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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.

DO YOUR FIGURING HERE.

1. On level ground, a vertical rod 12 feet tall casts a shadow 4 feet long, and at the same time a nearby vertical flagpole casts a shadow 12 feet long. How many feet tall is the flagpole?

A. 4
B. 8
C. 12
D. 20
E. 36

2. Kalino earned 85, 95, 93, and 80 points on the 4 tests, each worth 100 points, given so far this term. How many points must he earn on his fifth test, also worth 100 points, to average 90 points for the 5 tests given this term?

F. 87
G. 88
H. 90
J. 92
K. 97

3. If $x = -5$, what is the value of $\frac{x^2 - 1}{x + 1}$?

A. -6

B. -4

C. 4

D. $5\frac{4}{5}$

E. 19

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DO YOUR FIGURING HERE.

4. Kaya ran $1\frac{2}{5}$ miles on Monday and $2\frac{1}{3}$ miles on Tuesday. What was the total distance, in miles, Kaya ran during those 2 days?

   F. $3\frac{2}{15}$
   G. $3\frac{3}{8}$
   H. $3\frac{2}{5}$
   J. $3\frac{7}{15}$
   K. $3\frac{11}{15}$

5. Consider the 3 statements below to be true.

   All insects that are attracted to honey are ants.
   Insect I is not an ant.
   Insect J is attracted to honey.

   Which of the following statements is necessarily true?

   A. Insect I is an ant not attracted to honey.
   B. Insect I is an ant attracted to honey.
   C. Insect I is attracted to honey.
   D. Insect J is not attracted to honey.
   E. Insect J is an ant.

6. What is the value of the expression $\sqrt{\frac{m}{x-3}}$ when $x = -1$ and $m = -16$?

   F. -2
   G. 2
   H. $2\sqrt{2}$
   J. $2i$
   K. $2i\sqrt{2}$

7. Tickets for a community theater production cost \$6 each when bought in advance and \$8 each when bought at the door. The theater group's goal is at least \$2,000 in ticket sales for opening night. The theater group sold 142 opening-night tickets in advance. What is the minimum number of tickets they need to sell at the door on opening night to make their goal?

   A. 143
   B. 144
   C. 192
   D. 250
   E. 357

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DO YOUR FIGURING HERE.

8. Mark and Juanita own a sandwich shop. They offer 3 kinds of bread, 5 kinds of meat, and 3 kinds of cheese. Each type of sandwich has a combination of exactly 3 ingredients: 1 bread, 1 meat, and 1 cheese. How many types of sandwiches are possible?

F. 11
G. 15
H. 30
J. 45
K. 120

9. If $12(x - 11) = -15$, then $x = ?$

A. $-\frac{49}{4}$

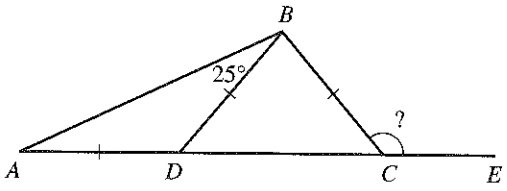
B. $-\frac{13}{6}$

C. $-\frac{5}{4}$

D. $-\frac{1}{3}$

E. $\frac{39}{4}$

10. In the figure below, A, D, C, and E are collinear. $\overline{AD}$, $\overline{BD}$, and $\overline{BC}$ are all the same length, and the angle measure of $\angle ABD$ is as marked. What is the degree measure of $\angle BCE$?



F. 50°
G. 100°
H. 105°
J. 130°
K. 160°

11. If $f(x) = 9x^2 + 5x - 8$, then $f(-2) = ?$

A. −54
B. −18
C. 18
D. 36
E. 38

12. What is the least common multiple of 30, 20, and 70 ?

F. 40
G. 42
H. 120
J. 420
K. 42,000

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DO YOUR FIGURING HERE.

13. While doing a problem on his calculator, Tom meant to divide a number by 2, but instead he accidentally multiplied the number by 2. Which of the following calculations could Tom then do to the result on the calculator screen to obtain the result he originally wanted?

A. Subtract the original number
B. Multiply by 2
C. Multiply by 4
D. Divide by 2
E. Divide by 4

14. The 8-sided figure below is divided into 5 congruent squares. The total area of the 5 squares is 125 square inches. What is the perimeter, in inches, of the figure?

