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## 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.

1.  $|7 - 3| - |3 - 7| = ?$

- A. -8
- B. -6
- C. -4
- D. 0
- E. 8

2. A consultant charges \$45 for each hour she works on a consultation, plus a flat \$30 consulting fee. How many hours of work are included in a \$210 bill for a consultation?

- F.  $2\frac{4}{5}$
- G. 4
- H.  $4\frac{2}{3}$
- J.  $5\frac{1}{2}$
- K. 7

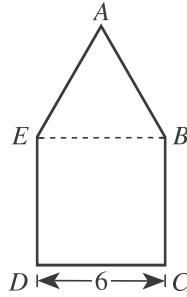
3. Vehicle A averages 14 miles per gallon of gasoline, and Vehicle B averages 36 miles per gallon of gasoline. At these rates, how many more gallons of gasoline does Vehicle A need than Vehicle B to make a 1,008-mile trip?

- A. 25
- B. 28
- C. 44
- D. 50
- E. 72

4.  $t^2 - 59t + 54 - 82t^2 + 60t$  is equivalent to:

- F.  $-26t^2$
- G.  $-26t^6$
- H.  $-81t^4 + t^2 + 54$
- J.  $-81t^2 + t + 54$
- K.  $-82t^2 + t + 54$

5. The figure below is composed of square  $BCDE$  and equilateral triangle  $\triangle ABE$ . The length of  $\overline{CD}$  is 6 inches. What is the perimeter of  $ABCDE$ , in inches?



- A. 18
- B. 24
- C. 30
- D. 42
- E. 45

6. The expression  $(4z + 3)(z - 2)$  is equivalent to:

- F.  $4z^2 - 5$
- G.  $4z^2 - 6$
- H.  $4z^2 - 3z - 5$
- J.  $4z^2 - 5z - 6$
- K.  $4z^2 + 5z - 6$

7. If 40% of a given number is 8, then what is 15% of the given number?

- A. 1.2
- B. 1.8
- C. 3.0
- D. 5.0
- E. 6.5

8. The 6 consecutive integers below add up to 447.

$$\begin{array}{c} x - 2 \\ x - 1 \\ x \\ x + 1 \\ x + 2 \\ x + 3 \end{array}$$

What is the value of  $x$ ?

- F. 72
- G. 73
- H. 74
- J. 75
- K. 76

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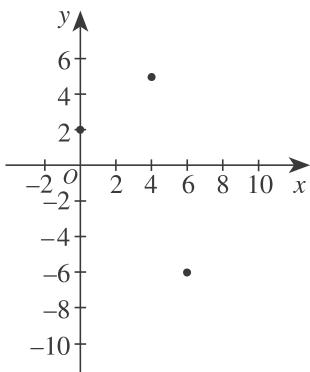


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9. In the standard  $(x,y)$  coordinate plane, point  $M$  with coordinates  $(5,4)$  is the midpoint of  $\overline{AB}$ , and  $B$  has coordinates  $(7,3)$ . What are the coordinates of  $A$ ?

- A.  $(17,11)$
- B.  $(9,2)$
- C.  $(6,3.5)$
- D.  $(3,5)$
- E.  $(-3,-5)$

10. Rectangle  $ABCD$  has vertices  $A(4,5)$ ,  $B(0,2)$ , and  $C(6,-6)$ . These vertices are graphed below in the standard  $(x,y)$  coordinate plane. What are the coordinates of vertex  $D$ ?

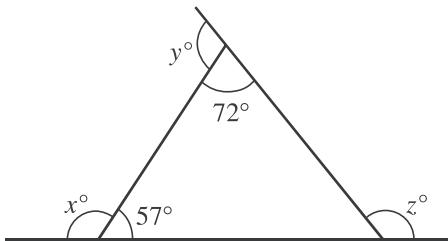


11. Daisun owns 2 sportswear stores (X and Y). She stocks 3 brands of T-shirts (A, B, and C) in each store. The matrices below show the numbers of each type of T-shirt in each store and the cost for each type of T-shirt. The value of Daisun's T-shirt inventory is computed using the costs listed. What is the total value of the T-shirt inventory for Daisun's 2 stores?

