



## 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. The weekly fee for staying at the Pleasant Lake Campground is \$20 per vehicle and \$10 per person. Last year, weekly fees were paid for  $v$  vehicles and  $p$  persons. Which of the following expressions gives the total amount, in dollars, collected for weekly fees last year?
  - A.  $20v + 10p$
  - B.  $20p + 10v$
  - C.  $10(v + p)$
  - D.  $30(v + p)$
  - E.  $10(v + p) + 20p$
2. If  $r = 9$ ,  $b = 5$ , and  $g = -6$ , what does  $(r + b - g)(b + g)$  equal?
  - F.  $-20$
  - G.  $-8$
  - H.  $8$
  - J.  $19$
  - K.  $20$
3. A copy machine makes 60 copies per minute. A second copy machine makes 80 copies per minute. The second machine starts making copies 2 minutes after the first machine starts. Both machines stop making copies 8 minutes after the first machine started. Together, the 2 machines made how many copies?
  - A. 480
  - B. 600
  - C. 680
  - D. 720
  - E. 960
4. Marlon is bowling in a tournament and has the highest average after 5 games, with scores of 210, 225, 254, 231, and 280. In order to maintain this exact average, what *must* be Marlon's score for his 6th game?
  - F. 200
  - G. 210
  - H. 231
  - J. 240
  - K. 245
5. Joelle earns her regular pay of \$7.50 per hour for up to 40 hours of work in a week. For each hour over 40 hours of work in a week, Joelle is paid  $1\frac{1}{2}$  times her regular pay. How much does Joelle earn for a week in which she works 42 hours?
  - A. \$126.00
  - B. \$315.00
  - C. \$322.50
  - D. \$378.00
  - E. \$472.50
6. Which of the following mathematical expressions is equivalent to the verbal expression "A number,  $x$ , squared is 39 more than the product of 10 and  $x$ " ?
  - F.  $2x = 39 + 10x$
  - G.  $2x = 39x + 10x$
  - H.  $x^2 = 39 - 10x$
  - J.  $x^2 = 39 + x^{10}$
  - K.  $x^2 = 39 + 10x$
7. If  $9(x - 9) = -11$ , then  $x = ?$ 
  - A.  $-\frac{92}{9}$
  - B.  $-\frac{20}{9}$
  - C.  $-\frac{11}{9}$
  - D.  $-\frac{2}{9}$
  - E.  $\frac{70}{9}$



8. Discount tickets to a basketball tournament sell for \$4.00 each. Enrico spent \$60.00 on discount tickets, \$37.50 less than if he had bought the tickets at the regular price. What was the regular ticket price?
- F. \$ 2.50  
G. \$ 6.40  
H. \$ 6.50  
J. \$ 7.50  
K. \$11.00
9. The expression  $(3x - 4y^2)(3x + 4y^2)$  is equivalent to:
- A.  $9x^2 - 16y^4$   
B.  $9x^2 - 8y^4$   
C.  $9x^2 + 16y^4$   
D.  $6x^2 - 16y^4$   
E.  $6x^2 - 8y^4$
10. A rectangle has an area of 32 square feet and a perimeter of 24 feet. What is the shortest of the side lengths, in feet, of the rectangle?
- F. 1  
G. 2  
H. 3  
J. 4  
K. 8
11. In  $\triangle ABC$ , the sum of the measures of  $\angle A$  and  $\angle B$  is  $47^\circ$ . What is the measure of  $\angle C$ ?
- A.  $47^\circ$   
B.  $86^\circ$   
C.  $94^\circ$   
D.  $133^\circ$   
E.  $143^\circ$
12. In the school cafeteria, students choose their lunch from 3 sandwiches, 3 soups, 4 salads, and 2 drinks. How many different lunches are possible for a student who chooses exactly 1 sandwich, 1 soup, 1 salad, and 1 drink?
- F. 2  
G. 4  
H. 12  
J. 36  
K. 72
13. For 2 consecutive integers, the result of adding the smaller integer and triple the larger integer is 79. What are the 2 integers?
- A. 18, 19  
B. 19, 20  
C. 20, 21  
D. 26, 27  
E. 39, 40
14. A function  $f(x)$  is defined as  $f(x) = -8x^2$ . What is  $f(-3)$ ?
- F. -72  
G. 72  
H. 192  
J. -576  
K. 576
15. If  $3^x = 54$ , then which of the following must be true?
- A.  $1 < x < 2$   
B.  $2 < x < 3$   
C.  $3 < x < 4$   
D.  $4 < x < 5$   
E.  $5 < x$
16. What is the least common multiple of 70, 60, and 50?
- F. 60  
G. 180  
H. 210  
J. 2,100  
K. 210,000
17. Hot Shot Electronics is designing a packing box for its new line of Acoustical Odyssey speakers. The box is a rectangular prism of length 45 centimeters, width 30 centimeters, and volume 81,000 cubic centimeters. What is the height, in centimeters, of the box?
- A. 75  
B. 60  
C. 48  
D. 27  
E. 18
18. Four points,  $A$ ,  $B$ ,  $C$ , and  $D$ , lie on a circle having a circumference of 15 units.  $B$  is 2 units counterclockwise from  $A$ .  $C$  is 5 units clockwise from  $A$ .  $D$  is 7 units clockwise from  $A$  and 8 units counterclockwise from  $A$ . What is the order of the points, starting with  $A$  and going clockwise around the circle?
- F.  $A, B, C, D$   
G.  $A, B, D, C$   
H.  $A, C, B, D$   
J.  $A, C, D, B$   
K.  $A, D, C, B$
19. A group of cells grows in number as described by the equation  $y = 16(2)^t$ , where  $t$  represents the number of days and  $y$  represents the number of cells. According to this formula, how many cells will be in the group at the end of the first 5 days?
- A. 80  
B. 160  
C. 400  
D. 512  
E. 1,280



