

Practice Multiple-Choice Tests

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Form 0964E

The ACT[®]

2009 | 2010

Directions

This booklet contains tests in English, Mathematics, Reading, and Science. These tests measure skills and abilities highly related to high school course work and success in college. **CALCULATORS MAY BE USED ON THE MATHEMATICS TEST ONLY.**

The questions in each test are numbered, and the suggested answers for each question are lettered. On the answer document, the rows of ovals are numbered to match the questions, and the ovals in each row are lettered to correspond to the suggested answers.

For each question, first decide which answer is best. Next, locate on the answer document the row of ovals numbered the same as the question. Then, locate the oval in that row lettered the same as your answer. Finally, fill in the oval completely. Use a soft lead pencil and make your marks heavy and black. **DO NOT USE INK OR A MECHANICAL PENCIL.**

Mark only one answer to each question. If you change your mind about an answer, erase your first mark thoroughly before marking your new answer. For each question, make certain that you mark in the row of ovals with the same number as the question.

Only responses marked on your answer document will be scored. Your score on each test will be based only on the number of questions you answer correctly during the time allowed for that test. You will NOT be penalized for guessing. **IT IS TO YOUR ADVANTAGE TO ANSWER EVERY QUESTION EVEN IF YOU MUST GUESS.**

You may work on each test ONLY when your test supervisor tells you to do so. If you finish a test before time is called for that test, you should use the time remaining to reconsider questions you are uncertain about in that test. You may NOT look back to a test on which time has already been called, and you may NOT go ahead to another test. To do so will disqualify you from the examination.

Lay your pencil down immediately when time is called at the end of each test. You may NOT for any reason fill in or alter ovals for a test after time is called for that test. To do so will disqualify you from the examination.

Do not fold or tear the pages of your test booklet.

**DO NOT OPEN THIS BOOKLET
UNTIL TOLD TO DO SO.**

ACT[®]

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ENGLISH TEST

45 Minutes—75 Questions

DIRECTIONS: In the five passages that follow, certain words and phrases are underlined and numbered. In the right-hand column, you will find alternatives for the underlined part. In most cases, you are to choose the one that best expresses the idea, makes the statement appropriate for standard written English, or is worded most consistently with the style and tone of the passage as a whole. If you think the original version is best, choose “NO CHANGE.” In some cases, you will find in the right-hand column a question about the underlined part. You are to choose the best answer to the question.

You will also find questions about a section of the passage, or about the passage as a whole. These questions do not refer to an underlined portion of the passage, but rather are identified by a number or numbers in a box.

For each question, choose the alternative you consider best and fill in the corresponding oval on your answer document. Read each passage through once before you begin to answer the questions that accompany it. For many of the questions, you must read several sentences beyond the question to determine the answer. Be sure that you have read far enough ahead each time you choose an alternative.

PASSAGE I

The Potter’s Kiln

Unbricking a kiln after a firing is like a person
1

uncovering buried treasure. As the potter takes bricks away
2
to create an opening into the oven, an expanding view

of gleaming shapes rewards the artist for months
3
of hard work.

The process of creating ceramics begins in a studio. My friend Ellen is typical of many more potters in that
4
some pieces she shapes on a spinning potter’s wheel and others she builds on a work table from coils or slabs of clay. Over many weeks, as time goes by, her collection
5
slowly grows: clay bowls, cups, vases, and sculptures fill the studio. She dries them on racks, dips them in glazes, and dries them again.

- A. NO CHANGE
B. someone
C. a potter
D. OMIT the underlined portion.
- The writer would like to suggest the potter’s cautious pace and sense of anticipation in opening the kiln. Given that all the choices are true, which one best accomplishes the writer’s goal?
F. NO CHANGE
G. removes bricks by hand
H. removes one brick at a time
J. experiences great anticipation and removes bricks
- A. NO CHANGE
B. rewarding
C. reward
D. as a reward for
- F. NO CHANGE
G. of many
H. mostly of
J. for most
- A. NO CHANGE
B. with the passing of time,
C. gradually,
D. OMIT the underlined portion.



