

Form 74H

(December 2016)



The **ACT**[®]

2016|2017

In response to your request for Test Information Release materials, this booklet contains the test questions, scoring keys, and conversion tables used in determining your ACT scores. Enclosed with this booklet is a report that lists each of your answers, shows whether your answer was correct, and, if your answer was not correct, gives the correct answer.

If you wish to order a photocopy of your answer document—including, if you took the writing test, a copy of your written essay—please use the order form on the inside back cover of this booklet.

ACT

PO BOX 168
IOWA CITY, IA 52243-0168

©2016 by ACT, Inc. All rights reserved.
NOTE: This test material is the confidential copyrighted property of ACT, Inc., and may not be copied, reproduced, sold, or otherwise transferred without the prior express written permission of ACT, Inc. Violators of ACT's copyrights are subject to civil and criminal penalties.

MATHEMATICS TEST

60 Minutes—60 Questions

DIRECTIONS: Solve each problem, choose the correct answer, and then fill in the corresponding oval on your answer document.

Do not linger over problems that take too much time. Solve as many as you can; then return to the others in the time you have left for this test.

You are permitted to use a calculator on this test. You may use your calculator for any problems you choose,

but some of the problems may best be done without using a calculator.

Note: Unless otherwise stated, all of the following should be assumed.

1. Illustrative figures are NOT necessarily drawn to scale.
2. Geometric figures lie in a plane.
3. The word *line* indicates a straight line.
4. The word *average* indicates arithmetic mean.

DO YOUR FIGURING HERE.

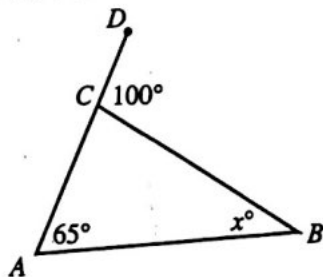
1. The 32-member French Club is meeting to choose a student government representative. The members decide that the representative, who will be chosen at random, CANNOT be any of the 5 officers of the club. What is the probability that Luis, who is a member of the club but NOT an officer, will be chosen?

- A. 0
- B. $\frac{1}{32}$
- C. $\frac{1}{27}$
- D. $\frac{6}{32}$
- E. $\frac{1}{5}$

2. The statement $\triangle ABC \cong \triangle DEF$ is true. Which of the following statements *must* be true?

- F. $\overline{AB} \cong \overline{DF}$
- G. $\overline{AC} \cong \overline{EF}$
- H. $\overline{BC} \cong \overline{DF}$
- J. $\angle A \cong \angle F$
- K. $\angle C \cong \angle F$

3. In the figure below, C lies on \overline{AD} , the measure of $\angle BAC$ is 65° , the measure of $\angle BCD$ is 100° , and the measure of $\angle ABC$ is x° .

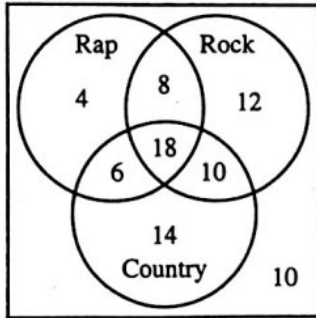


What is the value of x ?

- A. 15
- B. 25
- C. 35
- D. 65
- E. 80



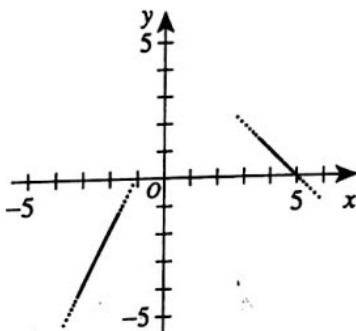
4. A group of students was surveyed about what types of music each had listened to during the previous week. Students could choose 1, 2, or 3 types of music (Rap, Rock, or Country), or they could respond "none of these music types." Only 10 students responded with "none of these music types," and 18 students responded that they had listened to all 3 types. In the figure below, the 8 regions show the numbers of responses in each category.



DO YOUR FIGURING HERE.

One region had exactly 8 responses. What type(s) of music did those 8 students respond they had listened to during the previous week?

