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. Given $x = 5$, $y = 3$, and $z = -6$, $(x + y - z)(y + z) = ?$

A. -42
B. -6
C. 6
D. 11
E. 18

2. Each student attending the East Central High School preprom dinner must choose 1 item from each of 3 categories: entrée, side dish, and beverage. There are 3 entrée choices, 4 side dish choices, and 2 beverage choices. How many different dinner combinations for each student are possible?

F. 8
G. 9
H. 12
J. 14
K. 24

3. A bag contains 13 solid-colored marbles: 3 red, 5 white, 4 black, and 1 yellow. If only 1 marble is selected, what is the probability of randomly selecting 1 marble that is NOT black?

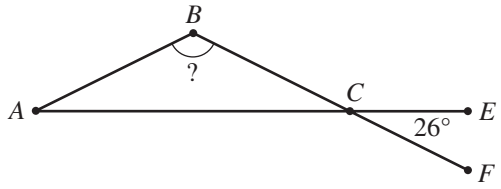
A. $\frac{1}{9}$
B. $\frac{4}{9}$
C. $\frac{4}{13}$
D. $\frac{9}{13}$
E. $\frac{9}{26}$

DO YOUR FIGURING HERE.

4. Sam works at Glendale Hospital and earns \$12 per hour for the first 40 hours and \$18 per hour for every additional hour he works each week. Last week, Sam earned \$570. To the nearest whole number, how many hours did he work?

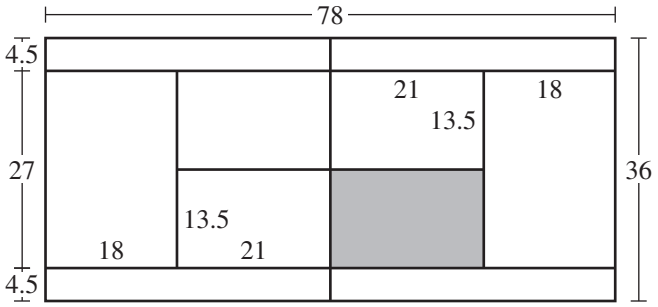
F. 32
G. 35
H. 38
J. 45
K. 48

5. In the figure below, $\overline{AB}$ is congruent to $\overline{BC}$, and $\overline{AE}$ intersects $\overline{BF}$ at C. What is the measure of $\angle B$?



A. 26°
B. 38°
C. 52°
D. 128°
E. 154°

6. The dimensions, in feet, of a standard tennis court are shown in the figure below. All lines that meet in the figure do so at right angles. Which of the following values is closest to the area, in square feet, of the 1 service box shown shaded?



F. 284
G. 527
H. 567
J. 1,053
K. 1,134

7. In scientific notation, what is the product of 3 and 0.000 000 72 ?

A. 2.16×10^{-7}
B. 2.16×10^{-6}
C. 2.4×10^{-8}
D. 2.4×10^{-7}
E. 6.9×10^{-7}

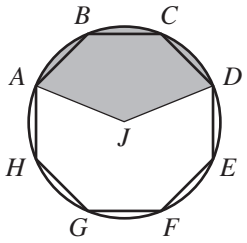
DO YOUR FIGURING HERE.

8. If $f(x) = (4x + 3)^2$, then $f(1) = ?$

F. 7
G. 14
H. 19
J. 25
K. 49

9. Regular octagon *ABCDEFGH* is inscribed in a circle, as shown below. The sector of the circle bounded by radii $\overline{AJ}$ and $\overline{DJ}$ and by $\overset{\frown}{AD}$ is shaded. The area of the shaded sector is what fraction of the area of the circle?

A. $\frac{1}{8}$
B. $\frac{1}{4}$
C. $\frac{3}{10}$
D. $\frac{3}{8}$
E. $\frac{1}{2}$



10. The expression $(2x + 3)(5x - 6)$ is equivalent to:

F. $7x^2 - 18$
G. $7x^2 + 3x - 18$
H. $10x^2 - 18$
J. $10x^2 - 3x - 18$
K. $10x^2 + 3x - 18$

11. A cake recipe requires $\frac{5}{8}$ cup of flour. Mary and Haloa decide to make the cake together. Mary has $\frac{1}{3}$ cup of flour and Haloa has $\frac{1}{4}$ cup of flour. How many more cups of flour do they need to make the cake?