At last, Ellen will have enough pieces for a firing. She then carries the assortment outside to the wood-fired kiln, it is a brick structure designed to bake pottery to a⁶ hardness and transform glazes to glorious colors that drying alone won't achieve. 7 The chamber is just big

enough for her to crouch in as she carefully arranges⁸ the pieces inside. When the objects are in place, she backs out gingerly and seals the chamber shut with bricks.

The next morning, using twigs, for kindling⁹ she starts a small blaze in the firebox, located directly below the main chamber. The fire grows steadily throughout the day as she feeds it lumber scraps and then logs. By nightfall a controlled inferno roars¹⁰ in the kiln.

Occasionally,¹¹ the fire chugs like a train engine, hungry for more oxygen. Each time the fire is stoked, sparks

shoot from the chimney into¹² the night sky.

6. **F.** NO CHANGE
G. the brick structure is
H. a brick structure
J. brick
7. The writer is considering deleting the phrase “and transform glazes to glorious colors” from the preceding sentence. Should the phrase be kept or deleted?
 - A.** Kept, because it emphasizes that painting pottery is a time-consuming process.
 - B.** Kept, because it is relevant to the essay’s focus on the role of kilns in making pottery.
 - C.** Deleted, because the appearance of the pottery is not as important to the essay’s focus as how kilns function.
 - D.** Deleted, because this level of detail is not consistent with the essay’s description of a kiln firing.
8. **F.** NO CHANGE
G. stoops to carefully arrange
H. bends over to arrange with care
J. carefully stoops over to arrange
9. **A.** NO CHANGE
B. morning, using twigs for kindling,
C. morning, using twigs for kindling;
D. morning using twigs, for kindling,
10. The writer would like to indicate that at this point the fire is extremely intense. Given that all the choices are true, which one best accomplishes the writer’s goal?
 - F.** NO CHANGE
 - G.** the fire is stronger than ever
 - H.** there is more heat being produced
 - J.** a kind of intense blaze takes place
11. Which of the following alternatives to the underlined portion would NOT be acceptable?
 - A.** On occasion,
 - B.** Once in a while,
 - C.** Now and then,
 - D.** Time or again,
12. Which of the following alternatives to the underlined portion would NOT be acceptable?
 - F.** at the chimney in
 - G.** up the chimney toward
 - H.** through the chimney up into
 - J.** out the chimney into



Periodically, Ellen looks through a porthole in the wall of the kiln to determine the fire's intensity. The clay pieces gleam white-hot amid the flames. At last, when the temperature soars out of sight, she knows the firing is nearing its end.

Having died down, she bricks up the firebox as well, sealing the remaining heat inside. In a few days, when the kiln has cooled, Ellen opens the chamber, revealing the results of her labor and of the fire's magic. Each piece shines as it meets the light of day.

13. Given that all the choices are true, which one provides the most specific detail and maintains the style and tone of the essay?
- A. NO CHANGE
 - B. rises beyond belief,
 - C. soars well above a thousand degrees,
 - D. elevates in increments to the point that a temperature of more than one thousand degrees is reached,
14. F. NO CHANGE
G. Finally it dies
H. With a blaze that dies
J. Once the blaze dies
15. A. NO CHANGE
B. labor, which is the fire's
C. labor, of which the fire is
D. labor, and the fire is

PASSAGE II

A Family Heirloom

I live with my father in the summer, when I'm on vacation from school. Last week, he told me he had to go on a business trip in connection with his work and that I'd be staying with his sister for three days. Although I love my aunt, I wasn't happy about the prospect of three days at her house with nothing to do. It turns out I was in for a surprise.

Soon after I arrived, my aunt said she had a gift for me. "It belonged to my mother, your grandma. I'm sorry you never had the chance to know her," she told me.

16. F. NO CHANGE
G. having something to do with his job
H. that involved traveling to another city
J. OMIT the underlined portion.
17. Which of the following alternatives to the underlined portion would NOT be acceptable?
- A. Not long
 - B. A short time
 - C. As soon
 - D. Shortly
18. F. NO CHANGE
G. aunt, said
H. aunt said,
J. aunt said;



I was expecting my aunt to hand me a ring or a bracelet, or maybe an old book, but instead she led me outside. 19

[1] She pointed to a corner of the yard, where a tortoise was calmly munching a dandelion. [2] Rosie must have heard us talking, because she began to amble over to us. ²⁰ [3] She was over a foot long and about seven inches high. [4] As soon as my aunt assured me that Rosie ²¹ wouldn't snap or bite, I reached down to stroke her neck, admiring her brown and tan carapace, or upper shell. 22

Rosie, it turns out is: a desert tortoise that my ²³ grandmother had started raising over twenty years ²⁴ ago. My aunt said that she would have checked with ²⁵ my parents, who each agreed that if I wanted to take responsibility for Rosie, I could take her home with me.

