



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

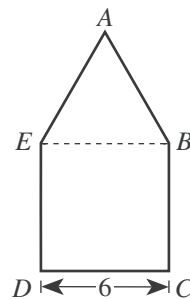
2. A consultant charges \$45 for each hour she works on a consultation, plus a flat \$30 consulting fee. How many hours of work are included in a \$210 bill for a consultation?

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?

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?



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?

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

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

What is the value of  $x$ ?

**GO ON TO THE NEXT PAGE.**



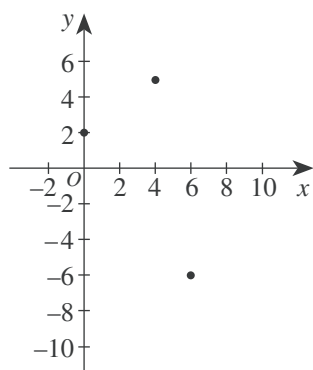
9. In the standard  $(x,y)$  coordinate plane, point  $M$  with coordinates  $(5,4)$  is the midpoint of  $\overline{AB}$ , and  $B$  has coordinates  $(7,3)$ . What are the coordinates of  $A$ ?

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               |

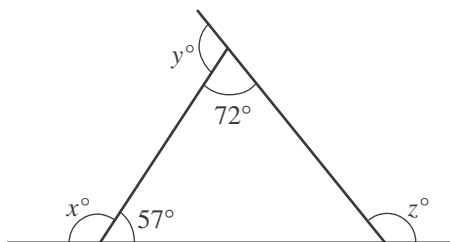
10. Rectangle  $ABCD$  has vertices  $A(4,5)$ ,  $B(0,2)$ , and  $C(6,-6)$ . These vertices are graphed below in the standard  $(x,y)$  coordinate plane. What are the coordinates of vertex  $D$ ?



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?

|   | A   | B   | C   | Cost   |
|---|-----|-----|-----|--------|
| X | 100 | 200 | 150 | A \$ 5 |
| Y | 120 | 50  | 100 | B \$10 |
|   |     |     |     | C \$15 |

- 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  $z$ ?



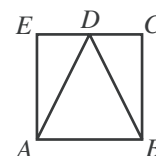
13. What percent of the voters polled chose Whitney in the poll?

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?

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  $\triangle ADB$ ?





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?

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?

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

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

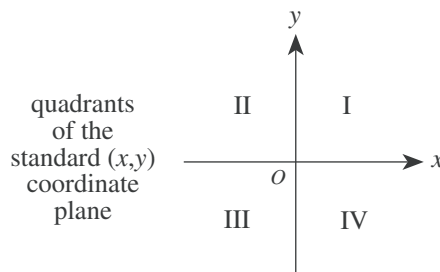
21. What values of  $x$  are solutions for  $x^2 + 2x = 8$ ?

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.  $\frac{1}{a^2}$

can be more than one quadrant.

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?



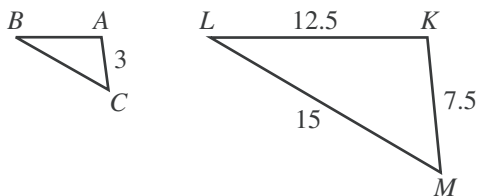
24. The fixed costs of manufacturing basketballs in a factory are \$1,400.00 per day. The variable costs are \$5.25 per basketball. Which of the following expressions can be used to model the cost of manufacturing  $b$  basketballs in 1 day?

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.”)



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?

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?

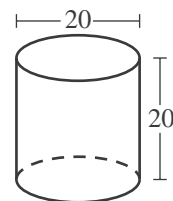
F. 6  
G. 12  
H. 24  
J. 48  
K. 220

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?

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?

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.)



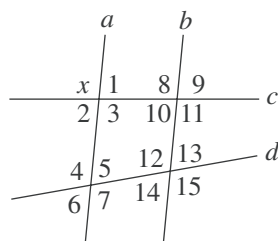
32. Given  $f(x) = 4x + 1$  and  $g(x) = x^2 - 2$ , which of the following is an expression for  $f(g(x))$ ?



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  $\angle x$ ?

