



Math Test – No Calculator

25 MINUTES, 20 QUESTIONS

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

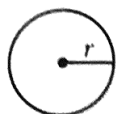
DIRECTIONS

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.
3. Figures provided in this test are drawn to scale unless otherwise indicated.
4. All figures lie in a plane unless otherwise indicated.
5. Unless otherwise indicated, the domain of a given function f is the set of all real numbers x for which $f(x)$ is a real number.

REFERENCE



$$A = \pi r^2$$

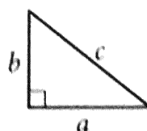
$$C = 2\pi r$$



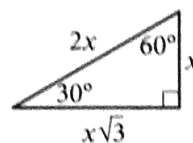
$$A = \ell w$$



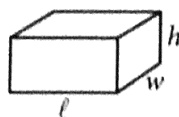
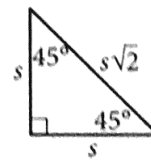
$$A = \frac{1}{2}bh$$



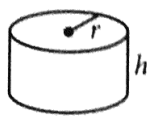
$$c^2 = a^2 + b^2$$



Special Right Triangles



$$V = \ell wh$$



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



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



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



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

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

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

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



1

Which of the following expressions is equal to 0 for some value of x ?

- ☒ A) $|x - 1| - 1$
 B) $|x + 1| + 1$
 C) $|1 - x| + 1$
 D) $|x - 1| + 1$

$x = 2$
 $\left. \begin{array}{l} \text{A) } |x-1|-1 \\ \text{B) } |x+1|+1 \\ \text{C) } |1-x|+1 \end{array} \right\} \geq 1$
 $\text{D) } |x-1|+1$

2

$$f(x) = \frac{3}{2}x + b$$

In the function above, b is a constant. If $f(6) = 7$, what is the value of $f(-2)$?

- ☒ A) -5
 B) -2
 C) 1
 D) 7

$f(6) = 7 = \frac{3}{2} \cdot 6 + b$
 $7 = 9 + b$
 $b = -2$

$\Rightarrow f(-2) = -3 + b$
 $= -5$

3

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

$$4(y + 1) = x$$

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

- ☒ A) 2
 B) 4
 C) 12
 D) 24

$x = 6y = 4y + 4$
 $y = 2$
 $\Rightarrow x = 12$

4

If $f(x) = -2x + 5$, what is $f(-3x)$ equal to?

- A) $-6x - 5$
☒ B) $6x + 5$
 C) $6x - 5$
 D) $6x^2 - 15x$

$f(-3x) = -2(-3x) + 5$
 $= 6x + 5$



5

$$3(2x + 1)(4x + 1)$$

Which of the following is equivalent to the expression above?

A) $45x$

B) $24x^2 + 3$

C) $24x^2 + 18x + 3$

D) $18x^2 + 6$

$$3(8x^2 + 6x + 1)$$



6

If $\frac{a-b}{b} = \frac{3}{7}$, which of the following must also be true?

A) $\frac{a}{b} = -\frac{4}{7}$

B) $\frac{a}{b} = \frac{10}{7}$

C) $\frac{a+b}{b} = \frac{10}{7}$

D) $\frac{a-2b}{b} = -\frac{11}{7}$

~~$$\frac{a-b}{b} = \frac{3}{7}$$~~

$$\frac{a}{b} - 1 = \frac{3}{7}$$

$$\frac{a}{b} = \frac{3}{7} + 1$$

$$= \frac{10}{7}$$



7

While preparing to run a marathon, Amelia created a training schedule in which the distance of her longest run every week increased by a constant amount. If Amelia's training schedule requires that her longest run in week 4 is a distance of 8 miles and her longest run in week 16 is a distance of 26 miles, which of the following best describes how the distance Amelia runs changes between week 4 and week 16 of her training schedule?

A) Amelia increases the distance of her longest run by 0.5 miles each week.

B) Amelia increases the distance of her longest run by 2 miles each week.