19. The writer is considering deleting the first part of the preceding sentence, so that the sentence would read:
She led me outside.
If the writer were to make this change, the essay would primarily lose:
- A. details that indicate to the reader what will eventually happen.
 - B. the contrast between the gift and what the narrator had anticipated receiving.
 - C. examples of the kinds of gifts the narrator normally receives.
 - D. an indication of how close the narrator and her aunt are.
20. F. NO CHANGE
G. have heard of
H. of heard about
J. of heard
21. Which of the following alternatives to the underlined portion would NOT be acceptable?
- A. After my
 - B. When my
 - C. My
 - D. Once my
22. Upon reviewing this paragraph and realizing that some information has been left out, the writer composes the following sentence:
"This is Rosie," she announced.
This sentence should most logically be placed after Sentence:
- F. 1.
 - G. 2.
 - H. 3.
 - J. 4.
23. A. NO CHANGE
B. Rosie, it turns out, is
C. Rosie, it turns out is
D. Rosie it turns out, is
24. Which of the following alternatives to the underlined portion would NOT be acceptable?
- F. begun to raise
 - G. started to raise
 - H. started up raising
 - J. begun raising
25. A. NO CHANGE
B. had checked
C. would check
D. must check



It's interesting that Rosie is older than I am.

²⁶
Tortoises are land-dwelling, vegetarian turtles. They can

experience the satisfaction of contentment through a diet
²⁷
of grass clippings, lettuce, broccoli, melons, and other

vegetables and fruit. They like to warm themselves in the
²⁸
sun but will burrow into the ground when they want to be
safe and cool. I learned that I should build plywood

enclosures in each of my parents' backyards so that
²⁹
Rosie would be safe year-round.

I learned that tortoises are among the most
endangered families in reptiles. That means having a
tortoise is a privilege, and I'm proud that my family has
³⁰
entrusted me with Rosie's care. By caring for Rosie I'll be
able to share something with the grandma I never knew.

26. Given that all the choices are true, which one most effectively introduces the information that follows in this paragraph?

- F. NO CHANGE
- G. I asked my aunt about Rosie's needs and care.
- H. Most tortoise species are now found only in Africa.
- J. Some giant tortoises weigh as much as 180 kilograms.

27. A. NO CHANGE
B. reap their necessary nutritional requirements from
C. be kept as happy as a clam with
D. be adequately nourished by

28. Which choice provides the most specific and precise information?

- F. NO CHANGE
- G. things they could eat.
- H. edible items.
- J. fresh foods.

29. A. NO CHANGE
B. parent's backyards
C. parents backyards
D. parents backyards,

30. F. NO CHANGE
G. families of
H. family in
J. family of

PASSAGE III

The following paragraphs may or may not be in the most logical order. Each paragraph is numbered in brackets, and question 45 will ask you to choose where Paragraph 5 should most logically be placed.

A Thirst for Knowledge

[1]

Benjamin Banneker, African American
inventor and astronomer, grew up on his
family's farm in colonial Maryland. Though
³¹

31. A. NO CHANGE
B. family's
C. families'
D. families



he had limited access to formal education, Banneker
³²
nevertheless demonstrated a keen curiosity and a
consuming interest in acquiring knowledge.

[2]

Banneker's grandmother was an indentured
servant from England whom, after completing the term
³³
of her contract, bought some land and then married a freed
slave. ³⁴ Their daughter Mary—Benjamin's mother—
also married a freed slave. Benjamin's grandmother taught

him to read, and he attended a one-room Quaker school
³⁵
when the farmwork slowed down during the winter.