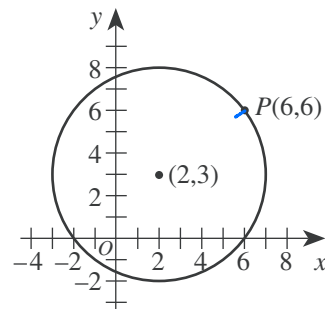


35.  $(3x^3)^3$  is equivalent to:

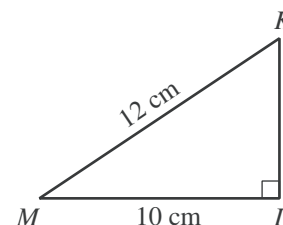
36. Which of the following is equivalent to the inequality  $4x - 8 > 8x + 16$ ?

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 ( $\circlearrowright$ ) about the center of the circle?

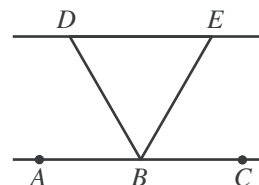
- A.  $(2, 3)$   
B.  $(3, 2)$   
C.  $(5, -1)$   
D.  $(6, 0)$   
E.  $(7, 3)$



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



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  $\angle DBE$ ?

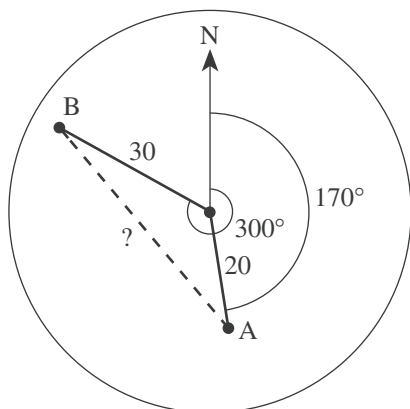


40. If there are  $8 \times 10^{12}$  hydrogen molecules in a volume of  $4 \times 10^4$  cubic centimeters, what is the average number of hydrogen molecules per cubic centimeter?

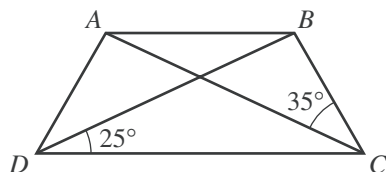


41. In the figure below, a radar screen shows 2 ships. Ship A is located at a distance of 20 nautical miles and bearing  $170^\circ$ , and Ship B is located at a distance of 30 nautical miles and bearing  $300^\circ$ . Which of the following is an expression for the straight-line distance, in nautical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

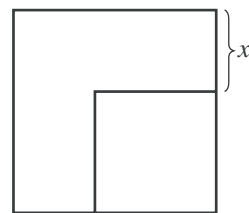
(Note: For  $\triangle ABC$  with side of length  $a$  opposite  $\angle A$ , side of length  $b$  opposite  $\angle B$ , and side of length  $c$  opposite  $\angle C$ , the law of cosines states  $c^2 = a^2 + b^2 - 2ab \cos \angle C$ .)



- 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  $\angle DBC$ ?



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?



45. Which of the following is a rational number?

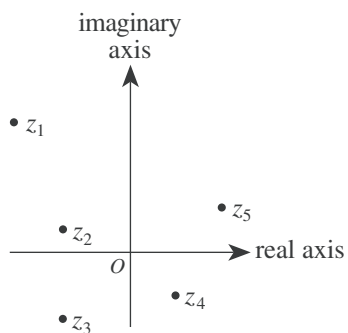
- A.  $\sqrt{2}$   
 B.  $\sqrt{\pi}$   
 C.  $\sqrt{7}$   
 D.  $\sqrt{\frac{5}{25}}$   
 E.  $\sqrt{\frac{64}{49}}$

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?



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?

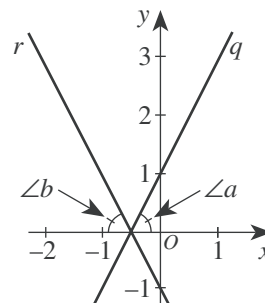
- F.  $z_1$   
G.  $z_2$   
H.  $z_3$   
J.  $z_4$   
K.  $z_5$



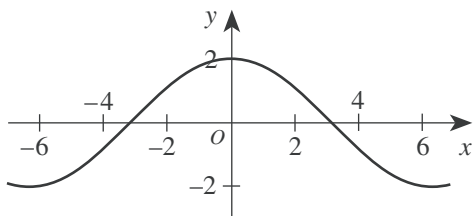
49. In the real numbers, what is the solution of the equation  $8^{2x+1} = 4^{1-x}$ ?

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?

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  $r$ ?