20. The length of a rectangle is 3 times the length of a smaller rectangle. The 2 rectangles have the same width. The area of the smaller rectangle is  $A$  square units. The area of the larger rectangle is  $kA$  square units. Which of the following is the value of  $k$ ?

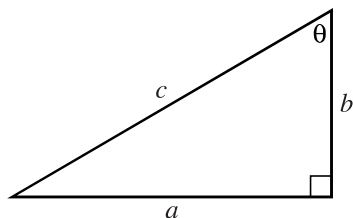
F.  $\frac{1}{9}$   
 G.  $\frac{1}{3}$   
 H. 1  
 J. 3  
 K. 9

21.  $(a + 2b + 3c) - (4a + 6b - 5c)$  is equivalent to:

A.  $-4a - 8b - 2c$   
 B.  $-4a - 4b + 8c$   
 C.  $-3a + 8b - 2c$   
 D.  $-3a - 4b - 2c$   
 E.  $-3a - 4b + 8c$

22. The dimensions of the right triangle shown below are given in feet. What is  $\sin \theta$ ?

F.  $\frac{a}{b}$   
 G.  $\frac{a}{c}$   
 H.  $\frac{b}{c}$   
 J.  $\frac{b}{a}$   
 K.  $\frac{c}{a}$



23. In a basketball passing drill, 5 basketball players stand evenly spaced around a circle. The player with the ball (the passer) passes it to another player (the receiver). The receiver cannot be the player to the passer's immediate right or left and cannot be the player who last passed the ball. A designated player begins the drill as the first passer. This player will be the receiver for the first time on which pass of the ball?

A. 4th  
 B. 5th  
 C. 6th  
 D. 10th  
 E. 24th

24. Lines  $p$  and  $n$  lie in the standard  $(x,y)$  coordinate plane. An equation for line  $p$  is  $y = 0.12x + 3,000$ . The slope of line  $n$  is 0.1 greater than the slope of line  $p$ . What is the slope of line  $n$ ?

F. 0.012  
 G. 0.02  
 H. 0.22  
 J. 1.2  
 K. 300

25. The expression  $-8x^3(7x^6 - 3x^5)$  is equivalent to:

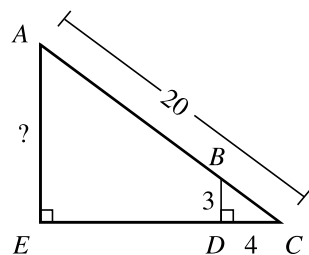
A.  $-56x^9 + 24x^8$   
 B.  $-56x^9 - 24x^8$   
 C.  $-56x^{18} + 24x^{15}$   
 D.  $-56x^{18} - 24x^{15}$   
 E.  $-32x^4$

26.  $-3|-6 + 8| = ?$

F. -42  
 G. -6  
 H. -1  
 J. 6  
 K. 42

27. In right triangle  $\triangle ACE$  below,  $\overline{BD}$  is parallel to  $\overline{AE}$ , and  $\overline{BD}$  is perpendicular to  $\overline{EC}$  at  $D$ . The length of  $\overline{AC}$  is 20 feet, the length of  $\overline{BD}$  is 3 feet, and the length of  $\overline{CD}$  is 4 feet. What is the length, in feet, of  $\overline{AE}$ ?

