



# Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

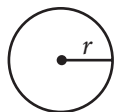
## DIRECTIONS

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

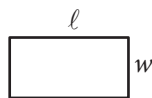
- The use of a calculator **is not permitted**.
- All variables and expressions used represent real numbers unless otherwise indicated.
- Figures provided in this test are drawn to scale unless otherwise indicated.
- All figures lie in a plane unless otherwise indicated.
- Unless otherwise indicated,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

## REFERENCE

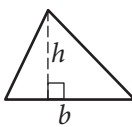


$$A = \pi r^2$$

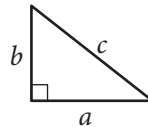
$$C = 2\pi r$$



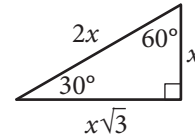
$$A = \ell w$$



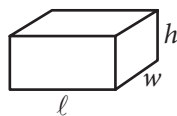
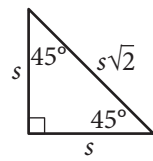
$$A = \frac{1}{2}bh$$



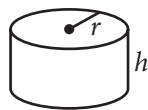
$$c^2 = a^2 + b^2$$



Special Right Triangles



$$V = \ell wh$$



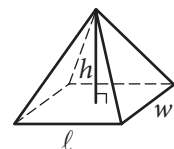
$$V = \pi r^2 h$$



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



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



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

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

The number of radians of arc in a circle is  $2\pi$ .

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



1

$$x + y = 75$$

The equation above relates the number of minutes,  $x$ , Maria spends running each day and the number of minutes,  $y$ , she spends biking each day. In the equation, what does the number 75 represent?

- A) The number of minutes spent running each day
- B) The number of minutes spent biking each day
- C) The total number of minutes spent running and biking each day
- D) The number of minutes spent biking for each minute spent running

2

Which of the following is equivalent to  $3(x + 5) - 6$  ?

- A)  $3x - 3$
- B)  $3x - 1$
- C)  $3x + 9$
- D)  $15x - 6$

3

$$x = y - 3$$

$$\frac{x}{2} + 2y = 6$$

Which ordered pair  $(x, y)$  satisfies the system of equations shown above?

- A)  $(-3, 0)$
- B)  $(0, 3)$
- C)  $(6, -3)$
- D)  $(36, -6)$

4

Which of the following complex numbers is equal to  $(5 + 12i) - (9i^2 - 6i)$ , for  $i = \sqrt{-1}$  ?

- A)  $-14 - 18i$
- B)  $-4 - 6i$
- C)  $4 + 6i$
- D)  $14 + 18i$



5

If  $f(x) = \frac{x^2 - 6x + 3}{x - 1}$ , what is  $f(-1)$  ?

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

6

A company that makes wildlife videos purchases camera equipment for \$32,400. The equipment depreciates in value at a constant rate for 12 years, after which it is considered to have no monetary value. How much is the camera equipment worth 4 years after it is purchased?

- A) \$10,800
- B) \$16,200
- C) \$21,600
- D) \$29,700

7

$$x^2 + 6x + 4$$

Which of the following is equivalent to the expression above?

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

8

Ken is working this summer as part of a crew on a farm. He earned \$8 per hour for the first 10 hours he worked this week. Because of his performance, his crew leader raised his salary to \$10 per hour for the rest of the week. Ken saves 90% of his earnings from each week. What is the least number of hours he must work the rest of the week to save at least \$270 for the week?

- A) 38
- B) 33
- C) 22
- D) 16



9

Marisa needs to hire at least 10 staff members for an upcoming project. The staff members will be made up of junior directors, who will be paid \$640 per week, and senior directors, who will be paid \$880 per week. Her budget for paying the staff members is no more than \$9,700 per week. She must hire at least 3 junior directors and at least 1 senior director. Which of the following systems of inequalities represents the conditions described if  $x$  is the number of junior directors and  $y$  is the number of senior directors?

- A)  $640x + 880y \geq 9,700$   
 $x + y \leq 10$   
 $x \geq 3$   
 $y \geq 1$
- B)  $640x + 880y \leq 9,700$   
 $x + y \geq 10$   
 $x \geq 3$   
 $y \geq 1$
- C)  $640x + 880y \geq 9,700$   
 $x + y \geq 10$   
 $x \leq 3$   
 $y \leq 1$
- D)  $640x + 880y \leq 9,700$   
 $x + y \leq 10$   
 $x \leq 3$   
 $y \leq 1$

10

$$ax^3 + bx^2 + cx + d = 0$$

In the equation above,  $a$ ,  $b$ ,  $c$ , and  $d$  are constants. If the equation has roots  $-1$ ,  $-3$ , and  $5$ , which of the following is a factor of  $ax^3 + bx^2 + cx + d$  ?