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

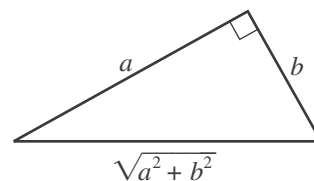


The function is:

- 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  $x = \pi$ .

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  $\cos\left[\tan^{-1}\left(\frac{a}{b}\right)\right]$ ?

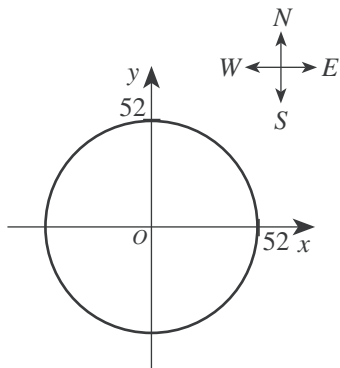
- A.  $\frac{a}{b}$   
B.  $\frac{b}{a}$   
C.  $\frac{a}{\sqrt{a^2 + b^2}}$   
D.  $\frac{b}{\sqrt{a^2 + b^2}}$   
E.  $\frac{\sqrt{a^2 + b^2}}{a}$





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.



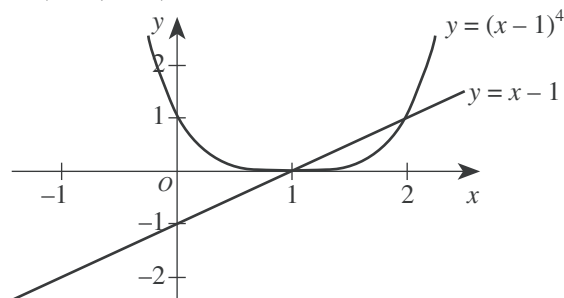
54. Which of the following is closest to the area, in square miles, of the region of coverage of the radio signal?

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

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.)

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  $(x - 1)^4 < (x - 1)$ ?

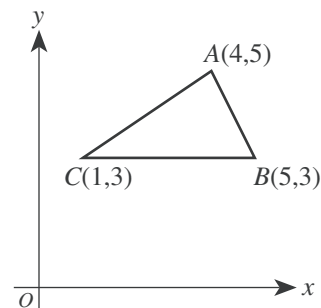


- A.  $x < 1$   
 B.  $1 < x < 2$   
 C.  $x > 2$   
 D.  $x < 2$   
 E.  $1 < x < 2$

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?

END OF TEST 2

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



## READING TEST

35 Minutes—40 Questions

**DIRECTIONS:** There are four passages in this test. Each passage is followed by several questions. After reading a passage, choose the best answer to each question and fill in the corresponding oval on your answer document. You may refer to the passages as often as necessary.

## Passage I

**PROSE FICTION:** This passage is adapted from the short story “The Threshold” by Cristina Peri Rossi (original Spanish version ©1986 by Cristina Peri Rossi; translation ©1993 by Mary Jane Treacy).

The woman never dreams and this makes her intensely miserable. She thinks that by not dreaming she is unaware of things about herself that dreams would surely give her. She doesn’t have the door of  
5 dreams that opens every night to question the certainties of the day. She stays at the threshold, and the door is always closed, refusing her entrance. I tell her *that* in itself is a dream, a nightmare: to be in front of a door which will not open no matter how much we push at the  
10 latch or pound the knocker. But in truth, the door to that nightmare doesn’t have a latch or a knocker; it is total surface, brown, high and smooth as a wall. Our blows strike a body without an echo.

“There’s no such thing as a door without a key,”  
15 she tells me, with the stubborn resistance of one who does not dream.

“There are in dreams,” I tell her. In dreams, doors don’t open, rivers run dry, mountains turn around in circles, telephones are made of stone. Elevators stop in the  
20 middle of floors, and when we go to the movies all the seats have their backs to the screen. Objects lose their functionality in dreams in order to become obstacles, or they have their own laws that we don’t know anything about.

25 She thinks that the woman who does not dream is the enemy of the waking woman because she robs her of parts of herself, takes away the wild excitement of revelation when we think we have discovered something that we didn’t know before or that we had  
30 forgotten.

“A dream is a piece of writing,” she says sadly, “a work that I don’t know how to write and that makes me different from others, all the human beings and animals who dream.”

