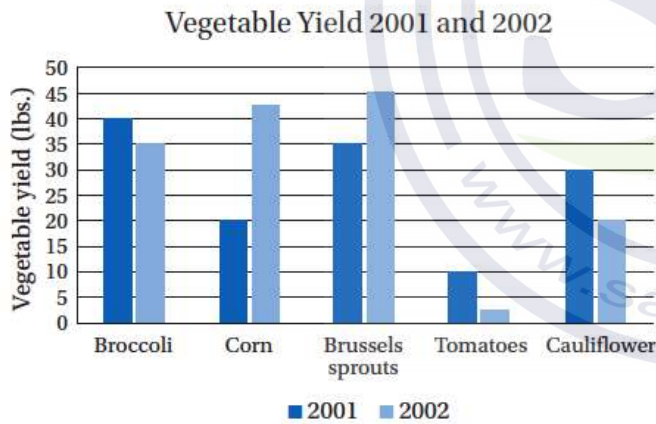
- A) 44.0%
- B) 56.0%
- C) 112.5%
- D) 225.0%

19

In a scatterplot of the data where 2001 yield is plotted on the x -axis and 2002 yield is plotted on the y -axis for each vegetable crop, how many data points would fall below the line $y = x$?

- A) 1
- B) 2
- C) 3
- D) 4

Questions 18 and 19 refer to the following information.



The bar graph above shows the total yield of five different crops on a particular farm in the years 2001 and 2002.

20

A gardener has three right cylindrical flower pots, each with a diameter of 16 cm, that she will fill with potting soil. If her bag of potting soil contains $1,000 \text{ in}^3$ of soil, and she fills all three flower pots to a height of 20 cm, approximately how many cubic inches of soil will be left in the bag? ($1 \text{ cm}^3 = 0.061 \text{ in}^3$)

- A) 64
- B) 264
- C) 736
- D) 755

Questions 21 and 22 refer to the following information.

$$B = \frac{L}{4\pi D^2}$$

The apparent brightness of an object B is related to the luminosity of the object L and the square of the distance between the observer and the object D according to the formula above.

21

Which of the following expresses the distance between the object and the observer in terms of the apparent brightness and the luminosity of the object?

- A) $D = \sqrt{\frac{L}{4\pi B}}$
- B) $D = \sqrt{\frac{4\pi B}{L}}$
- C) $D = \left(\frac{L}{4\pi B}\right)^2$
- D) $D = \sqrt{\frac{4\pi}{BL}}$

22

An astronomer on Earth measures the brightness of two stars, Star A and Star B, that have the same luminosity. She finds that the brightness of Star A is 156% greater than the brightness of Star B. The distance from Earth to Star B is how many times the distance from Earth to Star A?

- A) 1.25
- B) 1.56
- C) 1.60
- D) 2.56

23

If the length of a rectangle is decreased by 10 percent and its width is increased by p percent, its area will increase by 26 percent, what is the value of p ?

- A) 36
- B) 38
- C) 40
- D) 42

24

Mr. Chu has a total of n gift certificates that he is giving out to his employees for the holidays. If he gives each employee 5 gift certificates, he will have 7 left over. To give each of his employees 6 gift certificates, he would need to have 9 more gift certificates. How many employees does Mr. Chu have?

- A) 12
- B) 16
- C) 18
- D) 22

25

The population of a colony of bacteria increases by 200% every 6 hours. If the current population of the colony is 20,000, which expression represents the colony's population h hours from now?

- A) $20,000(2)^{\frac{h}{6}}$
- B) $20,000(3)^{\frac{h}{6}}$
- C) $20,000(3)^{6h}$
- D) $20,000(3)^{\frac{6}{h}}$

26

$$h(t) = -16t^2 + 64t$$

The equation above expresses the approximate height, h , in feet, of a rocket t seconds after it is launched upwards from the ground until it hits the ground again. After how many seconds will the rocket reach its highest point?

- A) 2
- B) 4
- C) 8
- D) 16

27

$$x^2 + y^2 - 6x + 4y = 3$$

The equation of a circle in the xy -plane is shown above. What is the radius of the circle?

- A) 2
- B) 4
- C) 8
- D) 16

28

The equation $y = (x - 4)(x + 8)$ represents a parabola in the xy -plane. Which of the following is an equivalent form of this equation that shows the coordinates of the vertex of this parabola as constants or coefficients?

- A) $y = (x + 4)^2 - 8$
- B) $y = (x - 4)^2 + 8$
- C) $y = (x + 2)^2 - 36$
- D) $y = (x + 2)^2 + 36$

29

In the xy -plane, line m has a slope of 2 and crosses the x -axis at the point $\left(\frac{5}{2}, 0\right)$. Line n is perpendicular to line m and crosses the y -axis at the point $\left(0, -\frac{5}{2}\right)$. At what point do lines m and n intersect?

- A) $\left(\frac{5}{2}, -\frac{5}{2}\right)$
- B) $(4, -2)$
- C) $(1, -3)$
- D) $\left(2, -\frac{5}{2}\right)$

30

$$(x - a)^3 = x^3 - bx^2 + bx - a^3$$

If the equation above is true for all real values of x , and a and b are positive constants, what is the value of a ?

- A) 1
- B) 2
- C) 3
- D) It cannot be determined from the given information.

31

If a kayaker can only travel between 8 miles per hour and 12 miles per hour, what is one possible number of hours it could take the kayaker to travel 132 miles?

32

A ball rolls f feet and 7 inches. If the ball rolls a total of 115 inches, what is the value of f ?

33

A chemist heats a sample of liquid with a starting temperature of 20°C at a rate of 14°C per minute. How much time, in minutes, will it take for the liquid to reach its boiling point of 251°C ?

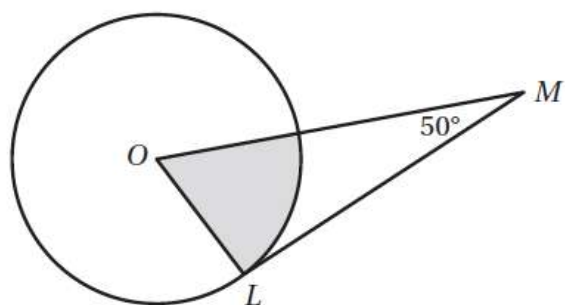
34

$$3(2x + 3)(-x + 4)$$

If the expression above is rewritten in the form $ax^2 + bx + c$, where a , b , and c are constants, what is the value of $a + b$?

35

A professor scores 15 of 20 exams himself and gives the other 5 to his teaching assistant to score. If the average score of the 15 exams graded by the professor is 87, and the average score of all 20 exams is 85, how many points lower is the average score of the teaching assistant's 5 exams than the average score of the professor's 15 exams?



In the figure above, the circle has a center O , line segment \overline{LM} is tangent to the circle at point L , and angle LMO has a measure of 50° . If the area of the circle is 108 square centimeters, what is the area, in square centimeters, of the shaded sector?

Questions 37 and 38 refer to the following information.

Enrique opens a bank account that earns 5% interest, compounded annually, with an initial deposit of P dollars. He uses the equation $A = P(1.05)^t$ to model the balance, A , of the account after t years.

37

Enrique calculates that if he does not make any withdrawals or deposits, the balance of the account after 2 years will be \$1,653.75. What is the value, in dollars, of Enrique's initial deposit?

38

Assuming that Enrique does not make any withdrawals or deposits, after 6 years, the interest that the account has earned will equal what percent of Enrique's initial deposit? Round your answer to the nearest whole number. (Ignore the percent symbol when gridding. For instance, enter 26% as 26.)