$$\begin{array}{l} \text{A} \quad \text{B} \quad \text{C} \\ \text{X} \quad \left[ \begin{matrix} 100 & 200 & 150 \end{matrix} \right] \\ \text{Y} \quad \left[ \begin{matrix} 120 & 50 & 100 \end{matrix} \right] \end{array} \quad \begin{array}{l} \text{Cost} \\ \text{A} \quad [\$5] \\ \text{B} \quad [\$10] \\ \text{C} \quad [\$15] \end{array}$$

- A. \$2,200
- B. \$2,220
- C. \$4,965
- D. \$5,450
- E. \$7,350

12. Given the triangle shown below with exterior angles that measure  $x^\circ$ ,  $y^\circ$ , and  $z^\circ$  as shown, what is the sum of  $x$ ,  $y$ , and  $z$ ?



Use the following information to answer questions 13–15.

A poll of 200 registered voters was taken before the election for mayor of Springdale. All 200 voters indicated which 1 of the 4 candidates they would vote for. The results of the poll are given in the table below.

Candidate	Number of voters
Blackcloud	50
Lue	80
Gomez	40
Whitney	30

13. What percent of the voters polled chose Whitney in the poll?

- A. 15%
- B. 20%
- C. 25%
- D. 30%
- E. 40%

14. If the poll is indicative of how the 10,000 registered voters of Springdale will actually vote in the election, which of the following is the best estimate of the number of votes Lue will receive in the election?

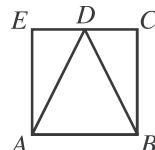
- F. 1,500
- G. 2,500
- H. 4,000
- J. 5,000
- K. 8,000

15. If the information in the table were converted into a circle graph (pie chart), then the central angle of the sector for Gomez would measure how many degrees?

- A.  $54^\circ$
- B.  $72^\circ$
- C.  $90^\circ$
- D.  $108^\circ$
- E.  $144^\circ$

16. In square  $ABCE$  shown below,  $D$  is the midpoint of  $\overline{CE}$ . Which of the following is the ratio of the area of  $\triangle ADE$  to the area of  $\triangle ADB$ ?

- F. 1:1
- G. 1:2
- H. 1:3
- J. 1:4
- K. 1:8



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17. Which of the following is the slope of a line parallel to the line  $y = \frac{2}{3}x - 4$  in the standard  $(x,y)$  coordinate plane?

- A.  $-4$
- B.  $-\frac{3}{2}$
- C.  $2$
- D.  $\frac{3}{2}$
- E.  $\frac{2}{3}$

18. Janelle cut a board 30 feet long into 2 pieces. The ratio of the lengths of the 2 pieces is 2:3. What is the length, to the nearest foot, of the shorter piece?

- F.  $5$
- G.  $6$
- H.  $12$
- J.  $15$
- K.  $18$

19. What is the smallest integer greater than  $\sqrt{58}$ ?

- A.  $4$
- B.  $7$
- C.  $8$
- D.  $10$
- E.  $30$

20. Sergio plans to paint the 4 walls of his room with 1 coat of paint. The walls are rectangular, and, according to his measurements, each wall is 10 feet by 15 feet. He will not need to paint the single 3-foot-by-5-foot rectangular window in his room and the  $3\frac{1}{2}$ -foot-by-7-foot rectangular door. Sergio knows that each gallon of paint covers between 300 and 350 square feet. If only 1-gallon cans of paint are available, which of the following is the minimum number of cans of paint Sergio needs to buy to paint his walls?

- F.  $1$
- G.  $2$
- H.  $3$
- J.  $4$
- K.  $5$

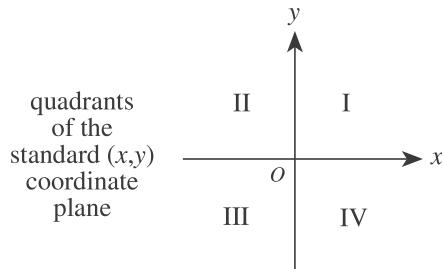
21. What values of  $x$  are solutions for  $x^2 + 2x = 8$ ?