35 She is like a tired traveler who stops at the threshold and stays there, stationary as a plant.

In order to console her, I tell her that perhaps she is too tired to cross through the doorway; maybe she

spends so much time looking for her dreams before  
40 falling asleep that she doesn’t see the images when they appear because her exhaustion has made her close those eyes that are inside of her eyes. When we sleep we have two pairs of eyes: the more superficial eyes, which are accustomed to seeing only the appearance of things and  
45 of dealing with light, and dream’s eyes; when the former close, the latter open up. She is the traveler on a long trip who stops at the threshold, half dead with fatigue, and can no longer pass over to the other side or cross the river or the border because she has closed  
50 both pairs of eyes.

“I wish I could open them,” she says simply.

Sometimes she asks me to tell her my dreams, and I know that later, in the privacy of her room with the light out, hiding, she’ll try to dream my dream. But to  
55 dream someone else’s dream is harder than writing someone else’s story, and her failures fill her with irritation. She thinks I have a power that she doesn’t have and this brings out her envy and bad humor. She thinks that the world of dreams is an extra life that some of us  
60 have, and her curiosity is only halfway satisfied when I am finished telling her the last one. (To tell dreams is one of the most difficult arts; perhaps only author Franz Kafka was able to do so without spoiling their mystery, trivializing their symbols or making them rational.)

65 Just as children can’t stand any slight change and love repetition, she insists that I tell her the same dream two or three times, a tale full of people I don’t know, strange forms, unreal happenings on the road, and she becomes annoyed if in the second version there are  
70 some elements that were not in the first.

The one she likes best is the amniotic dream, the dream of water. I am walking under a straight line that is above my head, and everything underneath is clear water that doesn’t make me wet or have any weight;  
75 you don’t see it or feel it, but you know it is there. I am walking on a ground of damp sand, wearing a white shirt and dark pants, and fish are swimming all around me. I eat and drink under the water but I never swim or float because the water is just like air, and I breathe it  
80 naturally. The line above my head is the limit that I never cross, nor do I have any interest in going beyond it.

She, in turn, would like to dream of flying, of slipping from tree to tree way above the rooftops.

GO ON TO THE NEXT PAGE.

1. Which of the following best describes the structure of the passage?
  - A. A dialogue between two people in which both relate their dreams in an almost equal amount of detail
  - B. An account of the narrator's perspective on the woman revealed primarily through the narrator's report of their conversations
  - C. A character sketch of two people as related by a narrator who knows both of them and their thoughts
  - D. A detailed narration of several of the narrator's dreams accompanied by a description of the woman's reactions to them
2. Based on the passage, which of the following statements best describes the overall attitudes of the narrator and the woman?
  - F. The woman is frustrated and despairing, while the narrator is supportive and reassuring.
  - G. The woman is bitter and resentful, while the narrator is detached and uninterested.
  - H. The woman is lonely and resigned, while the narrator is optimistic and relaxed.
  - J. The woman is dismayed and miserable, while the narrator is discontented and angry.
3. It can reasonably be inferred from the passage that the woman most strongly desires to attain which of the following qualities from dreaming?
  - A. Relaxation
  - B. Self-awareness
  - C. Entertainment
  - D. Self-control
4. Throughout the passage, the image of the door is used primarily as a metaphor for the boundary between:
  - F. alertness and fatigue.
  - G. dreams and nightmares.
  - H. wakefulness and sleeping.
  - J. not-dreaming and dreaming.
5. In relation to the first paragraph's earlier description of the nightmare, the narrator's comments in lines 10–13 primarily serve to:
  - A. reveal how to alter a dream in progress.
  - B. explain what caused the nightmare.
  - C. intensify the sense of hopelessness.
  - D. suggest the possibility of escape.
6. Which of the following statements about the amniotic dream is best supported by the passage?
  - F. It is the narrator's favorite dream.
  - G. The woman is particularly fond of hearing it related.
  - H. The narrator has dreamed this dream many times.
  - J. It is the dream the woman most strongly desires to dream.
7. According to the passage, one of the woman's worries about her present situation is that she:
  - A. will begin to dream too much.
  - B. suspects the narrator will desert her.
  - C. will watch her dreams become nightmares.
  - D. stands out as different from others.
8. Based on the narrator's account, the woman's approach to dreaming the narrator's dreams is best described as:
  - F. confrontational and powerful.
  - G. enthusiastic and playful.
  - H. precise and confident.
  - J. self-conscious and secretive.
9. As it is used in line 58, the word *humor* most nearly means:
  - A. personality.
  - B. whim.
  - C. mood.
  - D. comedy.
10. In the passage, the narrator most nearly describes Kafka as someone who:
  - F. diminished dreams by trying to unravel their mysteries.
  - G. explained the underlying rationality of dream symbols.
  - H. conveyed the essence of dreams in his writing.
  - J. found it too difficult to describe dreams artfully.