A. 10  
 B. 12  
 C. 15  
 D. 16  
 E. 17



28. As part of a lesson on motion, students observed a cart rolling at a constant rate along a straight line. As shown in the chart below, they recorded the distance,  $y$  feet, of the cart from a reference point at 1-second intervals from  $t = 0$  seconds to  $t = 5$  seconds.

$t$	0	1	2	3	4	5
$y$	14	19	24	29	34	39

Which of the following equations represents this data?

F.  $y = t + 14$   
 G.  $y = 5t + 9$   
 H.  $y = 5t + 14$   
 J.  $y = 14t + 5$   
 K.  $y = 19t$



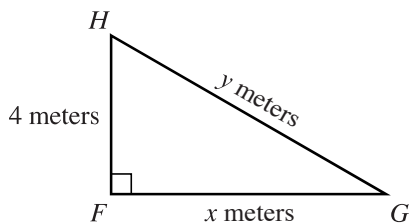
29. The inequality  $6(x + 2) > 7(x - 5)$  is equivalent to which of the following inequalities?

A.  $x < -23$   
 B.  $x < 7$   
 C.  $x < 17$   
 D.  $x < 37$   
 E.  $x < 47$

30. The sides of a square are 3 cm long. One vertex of the square is at  $(2,0)$  on a square coordinate grid marked in centimeter units. Which of the following points could also be a vertex of the square?

F.  $(-4, 0)$   
 G.  $(0, 1)$   
 H.  $(1, -1)$   
 J.  $(4, 1)$   
 K.  $(5, 0)$

31. For  $\triangle FGH$ , shown below, which of the following is an expression for  $y$  in terms of  $x$ ?

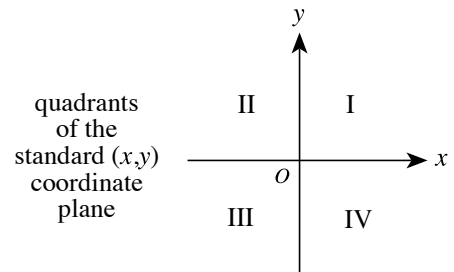


A.  $x + 4$   
 B.  $\sqrt{x^2 + 4}$   
 C.  $\sqrt{x^2 + 8}$   
 D.  $\sqrt{x^2 - 16}$   
 E.  $\sqrt{x^2 + 16}$

32. A bag contains 12 red marbles, 5 yellow marbles, and 15 green marbles. How many additional red marbles must be added to the 32 marbles already in the bag so that the probability of randomly drawing a red marble is  $\frac{3}{5}$ ?

F. 13  
 G. 18  
 H. 28  
 J. 32  
 K. 40

33. What are the quadrants of the standard  $(x,y)$  coordinate plane below that contain points on the graph of the equation  $4x - 2y = 8$ ?



A. I and III only  
 B. I, II, and III only  
 C. I, II, and IV only  
 D. I, III, and IV only  
 E. II, III, and IV only

34. The graph of  $y = -5x^2 + 9$  passes through  $(1, 2a)$  in the standard  $(x,y)$  coordinate plane. What is the value of  $a$ ?

F. 2  
 G. 4  
 H. 7  
 J. -1  
 K. -8

35. Jerome, Kevin, and Seth shared a submarine sandwich. Jerome ate  $\frac{1}{2}$  of the sandwich, Kevin ate  $\frac{1}{3}$  of the sandwich, and Seth ate the rest. What is the ratio of Jerome's share to Kevin's share to Seth's share?