A. $\frac{1}{24}$
B. $\frac{2}{7}$
C. $\frac{19}{56}$
D. $\frac{13}{24}$
E. $\frac{17}{24}$

DO YOUR FIGURING HERE.

12. Coach Shannon is buying packages of granola bars, juice boxes, and apples as snacks for her soccer team. The table below gives the number of snacks per package and the price per package.

Snack type	Snacks per package	Price per package
Granola bars	3	\$2.50
Juice boxes	4	\$3.00
Apples	5	\$4.50

What is the minimum total price of the snacks, all bought in whole packages, Coach Shannon buys so that each of the 15 girls on the team gets at least 1 snack of each type?

F. \$30.00
G. \$35.00
H. \$38.00
J. \$42.00
K. \$50.00

13. Given functions $f(x) = 5x + 1$ and $g(x) = x^2 - 2$, what is the value of $f(g(-3))$?

A. −198
B. −54
C. −39
D. 36
E. 194

14. For $7y = 2x - 5$, which of the following expressions gives x in terms of y ?

F. $\frac{7y - 5}{2}$

G. $\frac{7y + 5}{2}$

H. $\frac{7}{2}y - 5$

J. $\frac{7}{2}y + 5$

K. $5y + 5$

15. For an angle with measure α in a right triangle, $\sin \alpha = \frac{4}{5}$ and $\tan \alpha = \frac{4}{3}$. What is the value of $\cos \alpha$?

A. $\frac{3}{\sqrt{41}}$

B. $\frac{3}{5}$

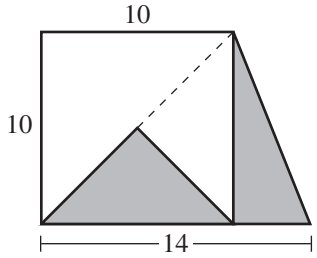
C. $\frac{3}{4}$

D. $\frac{3}{\sqrt{7}}$

E. $\frac{5}{3}$

DO YOUR FIGURING HERE.

16. A scale drawing of a proposed trapezoidal landscape design is shown in the figure below, with the given dimensions in meters. The trapezoid consists of a right triangle and a square divided into 3 isosceles right triangles. The unshaded regions will be white rock; the shaded triangular regions will be black rock. What is the area, in square meters, that will be black rock?



F. 20
G. 25
H. 45
J. 60
K. 70

17. One construction sign flashes every 6 seconds, and another construction sign flashes every 10 seconds. At a certain instant, the 2 signs flash at the same time. How many seconds elapse until the 2 signs next flash at the same time?

A. 4
B. 8
C. 16
D. 30
E. 60

18. Which of the following expressions is equivalent to $4x^2 + 8x - 12$?

F. $(4x - 3)(x + 4)$
G. $(4x + 3)(x - 4)$
H. $4(x - 3)(x - 1)$
J. $4(x - 3)(x + 1)$
K. $4(x + 3)(x - 1)$

19. A person's *vertical jump* is the difference between the maximum height the person can reach at the top of a jump and the maximum height the person can reach when standing. The maximum height Donald can reach at the top of his jump is 10 feet 4 inches, and the maximum height he can reach when standing is 7 feet 10 inches. What is Donald's vertical jump?

A. 2 feet 0 inches
B. 2 feet 4 inches
C. 2 feet 6 inches
D. 3 feet 0 inches
E. 3 feet 6 inches

DO YOUR FIGURING HERE.

Use the following information to answer questions 20–22.

Jocelyn wants to become a member of 1 of 3 gyms. The onetime sign-up fee, the monthly fee, and the late fee for each gym are shown in the table below. Monthly fees are due on the 1st day of each month for each gym. A onetime late fee is added to the monthly fee if the monthly fee is paid after the 1st day of that particular month. Felix, a coworker of Jocelyn's, became a member of PowerPeople on March 1.

Gym	Sign-up fee	Monthly fee	Late fee
PowerPeople	$35	$50	$ 5
FirmFactory	$ 0	$65	$10
TrimTime	$25	$60	$10

20. Given that Jocelyn becomes a member of TrimTime on July 1 and that she pays all monthly fees on time, what total amount will Jocelyn have paid to the gym by September 2 of that year?