## Passage II

**SOCIAL SCIENCE:** This passage is adapted from *The Little Ice Age: How Climate Made History, 1300–1850* by Brian Fagan (©2000 by Brian Fagan).

Speak the words “ice age,” and the mind turns to Cro-Magnon mammoth hunters on windswept European plains devoid of trees. But the Little Ice Age (approximately A.D. 1300–1850) was far from a deep freeze. Think instead of an irregular seesaw of rapid climatic shifts, driven by complex and still little understood interactions between the atmosphere and the ocean. The seesaw brought cycles of intensely cold winters and easterly winds, then switched abruptly to years of heavy spring and early summer rains, mild winters, and frequent Atlantic storms, or to periods of droughts, light northeasterly winds, and summer heat waves that baked growing corn fields under a shimmering haze. The Little Ice Age was an endless zigzag of climatic shifts, few lasting more than a quarter century. Today’s prolonged warming is an anomaly.

Reconstructing the climate changes of the past is extremely difficult, because reliable instrument records are but a few centuries old. For earlier times, we have but what are called proxy records reconstructed from incomplete written accounts, tree rings, and ice cores. Country clergy and amateur scientists with time on their hands sometimes kept weather records over long periods. Chronicles like those of the eighteenth-century diarist John Evelyn or monastery scribes are invaluable for their remarks on unusual weather, but their usefulness in making comparisons is limited. Remarks like “the worst rain storm in memory,” or “hundreds of fishing boats overwhelmed by mighty waves” do not an accurate meteorological record make, even if they made a deep impression at the time. The traumas of extreme weather events fade rapidly from human consciousness. Many New Yorkers still vividly remember the great heat wave of Summer 1999, but it will soon fade from collective memory, just like the great New York blizzard of 1888, which stranded hundreds of people in Grand Central station and froze dozens to death in deep snowdrifts.

A generation ago, we had a generalized impression of Little Ice Age climate compiled with painstaking care from a bewildering array of historical sources and a handful of tree-ring sequences. Today, the scatter of tree-ring records has become hundreds from throughout the Northern Hemisphere and many from south of the equator, too, amplified with a growing body of temperature data from ice cores drilled in Antarctica, Greenland, the Peruvian Andes, and other locations. We can now track the Little Ice Age as an intricate tapestry of short-term climatic shifts that rippled through European society during times of remarkable change—centuries that saw Europe emerge from medieval fiefdom and pass by stages through the Renaissance, the Age of Discovery, the Enlightenment, the French and Industrial revolutions, and the making of modern Europe.

To what extent did those climatic shifts alter the course of European history? Many archaeologists and historians are suspicious of the role of climate change in changing human societies—and with good reason. Environmental determinism, the notion that climate change was a primary cause of major developments like, say, agriculture, has been a dirty word in academia for generations. You certainly cannot argue that climate drove history in a direct and causative way to the point of toppling governments. Nor, however, can you contend that climate change is something that you can totally ignore. Throughout the Little Ice Age, into the nineteenth century, millions of European peasants lived at the subsistence level. Their survival depended on crop yields: cycles of good and poor harvests, of cooler and wetter spring weather, could make a crucial difference between hunger and plenty, life and death. The sufficiency or insufficiency of food was a powerful motivator of human action, sometimes on a national or even continent-wide scale, with consequences that could take decades to unfold.

Consider, for instance, the food crises that engulfed Europe during the Little Ice Age—the great hunger of 1315 to 1319, the food dearths of 1741, and 1816, “the year without a summer”—to mention only a few. These crises in themselves did not threaten the continued existence of Western civilization, but they surely played an important role in the formation of modern Europe. Some of these crises resulted from climatic shifts, others from human ineptitude or disastrous economic or political policy; many from a combination of all three. Environmental determinism may be intellectually bankrupt, but climate change is the ignored player on the historical stage.

11. The author most nearly characterizes the role of climate change in the course of history as one that:
  - A. is neither all important nor safely disregarded.
  - B. is rightly ignored by archaeologists and scientists.
  - C. was greater in medieval Europe than it is today.
  - D. will eventually be seen as direct and causative.
12. The main idea of the first paragraph is that the Little Ice Age:
  - F. was a period defined by prolonged global cooling.
  - G. occurred during the era of Cro-Magnon mammoth hunters.
  - H. was marked by frequent and short-term climate shifts.
  - J. resulted from interactions between the atmosphere and ocean.