F. 25
G. 60
H. 80
J. 100
K. 125

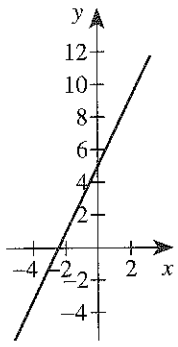
15. Hai has $100 available to buy USB drives to back up data for his business computers. Each USB drive has a price of $8, and Hai will pay a sales tax of 7% of the total price of the USB drives. What is the maximum number of USB drives Hai can buy?

A. 11
B. 12
C. 13
D. 14
E. 15

16. A certain computer performs 1.5×10^8 calculations per second. How many seconds would it take this computer to perform 6.0×10^{16} calculations?

F. 2.5×10^{-9}
G. 9.0×10^{0}
H. 4.0×10^{2}
J. 4.0×10^{8}
K. 9.0×10^{24}

17. One of the following is an equation of the linear relation shown in the standard (x,y) coordinate plane below. Which equation is it?



A. $y = 5x$
B. $y = 2x$
C. $y = 5x + 2$
D. $y = 2x - 5$
E. $y = 2x + 5$

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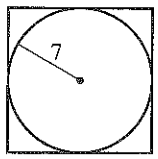
DO YOUR FIGURING HERE.

18. A square is circumscribed about a circle of 7-foot radius, as shown below. What is the area of the square, in square feet?

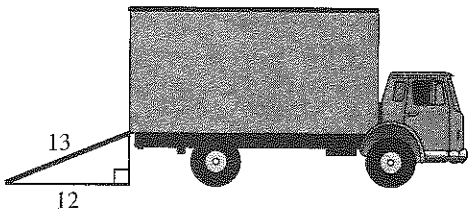


F. 49
G. 56
H. 98
J. 49π
K. 196

19. Two workers were hired to begin work at the same time. Worker A's contract called for a starting salary of \$20,000 with an increase of \$800 after each year of employment. Worker B's contract called for a starting salary of \$15,200 with an increase of \$2,000 after each year of employment. If x represents the number of full years' employment (that is, the number of yearly increases each worker has received), which of the following equations could be solved to determine the number of years until B's yearly salary equals A's yearly salary?

A. $20{,}000 + 800x = 15{,}200 + 2{,}000x$
B. $20{,}000 + 2{,}000x = 15{,}200 + 800x$
C. $(20{,}000 + 800)x = (15{,}200 + 2{,}000)x$
D. $(2{,}000 + 800)x = 20{,}000 - 15{,}200$
E. $(2{,}000 - 800)x = 20{,}000 + 15{,}200$

20. A ramp for loading trucks is 13 feet long and covers 12 feet along the level ground, as shown below. How many feet high is the highest point on the ramp?



F. 1
G. 2
H. 4
J. 5
K. $6\frac{1}{4}$

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21. The expression $7(x + 3) - 3(2x - 2)$ is equivalent to:

A. $x + 1$
B. $x + 15$
C. $x + 19$
D. $x + 23$
E. $x + 27$

DO YOUR FIGURING HERE.

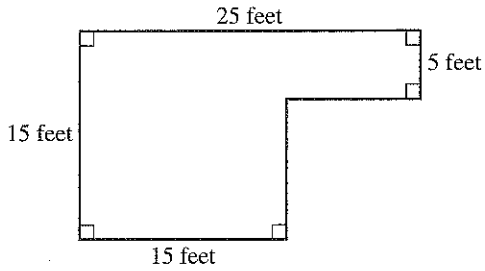
22. If 115% of a number is 460, what is 75% of the number?

F. 280
G. 300
H. 320
J. 345
K. 400

23. When $(2x - 3)^2$ is written in the form $ax^2 + bx + c$, where a, b, and c are integers, $a + b + c = ?$

A. −17
B. −5
C. 1
D. 13
E. 25

24. What is the area, in square feet, of the figure below?



F. 60
G. 80
H. 275
J. 375
K. 450

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DO YOUR FIGURING HERE.

