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.

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1. $|4 - 1| - |1 - 4| = ?$
   A. -6
   B. -3
   C. -2
   D. 0
   E. 6

2. When $y = 2x + 1$ and $y = 3$, which of the following is the value of x ?
   F. 2
   G. 1
   H. -1
   J. -2
   K. -5

3. To attend an annual banquet, members pay $16 per ticket while nonmembers pay $22 per ticket. What is the total amount, in dollars, from the sale of 80 member tickets and n nonmember tickets?
   A. $22n + 16(80)$
   B. $22(n + 80)$
   C. $22(n + 16)$
   D. $(22 + 16)n$
   E. $n + 80$

4. What is 150% of 50 ?
   F. 51.5
   G. 57.5
   H. 65
   J. 75
   K. 125

DO YOUR FIGURING HERE.

5. A box contains several marbles. Bill draws a marble at random from the box, notes that it is blue, and places the marble back in the box. Then Aiko draws a marble at random from the box, notes that her marble is blue, and places it back in the box. Which of the following is necessarily true?

   A. Bill and Aiko drew the same marble.
   B. The box contains marbles of at least 2 different colors.
   C. The box contains only blue marbles.
   D. The box contains at most 2 blue marbles.
   E. The box contains at least 1 blue marble.

DO YOUR FIGURING HERE.

6. A 21-foot-long board is cut into 3 pieces such that the first piece is twice as long as the second piece and the second piece is twice as long as the third piece. How many feet in length is the longest of the 3 pieces?

   (Note: Ignore the width of the saw cuts.)

   F. 7
   G. 9
   H. 10
   J. 12
   K. 14

7. What is the perimeter, in centimeters, of a rectangle with length 8 cm and width 3 cm ?

   A. 11
   B. 16
   C. 22
   D. 24
   E. 48

8. In the figure below, $\overline{AE}$ and $\overline{BD}$ intersect at C. What is the measure of $\angle E$?
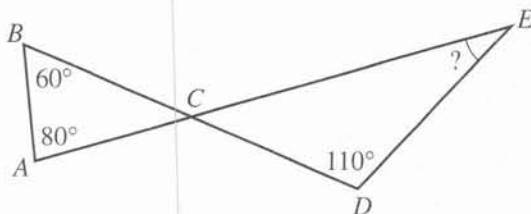
   F. 30°
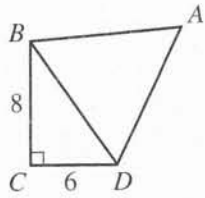   G. 35°
   H. 40°
   J. 60°
   K. 70°

DO YOUR FIGURING HERE.

9. The diagonal $\overline{BD}$ divides quadrilateral $ABCD$ into a right triangle and an equilateral triangle, as shown below. The given dimensions are in centimeters. How many centimeters long is $\overline{AD}$?

    A. $\sqrt{14}$
    B. 7
    C. 10
    D. 14
    E. 28

10. The circular face of a fair spinner has a red section, a blue section, and 2 yellow sections, as shown below. After being spun, the arrow of the spinner is equally likely to be pointing to any 1 of the 4 sections. What is the probability that, after the arrow has been spun, the section the arrow is pointing to is yellow?

    F. $\frac{1}{2}$
    G. $\frac{1}{3}$
    H. $\frac{1}{4}$
    J. $\frac{3}{4}$
    K. $\frac{1}{6}$
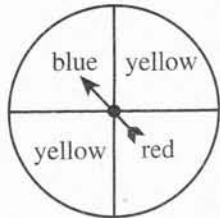
11. Let a square represent the value of x and a circle represent 1. Which of the following expressions accurately represents $2(3x + 5)$?

    A. ▢▢▢ ▢▢▢ + ○○○○○ ○○○○○

    B. ▢▢▢ ▢▢▢ + ○○○ ○○○○

    C. ▢▢▢ ▢▢▢ + ○○○○○

    D. ▢▢▢ + ○○○○○

    E. ○○▢▢▢ + ○○○ ○○○○

12. What is the slope-intercept form of $5x - y - 9 = 0$?

    F. $y = -5x - 9$
    G. $y = -5x + 9$
    H. $y = 5x - 9$
    J. $y = 5x + 9$
    K. $y = 9x - 5$

13. The points $S(4,10)$ and $T(6,-2)$ lie in the standard (x,y) coordinate plane. What is the midpoint of $\overline{ST}$?