13. The author uses the remark “the worst rain storm in memory” (line 28) primarily as an example of:
- A. the kind of well-meaning but ultimately useless records of unusual weather that Evelyn kept.
  - B. how people in the eighteenth century were deeply impressed by unusual weather.
  - C. people’s preoccupation with carefully rating and comparing unusual weather events.
  - D. how notes people in the past kept about unusual weather are of limited meteorological value today.
14. The author indicates that the common factor in the events and periods listed in lines 50–54 is that they:
- F. took place during the Little Ice Age.
  - G. were the result of the Little Ice Age.
  - H. were unaffected by the Little Ice Age.
  - J. occurred after the Little Ice Age.
15. By his statement in lines 71–75, the author most nearly means that during the Little Ice Age:
- A. food or the lack thereof could have far-reaching and long-lasting effects.
  - B. the difference between hunger and plenty was a very small one.
  - C. food shortages were relatively rare at the national or continental level.
  - D. the insufficiency of food motivated peasant farmers to work harder.
16. The author uses the events listed in lines 77–79 primarily to:
- F. show how weather-related disasters threatened the survival of Western civilization.
  - G. criticize subsistence-level agriculture as being too dependent on the weather.
  - H. illustrate how environmental determinism operated in the Little Ice Age.
  - J. suggest the part that climate shifts may have had in producing modern Europe.
17. The author cites all of the following as causes of the European food crises during the Little Ice Age EXCEPT:
- A. human ineptitude.
  - B. bad economic policy.
  - C. poor political policy.
  - D. bankrupt intellectualism.
18. The author calls the interactions that produced the Little Ice Age climate shifts:
- F. powerful and relatively straightforward.
  - G. complex and not yet well understood.
  - H. frequent and not often studied today.
  - J. intricate and generally beneficial to humans.
19. Which of the following is NOT listed in the passage as an element of the Little Ice Age?
- A. Heavy spring and early summer rains
  - B. Intensely cold winters and easterly winds
  - C. Droughts and light northeasterly winds
  - D. Mild winters and an unusually calm ocean
20. The author calls which of the following an anomaly?
- F. The daily weather of the Little Ice Age
  - G. Today’s prolonged warming
  - H. The climatic seesaw of the last hundred years
  - J. Little Ice Age corn yields

## Passage III

**HUMANITIES:** This passage is adapted from the article “Wherever He Went, Joy Was Sure to Follow” by Stanley Crouch (©2000 by The New York Times Company). *Tin Pan Alley* is a district famous for its composers and publishers of popular music.

As a jazz trumpeter and a singer, Louis Armstrong asserted a level of individuality in musical interpretation, recomposition and embellishment far more radical than any that had preceded it in Western music. When  
5 faced with a musical theme, Armstrong improvised an arrangement that boldly rephrased it, dropping notes he didn’t want to play and adding others. His featured improvisations brought the role of the jazz soloist to the fore. The immaculate logic of his improvised melodies,  
10 full of rhythmic surprises and virtuosic turns, influenced show-tune writers, jazz composers, big band arrangers and tap dancers. His harmonic innovations, as fellow trumpeter Wynton Marsalis has noted, were the most brilliant in the history of jazz: Armstrong figured  
15 out how to articulate the sound of the blues through Tin Pan Alley popular-music tunes without abandoning their harmonic underpinnings. “Louis Armstrong took two different musics and fused them so that they sounded perfectly compatible,” Mr. Marsalis says.

20 It was during the 1920’s and 30’s that Armstrong’s reputation took off. He set the music scene in his home town of New Orleans on fire before traveling to Chicago in 1921 to join his mentor, the cornetist King Oliver. For a year he went to New York, where he  
25 joined Fletcher Henderson’s jazz orchestra and turned the rhythm of the music around with his conception of playing with a swinging beat. Now almost a national musical terror, Armstrong returned to Chicago, then finally settled in New York in 1929.

30 From 1925 through the early 1930’s, he recorded dozens of masterpieces with large and small bands, popularized scat singing (jazz singing that uses nonsense syllables) and took on Tin Pan Alley, introducing  
35 one tune after another into jazz, where they became part of his repertory. His tone could be broad, soft and luminous or vocal or comical, or suddenly and indelibly noble, and when his music conquered Europe in the 30’s, it carried the tragic optimism of the American sensibility into the world at large. Wherever he went,  
40 swing was sure to follow. He almost single-handedly began a new spirit of freewheeling but perfectly controlled improvisation, tinged with playfulness, sorrow and sardonic irony.