- A.  $-4$  and  $2$
- B.  $-2$  and  $0$
- C.  $-2$  and  $4$
- D.  $0$  and  $2$
- E.  $6$  and  $8$

22. For all  $a > 1$ , the expression  $\frac{3a^4}{3a^6}$  equals:

- F.  $\frac{1}{2}$
- G.  $-a^2$
- H.  $a^2$
- J.  $-\frac{1}{a^2}$
- K.  $\frac{1}{a^2}$

23. If point  $M$  has a nonzero  $x$ -coordinate and a nonzero  $y$ -coordinate and the coordinates have opposite signs, then point  $M$  must be located in which of the 4 quadrants labeled below?



- A. I only
- B. III only
- C. I or III only
- D. I or IV only
- E. II or IV only

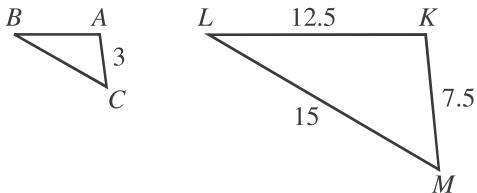
24. The fixed costs of manufacturing basketballs in a factory are \$1,400.00 per day. The variable costs are \$5.25 per basketball. Which of the following expressions can be used to model the cost of manufacturing  $b$  basketballs in 1 day?

- F.  $\$1,405.25b$
- G.  $\$5.25b - \$1,400.00$
- H.  $\$1,400.00b + \$5.25$
- J.  $\$1,400.00 - \$5.25b$
- K.  $\$1,400.00 + \$5.25b$



25. In the figure below, where  $\triangle ABC \sim \triangle KLM$ , lengths given are in centimeters. What is the perimeter, in centimeters, of  $\triangle ABC$ ?

(Note: The symbol  $\sim$  means “is similar to.”)



- A. 12  
B. 14  
C.  $21\frac{1}{2}$   
D. 35  
E.  $71\frac{3}{4}$
26. If  $\frac{3\sqrt{7}}{a\sqrt{7}} = \frac{3\sqrt{7}}{7}$  is true, then  $a = ?$

- F. 1  
G.  $\sqrt{7}$   
H. 7  
J. 21  
K. 49

27. A hot-air balloon 70 meters above the ground is falling at a constant rate of 6 meters per second while another hot-air balloon 10 meters above the ground is rising at a constant rate of 15 meters per second. To the nearest tenth of a second, after how many seconds will the 2 balloons be the same height above the ground?

- A. 8.9  
B. 6.7  
C. 2.9  
D. 0.4  
E. 0.2

28. A hiking group will go from a certain town to a certain village by van on 1 of 4 roads, from the village to a waterfall by riding bicycles on 1 of 2 bicycle paths, and then from the waterfall to their campsite by hiking on 1 of 6 trails. How many routes are possible for the hiking group to go from the town to the village to the waterfall to their campsite?

- F. 6  
G. 12  
H. 24  
J. 48  
K. 220

29. Cube A has an edge length of 2 inches. Cube B has an edge length double that of Cube A. What is the volume, in cubic inches, of Cube B?

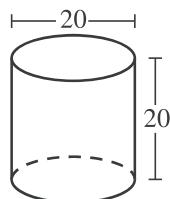
- A. 4  
B. 8  
C. 16  
D. 32  
E. 64

30. A formula used to compute the current value of a savings account is  $A = P(1 + r)^n$ , where  $A$  is the current value;  $P$  is the amount deposited;  $r$  is the rate of interest for 1 compounding period, expressed as a decimal; and  $n$  is the number of compounding periods. Which of the following is closest to the value of a savings account after 5 years if \$10,000 is deposited at 4% annual interest compounded yearly?

- F. \$10,400  
G. \$12,167  
H. \$42,000  
J. \$52,000  
K. \$53,782

31. A right circular cylinder is shown in the figure below, with dimensions given in centimeters. What is the total surface area of this cylinder, in square centimeters?