C) Amelia increases the distance of her longest run by 2 miles every 3 weeks.

D) Amelia increases the distance of her longest run by 1.5 miles each week.

$$\left. \begin{array}{l} d(4) = 8 \\ d(16) = 26 \end{array} \right\} \frac{\Delta d}{\Delta t} = \frac{18}{12} = 1.5$$





8

Which of the following equations represents a line that is parallel to the line with equation $y = -3x + 4$?

A) $6x + 2y = 15$

B) $3x - y = 7$

C) $2x - 3y = 6$

D) $x + 3y = 1$

parallel
 \Rightarrow slope $= -3$

$y = \frac{1}{3} - \frac{1}{3}x$

$y = \frac{15}{2} - 3x$ ✓

9

$$\sqrt{x-a} = x-4$$

If $a = 2$, what is the solution set of the equation above?

A) $\{3, 6\}$

B) $\{2\}$

C) $\{3\}$

D) $\{6\}$

$\sqrt{x-2} = x-4$

~~0, 2, 3, 6~~

By inspection,
 only 6 works

10

If $\frac{t+5}{t-5} = 10$, what is the value of t ?

A) $\frac{45}{11}$

B) 5

C) $\frac{11}{2}$

D) $\frac{55}{9}$

$t+5 = 10t-50$

$55 = 9t$

$t = \frac{55}{9}$

11

$x = 2y + 5 \rightarrow y = \frac{1}{2}x - \frac{5}{2}$

$y = (2x-3)(x+9)$

How many ordered pairs (x, y) satisfy the system of equations shown above?

A) 0

B) 1

C) 2

D) Infinitely many

$\frac{1}{2}x - \frac{5}{2} = 2x^2 + 18x - 3x - 27$

$\Rightarrow x - 5 = 4x^2 + 30x - 54$
 $\Rightarrow 0 = 4x^2 + 29x - 49$

$b^2 - 4ac = 29^2 - 4 \cdot 4 \cdot (-49)$
 > 0

$\Rightarrow 2$ real solns



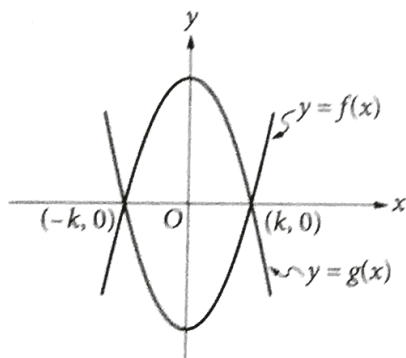
12

Ken and Paul each ordered a sandwich at a restaurant. The price of Ken's sandwich was x dollars, and the price of Paul's sandwich was \$1 more than the price of Ken's sandwich. If Ken and Paul split the cost of the sandwiches evenly and each paid a 20% tip, which of the following expressions represents the amount, in dollars, each of them paid? (Assume there is no sales tax.)

- A) $0.2x + 0.2$
 B) $0.5x + 0.1$
 C) $1.2x + 0.6$
 D) $2.4x + 1.2$

$K = x, P = 1 + x$
 $\text{Total} = (2x + 1) \cdot (1.2)$
 $\text{Each} = 1.2x + 0.6$

13



The functions f and g , defined by $f(x) = 8x^2 - 2$ and $g(x) = -8x^2 + 2$, are graphed in the xy -plane above. The graphs of f and g intersect at the points $(k, 0)$ and $(-k, 0)$. What is the value of k ?

- A) $\frac{1}{4}$
 B) $\frac{1}{2}$
 C) 1
 D) 2

$8x^2 - 2 = -8x^2 + 2$
 $16x^2 = 4$
 $x^2 = \frac{1}{4}$

14

$$\frac{8-i}{3-2i}$$

If the expression above is rewritten in the form $a + bi$, where a and b are real numbers, what is the value of a ? (Note: $i = \sqrt{-1}$)

- A) 2

B) $\frac{8}{3}$

- C) 3

D) $\frac{11}{3}$

$\frac{8-i}{3-2i} \cdot \frac{3+2i}{3+2i}$
 $= \frac{24 + 16i - 3i + 2}{9 + 4}$
 $= \frac{26 + 13i}{13}$

15

$$x^2 - \frac{k}{2}x = 2p$$

In the quadratic equation above, k and p are constants. What are the solutions for x ?