- **A.** $(1,-6)$
- **B.** $(2, 5)$
- **C.** $(3,-1)$
- **D.** $(5, 4)$
- **E.** $(9, 8)$

14. Kerry ordered a pizza: one half was topped with pepperoni for her brother Joel, and the other half was topped with extra cheese for herself. Kerry ate all of the half of the pizza with extra cheese. Joel ate $\frac{3}{5}$ of the half of the pizza with pepperoni. What fraction of the whole pizza did Joel eat?

- **F.** $\frac{1}{2}$
- **G.** $\frac{2}{5}$
- **H.** $\frac{3}{5}$
- **J.** $\frac{4}{7}$
- **K.** $\frac{3}{10}$

15. Given that $a = \frac{1}{2}$ and $b = \frac{1}{3}$, what is the value of $\frac{1}{2}\left(\frac{1}{a} + \frac{1}{b}\right)$?

- **A.** $\frac{3}{5}$
- **B.** $\frac{5}{6}$
- **C.** $\frac{5}{2}$
- **D.** 3
- **E.** 5

16. Guban went shopping at a department store that was having a storewide sale where every item was 10% off its marked price, including already discounted items. Guban found a sweater with an original price of $30.00 marked with a discounted price of 15% off its original price. There was a 6% sales tax on the final price of all items. How much did Guban pay for the sweater?
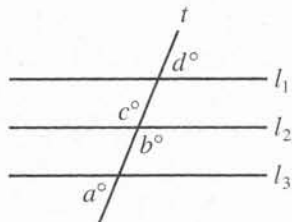
- **F.** $13.77
- **G.** $19.50
- **H.** $24.30
- **J.** $24.33
- **K.** $29.81

17. In the figure below, parallel lines l_1, l_2, and l_3 intersect transversal t. What is the value of $a + b + c + d$?

A. 180
B. 240
C. 270
D. 300
E. 360

18. Max bought several bags of organic lawn fertilizer, and each bag covers 5,000 square feet of lawn. He is fertilizing a lawn that is 50 feet wide. He pours 1 bag into the fertilizer spreader and begins fertilizing. Before he needs to refill the spreader, Max can fertilize a rectangle that is the width of the lawn and is how many feet long?

F.   50
G.   100
H. 2,450
J.   4,950
K. 5,050

19. Which of the following variable expressions would represent the area of a rectangle if its length is represented by $x + 2$ and its width is represented by $x - 1$?

A. $2x + 1$
B. $4x + 2$
C. $x^2 - 2$
D. $x^2 - x - 2$
E. $x^2 + x - 2$

20. A formula often used to find the dollar value of an investment is $A = P(1 + r)^t$, where A is the dollar value after t years, P is the initial amount invested, and r is the annual interest rate expressed as a decimal. According to this formula, which of the following is closest to the dollar value of $1,000 invested for 2 years at a 5% annual interest rate?

F. $1,050
G. $1,103
H. $2,000
J. $2,100
K. $2,250

21. A motorist traveled at an average speed of 50 miles per hour and arrived at his destination in exactly 20 minutes. Which of the following is closest to the number of miles he traveled?

- **A.** 10
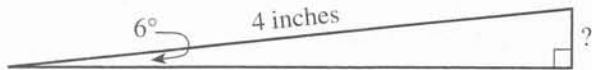- **B.** 12
- **C.** 17
- **D.** 20
- **E.** 25

22. Inez has 20 stamps. Some of the stamps are 40¢ stamps and the others are 25¢ stamps. The value of the 20 stamps is $6.95. How many 40¢ stamps does Inez have?

- **F.** 7
- **G.** 11
- **H.** 13
- **J.** 15
- **K.** 17

23. A line in the standard (x,y) coordinate plane has equation $3x - 2y = 6$. What is the slope of this line?

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

24. The right triangle shown below has a hypotenuse of 4 inches. The measure of the angle indicated is 6°. Which of the following is closest to the length, in inches, of the side opposite the 6° angle?