- F. Rap only
 G. Country and Rock only
 H. Country and Rap only
 J. Rap and Rock only
 K. All 3 types of music
5. What is the value of $2|2 - 9| - 3(4 + 2)$?
- A. -32
 B. -26
 C. -15
 D. -5
 E. -4
6. Portions of the graphs represented by the functions $-2x + y = 2$ and $x + y = 5$ are shown in the standard (x, y) coordinate plane below. Although only a portion of each graph is shown, the domain of each function is all real numbers. If it can be determined, at what point do the graphs intersect?



- F. $(-1, 5)$
 G. $(1, 4)$
 H. $(2, 5)$
 J. $(4, 1)$
 K. Cannot be determined from the given information



7. On a map, $\frac{1}{2}$ inch represents 10 actual miles. Two towns that are $4\frac{1}{2}$ inches apart on this map are how many actual miles apart?

A. 10
B. 20
C. $22\frac{1}{2}$
D. 45
E. 90

8. The cost of a long-distance call to a certain city is \$1.05 for the first minute and \$0.15 for each additional minute or part thereof. What is the cost of a 15-minute call to this city?

F. \$1.20
G. \$2.25
H. \$3.15
J. \$3.30
K. \$3.45

9. Property valued at \$56,000 is assessed at $\frac{3}{4}$ of its value. If the yearly tax is calculated as \$3 per \$100 of assessed value, what is the yearly tax on this property?

A. \$ 420
B. \$1,120
C. \$1,260
D. \$1,680
E. \$2,240

10. Tammy will draft 1 player at random from a list of 20 players for her fantasy football team. Each player in the list plays only 1 position. The number of players who play a particular position is given in the table below. What is the probability that the player Tammy drafts will be a kicker or a receiver?

Position	Number of players
Kicker	4
Linebacker	2
Quarterback	6
Receiver	8

F. $\frac{2}{25}$
G. $\frac{1}{5}$
H. $\frac{2}{5}$
J. $\frac{1}{2}$
K. $\frac{3}{5}$

DO YOUR FIGURING HERE.



11. Ben is saving money to buy a TV that costs \$495, including tax. Ben opens a savings account with a deposit of \$75 and deposits \$65 at the end of each month. What is the minimum number of months Ben will need to make deposits until he has enough money in his account to buy the TV?

A. 5
B. 6
C. 7
D. 8
E. 9

DO YOUR FIGURING HERE.

12. What is the slope of \overleftrightarrow{HM} , shown in the standard (x,y) coordinate plane below?

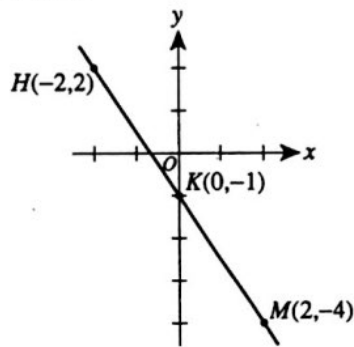
F. $-\frac{3}{2}$

G. -1

H. $-\frac{2}{3}$

J. $\frac{2}{3}$

K. $\frac{3}{2}$



13. The polynomial $45x^2 + 26x - 8$ is equivalent to the product of $(5x + 4)$ and which of the following binomials?

A. $9x - 4$
B. $9x - 2$
C. $9x + 4$
D. $40x - 12$
E. $40x - 2$

14. Given that $\sin^2 x = \frac{4}{13}$, what is $\cos^2 x$?

F. $\frac{4}{9}$

G. $\frac{9}{4}$

H. $\frac{9}{13}$

J. $\frac{13}{9}$

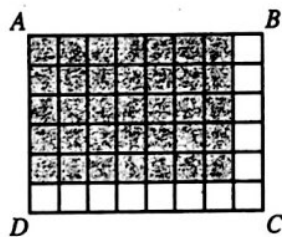
K. $\frac{13}{4}$



DO YOUR FIGURING HERE.

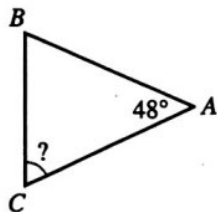
15. In the figure below, all of the small squares are equal in area, and the area of rectangle $ABCD$ is 1 square unit. Which of the following expressions represents the area, in square units, of the shaded region?