F. $ 85
G. $145
H. $180
J. $205
K. $215

21. Before October 1, Felix had paid all 7 of his monthly gym fees on time. He will make his next gym payment on October 4. What total amount must Felix pay on October 4 so that his gym account will be paid in full?

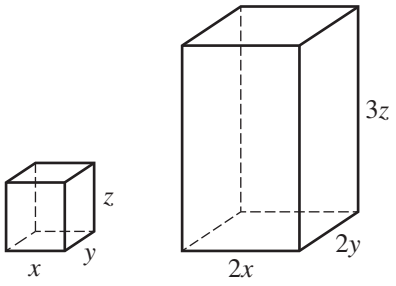
A. $50
B. $55
C. $70
D. $75
E. $90

22. Another gym, Good-As-New, has a sign-up fee equal to the mean of all the sign-up fees in the table. What is the sign-up fee for Good-As-New?

F. $ 8
G. $15
H. $20
J. $30
K. $58

DO YOUR FIGURING HERE.

23. The dimensions, in inches, of 2 rectangular prisms are shown in the figure below. The volume of the large prism is the same as the volume of how many of the small prisms?



A. 2
B. 4
C. 6
D. 7
E. 12

24. For what real number value of x is the equation $64^{\frac{1}{3}} = 2^x$ true?

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

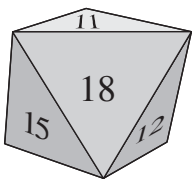
G. 2

H. 4

J. 6

K. 8

25. Suppose that the 8 identical faces of a regular octahedron, like the one shown below, are numbered from 11 through 18, with 1 number per face, and each face is equally likely to land down when the octahedron is tossed. What is the probability that, on 1 toss of this octahedron, the number on the face landing down is a prime number or an even number?



A. 0

B. $\frac{1}{8}$

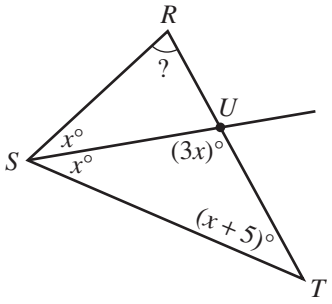
C. $\frac{1}{4}$

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

E. $\frac{7}{8}$

DO YOUR FIGURING HERE.

26. In $\triangle RST$ below, U is a point on $\overline{RT}$ such that $\overrightarrow{SU}$ is an angle bisector of $\angle RST$. What is $m\angle R$?



F. 43.75°
G. 50°
H. 70°
J. 90°
K. 100°

27. A lawn-and-garden store sells 2 types of grass seed: shade and sun. The numbers of bags sold on Friday and Saturday last week are given in matrix A; the selling price per bag and the profit per bag are given in matrix B. Price and profit are in dollars. What is the total profit for the sale of the 2 types of grass seed sold on Friday and Saturday?

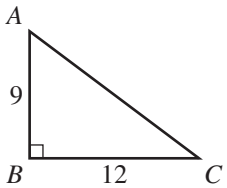
$$A = \begin{matrix} \\ \text{Friday} \\ \text{Saturday} \end{matrix}\!\!\begin{matrix} \text{shade} & \text{sun} \\ \end{matrix}\!\!\begin{bmatrix} 12 & 25 \\ 13 & 15 \end{bmatrix} \qquad B = \begin{matrix} \\ \text{shade} \\ \text{sun} \end{matrix}\!\!\begin{matrix} \text{price} & \text{profit} \\ \end{matrix}\!\!\begin{bmatrix} 11.75 & 1.70 \\ 8.00 & 1.50 \end{bmatrix}$$

A. \$ 65.00
B. \$ 97.50
C. \$102.50
D. \$110.50
E. \$208.00

28. What real value of x satisfies the equation $36^{x-1} = 6$?

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

29. In right triangle $\triangle ABC$ shown below, $AB = 9$ units and $BC = 12$ units. What is $\sin A$?

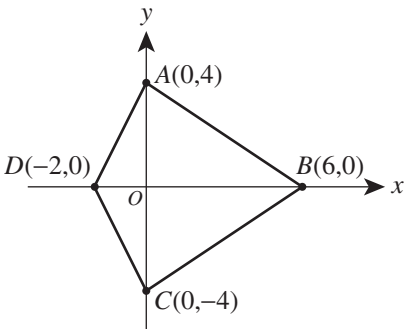


A. $\frac{3}{5}$
B. $\frac{3}{4}$
C. $\frac{4}{5}$
D. $\frac{5}{4}$
E. $\frac{4}{3}$

DO YOUR FIGURING HERE.