(Note: sin 6° ≈ 0.1045   sin 84° ≈ 0.9945
        cos 6° ≈ 0.9945   cos 84° ≈ 0.1045
        tan 6° ≈ 0.1051   tan 84° ≈ 9.5144)

- **F.** 0.105
- **G.** 0.418
- **H.** 0.420
- **J.** 3.978
- **K.** 38.057

GO ON TO THE NEXT PAGE.

25. A supermarket soup can display consists of 5 levels of stacked cans. The figure below shows an overhead view of the top level of cans (circles shaded and with solid borders) and the level of cans below it (circles with dashed borders). In the display, each level has 4 more cans than the level above it. How many cans are in the display?
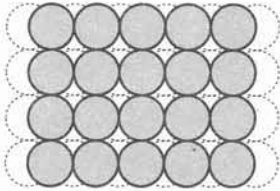
- A. 60
- B. 100
- C. 116
- D. 120
- E. 140

26. Which of the following could be the value of $\sqrt{c^2}$ for some integer c ?

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

27. The height of a triangle is 6 cm longer than the base from which the height is measured. If the area of the triangle is 80 square centimeters, what is the height, in centimeters?

- A. 4
- B. 16
- C. 22
- D. 43
- E. 77

28. For real numbers x and y such that $x - y < 0$, which of the following *must* be true?

- F. $x = y$
- G. $x > y$
- H. $x < y - x$
- J. $x < -y$
- K. $x < y$

29. In the standard (x,y) coordinate plane, a triangle has vertices $(-3,-3)$, $(-4,2)$, and $(-1,1)$. What will be the coordinates of the vertices after the triangle is shifted down 2 units?

   A. $(-5,-3)$, $(0,-4)$, and $(-1,-1)$
   B. $(-5,-3)$, $(-4,4)$, and $(-1,3)$
   C. $(-3,-1)$, $(4,-4)$, and $(3,1)$
   D. $(-3,-5)$, $(-4,4)$, and $(-1,3)$
   E. $(-3,-5)$, $(-4,0)$, and $(-1,-1)$

30. When solved for k, $-6 + 7k \geq 3 - 8k$ is equivalent to which of the following inequalities?

   F. $k \geq \frac{1}{5}$

   G. $k \geq \frac{3}{5}$

   H. $k \leq \frac{5}{3}$

   J. $k \leq 5$

   K. $k \geq 9$

31. In the figure below, $\triangle ABC$ is equilateral. Points D, E, and F are the midpoints of the sides of $\triangle ABC$. Points G, H, and I are the midpoints of the sides of $\triangle DEF$. A side of $\triangle ABC$ is how many times as long as a side of $\triangle GHI$?
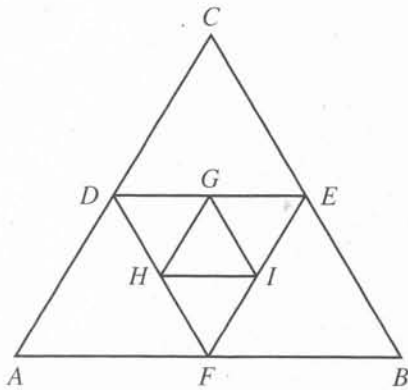
   A. 2
   B. 3
   C. 4
   D. 8
   E. 16

32. What fraction of $2\frac{1}{3}$ is $1\frac{1}{6}$?

   F. $\frac{1}{2}$

   G. $\frac{2}{9}$

   H. $\frac{1}{6}$

   J. $\frac{1}{9}$

   K. $\frac{1}{18}$

33. A greenhouse contained both 6-inch-high geraniums and 3-inch-high geraniums. The 6-inch-high geraniums were taken out of the greenhouse in early spring and grew at a rate of 1 inch per week. The 3-inch-high geraniums remained in the greenhouse and grew at a rate of $1\frac{1}{2}$ inches per week. After the 6-inch-high geraniums were taken outside, in how many weeks were both groups of geraniums the same height?