- A. $\frac{1}{8} \cdot \frac{1}{6}$
 B. $\frac{1}{8} \cdot \frac{5}{6}$
 C. $\frac{1}{8} \cdot \frac{7}{8}$
 D. $\frac{7}{8} \cdot \frac{1}{6}$
 E. $\frac{7}{8} \cdot \frac{5}{6}$



16. In $\triangle ABC$ shown below, the measure of $\angle A$ is 48° , and $\overline{AB} \cong \overline{AC}$. What is the measure of $\angle C$?

- F. 42°
 G. 48°
 H. 52°
 J. 66°
 K. 72°



17. The first 5 terms of a sequence are given in the table below. The sequence is defined by setting $a_1 = 9$ and $a_n = a_{n-1} + (n-1)^2$ for $n \geq 2$. What is the sixth term, a_6 , of this sequence?

a_1	a_2	a_3	a_4	a_5	a_6
9	10	14	23	39	?

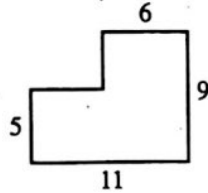
- A. 62
 B. 64
 C. 76
 D. 78
 E. 95

18. In the standard (x,y) coordinate plane, the line represented by which of the following equations goes through $(0,7)$ and is parallel to the line represented by $y = -2x - 4$?

- F. $y = -2x - 7$
 G. $y = -2x + 7$
 H. $y = \frac{1}{2}x - 7$
 J. $y = \frac{1}{2}x + 7$
 K. $y = 7x - 4$



19. A scale drawing of Corinne's bedroom floor is shown below. All given dimensions are in feet, and all intersecting line segments shown are perpendicular. Corinne wants to completely cover the floor with square hardwood tiles. Each tile has a side length of 1 foot, and no tiles will be cut. How many tiles will Corinne need to cover the floor?



- A. 63
B. 69
C. 74
D. 79
E. 84

DO YOUR FIGURING HERE.

20. A survey about 3 issues affecting Bluff City Park was given to 60 residents. The results of the survey are shown below.

Issue	Yes	No
Curfew	48	12
Skateboard use	26	34
Children under 14 accompanied by a person at least 14 years old	38	22

Assume that the results in the table accurately predict the response ratios for the town's 1,200 residents. How many of the 1,200 residents would respond No on the curfew issue?

- F. 240
G. 300
H. 600
J. 680
K. 960

21. In the standard (x,y) coordinate plane, the graph of the line $3x - 4y = d$ passes through the point $(-5,6)$. What is the value of d ?

- A. -39
B. -9
C. 2
D. 9
E. 38

22. Given u and v such that $(a^2)^u = a^{12}$ and $(a^v)^2 = a^8$ for all positive a , what is a^{u+v} ?

- F. a^5
G. a^{10}
H. a^{16}
J. a^{20}
K. a^{24}



DO YOUR FIGURING HERE.

23. In the standard (x,y) coordinate plane, a translation maps a point (x,y) to its image $(x-5, y+3)$. To what image does this translation map $(-3,-2)$?

A. $(-8,-5)$
 B. $(-8, 1)$
 C. $(-2, 1)$
 D. $(2,-5)$
 E. $(2, 1)$

24. Given $x = \frac{4a+b}{3}$, which of the following expressions is equivalent to b ?

F. $3x - 4a$

G. $3x + 4a$

H. $x - \frac{4a}{3}$

J. $\frac{x}{3} - 4a$

K. $\frac{x-4a}{3}$

25. Matt purchased a 60-foot-long roll of chain-link fence. He used the entire roll of fence to construct a rectangular pen for his dog. Given that the pen is 12 feet wide, what is its length, in feet?

A. 5
 B. 18
 C. 24
 D. 36
 E. 48

26. Angle $\angle JKL$ is shown below with the given lengths in coordinate units. What is the measure of $\angle JKL$ in radians?