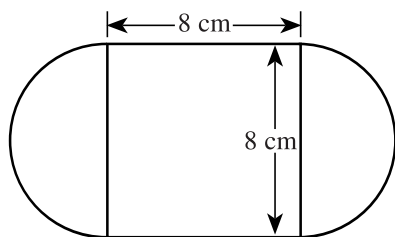
A. 2:3:6  
 B. 2:6:3  
 C. 3:1:2  
 D. 3:2:1  
 E. 6:3:2

36. A particular circle in the standard  $(x,y)$  coordinate plane has an equation of  $(x - 5)^2 + y^2 = 38$ . What are the radius of the circle, in coordinate units, and the coordinates of the center of the circle?

	radius	center
F.	$\sqrt{38}$	$(5, 0)$
G.	19	$(5, 0)$
H.	38	$(5, 0)$
J.	$\sqrt{38}$	$(-5, 0)$
K.	19	$(-5, 0)$

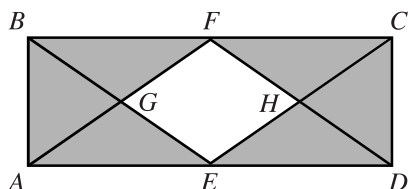


37. The figure below consists of a square and 2 semicircles, with dimensions as shown. What is the outside perimeter, in centimeters, of the figure?



- A.  $8 + 8\pi$   
 B.  $16 + 8\pi$   
 C.  $16 + 16\pi$   
 D.  $32 + 8\pi$   
 E.  $32 + 16\pi$

38. In the figure below, points  $E$  and  $F$  are the midpoints of sides  $\overline{AD}$  and  $\overline{BC}$  of rectangle  $ABCD$ , point  $G$  is the intersection of  $\overline{AF}$  and  $\overline{BE}$ , and point  $H$  is the intersection of  $\overline{CE}$  and  $\overline{DF}$ . The interior of  $ABCD$  except for the interior of  $EGFH$  is shaded. What is the ratio of the area of  $EGFH$  to the area of the shaded region?



- F. 1:2  
 G. 1:3  
 H. 1:4  
 J. 1:6  
 K. Cannot be determined from the given information

39. The coordinates of the endpoints of  $\overline{CD}$ , in the standard  $(x,y)$  coordinate plane, are  $(-4,-2)$  and  $(14,2)$ . What is the  $x$ -coordinate of the midpoint of  $\overline{CD}$ ?

- A. 0  
 B. 2  
 C. 5  
 D. 9  
 E. 10

40. What is the surface area, in square inches, of an 8-inch cube?

- F. 512  
 G. 384  
 H. 320  
 J. 256  
 K. 192

41. The equations below are linear equations of a system where  $a$ ,  $b$ , and  $c$  are positive integers.

$$\begin{aligned} ay + bx &= c \\ ay - bx &= c \end{aligned}$$

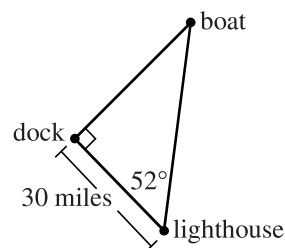
Which of the following describes the graph of at least 1 such system of equations in the standard  $(x,y)$  coordinate plane?

- I. 2 parallel lines  
 II. 2 intersecting lines  
 III. A single line

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

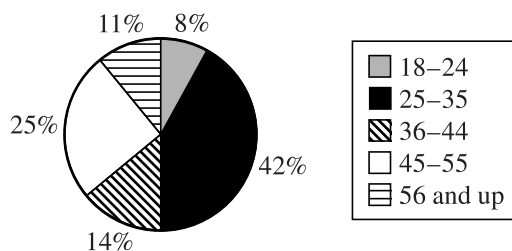
42. According to the measurements given in the figure below, which of the following expressions gives the distance, in miles, from the boat to the dock?

- F.  $30 \tan 52^\circ$   
 G.  $30 \cos 52^\circ$   
 H.  $30 \sin 52^\circ$   
 J.  $\frac{30}{\cos 52^\circ}$   
 K.  $\frac{30}{\sin 52^\circ}$



43. The circle graph below shows the distribution of registered voters, by age, for a community. Registered voters are randomly selected from this distribution to be called for jury duty. What are the odds (in the age range: not in the age range) that the first person called for jury duty is in the age range of 25–35 years?