A. $7\frac{1}{2}$

B. 6

C. $4\frac{1}{2}$

D. 3

E. $1\frac{1}{2}$

34. $(x^3 - 4x^2 + 5x) - (x^2 - 3x - 6)$ simplifies to:

F. $x^3 - 3x^2 + 2x + 6$
G. $x^3 - 3x^2 + 8x - 6$
H. $x^3 - 5x^2 + 2x - 6$
J. $x^3 - 5x^2 + 8x - 6$
K. $x^3 - 5x^2 + 8x + 6$

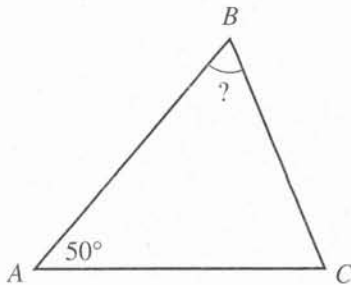**35.** A right triangle is shown in the figure below. Which of the following expressions gives θ ?
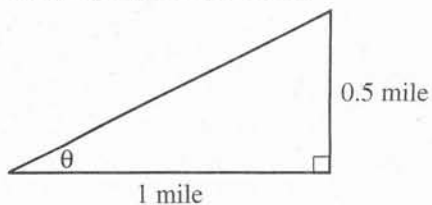
A. $\tan^{-1}\left(\frac{1}{2}\right)$

B. $\sin^{-1}\left(\frac{1}{2}\right)$

C. $\cos^{-1}\left(\frac{1}{2}\right)$

D. $\tan^{-1}(2)$

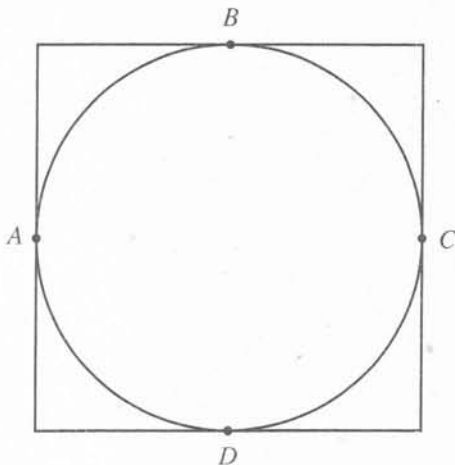E. $\sin^{-1}(2)$

DO YOUR FIGURING HERE.

36. In △ABC below, AB = AC and ∠A measures 50°. What is the measure of ∠B ?

F. 70°
G. 65°
H. 60°
J. 55°
K. 50°

37. The square below has an area of 64 square centimeters. The circle inscribed in the square is tangent to the square at A, B, C, and D. What is the area, in square centimeters, of the circle?

A. 4π
B. 8π
C. 16π
D. 32π
E. 64π

38. The 2 functions $f(x)$ and $g(x)$ are defined such that $f(x) = \frac{x+8}{2-x}$ and $g(x) = x^2 + 6x + 2$. What is the value of $f(g(-2))$?

F. -6

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

H. $\frac{1}{4}$
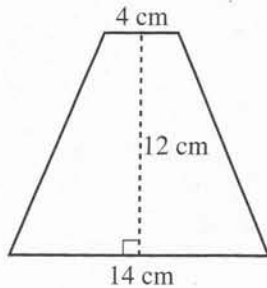
J. $\frac{3}{2}$

K. $\frac{53}{4}$

39. On a map of Blueville in the standard (x,y) coordinate plane, where 1 coordinate unit represents 1 block, the middle school is at (−8,3) and the high school is at (4,−2). What is the straight-line distance, in blocks, between the high school and the middle school?

    A.   13
    B.   17
    C. $\sqrt{7}$
    D. $\sqrt{13}$
    E. $\sqrt{17}$

40. What is the perimeter, in centimeters, of the isosceles trapezoid shown below?

    F.   18
    G.   30
    H.   42
    J.   44
    K.   56

41. Which of the following equations, when graphed in the standard (x,y) coordinate plane, would cross the x-axis at x = 2 and at x = −4 ?

    A. $y = 2(x − 2)(x + 4)$
    B. $y = 2(x − 2)(x − 4)$
    C. $y = 2(x + 2)(x + 4)$
    D. $y = 4(x − 2)(x − 4)$
    E. $y = 4(x + 2)(x − 4)$

42. A rectangular room is 13 feet long, 10 feet wide, and 9 feet high. Not accounting for doors and windows, what is the surface area, in square feet, of the 4 walls, ceiling, and floor of the room?