(Note: The total surface area of a cylinder is given by  $2\pi r^2 + 2\pi rh$  where  $r$  is the radius and  $h$  is the height.)



- A.  $300\pi$   
B.  $400\pi$   
C.  $500\pi$   
D.  $600\pi$   
E.  $1,600\pi$

32. Given  $f(x) = 4x + 1$  and  $g(x) = x^2 - 2$ , which of the following is an expression for  $f(g(x))$ ?

- F.  $-x^2 + 4x + 1$   
G.  $x^2 + 4x - 1$   
H.  $4x^2 - 7$   
J.  $4x^2 - 1$   
K.  $16x^2 + 8x - 1$

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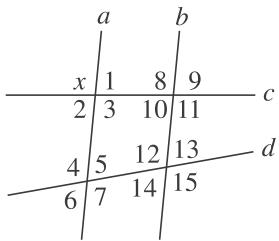
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33. The table below shows the total number of goals scored in each of 43 soccer matches in a regional tournament. What is the average number of goals scored per match, to the nearest 0.1 goal?

Total number of goals in a match	Number of matches with this total
0	4
1	10
2	5
3	9
4	7
5	5
6	1
7	2

- A. 1.0  
B. 2.8  
C. 3.0  
D. 6.1  
E. 17.1

34. Lines  $a$ ,  $b$ ,  $c$ , and  $d$  are shown below and  $a \parallel b$ . Which of the following is the set of all angles that must be supplementary to  $\angle x$ ?



- F. {1, 2}  
G. {1, 2, 5, 6}  
H. {1, 2, 9, 10}  
J. {1, 2, 5, 6, 9, 10}  
K. {1, 2, 5, 6, 9, 10, 13, 14}

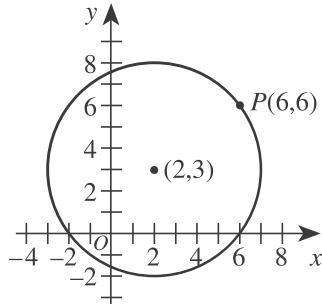
35.  $(3x^3)^3$  is equivalent to:

- A.  $x$   
B.  $9x^6$   
C.  $9x^9$   
D.  $27x^6$   
E.  $27x^9$

36. Which of the following is equivalent to the inequality  $4x - 8 > 8x + 16$ ?

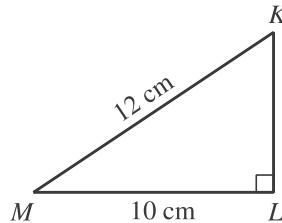
- F.  $x < -6$   
G.  $x > -6$   
H.  $x < -2$   
J.  $x > 2$   
K.  $x < 6$

37. As shown in the standard  $(x,y)$  coordinate plane below,  $P(6,6)$  lies on the circle with center  $(2,3)$  and radius 5 coordinate units. What are the coordinates of the image of  $P$  after the circle is rotated  $90^\circ$  clockwise ( $C'$ ) about the center of the circle?

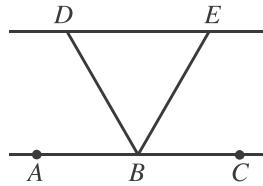


38. For right triangle  $\triangle KLM$  below, what is  $\sin \angle M$ ?

- F.  $\frac{10}{12}$   
G.  $\frac{12}{10}$   
H.  $\frac{\sqrt{44}}{10}$   
J.  $\frac{10}{\sqrt{44}}$   
K.  $\frac{\sqrt{44}}{12}$



39. In the figure below,  $B$  lies on  $\overline{AC}$ ,  $\overline{BD}$  bisects  $\angle ABE$ , and  $\overline{BE}$  bisects  $\angle CBD$ . What is the measure of  $\angle DBE$ ?



- A.  $90^\circ$   
B.  $60^\circ$   
C.  $45^\circ$   
D.  $30^\circ$   
E. Cannot be determined from the given information

40. If there are  $8 \times 10^{12}$  hydrogen molecules in a volume of  $4 \times 10^4$  cubic centimeters, what is the average number of hydrogen molecules per cubic centimeter?