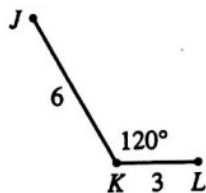
F. $\frac{2}{3\pi}$

G. $\frac{3}{2\pi}$

H. $\frac{\pi}{3}$

J. $\frac{2\pi}{3}$

K. $\frac{4\pi}{3}$



27. A rectangle is $3\sqrt{5}$ meters wide and $5\sqrt{5}$ meters long. What is the area, in square meters, of the rectangle?

A. 75
 B. $16\sqrt{5}$
 C. $15\sqrt{5}$
 D. $8\sqrt{10}$
 E. $8\sqrt{5}$



DO YOUR FIGURING HERE.

28. Which of the following operations will produce the largest result when substituted for the blank in the expression $11 \text{ --- } \left(-\frac{1}{83}\right)$?

F. Averaged with
 G. Divided by
 H. Minus
 J. Plus
 K. Multiplied by

29. In Westville on Tuesday, the high temperature was 30°C and the low temperature was 20°C . What was the difference between the high and low temperatures, in degrees *Fahrenheit*?

(Note: The relationship between the temperature c , in degrees Celsius, and the temperature f , in degrees Fahrenheit, is given by $c = \frac{5}{9}(f - 32)$.)

A. $5\frac{5}{9}^{\circ}\text{F}$
 B. 10°F
 C. $12\frac{2}{9}^{\circ}\text{F}$
 D. 18°F
 E. 46°F

30. A committee will be selected from a group of 12 women and 18 men. The committee will consist of 5 women and 5 men. Which of the following expressions gives the number of different committees that could be selected from these 30 people?

F. ${}_{30}P_{10}$
 G. $({}_{12}P_5)({}_{18}P_5)$
 H. ${}_{30}C_{10}$
 J. $({}_{30}C_5)({}_{30}C_5)$
 K. $({}_{12}C_5)({}_{18}C_5)$

31. Which of the following expressions is equal to

$$\frac{3}{4 - \sqrt{5}}?$$

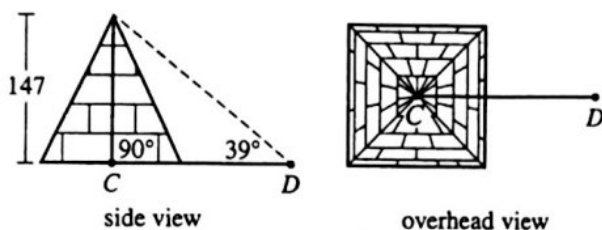
A. $\frac{3}{11}$
 B. $\frac{3}{7}$
 C. $\frac{12 - 3\sqrt{5}}{21}$
 D. $\frac{12 + \sqrt{15}}{11}$
 E. $\frac{12 + 3\sqrt{5}}{11}$



Use the following information to answer questions 32–34.

DO YOUR FIGURING HERE.

When it was constructed 4,500 years ago, the Great Pyramid in Egypt had a height of 147 meters and contained roughly 2.3 million stone blocks. It is estimated that 5.5 million tons of limestone, 8,000 tons of granite, and 500,000 tons of mortar were used in its construction. In the side view shown below, an ancient observer found the angle of elevation at D to the top of the pyramid to be 39° . The diagonals of the pyramid's square base, shown below, intersect at C .



32. When written in scientific notation, which of the following expressions is equal to the number of blocks used to construct the pyramid?
- F. 2.3×10^6
 - G. 7.8×10^6
 - H. 8.3×10^6
 - J. 23×10^5
 - K. 78×10^5
33. The perimeter of the pyramid's base was 920 meters when construction was completed. At that time, which of the following values is closest to the length, in meters, of each diagonal of the base?
- A. 30
 - B. 40
 - C. 230
 - D. 320
 - E. 650
34. Which of the following expressions is equal to the length, in meters, of \overline{DC} ?
- F. $147 \sin 39^\circ$
 - G. $147 \tan 39^\circ$
 - H. $\frac{147}{\cos 39^\circ}$
 - J. $\frac{147}{\sin 39^\circ}$
 - K. $\frac{147}{\tan 39^\circ}$



35. In $\triangle ABC$, $AB = 6$ cm, $AC = 12$ cm, $m\angle A = 60^\circ$, and \overline{AC} is the longest side. Which of the following statements about the measures of the angles in $\triangle ABC$ must be true?