    F.   337
    G.   414
    H.   544
    J.   674
    K. 1,170

43. The average of Pam's 8 test scores is 77 points. Pam takes a 9th test and earns a score of 95 points. If all 9 tests are equally weighted, what is Pam's new average?
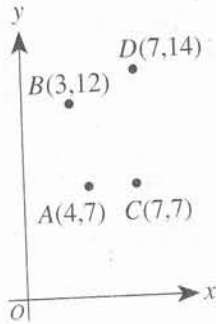
    A. 78
    B. 79
    C. 85
    D. 86
    E. 87

DO YOUR FIGURING HERE.

Use the following information to answer questions 44–46.

The points $A(4,7)$, $B(3,12)$, $C(7,7)$, and $D(7,14)$ are shown in the standard (x,y) coordinate plane below.

44. What is the slope of $\overleftrightarrow{BD}$?

   F. $-\dfrac{5}{11}$

   G. $\dfrac{5}{13}$

   H. $\dfrac{1}{2}$

   J. $\dfrac{9}{7}$

   K.   2

45. What is the cosine of the smallest angle in right triangle $\triangle ACD$?

   A. $\dfrac{7}{\sqrt{58}}$

   B. $\dfrac{7}{10}$

   C. $\dfrac{3}{\sqrt{58}}$

   D. $\dfrac{3}{7}$

   E. $\dfrac{\sqrt{58}}{10}$

46. How many distinct lines are there that each contain at least 2 of the 4 given points?

   F.   3
   G.   4
   H.   6
   J.   8
   K.   16

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ACT-68A

47. If x is any positive integer, then the sum of $6x$ and $11x$ is *always* divisible by which of the following?
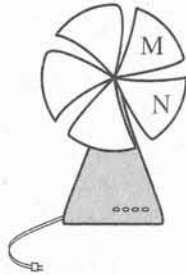
- A.   5
- B.   6
- C.   11
- D.   17
- E.   66

48. For what value of a would the following system of equations have infinitely many solutions?

$$3x - 2y = 6$$
$$6x - 4y = 3a$$

- F.   2
- G.   4
- H.   6
- J.   12
- K.   18

49. A fan has 5 identical blades that are equally spaced around the center of the fan, as shown below. What is the measure of the angle of rotation that would move Blade M clockwise ($\curvearrowright$) to the position of Blade N ?

- A.   18°
- B.   36°
- C.   45°
- D.   60°
- E.   72°

50. Cans A and B are both right circular cylinders. The radius of the base of Can A is 4 times the radius of the base of Can B, and the height of Can A is 5 times the height of Can B. The volume of Can A is how many times the volume of Can B ?

(Note: $V_{cylinder} = \pi r^2 h$)

- F.   9
- G.   20
- H.   40
- J.   80
- K.   100

51. What real value of a satisfies the equation $16^a = \dfrac{1}{64^{a+1}}$?

- A. -3
- B. -2
- C. $-\dfrac{3}{5}$
- D. $\dfrac{1}{10}$
- E. $\dfrac{1}{2}$

52. A box contains 100 cardboard circles. Written on each circle is one of the following numbers, with no numbers repeated: $\sqrt{1}, \sqrt{2}, \sqrt{3}, \cdots, \sqrt{100}$. A circle is drawn at random from the box. What is the probability that the number on the circle is a rational number?

F. $\dfrac{0}{100}$

G. $\dfrac{9}{100}$

H. $\dfrac{10}{100}$

J. $\dfrac{50}{100}$

K. $\dfrac{74}{100}$

53. By the law of cosines, $a^2 = b^2 + c^2 - 2bc \cos \angle A$ for a triangle with sides of lengths a, b, and c opposite $\angle A$, $\angle B$, and $\angle C$, respectively. A boat travels 25 miles due east, makes a 40° turn toward the north, and then travels 30 miles, as shown below. To the nearest mile, what is the straight-line distance between the boat's starting position and its ending position?