Use the following information to answer questions 30–32.

Shown below is quadrilateral $ABCD$ in the standard (x,y) coordinate plane.



30. What is the area, in square coordinate units, of $ABCD$?

F. 16
G. 24
H. 32
J. 48
K. 64

31. What is the perimeter, in coordinate units, of $ABCD$?

A. $4\sqrt{5}$
B. $4\sqrt{5} + 4\sqrt{13}$
C. $4\sqrt{13}$
D. 16
E. 144

32. What are the coordinates of the image of point B resulting from a rotation of 180° about the origin?

F. (−10, 0)
G. (−6, 0)
H. (−2, 0)
J. (0,−6)
K. (6, 0)

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33. Which of the following expressions is equivalent to $\frac{x^2 + 4x - 12}{x^2 - 36}$ for $x^2 - 36 \neq 0$?

A. $\frac{4x}{3}$
B. $\frac{x-2}{x-6}$
C. $\frac{x+2}{x+6}$
D. $\frac{x-3}{-9}$
E. $\frac{x+3}{x+9}$

DO YOUR FIGURING HERE.

34. The rectangular top surface of a patio is 4 feet longer than it is wide and has an area of 192 square feet. What is the width, in feet, of the rectangular top surface of the patio?

F. 12
G. 16
H. 24
J. 46
K. 48

35. In the standard (x,y) coordinate plane, what is the slope of the line that contains $(-2,-2)$ and has a y-intercept of 1 ?

A. -1
B. $\frac{2}{3}$
C. 1
D. $\frac{3}{2}$
E. 3

36. Veronica delivers 27 copies of the *News Report* and 22 copies of the *City Times* to 38 of the 40 houses on Oakland Street. No house receives more than 1 copy of each newspaper. How many houses receive both newspapers?

F. 2
G. 5
H. 7
J. 9
K. 11

37. $|-3| + |-5|(7 - 3) = ?$

A. -41
B. -23
C. 23
D. 32
E. 35

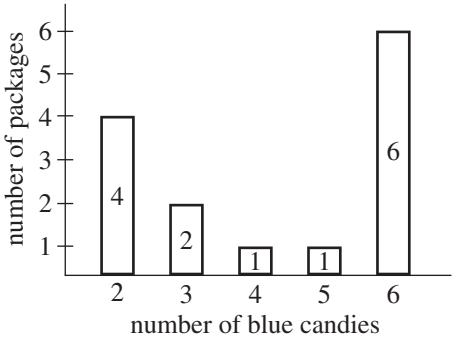
38. Julia, an archaeology student, needs to dig 6 cylindrical pits at an archaeological site. Each pit will be 8 feet in diameter and 6 feet deep. Since she needs to work slowly and carefully, Julia can remove dirt at an average rate of 3 cubic feet per hour. Which of the following values is closest to the number of hours it will take Julia to dig all 6 pits?

(Note: The volume, V, of a cylinder with radius r and height h is $V = \pi r^2 h$; $\pi \approx 3.14$.)

F. 100
G. 200
H. 400
J. 600
K. 800

DO YOUR FIGURING HERE.

39. Hector counted the number of blue candies in each of 14 packages and summarized his data in the frequency bar graph below.



What is the median of the numbers of blue candies in the 14 packages?

A. 4.0
B. 4.2
C. 4.5
D. 5.0
E. 6.0

40. In certain years, July, a month with 31 days, has exactly 4 Mondays and 4 Fridays. The first of July in those years will be on:

F. Tuesday.
G. Wednesday.
H. Thursday.
J. Saturday.
K. Sunday.

41. Ms. Siochi has a rectangular lot with a perimeter of 100 meters. She paid $2,420.00 for fencing to install along the entire perimeter. She chose standard fencing for 3 sides of the lot and decorative fencing for 1 of the 20-meter sides. Ms. Siochi paid $1.00 more per meter for the decorative fencing than for the standard fencing. How much did Ms. Siochi pay per meter for the decorative fencing?