25. Barb is going to cover a rectangular area 8 feet by 10 feet with rectangular paving blocks that are 4 inches by 8 inches by 2 inches to make a flat patio. What is the minimum number of paving blocks she will need if all the paving blocks will face the same direction?

(Note: Barb will not cut any of the paving blocks.)

A. 80
B. 360
C. 601
D. 960
E. 1,213

26. What is the slope of the line represented by the equation $6y - 14x = 5$?

F. -14

G. $\frac{5}{6}$

H. $\frac{7}{3}$

J. 6

K. 14

27. Let m and n be 2 positive integers, such that $m < n$. Which of the following compound inequalities *must* be true?

A. $0 < \sqrt{mn} < m$
B. $1 < \sqrt{mn} < m$
C. $m < \sqrt{mn} < n$
D. $\sqrt{m} < \sqrt{mn} < \sqrt{n}$
E. $\sqrt{m-n} < \sqrt{mn} < \sqrt{m+n}$

28. Two similar triangles have perimeters in the ratio 3:5. The sides of the smaller triangle measure 3 cm, 5 cm, and 7 cm, respectively. What is the perimeter, in centimeters, of the larger triangle?

F. 15
G. 18
H. 20
J. 25
K. 36

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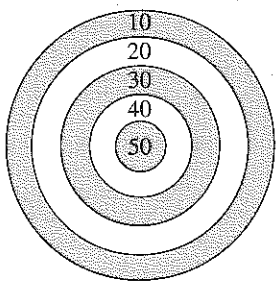
DO YOUR FIGURING HERE.

29. Thomas and Jonelle are playing darts in their garage using the board with the point values for each region shown below. The radius of the outside circle is 10 inches, and each of the other circles has a radius 2 inches smaller than the next larger circle. All of the circles have the same center. Thomas has only 1 dart left to throw and needs at least 30 points to win the game. Assuming that his last dart hits at a random point within a single region on the board, what is the percent chance that Thomas will win the game?



A. 36%
B. 30%
C. 16%
D. 9%
E. $1\frac{1}{2}\%$

30. When asked his age, the algebra teacher said, "If you square my age, then subtract 23 times my age, the result is 50." How old is he?

F. 23
G. 25
H. 27
J. 46
K. 50

31. The distance, d, an accelerating object travels in t seconds can be modeled by the equation $d = \frac{1}{2}at^2$, where a is the acceleration rate, in meters per second per second. If a car accelerates from a stop at the rate of 20 meters per second per second and travels a distance of 80 meters, about how many seconds did the car travel?

A. Between 1 and 2
B. Between 2 and 3
C. Between 3 and 4
D. 4
E. 8

32. Which of the following is the set of all real numbers x such that $x + 3 > x + 5$?

F. The empty set
G. The set containing all real numbers
H. The set containing all negative real numbers
J. The set containing all nonnegative real numbers
K. The set containing only zero

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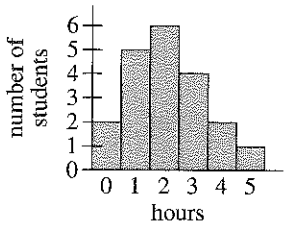
DO YOUR FIGURING HERE.

Use the following information to answer questions 33–35.

A survey in a study skills class asked the 20 students enrolled in the class how many hours (rounded to the nearest hour) they had spent studying on the previous evening. The 20 responses are summarized by the histogram below.



33. What fraction of the students responded that they had spent less than 3 hours studying?

A. $\frac{13}{100}$

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

C. $\frac{3}{10}$

D. $\frac{13}{20}$

E. $\frac{17}{20}$

34. The teacher decides to show the data in a circle graph (pie chart). What should be the measure of the central angle of the sector for 3 hours?

F. 18°
G. 20°
H. 36°
J. 72°
K. 90°

35. To the nearest tenth of an hour, what is the average number of hours for the 20 survey responses?

A. 2.0
B. 2.1
C. 2.3
D. 2.5
E. 3.0

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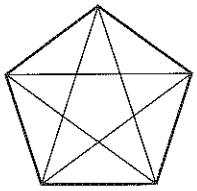
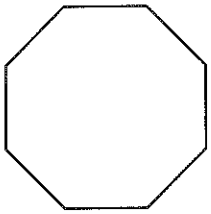
DO YOUR FIGURING HERE.