(Note: $\cos 40° \approx 0.766$, $\cos(180 - \alpha) = -\cos \alpha$)
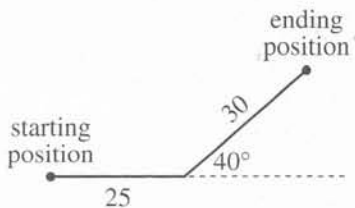
A. 55
B. 52
C. 50
D. 31
E. 19

54. The function $f(x)$ is defined below. What is the value of $f(-1)$?

$$f(x) = \begin{cases} |x| + 1, \text{ if } x \le -1 \\ |x| - 2, \text{ if } x > -1 \end{cases}$$

F. -3
G. -1
H. 0
J. 1
K. 2

55. Which of the following equations given in factored form has roots at $\frac{1}{2}$, $\frac{3}{4}$, i, and $-i$?

A. $(2x - 1)(4x - 3)(x^2 + 1) = 0$
B. $(2x - 1)(4x - 3)(x^2 - 1) = 0$
C. $(2x + 1)(4x - 3)(x^2 + 1) = 0$
D. $(2x + 1)(4x - 3)(x^2 - 1) = 0$
E. $(2x + 1)(4x + 3)(x^2 + 1) = 0$

Use the following information to answer questions 56–58.

The table below shows an electric utility company's old and new rates. In the table, kWh stands for kilowatt-hour, a standard unit for measuring electrical energy.

Runion Electric Association Rates		
	Old rate	New rate
Monthly service charge	$7.00	$11.00
Energy-use charge		
first 1,500 kWh	6.6¢/kWh	6.7¢/kWh
kWh over 1,500	6.2¢/kWh	6.2¢/kWh

56. LaTasha is a computer programmer for the electric company. She updated the program for calculating customers' monthly bills. Which of the following is an expression that uses the new rates to calculate the bill, in dollars, of a customer who uses x kWh of electricity during the month, where $x > 1,500$?

F. $7 + 0.062(1,500) + 0.067(x - 1,500)$
G. $7 + 0.066(1,500) + 0.062(x - 1,500)$
H. $11 + 0.062x$
J. $11 + 0.062(1,500) + 0.067(x - 1,500)$
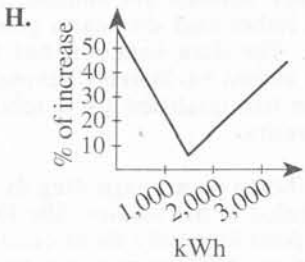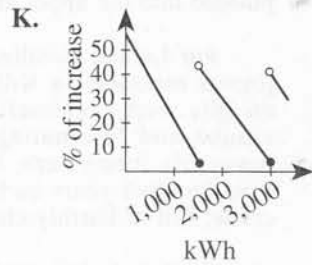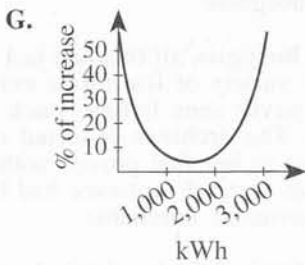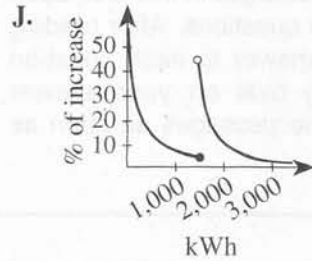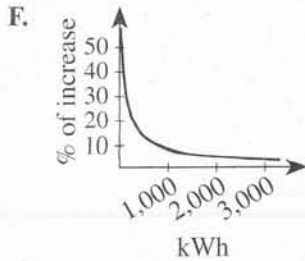K. $11 + 0.067(1,500) + 0.062(x - 1,500)$

57. By about what percent did the monthly service charge increase from the old rate to the new rate?

A. 4%
B. 36%
C. 40%
D. 57%
E. 64%

58. Which of the following is the graph of the function that gives the percent of increase for electric bills calculated under the new rates compared to the bills calculated under the old rates?

DO YOUR FIGURING HERE.

F.

J.

G.

K.

H.

59. Which of the following equations describes a line that is perpendicular to a line with equation $5x - 6y = 30$?

   A. $5x - 6y = 15$
   B. $5x + 6y = 24$
   C. $6x - 5y = 12$
   D. $6x + 5y = 10$
   E. $7x - 8y = 32$

60. In a regular pentagon, all 5 interior angles are congruent. What is the measure of each interior angle of a regular pentagon?

   F. 36°
   G. 60°
   H. 72°
   J. 108°
   K. 120°

END OF TEST 2

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

DO NOT RETURN TO THE PREVIOUS TEST.