(Note: $m\angle X$ denotes the measure of angle X .)

- A. $m\angle A = m\angle B = m\angle C$
- B. $m\angle B > m\angle A > m\angle C$
- C. $m\angle B = m\angle C > m\angle A$
- D. $m\angle B > m\angle C = m\angle A$
- E. $m\angle C > m\angle A > m\angle B$

DO YOUR FIGURING HERE.

36. Erika is landscaping her front yard. The yard, which is level, has the shape of a rectangle that is 60 feet wide by 80 feet long. To cover the yard with a layer of topsoil having a uniform depth of 4 inches ($\frac{1}{3}$ foot), Erika needs to use how many cubic feet of topsoil?

- F. 1,600
- G. 1,920
- H. 4,800
- J. 14,400
- K. 19,200

37. Suzanne and Chad are going to bake and deliver cookies to college students during final exam week. They estimate it will cost \$4 for the ingredients to make each batch of cookies and \$50 to buy the mixer, bowls, and other utensils they will need. They decide to sell the cookies for \$5 per batch. Assume they have no other expenses. Which of the following equations represents the profit, P dollars, they will make on b batches of cookies?

- A. $P = 49b$
- B. $P = 54b - 5$
- C. $P = 55b - 4$
- D. $P = -b + 50$
- E. $P = b - 50$

38. The sum of the measures of $\angle A$ and $\angle B$ is 90° . The sum of the measures of $\angle A$ and $\angle C$ is 180° . The sum of the measures of $\angle B$ and $\angle D$ is 180° . What is the sum of the measures of $\angle C$ and $\angle D$?

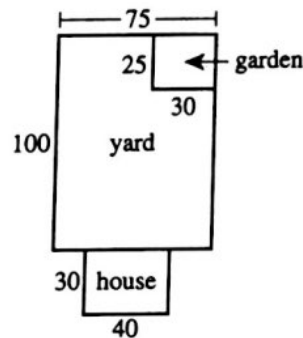
- F. 45°
- G. 90°
- H. 180°
- J. 270°
- K. 360°



Use the following information to answer questions 39–41.

DO YOUR FIGURING HERE.

The figure below shows the top view of the Santana family's house and yard. The Santanas' rectangular house is 40 feet wide and 30 feet long, and their rectangular yard is 75 feet wide and 100 feet long. The Santanas have a rectangular garden in the back corner of their yard that is 30 feet wide and 25 feet long. The garden currently contains 48 flower bulbs: 10 tulip bulbs, 18 daffodil bulbs, and 20 crocus bulbs.



39. The yard will be enclosed by a fence and the back side of the house. The fence will begin at one back corner of the house and will end at the other. What is the minimum number of feet of fencing needed to enclose the yard?
- A. 215
B. 275
C. 310
D. 315
E. 350
40. The area of the garden is what percent of the area of the yard?
- F. 9%
G. 10%
H. 11%
J. 25%
K. 40%
41. Beginning next year, Mr. Santana will increase the number of bulbs in the garden each year so that the numbers form a geometric sequence. In 3 years, there will be 162 bulbs in the garden. By what factor will the number of bulbs be multiplied each year?
- A. 1.125
B. 1.5
C. 3.375
D. 4.85
E. 38



DO YOUR FIGURING HERE.

42. Suspended from the ceiling is a weight on a large spring that is oscillating up and down. The distance, d inches, between the location of the center of the mass of the weight after t seconds and the weight's equilibrium location at $t = 0$ is modeled by the function $d = 5 \sin(4\pi t)$. What is the amplitude of the function?

F. $\frac{1}{2}$
 G. 2
 H. 4
 J. 5
 K. 10

43. Given that $i^2 = -1$ and that k is a positive integer, what is the value of $i^{(4k+2)}$?

A. $-i$
 B. -1
 C. 0
 D. 1
 E. i

44. Ling asked 11 people how many text messages each of them sent last week. Each of the 11 responses was in one of the intervals given in the table below. Which interval contains the median of the data?