36. Pentagons have 5 diagonals, as illustrated below.



How many diagonals does the octagon below have?



F. 8
G. 16
H. 20
J. 30
K. 40

37. The bottom of the basket of a hot-air balloon is parallel to the level ground. One taut tether line 144 feet long is attached to the center of the bottom of the basket and is anchored to the ground at an angle of 72°, as shown in the figure below. Which of the following expressions gives the distance, in feet, from the center of the bottom of the basket to the ground?

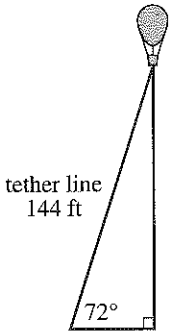
A. $\frac{144}{\cos 72°}$

B. $\frac{144}{\sin 72°}$

C. 144 tan 72°

D. 144 cos 72°

E. 144 sin 72°



38. The coordinates of the endpoints of $\overline{GH}$, in the standard (x,y) coordinate plane, are $(-8,-3)$ and $(2,3)$. What is the x-coordinate of the midpoint of $\overline{GH}$?

F. −6
G. −3
H. 0
J. 3
K. 5

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DO YOUR FIGURING HERE.

39. Let $2x + 3y = 4$ and $5x + 6y = 7$. What is the value of $8x + 9y$?

A. -10
B. -1
C. 2
D. 7
E. 10

40. What are the values of θ, between 0 and 2π, when $\tan\theta = -1$?

F. $\frac{\pi}{4}$ and $\frac{3\pi}{4}$ only

G. $\frac{3\pi}{4}$ and $\frac{5\pi}{4}$ only

H. $\frac{3\pi}{4}$ and $\frac{7\pi}{4}$ only

J. $\frac{5\pi}{4}$ and $\frac{7\pi}{4}$ only

K. $\frac{\pi}{4}$, $\frac{3\pi}{4}$, $\frac{5\pi}{4}$, and $\frac{7\pi}{4}$

41. For the complex number i and an integer x, which of the following is a possible value of i^x ?

A. 0
B. 1
C. 2
D. 3
E. 4

42. A can of soda pop has the shape of a right circular cylinder with an inside height of 6 inches and an inside diameter of 2 inches. When you pour the soda pop from the full can into a cylindrical glass with an inside diameter of 3 inches, about how many inches high is the soda pop in the glass?

(Note: The volume of a right circular cylinder is $\pi r^2 h$.)

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

G. 4

H. 5

J. $6\frac{2}{3}$

K. 8

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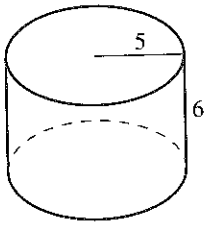
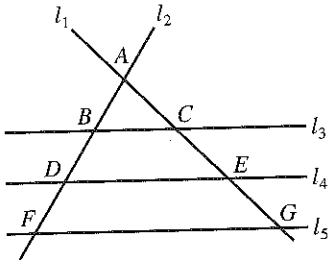
DO YOUR FIGURING HERE.

43. The height and radius of the right circular cylinder below are given in meters. What is the volume, in cubic meters, of the cylinder?



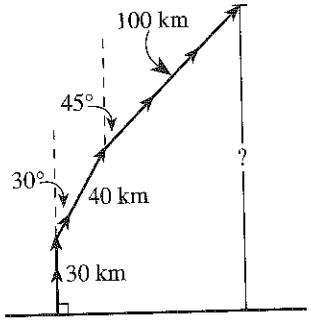
A. 30π
B. 31π
C. 150π
D. 180π
E. 900π

44. Lines l_1 and l_2 intersect each other and 3 parallel lines, l_3, l_4, and l_5, at the points shown in the figure below. The ratio of the perimeter of $\triangle ABC$ to the perimeter of $\triangle AFG$ is 1:3. The ratio of DE to FG is 2:3. What is the ratio of AC to CE ?



F. 1:1
G. 1:2
H. 1:3
J. 2:1
K. 3:1

45. A rocket lifted off from a launch pad and traveled vertically 30 kilometers, then traveled 40 kilometers at 30° from the vertical, and then traveled 100 kilometers at 45° from the vertical, as shown in the figure below. At that point, the rocket was how many kilometers above the height of the launch pad?