Like all innovators, Armstrong was also called  
45 upon to perform superhuman feats. Armstrong had endless energy and could play and play and play with the evangelical fire and charisma that brings a new art into being. He extended the range of his instrument, asserted unprecedented rhythmic fluidity and had the  
50 greatest endurance of any trumpet player who ever lived. As a young man, he could play five shows in a theater a day, be the featured soloist on virtually every piece and end each show with 100 high C notes. His

glissandos—rapid slides up or down a musical scale—  
55 were so pronounced that trumpeters of the London Philharmonic Orchestra had to inspect his horn to be convinced that it was not made differently from theirs.

By his death in 1971, Armstrong had influenced the entirety of American music, instrumentally and  
60 vocally, inspiring his own generation and successive ones. I can recall some 30 years ago talking with a concert percussionist who knew Armstrong and the rest of the people who were rising to the top during the middle and late 20’s. Referring to a certain concert piece,  
65 which had a more extensive drum part than usual, he said, “When I get that going, I can put my Louis Armstrong influence in and, without them even knowing it, the orchestra starts to swing for a bit.” On a more recent occasion, unless I was imagining it, I even heard  
70 rapper Heavy D slip a phrase over the mechanical hip-hop beat that had an Armstrong arch to it.

To get right down to it, no one in jazz ever played with greater emotional range than Armstrong, whose New Orleans experiences meant that he worked every-  
75 thing from christenings to funerals. In the streets, he picked up all the folk chants and songs. While traveling around town, he heard traces of French and Italian opera that suffused his sensibility and his memory. But beyond all that, what Armstrong wanted to give his lis-  
80 teners was the kind of pleasure music gave him, which is what most artists are after. When he wrote or talked of New Orleans, of being out there with his horn or following the parades or listening to mentors like Joe Oliver, Armstrong never failed to project a joy so pro-  
85 found that it became an antidote to the blues of daily living. He had a determination to swallow experience whole and taste it all and only then to spit out the bitter parts.

21. Which of the following statements best expresses the main idea of the passage?
- A. Armstrong was an exceedingly gifted musician whose emotional range was nonetheless somewhat narrow.
  - B. One of the greatest jazz trumpeters of all time, Armstrong is best known for his soft and luminous tone.
  - C. Armstrong has had a profound effect on music, one that has been both wide ranging and long lasting.
  - D. A pioneering jazz trumpeter and singer, Armstrong recorded numerous masterpieces in the mid to late 1920s.



22. Which of the following questions is NOT answered in the passage?
- F. In terms of Western music history, what was so radical about Armstrong's playing and singing?
  - G. What aspect of Armstrong's music brought the role of the jazz soloist to the fore?
  - H. What style of jazz singing did Armstrong popularize?
  - J. Which of Armstrong's recorded masterpieces most changed American music?
23. The passage suggests that Armstrong's most important contribution to jazz was his:
- A. musical conquest of Europe.
  - B. emphasis on improvisation.
  - C. work with King Oliver.
  - D. invention of the blues sound.
24. The main function of the second paragraph (lines 20–29) is to:
- F. identify some of Armstrong's mentors, such as King Oliver.
  - G. list some of the early events in Armstrong's developing career.
  - H. contrast Armstrong's opinions of King Oliver and Fletcher Henderson.
  - J. describe the musical style Armstrong developed jointly with Fletcher Henderson.
25. All of the following details are used in the passage to demonstrate Armstrong's endurance as a young musician EXCEPT that he:
- A. would be the featured soloist on almost every piece in a show.
  - B. ended shows with a long series of high notes.
  - C. once managed to play for an entire night.
  - D. could play five shows a day.
26. The last paragraph establishes all of the following about Armstrong EXCEPT:
- F. his strong desire to reshape American music.
  - G. his cheerful demeanor and sense of mission.
  - H. the range of influences on his music.
  - J. the varied settings in which he performed.
27. One of the main points in the last paragraph is that through his music, Armstrong attempted to promote in his listeners a sense of:
- A. awe.
  - B. determination.
  - C. pleasure.
  - D. nostalgia.
28. According to the passage, which of the following cities is the last one Armstrong is said to have lived in?
- F. New Orleans
  - G. New York
  - H. Chicago
  - J. Paris
29. The author most likely includes the information in lines 53–57 to suggest:
- A. Armstrong's highly developed skill.
  - B. Armstrong's unease with orchestral music.
  - C. that Armstrong used an unusual trumpet.
  - D. that Armstrong invented the glissando.
30. Which of the following words best describes how the orchestra referred to in the fifth paragraph (lines 58–71) is said to have started to swing?
- F. Reluctantly
  - G. Intentionally
  - H. Unconsciously
  - J. Optimistically

## Passage IV

**NATURAL SCIENCE:** This passage is adapted from the article “Needles & Nerves” by Catherine Dold (©1999 by The Walt Disney Company).