[3]

In 1753, at the age of twenty-two, Banneker
constructed a clock out of hand-carved wooden parts,
³⁶
displayed his mechanical skills, and displaying his interest
³⁶
in learning. He had dismantled a pocket watch borrowed
³⁶

from a traveling merchant, made detailed drawings of it's
³⁷
components, and returned it—fully functioning—to the
merchant. Based on those drawings, Banneker designed
the works for his own clock and carved the gears, wheels,

32. Which of the following alternatives to the underlined portion would NOT be acceptable?
- F. limiting his access to formal education,
 - G. his access to formal education was limited,
 - H. it was difficult for him to acquire formal education,
 - J. having limited access to formal education,

33. A. NO CHANGE
B. who,
C. which,
D. OMIT the underlined portion.

34. At this point, the writer is considering adding the following true statement:

Indentured servants needed a master's permission to leave their place of work, to perform work for others, or to keep money for personal use.

Should the writer add this sentence here?

- F. Yes, because it shows the extent of control that masters held over indentured servants.
 - G. Yes, because it is necessary to understanding the essay as a whole.
 - H. No, because it provides information that is included elsewhere in the essay.
 - J. No, because it would distract readers from the main topic of the essay.
35. Which of the following alternatives to the underlined portion would NOT be acceptable?

- A. read; he
- B. read, and he also
- C. read he
- D. read. He

36. Which choice provides the most logical arrangement of the parts of this sentence?

- F. NO CHANGE
- G. displayed his skills when he constructed a clock out of hand-carved wooden parts and displayed his interest in mechanical skills.
- H. displayed his interest in learning and his mechanical skills when he constructed a clock out of hand-carved wooden parts.
- J. displayed his interest in mechanical skills by constructing a clock out of hand-carved wooden parts and his interest in learning.

37. A. NO CHANGE
B. its'
C. its
D. their

GO ON TO THE NEXT PAGE.



and other moving parts. The clock keeps precise time

38

for—can you believe it?—over forty years.

39

[4]

Banneker lived and worked on the family farm.

After his father died in 1759, Banneker took over the responsibility of the farm and the care of his mother and younger sisters. In addition, he pursued scientific studies

40

and taught himself to play the flute and violin. 41

[5]

In 1788, a neighbor loaned Banneker some astronomical instruments and four books on mathematics and astronomy. Banneker quickly became engrossed in his studies and began to calculate the paths of the Sun, Moon, and other celestial bodies. Using them, he predicted a solar eclipse that occurred the next year. He also began to

42

calculate annual tables of yearly sets of astronomical data, which became the basis for almanacs published under his name from 1792 through 1797.

43

[6]

Grandson of an indentured servant, Benjamin Banneker liked to study music and astronomy.

44

44

38. F. NO CHANGE
G. has kept
H. kept
J. still keeps
39. A. NO CHANGE
B. for over forty years. Amazing!
C. for over forty unbelievable years.
D. for over forty years.

40. F. NO CHANGE
G. sisters. Therefore,
H. sisters, in addition,
J. sisters, therefore,

41. If the writer were to delete the last part of the preceding sentence (ending the sentence with a period after the word *studies*), the paragraph would primarily lose:
- A. support for the essay's point about Banneker's love of learning.
B. a direct link to the previous paragraph.
C. a humorous description of Banneker's other interests.
D. an extensive digression about music.

42. F. NO CHANGE
G. these calculations,
H. those,
J. these things,
43. A. NO CHANGE
B. covering a year's worth
C. about twelve months
D. OMIT the underlined portion.

44. Given that all the choices are true, which one most effectively concludes and summarizes this essay?
- F. NO CHANGE
G. Calculator of the paths of the Sun and Moon, Benjamin Banneker became interested in how things work when he took apart a pocket watch and made some drawings.
H. Clock designer and farmer, Benjamin Banneker acquired responsibility for the farm at a young age but retained an interest in learning.
J. Farmer, inventor, and self-taught mathematician and astronomer, Benjamin Banneker took advantage of every opportunity to learn and contribute to the society of his time.



Question 45 asks about the preceding passage as a whole.

45. For the sake of the logic and coherence of this essay, Paragraph 5 should be placed:
- A. where it is now.
 - B. after Paragraph 1.
 - C. after Paragraph 2.
 - D. after Paragraph 3.