A. $22.40
B. $23.40
C. $24.00
D. $25.00
E. $26.00

42. Students use dowel rods to learn about equations. They lay several rods, some of which are red and some of which are white, end to end. The length of each red rod is R centimeters, and the length of each white rod is W centimeters. The students determine that the total length of 2 red rods and 7 white rods is the same as the total length of 4 red rods and 3 white rods. Based on this relationship, which of the following equations must be true?

F. $R = 2W$
G. $R = 3W$
H. $3R = 5W$
J. $7R = 9W$
K. $9R = 7W$

DO YOUR FIGURING HERE.

43. For $i = \sqrt{-1}$, $(2 + 2i)^2 = ?$

A. -16
B. 0
C. $8i$
D. $4 + 2i$
E. $4 + 4i$

44. For all θ such that $\cos\theta \neq 0$ and $\sin\theta \neq 0$, which of the following expressions is equal to $\frac{\tan\theta}{\sec\theta}$?

F. $\cos\theta$

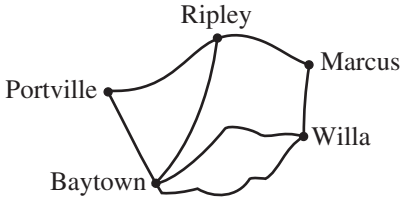
G. $\sin\theta$

H. $\frac{1}{\sin\theta}$

J. $\frac{\cos\theta}{\sin^2\theta}$

K. $\frac{\sin\theta}{\cos^2\theta}$

45. The map below shows the 5 villages and the 7 roads on Gull Island. All residential mailboxes on Gull Island are located along these roads. During a mail run, the island's mail carrier travels on each road exactly once, but she may pass through a village more than once. The carrier starts her run in 1 of the 5 villages and ends her run in 1 of the 4 remaining villages. One of the following pairs of villages gives the starting point and ending point for the mail run. Which one?



	starting point	ending point
A.	Baytown	Marcus
B.	Baytown	Ripley
C.	Marcus	Portville
D.	Portville	Willa
E.	Ripley	Willa

46. Which of the following sets is the range of the function $f(x) = 3 + \left(\frac{x^2 - 5x + 6}{x^2 + 5x - 6}\right)^2$?

F. $(0, 3)$
G. $[0, \infty)$
H. $(-\infty, \infty)$
J. $[-3, \infty)$
K. $[3, \infty)$

DO YOUR FIGURING HERE.

47. Mr. Schulte has a fair 12-sided die, with the sides numbered from 1 through 12. On both Monday and Tuesday, Mr. Schulte will roll the die 1 time. If the side that lands faceup is numbered with a prime number, Mr. Schulte will collect the homework that day—otherwise, he will not collect the homework. What is the probability that Mr. Schulte will collect homework on both Monday and Tuesday?

(Note: 1 is NOT a prime number.)

A. $\left(\frac{5}{12}\right)^2$

B. $\left(\frac{6}{12}\right)^2$

C. $\left(\frac{7}{12}\right)^2$

D. $2\left(\frac{5}{12}\right)$

E. $2\left(\frac{6}{12}\right)$

48. The table below gives the number of Jerry's Construction workers needed to frame a specific type of house in certain selected numbers of days. Given that all the workers work at the same rate, how many workers will it take to frame this specific type of house in 10 days?

Workers	Days
2	15
?	10
6	5
30	1

F. 3
G. 4
H. 7
J. 10
K. 12

49. Considering only positive integer factors, which of the following integers has an odd number of distinct factors?

A. 16
B. 20
C. 23
D. 27
E. 35

DO YOUR FIGURING HERE.

50. A solution is 5% alcohol and 95% water. A second solution is 20% alcohol and 80% water. If 2 gallons of the first solution are mixed with 1 gallon of the second solution, the resulting solution is what percent alcohol?