Acupuncture and other forms of traditional Chinese medicine have been around for more than 4,000 years. Yet the explanation for how acupuncture—and Chinese medicine as a whole—works has long been a mystery for most Western doctors. The basic theory is outlined in a text from 200 B.C. It recognizes in people and in nature a vital energy or life force known as qi. Qi is the source of movements ranging from voluntary muscle action to blood flow; it protects the body from external influences, and it generates warmth. Qi flows through the body and to the organs by way of an extensive system of channels known as meridians. If the flow of the force is disturbed, the theory goes, the resulting deficiency, excess, or stagnation of qi causes bodily malfunction and thus illness.

Acupuncture, in which needles are inserted into specific points along the meridians and manipulated, is said to restore the proper flow of qi and thereby return the body to health. Practitioners recognize some 1,500 acupoints, most of which have no obvious relationship to their intended targets. For example, a point on the second toe is used to treat headaches and toothaches, while a point near the elbow enhances the immune system.

Another integral concept is the tension between two ever-present, complementary forces of nature, yin and yang. When their balance is disturbed, the theory goes, people get sick. Yin conditions reflect a lack of qi: pale face, cold extremities, slow pulse, depression. Yang conditions result from an excess of qi: red face, fever, fast pulse, agitation.

Doctors and licensed practitioners administer between 9 and 12 million acupuncture treatments each year in the United States, commonly for pain control.

According to neuroscientist Bruce Pomeranz, of the University of Toronto, numerous studies over the past 20 years have shown that inserting needles into acupoints stimulates nerves in the underlying muscles. That stimulation, researchers believe, sends impulses up the spinal cord to a relatively primitive part of the brain known as the limbic system, as well as to the mid-brain and the pituitary gland. Somehow this signaling leads to the release of endorphins and monoamines, chemicals that block pain signals in the spinal cord and the brain.

“The endorphin story is really nailed down,” says Pomeranz. “The acupoints that have been mapped over thousands of years are likely the spots where nerves are concentrated.” But the endorphin story “doesn’t explain many of the other claims of acupuncture,” he continues. “There have been a number of clinical trials showing that acupuncture is extremely useful for the nausea

caused by chemotherapy and early pregnancy. That’s not the endorphin system.”

Nor does the endorphin story explain what physicist Zang-Hee Cho found when exploring acupoints that are traditionally used to treat vision problems. The points are not found near the eyes but on the outside of the foot, running from the little toe to the ankle. Acupuncturists hold that stimulation of these points with needles will affect the eyes via the system of meridians rather than through the central nervous system.

To test that premise, Cho strapped student volunteers into an fMRI (functional magnetic resonance imaging) machine, the results from which can be viewed as colorful brain activation maps. Cho first stimulated the eyes of the volunteers by flashing a light in front of them. The resulting images, as expected, showed a concentration of color—an increase in activity—in the visual cortex, the portion of the brain that is known to be involved in eye function. Then Cho had an acupuncturist stimulate one of the vision-related acupoints. In one person after another, the very same region of the brain lit up on the fMRI image. The magnitude of brain activity seen on acupuncture stimulation was nearly as strong as that elicited by the flash of light. To eliminate the possibility of a placebo effect, Cho also stimulated a nonacupoint, in the big toe. There was no response in the visual cortex.

Like many preliminary scientific reports, Cho’s study raises more questions than it answers. Still, he has demonstrated new functional effects of acupuncture. “Classically, acupuncture was the ultimate in experimentation; people collected data for thousands of years,” says Joie Jones, professor of radiological sciences at the University of California at Irvine and coauthor of the study. “With these studies, we’ve demonstrated that for at least some acupuncture points [a connection] goes through the brain.”

31. The passage mentions that the onset of illness would be caused by any of the following EXCEPT:

- A. a shortage of qi.
- B. an excess of qi.
- C. a change in the temperature of qi.
- D. a disruption in the flow of qi.