PASSAGE IV

Kayaks and Kayaking

Kayaks are lightweight canoes originally used for hunting and fishing by the Inuit peoples of the northern coasts of North America. Today, many people use kayaks recreationally for white-water sports and for touring wilderness areas that are extremely wild.

46

Most kayaks are made of rubberized cloth, molded plastic, or fiberglass. It is covered except for the opening

47

in which the paddler or paddlers sit. [48] The two principal

types of kayaks are; the easily maneuverable white-water

49

kayak and the largest sea kayak.

50

[1] Kayaking in white

water the tumultuous rapids of swift-moving rivers
appeals to people seeking adventure and excitement.

51

46. F. NO CHANGE
G. of great remoteness.
H. that are uncivilized.
J. OMIT the underlined portion and end the sentence with a period.
47. A. NO CHANGE
B. One is
C. They are
D. Which are
48. The writer is considering deleting the preceding sentence. Should this sentence be kept or deleted?
- F. Kept, because the reader needs to understand the different types of kayaks.
 - G. Kept, because it helps the reader visualize the kayak's construction.
 - H. Deleted, because it is not relevant to the preceding sentence.
 - J. Deleted, because it is unnecessarily wordy.
49. A. NO CHANGE
B. kayaks, are
C. kayaks are
D. kayaks—are
50. F. NO CHANGE
G. very biggest
H. more large
J. larger
51. A. NO CHANGE
B. water; the tumultuous rapids of swift-moving rivers,
C. water, the tumultuous rapids of swift-moving rivers,
D. water the tumultuous rapids of swift-moving rivers,



[2] Designed to maneuver through rapids and around treacherous rocks, many white-water kayaks are only six to nine feet long. [3] Because the center of gravity of the paddler rides low in the water, kayaks are stable boats not easily capsized. [4] White-water kayakers are, at last,⁵² advised to wear helmets and flotation vests to prevent injury. [5] The longer sea kayaks are designed for distance and speed rather than maneuverability. [6] Some models have two or three seats. [7] Sea or coastal kayaking offers easy access to wetlands, marshes, and wildlife habitats along shores.

[8] Kayaks can float in less than a foot of water, so⁵³

a nature watcher⁵⁴ can quietly paddle through shallows

frequented by shorebirds and other wildlife. 55

Equipment for both types of kayaks are⁵⁶ similar, and

fairly simple. Kayakers use a short, double-bladed paddle,⁵⁷ an elasticized sprayskirt fits snugly around the waist of the seated paddler to keep water out of the boat. In fact, a kayak can roll over and be brought back upright without taking on water.

52. F. NO CHANGE
G. for example,
H. therefore,
J. nevertheless,

53. Which of the following alternatives to the underlined portion would be LEAST acceptable?

- A. water. Thus,
B. water. Consequently,
C. water, and, as a result,
D. water. Yet

54. Which choice fits most specifically with the information at the end of this sentence?

- F. NO CHANGE
G. person
H. paddler
J. fun seeker

55. If the writer were to divide the preceding paragraph into two shorter paragraphs in order to differentiate between the two types of kayaks discussed in the essay, the new paragraph should begin with Sentence:

- A. 3.
B. 4.
C. 5.
D. 6.

56. F. NO CHANGE
G. is
H. were
J. was

57. A. NO CHANGE
B. paddle, and
C. paddle, so
D. paddle



Propelling a kayak works the upper-body muscles.

The paddler pulls one end through the water of the paddle on alternating sides of the boat. Skilled kayakers sense the nuances of water movement by means of the kayak hull and adjust their stroke force and pace to keep the kayak on course. But all kayakers can appreciate the nuances of nature as they travel on water in this simple, but

versatile boat. 60

58. The best placement for the underlined portion would be:

- F. where it is now.
- G. after the word *paddler*.
- H. after the word *pulls*.
- J. after the word *paddle*.