A) $x = \frac{k}{4} \pm \frac{\sqrt{k^2 + 2p}}{4}$

B) $x = \frac{k}{4} \pm \frac{\sqrt{k^2 + 32p}}{4}$

C) $x = \frac{k}{2} \pm \frac{\sqrt{k^2 + 2p}}{2}$

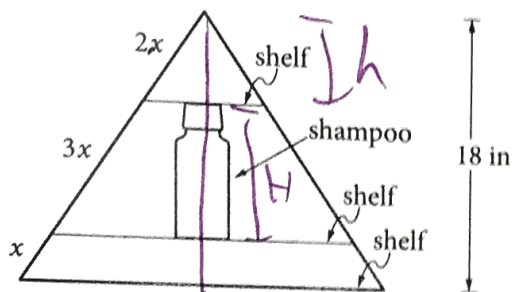
D) $x = \frac{k}{2} \pm \frac{\sqrt{k^2 + 32p}}{4}$

$x^2 - \frac{k}{2}x - 2p = 0$
 $x = \frac{\frac{k}{2} \pm \sqrt{\frac{k^2}{4} + 8p}}{2}$
 $= \frac{k \pm \sqrt{k^2 + 32p}}{4}$

~~D) $x = \frac{k}{2} \pm \frac{\sqrt{k^2 + 32p}}{4}$~~ *oops*



16



Jim has a triangular shelf system that attaches to his showerhead. The total height of the system is 18 inches, and there are three parallel shelves as shown above. What is the maximum height, in inches, of a shampoo bottle that can stand upright on the middle shelf?

$$\frac{18}{6x} = \frac{H+h}{5x} = \frac{h}{2x}$$

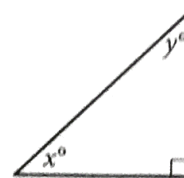
$$3 = \frac{H+h}{5} = \frac{h}{2}$$

$$\Rightarrow h = 6,$$

$$\frac{H+6}{5} = 3$$

$$H = 9$$

17



In the triangle above, the sine of x° is 0.6. What is the cosine of y° ?

$$\sin(x^\circ) = \cos(y^\circ)$$

$$\boxed{0.6}$$

18

$$x^3 - 5x^2 + 2x - 10 = 0$$

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

Guess and check:

$$x=2 = 8 - 20 + 4 - 10 < 0$$

$$x=3 = 27 - 45 + 6 - 10 < 0$$

$$x=-1 = -1 - 5 - 2 - 10 < 0$$

$$x=4 = 64 - 80 + 8 - 10 < 0$$

$$x=5 = 125 - 125 + 10 - 10 = 0$$

$$\boxed{x=5}$$



$$-3x + 4y = 20$$

$$6x + 3y = 15$$

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

$$-6x + 8y = 40$$

$$6x + 3y = 15$$

$$11y = 55$$

$$y = 5$$

$$76x + 15 = 15$$

$$\boxed{x = 0} \checkmark$$

20

The mesosphere is the layer of Earth's atmosphere between 50 kilometers and 85 kilometers above Earth's surface. At a distance of 50 kilometers from Earth's surface, the temperature in the mesosphere is -5° Celsius, and at a distance of 80 kilometers from Earth's surface, the temperature in the mesosphere is -80° Celsius. For every additional 10 kilometers from Earth's surface, the temperature in the mesosphere decreases by k° Celsius, where k is a constant. What is the value of k ?

$$T(50) = -5$$

$$T(80) = -80$$

$$m = -k$$

$$\text{slope} = \frac{-75}{30} = -2.5$$

$$\boxed{k = 2.5} \checkmark$$

STOP

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