A. 100
B. 170
C. 190
D. $20\sqrt{3} + 50\sqrt{2}$
E. $30 + 20\sqrt{3} + 50\sqrt{2}$

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DO YOUR FIGURING HERE.

46. Machine A produces 500 springs a day. The number of *defective* springs produced by this machine each day is recorded for 60 days. Based on the distribution given below, what is the expected value of the number of *defective* springs produced by Machine A in any single day?

Number, n, of defective springs produced	Probability that n defective springs are produced in any single day
0	0.70
1	0.20
2	0.05
3	0.05

F. 0.00
G. 0.45
H. 0.70
J. 1.00
K. 1.50

47. The height above the ground, h units, of an object t seconds after being thrown from the top of a building is given by the equation $h = -2t^2 + 10t + 48$. An equivalent factored form of this equation shows that the object:

A. starts at a point 2 units off the ground.
B. reaches a maximum height of 3 units.
C. reaches a maximum height of 8 units.
D. reaches the ground at 3 seconds.
E. reaches the ground at 8 seconds.

48. For all positive values of g and h, which of the following expressions is equivalent to $g^2\sqrt{g^5} \cdot h^2\sqrt[4]{h^5}$?

F. $g^2h^2\sqrt[5]{g^2h^2}$
G. $g^3h\sqrt[4]{g^2h^3}$
H. $g^4h^3\sqrt[4]{g^2h}$
J. $g^4h^4\sqrt{gh}$
K. g^7h^7

49. The value of $\log_5\left(5^{\frac{13}{2}}\right)$ is between which of the following pairs of consecutive integers?

A. 0 and 1
B. 4 and 5
C. 5 and 6
D. 6 and 7
E. 9 and 10

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DO YOUR FIGURING HERE.

Use the following information to answer questions 50–52.

A storage facility is currently offering a special rate to customers who sign contracts for 6 months or more. According to this special rate, the first month's rent is \$1, and for each month after the first month, customers pay the regular monthly rental rate. The table below shows the storage unit sizes available, the floor dimensions, and the regular monthly rental rate. All the units have the same height.

Size	Floor dimensions, in meters	Regular monthly rental rate
1	2 × 4	\$ 30
2	4 × 4	\$ 60
3	4 × 8	\$100
4	8 × 8	\$150
5	8 × 16	\$200

50. Daria will sign a contract to rent a Size 3 unit for 12 months at the current special rate. The amount Daria will pay for 12 months at the current special rate represents what percent decrease from the regular rental rate for 12 months?

F. 8.25%
G. 8.33%
H. 8.42%
J. 9.00%
K. 9.09%

51. Size 5 units can be subdivided to form other sizes of units. What is the greatest number of Size 1 units that can be formed from a single Size 5 unit?

A. 2
B. 4
C. 8
D. 10
E. 16

52. Janelle, the owner of the storage facility, is considering building new units that have floor dimensions larger than Size 5 units. She will use the floor area to determine the heating requirements of these larger units. For this calculation, Janelle will use the same relationship between the unit size number and the respective floor area for Sizes 1 through 5. Which of the following expressions gives the floor area, in square meters, of a Size x storage unit?

F. $2^3 \cdot x$
G. 2^{3x}
H. $2^{(2+x)}$
J. $2(x+1)^2$
K. $(x+2)^2$

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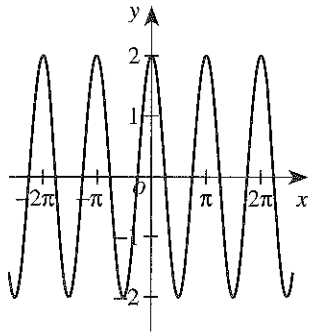
DO YOUR FIGURING HERE.

53. A trigonometric function with equation $y = a\sin(bx + c)$, where a, b, and c are real numbers, is graphed in the standard (x,y) coordinate plane below. The *period* of this function $f(x)$ is the smallest positive number p such that $f(x + p) = f(x)$ for every real number x. One of the following is the period of this function. Which one is it?