- F.  $5 \times 10^{-9}$   
G.  $2 \times 10^3$   
H.  $2 \times 10^8$   
J.  $32 \times 10^{16}$   
K.  $32 \times 10^{48}$

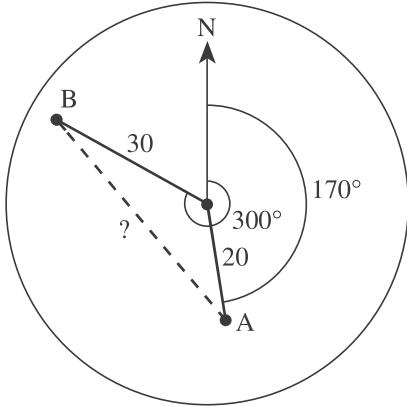
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41. In the figure below, a radar screen shows 2 ships. Ship A is located at a distance of 20 nautical miles and bearing  $170^\circ$ , and Ship B is located at a distance of 30 nautical miles and bearing  $300^\circ$ . Which of the following is an expression for the straight-line distance, in nautical miles, between the 2 ships?

(Note: For  $\triangle ABC$  with side of length  $a$  opposite  $\angle A$ , side of length  $b$  opposite  $\angle B$ , and side of length  $c$  opposite  $\angle C$ , the law of cosines states  $c^2 = a^2 + b^2 - 2ab \cos \angle C$ .)

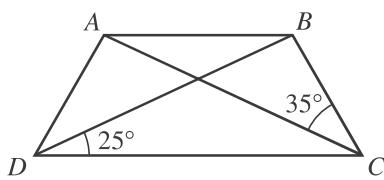


- A.  $\sqrt{20^2 + 30^2 - 2(20)(30)\cos 60^\circ}$   
 B.  $\sqrt{20^2 + 30^2 - 2(20)(30)\cos 130^\circ}$   
 C.  $\sqrt{20^2 + 30^2 - 2(20)(30)\cos 170^\circ}$   
 D.  $\sqrt{20^2 + 30^2 - 2(20)(30)\cos 300^\circ}$   
 E.  $\sqrt{20^2 + 30^2 - 2(20)(30)\cos 470^\circ}$

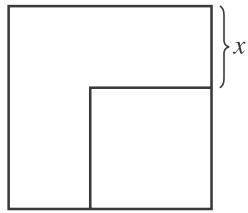
42. What rational number is halfway between  $\frac{1}{5}$  and  $\frac{1}{3}$  ?
- F.  $\frac{1}{2}$   
 G.  $\frac{1}{4}$   
 H.  $\frac{2}{15}$   
 J.  $\frac{4}{15}$   
 K.  $\frac{8}{15}$

43. In isosceles trapezoid  $ABCD$ ,  $\overline{AB}$  is parallel to  $\overline{DC}$ ,  $\angle BDC$  measures  $25^\circ$ , and  $\angle BCA$  measures  $35^\circ$ . What is the measure of  $\angle DBC$  ?

- A.  $85^\circ$   
 B.  $95^\circ$   
 C.  $105^\circ$   
 D.  $115^\circ$   
 E.  $125^\circ$



44. In the figure below, the area of the larger square is 50 square centimeters and the area of the smaller square is 18 square centimeters. What is  $x$ , in centimeters?



- F. 2  
 G.  $2\sqrt{2}$   
 H.  $4\sqrt{2}$   
 J. 16  
 K. 32

45. Which of the following is a rational number?

- A.  $\sqrt{2}$   
 B.  $\sqrt{\pi}$   
 C.  $\sqrt{7}$   
 D.  $\sqrt{\frac{5}{25}}$   
 E.  $\sqrt{\frac{64}{49}}$

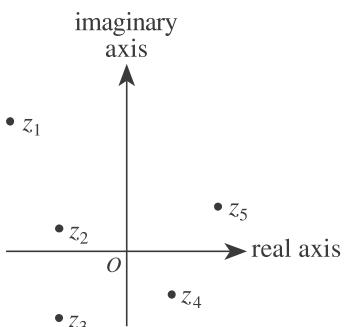
46. If  $a < b$ , then  $|a - b|$  is equivalent to which of the following?
- F.  $a + b$   
 G.  $-(a + b)$   
 H.  $\sqrt{a - b}$   
 J.  $a - b$   
 K.  $-(a - b)$

47. Tom has taken 5 of the 8 equally weighted tests in his U.S. History class this semester, and he has an average score of exactly 78.0 points. How many points does he need to earn on the 6th test to bring his average score up to exactly 80.0 points?