Distribution of Registered Voters by Age

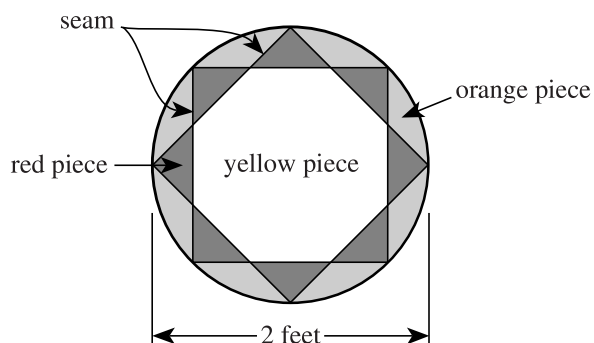


- A. 1:3  
 B. 7:8  
 C. 7:43  
 D. 21:29  
 E. 42:25



Use the following information to answer questions 44–46.

The figure below shows the design of a circular stained-glass panel on display at Hopewell's Antique Shop. Seams separate the pieces of the panel. All red triangular pieces shown are congruent and have a common vertex with each adjoining triangular piece. The 2 squares shown are inscribed in the circle. The diameter of the panel is 2 feet.



44. The design of the stained-glass panel has how many lines of symmetry in the plane of the panel?

F. 2  
G. 4  
H. 8  
J. 16  
K. Infinitely many

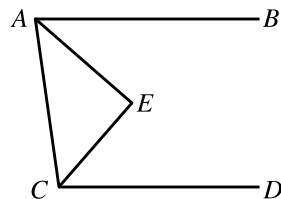
45. What is the area of the stained-glass panel, to the nearest 0.1 square foot?

A. 3.1  
B. 4.0  
C. 6.2  
D. 8.0  
E. 12.6

46. Kaya wants to install a new circular stained-glass window in her living room. The design of the window will be identical to that of the panel. The diameter of the new window will be 75% longer than the diameter of the panel. The new window will be how many feet in diameter?

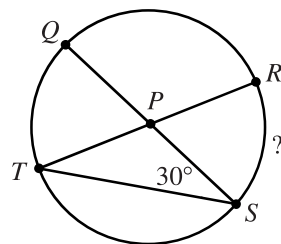
F. 1.50  
G. 2.50  
H. 2.75  
J. 3.50  
K. 4.00

47. In the figure below,  $\overline{AB} \parallel \overline{CD}$ ,  $\overline{AE}$  bisects  $\angle BAC$ , and  $\overline{CE}$  bisects  $\angle ACD$ . If the measure of  $\angle BAC$  is  $82^\circ$ , what is the measure of  $\angle AEC$ ?



- A.  $86^\circ$   
B.  $88^\circ$   
C.  $90^\circ$   
D.  $92^\circ$   
E. Cannot be determined from the given information

48. In the circle shown below, chords  $\overline{TR}$  and  $\overline{QS}$  intersect at  $P$ , which is the center of the circle, and the measure of  $\angle PST$  is  $30^\circ$ . What is the degree measure of minor arc  $\widehat{RS}$ ?



- F.  $30^\circ$   
G.  $45^\circ$   
H.  $60^\circ$   
J.  $90^\circ$   
K. Cannot be determined from the given information

49. For what value of  $a$  would the following system of equations have an infinite number of solutions?

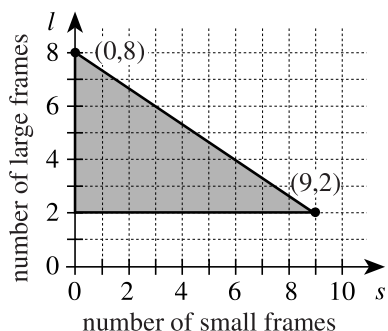
$$\begin{aligned} 2x - y &= 8 \\ 6x - 3y &= 4a \end{aligned}$$

- A. 2  
B. 6  
C. 8  
D. 24  
E. 32



Use the following information to answer questions 50–52.

Marcia makes and sells handcrafted picture frames in 2 sizes: small and large. It takes her 2 hours to make a small frame and 3 hours to make a large frame. The shaded triangular region shown below is the graph of a system of inequalities representing weekly constraints Marcia has in making the frames. For making and selling  $s$  small frames and  $l$  large frames, Marcia makes a profit of  $30s + 70l$  dollars. Marcia sells all the frames she makes.



50. The weekly constraint represented by the horizontal line segment containing  $(9, 2)$  means that each week Marcia makes a minimum of:

F. 2 large frames.  
G. 9 large frames.  
H. 2 small frames.  
J. 9 small frames.  
K. 11 small frames.

51. For every hour that Marcia spends making frames in the second week of December each year, she donates \$3 from that week's profit to a local charity. This year, Marcia made 4 large frames and 2 small frames in that week. Which of the following is closest to the percent of that week's profit Marcia donated to the charity?