F. 10%

G. $12\frac{1}{2}\%$

H. 15%

J. 25%

K. 30%

51. In the standard (x,y) coordinate plane, the graph of the equation $y = 3\sin(2x + 0.5\pi)$ has what amplitude and period?

	amplitude	period
A.	3	π
B.	3	2π
C.	3	4π
D.	6	π
E.	6	2π

52. A pet shop always has 54 hamsters that are either solid-colored or multicolored in the front of the store for customers to see. Any additional hamsters are kept in an area at the back of the store. Which of the following ratios of solid-colored hamsters to multicolored hamsters is possible for the hamsters in the front of this pet shop?

F. 1:54
G. 2:7
H. 3:2
J. 6:1
K. 6:9

53. A cookie jar contains 10 cookies of 3 types. There are 5 chocolate-chip cookies, 3 oatmeal-raisin cookies, and 2 sugar cookies. You reach into the jar and choose a cookie at random and then, without replacing the first cookie, reach into the jar and choose another cookie at random. What is the probability that both of the cookies you choose are the same type?

A. $\frac{2}{10}$

B. $\frac{10}{27}$

C. $\frac{28}{90}$

D. $\frac{28}{100}$

E. $\frac{30}{720}$

DO YOUR FIGURING HERE.

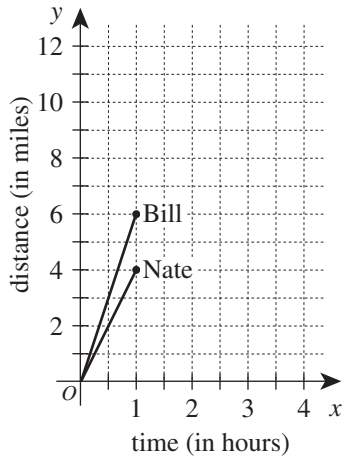
54. Quadrilateral *ABCD* is a parallelogram. Which of the following statements about *ABCD must* be true?

F. The diagonals bisect each other.
G. The diagonals are perpendicular.
H. The diagonals are congruent.
J. All 4 sides are congruent.
K. All 4 interior angles are congruent.

55. For all m such that $0 < m < 1$, the value of m^{-1} *must* be:

A. greater than m.
B. equal to m.
C. less than m, but greater than 0.
D. equal to 0.
E. less than 0.

56. Bill and Nate are participating in a fund-raising event in which they run or walk a distance of 30 miles. A graph representing their progress during the first hour is shown in the standard (x,y) coordinate plane below.



Assume that Bill continues to travel at the same speed until he reaches the finish line. One of the following phrases describes how Nate will need to change his average speed for the remainder of the event in order to finish at exactly the same time as Bill. Which one?

F. Decrease it by 2 mph
G. Decrease it by 2.5 mph
H. Increase it by 2 mph
J. Increase it by 2.5 mph
K. Increase it by 4 mph

DO YOUR FIGURING HERE.

57. The math club is selling T-shirts as a fund-raiser. There is a linear relationship between x, the number of T-shirts sold, and y, the profit in dollars from selling the T-shirts. When the club sells 6 shirts, it makes a profit of \$10; when it sells 10 shirts, it makes a profit of \$20. Which of the following equations gives the relationship between x and y ?

A. $y = \frac{2}{5}x + 2$

B. $y = \frac{2}{5}x + \frac{38}{5}$

C. $y = \frac{5}{2}x + 4$

D. $y = \frac{5}{2}x + 5$

E. $y = \frac{5}{2}x - 5$

58. For the following system of equations

$$2^{x-y} = 32$$
$$2^{x+y} = 8,$$

$y = ?$

F. −3
G. −1
H. 1
J. 2
K. 3

59. Nineteen students are eligible to play doubles tennis. What is the maximum number of different 2-person teams possible?

A. 9
B. 38
C. 76
D. 171
E. 342

60. In the equation $ax^2 + bx + c = 0$, coefficients a, b, and c are positive real numbers. If $a = c$ and both roots of the quadratic equation are real numbers, which of the following relations must hold between a and b ?

F. $a > 2c$

G. $a = b$

H. $a \geq 2b$

J. $a > b$

K. $a \leq \frac{b}{2}$

END OF TEST 2

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

DO NOT RETURN TO THE PREVIOUS TEST.