- A)  $x - 1$   
B)  $x + 1$   
C)  $x - 3$   
D)  $x + 5$



11

The expression  $\frac{x^{-2}y^{\frac{1}{2}}}{x^{\frac{1}{3}}y^{-1}}$ , where  $x > 1$  and  $y > 1$ , is

equivalent to which of the following?

A)  $\frac{\sqrt{y}}{\sqrt[3]{x^2}}$

B)  $\frac{y\sqrt{y}}{\sqrt[3]{x^2}}$

C)  $\frac{y\sqrt{y}}{x\sqrt{x}}$

D)  $\frac{y\sqrt{y}}{x^2\sqrt[3]{x}}$

12

The function  $f$  is defined by  $f(x) = (x + 3)(x + 1)$ . The graph of  $f$  in the  $xy$ -plane is a parabola. Which of the following intervals contains the  $x$ -coordinate of the vertex of the graph of  $f$ ?

A)  $-4 < x < -3$

B)  $-3 < x < 1$

C)  $1 < x < 3$

D)  $3 < x < 4$



13

Which of the following expressions is equivalent to

$$\frac{x^2 - 2x - 5}{x - 3} ?$$

- A)  $x - 5 - \frac{20}{x - 3}$
- B)  $x - 5 - \frac{10}{x - 3}$
- C)  $x + 1 - \frac{8}{x - 3}$
- D)  $x + 1 - \frac{2}{x - 3}$

14

A shipping service restricts the dimensions of the boxes it will ship for a certain type of service. The restriction states that for boxes shaped like rectangular prisms, the sum of the perimeter of the base of the box and the height of the box cannot exceed 130 inches. The perimeter of the base is determined using the width and length of the box. If a box has a height of 60 inches and its length is 2.5 times the width, which inequality shows the allowable width  $x$ , in inches, of the box?

- A)  $0 < x \leq 10$
- B)  $0 < x \leq 11\frac{2}{3}$
- C)  $0 < x \leq 17\frac{1}{2}$
- D)  $0 < x \leq 20$

15

The expression  $\frac{1}{3}x^2 - 2$  can be rewritten as  $\frac{1}{3}(x - k)(x + k)$ , where  $k$  is a positive constant.

What is the value of  $k$  ?

- A) 2
- B) 6
- C)  $\sqrt{2}$
- D)  $\sqrt{6}$



**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  $7/2$ . (If  $\begin{array}{|c|c|c|c|} \hline 3 & 1 & / & 2 \\ \hline \bullet & \bullet & \bullet & \bullet \\ \hline \end{array}$  is entered into the grid, 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
•	•	•	•
0	0	0	0
1	1	•	1
2	2	2	•
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
•	7	7	7
8	8	8	8
9	9	9	9

Grid in result.

Answer: 2.5

	2	.	5
•	•	•	•
0	0	0	0
1	1	1	1
2	•	2	2
3	3	3	3
4	4	4	4
5	5	5	•
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

← Fraction line

← Decimal point

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

	2	/	3
•	•	•	•
0	0	0	0
1	1	1	1
2	•	2	2
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

.	6	6	6
•	•	•	•
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	•	•	•
7	7	7	7
8	8	8	8
9	9	9	9

.	6	6	7
•	•	•	•
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	•	•	•
7	7	7	•
8	8	8	8
9	9	9	9

Answer: 201 – either position is correct

	2	0	1
•	•	•	•
0	0	•	0
1	1	1	•
2	•	2	2
3	3	3	3

2	0	1	
•	•	•	•
0	•	0	0
1	1	•	1
•	2	2	2
3	3	3	3

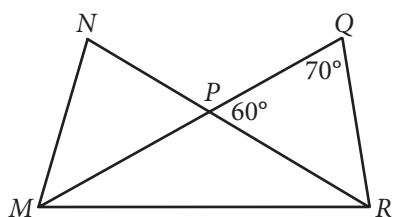
**NOTE:** You may start your answers in any column, space permitting. Columns you don't need to use should be left blank.



16

If  $2x + 8 = 16$ , what is the value of  $x + 4$  ?

17



In the figure above,  $\overline{MQ}$  and  $\overline{NR}$  intersect at point  $P$ ,  $NP = QP$ , and  $MP = PR$ . What is the measure, in degrees, of  $\angle QMR$  ? (Disregard the degree symbol when gridding your answer.)

18

The number of radians in a 720-degree angle can be written as  $a\pi$ , where  $a$  is a constant. What is the value of  $a$  ?





19

The graph of a line in the  $xy$ -plane passes through the point  $(1, 4)$  and crosses the  $x$ -axis at the point  $(2, 0)$ . The line crosses the  $y$ -axis at the point  $(0, b)$ . What is the value of  $b$  ?

20

$$(7532 + 100y^2) + 10(10y^2 - 110)$$

The expression above can be written in the form  $ay^2 + b$ , where  $a$  and  $b$  are constants. What is the value of  $a + b$  ?

**STOP**

**If you finish before time is called, you may check your work on this section only.**

**Do not turn to any other section.**