A. $\frac{\pi}{2}$

B. π

C. 2π

D. 4π

E. 2

54. The component forms of vectors $\mathbf{u}$ and $\mathbf{v}$ are given by $\mathbf{u} = \langle 5,3\rangle$ and $\mathbf{v} = \langle 2,-7\rangle$. Given that $2\mathbf{u} + (-3\mathbf{v}) + \mathbf{w} = \mathbf{0}$, what is the component form of $\mathbf{w}$?

F. $\langle -16,\ 15\rangle$

G. $\langle\ -4,-27\rangle$

H. $\langle\ \ 3,\ 10\rangle$

J. $\langle\ \ 4,\ 27\rangle$

K. $\langle\ 16,-15\rangle$

55. For how many integers x is the equation $3^{x+1} = 9^{x-2}$ true?

A. 0
B. 1
C. 2
D. 3
E. An infinite number

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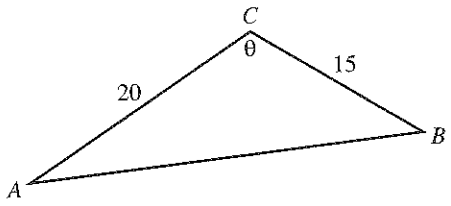
DO YOUR FIGURING HERE.

56. In $\triangle ABC$ shown below, the length of $\overline{AC}$ and the measure of θ will remain constant. The length of $\overline{AC}$ is 20 inches and the measure of $\angle C$ is equal to θ. Initially, the length of $\overline{BC}$ is 15 inches, and the length of $\overline{BC}$ is the function given by $f(t) = 15 - 2t$, where t is time, in seconds, since the length of $\overline{BC}$ began to decrease. What is the time, t, at which the resulting triangle will have an area that is $\frac{1}{2}$ the area of the original triangle?

(Note: The area of a triangle is $\frac{1}{2}ab \sin x$, where a and b are the lengths of the sides that form the interior angle with measure x.)



F. 0

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

H. $\frac{15}{4}$

J. $\frac{45}{8}$

K. $\frac{45}{4}$

57. Which of the following expressions gives the number of distinct permutations of the letters in PEOPLE ?

A. 6!

B. 4(4!)

C. $\frac{6!}{4!}$

D. $\frac{6!}{2!}$

E. $\frac{6!}{(2!)(2!)}$

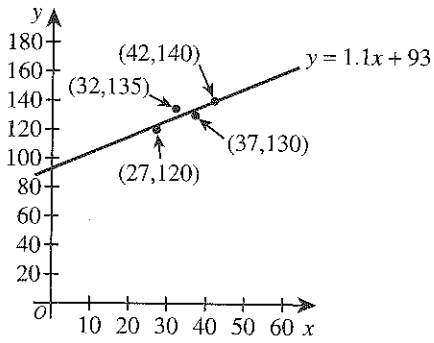
GO ON TO THE NEXT PAGE.

58. Which of the following expressions is equivalent to $49x^2 + 81$?

DO YOUR FIGURING HERE.

F. $(7x + 9)^2$
G. $(7x + 9i)^2$
H. $(7x - 9i)^2$
J. $(7x - 9)(7x + 9)$
K. $(7x - 9i)(7x + 9i)$

59. A bivariate data set of observed values along with a line of best fit for the data set are shown in the standard (x,y) coordinate plane below. The set of 4 residuals for the model is given by $y_i - y(x_i)$, for $i = 1, 2, 3, 4$, where y_i is the observed y-value corresponding to the input x_i, and $(x_i, y(x_i))$ is on the line of best fit. What is the absolute value of the largest residual for this model?



A. 2.5
B. 6.8
C. 15.0
D. 20.0
E. 42.0

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2 △ △ △ △ △ △ △ △ △ 2

DO YOUR FIGURING HERE.

60. For the first 5 possible values of x, the table below gives the probability, $P(x)$, that a certain factory machine will make x errors on any given workday.

x errors	$P(x)$
0	0.0823
1	0.2185
2	0.2712
3	0.2046
4	0.1238

Which of the following values is closest to the probability that this machine will make at least 1 error on any given workday?

F. 0.2185
G. 0.5996
H. 0.6992
J. 0.8181
K. 0.9177

END OF TEST 2

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

DO NOT RETURN TO THE PREVIOUS TEST.