Number of text messages sent	Number of responses
31–40	1
41–50	2
51–60	2
61–70	3
71–80	3

F. 31–40
 G. 41–50
 H. 51–60
 J. 61–70
 K. 71–80

45. For all real numbers a , b , and c , which of the following expressions is equal to $|a - b - c|$?

A. $|a + b + c|$
 B. $|a + b - c|$
 C. $|a - b + c|$
 D. $|-a + b + c|$
 E. $|-a - b - c|$



46. Given $g(x) = \frac{x+1}{x^2}$, which of the following expressions is equal to $g(x-1)$ for all x in its domain?

DO YOUR FIGURING HERE.

F. $\frac{x}{x^2 - 2x + 1}$

G. $\frac{x}{x^2 - 1}$

H. $\frac{x}{2x - 2}$

J. $\frac{x+1}{x-1}$

K. $\frac{-x^2 + x + 1}{x^2}$

47. A circle with radius 10 cm is divided into 3 congruent arcs. What is the length, in centimeters, of each of the 3 arcs?

A. $\frac{10\pi}{3}$

B. $\frac{20\pi}{3}$

C. 10π

D. $\frac{40\pi}{3}$

E. 20π

48. Consider all positive integers that are multiples of 20 and that are less than or equal to 300. What fraction of those integers are multiples of 15?

F. $\frac{1}{3}$

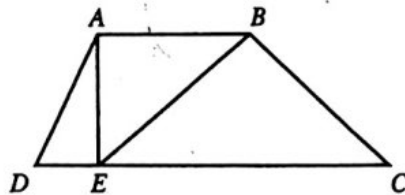
G. $\frac{1}{5}$

H. $\frac{1}{15}$

J. $\frac{7}{15}$

K. $\frac{8}{15}$

49. In the figure below, $ABCD$ is a trapezoid with \overline{AE} perpendicular to \overline{AB} ; \overline{AE} is 10 units long; and \overline{DC} is 28 units long. If the area of right triangle $\triangle EBA$ is 60 square units, what is the area, in square units, of trapezoid $ABCD$?



- A. 140
B. 170
C. 180
D. 200
E. 240

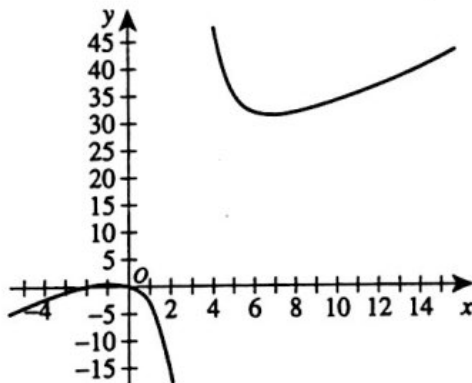


50. The fraction $\frac{2}{7}$ is equivalent to $0.\overline{285714}$. What is the digit in the 1,001st decimal place of $0.\overline{285714}$?

DO YOUR FIGURING HERE.

(Note: The digit in the 4th decimal place of $0.\overline{285714}$ is 7.)

- F. 1
G. 2
H. 4
J. 5
K. 7
51. The 3 lines with equations $y = 4$, $x = -3$, and $y = x$, respectively, bound a unique triangular region in the standard (x,y) coordinate plane. Which of the following descriptions is the best classification of this triangle?
- A. Equilateral
B. Acute isosceles
C. Right isosceles
D. Acute scalene
E. Right scalene
52. At what point in the standard (x,y) coordinate plane do the asymptotes of the function $y = \frac{2x(x+2)}{x-3}$, graphed below, intersect?



- F. $(-\frac{7}{3}, 3)$
G. $(\frac{7}{3}, 10)$
H. $(3, 10)$
J. $(3, 16)$
K. $(3, 31)$

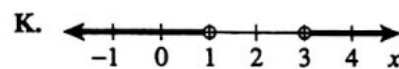
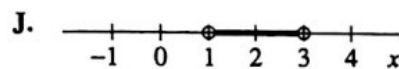
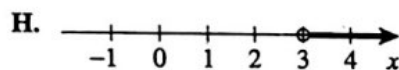
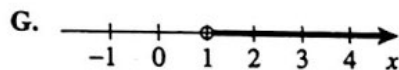
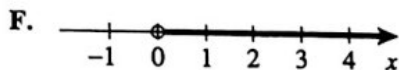


53. The employees at a hotel reservation center assign an 8-digit confirmation number (CN) to each customer making a reservation. The first digit in each CN is 8. The other 7 digits can be any digit 0 through 9, and digits may repeat. How many possible 8-digit CNs are there?