- A. 90  
 B. 88  
 C. 82  
 D. 80  
 E. 79



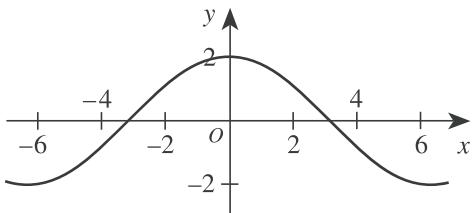
48. In the complex plane, the horizontal axis is called the *real axis* and the vertical axis is called the *imaginary axis*. The complex number  $a + bi$  graphed in the complex plane is comparable to the point  $(a,b)$  graphed in the standard  $(x,y)$  coordinate plane. The *modulus* of the complex number  $a + bi$  is given by  $\sqrt{a^2 + b^2}$ . Which of the complex numbers  $z_1$ ,  $z_2$ ,  $z_3$ ,  $z_4$ , and  $z_5$  below has the greatest modulus?



49. In the real numbers, what is the solution of the equation  $8^{2x+1} = 4^{1-x}$ ?

- A.  $-\frac{1}{3}$
- B.  $-\frac{1}{4}$
- C.  $-\frac{1}{8}$
- D. 0
- E.  $\frac{1}{7}$

50. The graph of the trigonometric function  $y = 2 \cos\left(\frac{1}{2}x\right)$  is shown below.



The function is:

- F. even (that is,  $f(x) = f(-x)$  for all  $x$ ).
- G. odd (that is,  $f(-x) = -f(x)$  for all  $x$ ).
- H. neither even nor odd.
- J. the inverse of a cotangent function.
- K. undefined at  $x = \pi$ .

51. An integer from 100 through 999, inclusive, is to be chosen at random. What is the probability that the number chosen will have 0 as at least 1 digit?

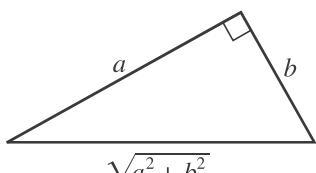
- A.  $\frac{19}{900}$
- B.  $\frac{81}{900}$
- C.  $\frac{90}{900}$
- D.  $\frac{171}{900}$
- E.  $\frac{271}{1,000}$

52. In the figure below, line  $q$  in the standard  $(x,y)$  coordinate plane has equation  $-2x + y = 1$  and intersects line  $r$ , which is distinct from line  $q$ , at a point on the  $x$ -axis. The angles,  $\angle a$  and  $\angle b$ , formed by these lines and the  $x$ -axis are congruent. What is the slope of line  $r$ ?

- F. -2
- G.  $-\frac{1}{2}$
- H.  $\frac{1}{2}$
- J. 2
- K. Cannot be determined from the given information

53. In the right triangle below,  $0 < b < a$ . One of the angle measures in the triangle is  $\tan^{-1}\left(\frac{a}{b}\right)$ . What is  $\cos\left[\tan^{-1}\left(\frac{a}{b}\right)\right]$ ?

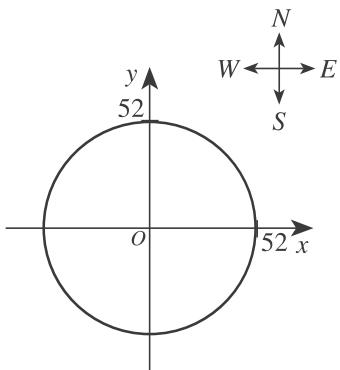
- A.  $\frac{a}{b}$
- B.  $\frac{b}{a}$
- C.  $\frac{a}{\sqrt{a^2 + b^2}}$
- D.  $\frac{b}{\sqrt{a^2 + b^2}}$
- E.  $\frac{\sqrt{a^2 + b^2}}{a}$





Use the following information to answer questions 54–56.