A. 6%  
B. 12%  
C. 14%  
D. 16%  
E. 19%

52. What is the maximum profit Marcia can earn from the picture frames she makes in 1 week?

F. \$410  
G. \$460  
H. \$540  
J. \$560  
K. \$690

53. The *determinant* of a matrix  $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$  equals  $ad - cb$ .

What must be the value of  $x$  for the matrix  $\begin{bmatrix} x & 8 \\ x & x \end{bmatrix}$  to

have a determinant of  $-16$ ?

A.  $-4$   
B.  $-2$   
C.  $-\frac{8}{5}$   
D.  $\frac{8}{3}$   
E.  $4$

54. A formula for finding the value,  $A$  dollars, of  $P$  dollars invested at  $i\%$  interest compounded annually for  $n$  years is  $A = P(1 + 0.01i)^n$ . Which of the following is an expression for  $P$  in terms of  $i$ ,  $n$ , and  $A$ ?

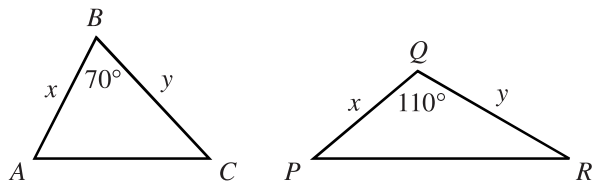
F.  $A - 0.01i^n$   
G.  $A + 0.01i^n$   
H.  $\left(\frac{A}{1 + 0.01i}\right)^n$   
J.  $\frac{A}{(1 - 0.01i)^n}$   
K.  $\frac{A}{(1 + 0.01i)^n}$

55. If  $x$  and  $y$  are real numbers such that  $x > 1$  and  $y < -1$ , then which of the following inequalities *must* be true?

A.  $\frac{x}{y} > 1$   
B.  $|x|^2 > |y|$   
C.  $\frac{x}{3} - 5 > \frac{y}{3} - 5$   
D.  $x^2 + 1 > y^2 + 1$   
E.  $x^{-2} > y^{-2}$



56. Triangles  $\triangle ABC$  and  $\triangle PQR$  are shown below. The given side lengths are in centimeters. The area of  $\triangle ABC$  is 30 square centimeters. What is the area of  $\triangle PQR$ , in square centimeters?



- F. 15  
G. 19  
H. 25  
J. 30  
K. 33
57. Triangle  $\triangle ABC$  is shown in the figure below. The measure of  $\angle A$  is  $40^\circ$ ,  $AB = 18$  cm, and  $AC = 12$  cm. Which of the following is the length, in centimeters, of  $\overline{BC}$  ?
- (Note: For a triangle with sides of length  $a$ ,  $b$ , and  $c$  opposite angles  $\angle A$ ,  $\angle B$ , and  $\angle C$ , respectively, the law of sines states  $\frac{\sin \angle A}{a} = \frac{\sin \angle B}{b} = \frac{\sin \angle C}{c}$  and the law of cosines states  $c^2 = a^2 + b^2 - 2ab \cos \angle C$ .)
- 
- A.  $12 \sin 40^\circ$   
B.  $18 \sin 40^\circ$   
C.  $\sqrt{18^2 - 12^2}$   
D.  $\sqrt{12^2 + 18^2}$   
E.  $\sqrt{12^2 + 18^2 - 2(12)(18) \cos 40^\circ}$
58. What is the sum of the first 4 terms of the arithmetic sequence in which the 6th term is 8 and the 10th term is 13 ?
- F. 10.5  
G. 14.5  
H. 18  
J. 21.25  
K. 39.5
59. In the equation  $x^2 + mx + n = 0$ ,  $m$  and  $n$  are integers. The *only* possible value for  $x$  is  $-3$ . What is the value of  $m$  ?
- A. 3  
B.  $-3$   
C. 6  
D.  $-6$   
E. 9
60. The solution set of which of the following equations is the set of real numbers that are 5 units from  $-3$  ?
- F.  $|x + 3| = 5$   
G.  $|x - 3| = 5$   
H.  $|x + 5| = 3$   
J.  $|x - 5| = 3$   
K.  $|x + 5| = 3$

END OF TEST 2

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

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