A. 8^7
 B. 9^7
 C. 10^7
 D. 8^8
 E. 10^8

DO YOUR FIGURING HERE.

54. Which of the following number line graphs represents all values in the domain of the function $y = \log_{10}(x^2 - 4x + 3)$?



55. What is the determinant of the matrix shown below?

$$\begin{vmatrix} 8 & 3 \\ -5 & -2 \end{vmatrix}$$

A. 34
 B. 4
 C. -1
 D. -25
 E. -31

56. At Wafer Technologies, identification codes each consist of the following sequence: 1 digit, 4 letters, 1 digit. For any 1 code, the digits (0-9) may be the same, but the letters, each from the English alphabet, must all be different. Which of the following expressions gives the probability that a randomly selected identification code contains the word MATH, spelled correctly?

F. $\frac{10^2}{10^2(26^4)}$

G. $\frac{10^2}{10^2(26)(25)(24)(23)}$

H. $\frac{10^2}{10(9)(26)(25)(24)(23)}$

J. $\frac{10^2(4)(3)(2)(1)}{10^2(26^4)}$

K. $\frac{10^2(4)(3)(2)(1)}{10(26)(25)(24)(23)}$



57. What is the distance, in coordinate units, between $2 + 6i$ and $-4 + 3i$ in the complex plane?

A. 7
 B. 9
 C. $\sqrt{13}$
 D. $\sqrt{45}$
 E. $\sqrt{85}$

DO YOUR FIGURING HERE.

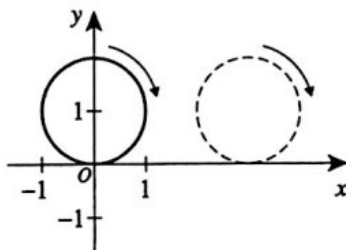
58. What is the minimum value of $f(x) = |-(x - h)^2 + k| - q$ for each set of positive real numbers, h , k , and q ?

F. $-q$
 G. $-k$
 H. k
 J. $-k - q$
 K. $k - q$

59. Which of the following data sets has the greatest standard deviation?

A. 1, 1, 1, 10, 10, 10
 B. 1, 2, 3, 4, 5, 6
 C. 2, 6, 6, 10, 10, 12
 D. 5, 5, 5, 5, 5, 5
 E. 5, 6, 7, 8, 9, 10

60. The circle with equation $x^2 + (y - 1)^2 = 1$ is graphed in the standard (x, y) coordinate plane below. Suppose the circle rolls along the positive x -axis for 2 rotations and then stops. Which of the following is an equation of the circle in its new position?



F. $(x + 2)^2 + (y - 1)^2 = 1$
 G. $(x + 2\pi)^2 + (y - 1)^2 = 1$
 H. $(x + 4\pi)^2 + (y - 1)^2 = 1$
 J. $(x - 2\pi)^2 + (y - 1)^2 = 1$
 K. $(x - 4\pi)^2 + (y - 1)^2 = 1$

END OF TEST 2

STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.

DO NOT RETURN TO THE PREVIOUS TEST.

math

1. C	11. C	21. A	31. E	41. B	51. C
2. K	12. F	22. G	32. F	42. J	52. J
3. C	13. B	23. B	33. D	43. B	53. C
4. J	14. H	24. F	34. K	44. J	54. K
5. E	15. E	25. B	35. B	45. D	55. C
6. G	16. J	26. J	36. F	46. F	56. G
7. E	17. B	27. A	37. E	47. B	57. D
8. H	18. G	28. H	38. J	48. F	58. F
9. C	19. D	29. D	39. C	49. D	59. A
10. K	20. F	30. K	40. G	50. F	60. K