The radio signal from the transmitter site of radio station WGGW can be received only within a radius of 52 miles in all directions from the transmitter site. A map of the region of coverage of the radio signal is shown below in the standard  $(x,y)$  coordinate plane, with the transmitter site at the origin and 1 coordinate unit representing 1 mile.



54. Which of the following is closest to the area, in square miles, of the region of coverage of the radio signal?

- F. 2,120  
G. 2,700  
H. 4,250  
J. 8,500  
K. 16,990

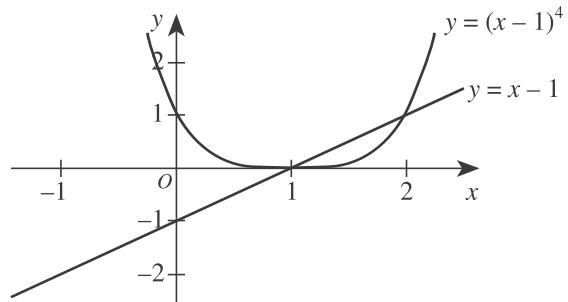
55. Which of the following is an equation of the circle shown on the map?

- A.  $x + y = 52$   
B.  $(x + y)^2 = 52$   
C.  $(x + y)^2 = 52^2$   
D.  $x^2 + y^2 = 52$   
E.  $x^2 + y^2 = 52^2$

56. The transmitter site of radio station WGGW and the transmitter site of another radio station, WGWB, are on the same highway 100 miles apart. The radio signal from the transmitter site of WGWB can be received only within a radius of 60 miles in all directions from the WGWB transmitter site. For how many miles along the highway can the radio signals of *both* stations be received?

- (Note: Assume the highway is straight.)  
F. 8  
G. 12  
H. 40  
J. 44  
K. 48

57. The graphs of the equations  $y = x - 1$  and  $y = (x - 1)^4$  are shown in the standard  $(x,y)$  coordinate plane below. What real values of  $x$ , if any, satisfy the inequality  $(x - 1)^4 < (x - 1)$ ?

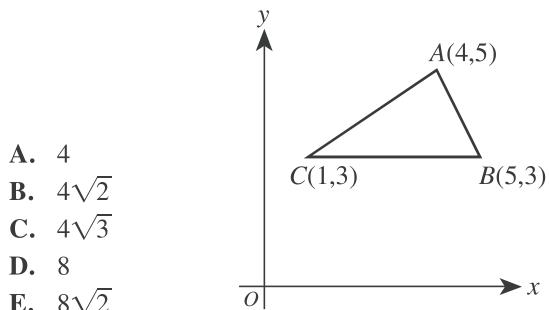


- A. No real values  
B.  $x < 0$  and  $x > 1$   
C.  $x < 1$  and  $x > 2$   
D.  $0 < x < 1$   
E.  $1 < x < 2$

58. For every positive 2-digit number,  $x$ , with tens digit  $t$  and units digit  $u$ , let  $y$  be the 2-digit number formed by reversing the digits of  $x$ . Which of the following expressions is equivalent to  $x - y$ ?

- F.  $9(t - u)$   
G.  $9(u - t)$   
H.  $9t - u$   
J.  $9u - t$   
K. 0

59. In the figure below, the vertices of  $\triangle ABC$  have  $(x,y)$  coordinates  $(4,5)$ ,  $(5,3)$ , and  $(1,3)$ , respectively. What is the area of  $\triangle ABC$ ?



60. The sum of an infinite geometric series with first term  $a$  and common ratio  $r < 1$  is given by  $\frac{a}{1-r}$ . The sum of a given infinite geometric series is 200, and the common ratio is 0.15. What is the second term of this series?

- F. 25.5  
G. 30  
H. 169.85  
J. 170  
K. 199.85

**END OF TEST 2**

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