59. A. NO CHANGE

- B. simple
- C. simple—
- D. simple;

60. If the writer were to delete this final paragraph from the essay, which of the following would be lost?

- F. A detailed description of the muscles involved in kayaking
- G. A comment on the relationships among kayakers, kayaks, and water
- H. A scientific explanation of how water moves around the hull of a kayak
- J. A plea to kayakers to be careful of the environment

PASSAGE V

Extremophiles: Amazing Microbial Survivors

[1]

Some live in airless seams of burning rock; miles beneath Earth's surface and around the hydrothermal vents of deep-sea volcanoes. Others, salt-encrusted, "sleep" in ancient caverns, waking after centuries

to feed and to be bred. Radioactive pools of toxic

waste are okay for others to live in; even acid cannot kill them. In lightless vacuums and locales once

thought to hot, to cold or to poisonous, to sustain life, there exists a wealth of microbial organisms.

61. A. NO CHANGE
B. seams, of burning rock
C. seams of burning rock
D. seams, of burning rock,

62. Which of the following alternatives to the underlined portion would NOT be acceptable?

- F. caverns. Then they wake
- G. caverns and then wake
- H. caverns, only to wake
- J. caverns. Waking

63. A. NO CHANGE
B. for breeding.
C. to breed.
D. breeding.

64. F. NO CHANGE
G. are all right for others to live in;
H. are home to still others;
J. suit others to a tee;

65. A. NO CHANGE
B. too hot, too cold, or too poisonous
C. too hot, too cold, or too poisonous,
D. to hot, to cold, or to poisonous



These single-celled survivors called extremophiles,
 don't merely endure environments too severe for

other life forms; they thrive in them.

[2]

Heat-loving extremophiles, or
 thermophiles, flourished in temperatures over
 150 degrees Celsius. Scientists have collected
 them from the Yellowstone National Park's thermal
pools, the park abounding with geysers like Old Faithful,
 and from radioactive rock deep within South African
 gold mines.

[3]

In the hot waters surrounding Juan de
 Fuca Ridge in the Pacific Ocean, thermophiles
 ensure the survival of other marine life. 70

Here, the ocean floor is scarred by
 earthquakes and underwater volcanoes.

66. F. NO CHANGE
 G. survivors, called extremophiles,
 H. survivors, called extremophiles
 J. survivors called extremophiles;
67. Which of the following alternatives to the underlined portion would NOT be acceptable?
 A. forms; rather, they
 B. forms—they
 C. forms. They
 D. forms they
68. F. NO CHANGE
 G. were flourishing
 H. had flourished
 J. flourish
69. A. NO CHANGE
 B. pools, in contrast to the cool depths of Scandinavian fjords,
 C. pools, natural wonders formed by geologic magic,
 D. pools
70. The writer is considering deleting the following phrase from the preceding sentence (and revising the capitalization accordingly):
 In the hot waters surrounding Juan de Fuca Ridge in the Pacific Ocean,
 Should this phrase be kept or deleted?
 F. Kept, because it clarifies that thermophiles live in both the Pacific Ocean and Juan de Fuca Ridge.
 G. Kept, because it provides specific details about the "Here" referred to in the next sentence.
 H. Deleted, because it contradicts the preceding paragraph, which makes it clear that thermophiles do not live in water only.
 J. Deleted, because this information is provided later in this paragraph.
71. Given that all the choices are true, which one most specifically and vividly describes the underwater terrain?
 A. NO CHANGE
 B. there are signs of both seismic and volcanic activity.
 C. the results of earthquakes and volcanic eruptions are evident.
 D. the effect of earthquake and volcanic activity is apparent.

Poisonous waters from cracks at temperatures up to 360 degrees Celsius gush in the ocean floor, and thermophiles convert the toxic chemicals into food for crabs, giant worms, and other deep-sea life.

[4]

Psychrophiles live in harsh and inhospitable places on our planet. One ancient breed of psychrophile lives in million-year-old ice miles below an Antarctic glacier. In the ice of the South Pole, psychrophiles survive not only darkness and subzero temperatures but also ultraviolet radiation.

[5]

If life can persist in extreme environments on Earth, scientists speculate that life may endure under similar conditions elsewhere, perhaps in the frozen seas or the exploding volcanoes of Jupiter's moons, or beneath the barren landscape of Mars. 74

Nevertheless, findings suggest that life—at least on the microbial level—may flourish throughout the universe in places we have yet to look.

72. The best placement for the underlined portion would be:

- F. where it is now.
- G. after the word *temperatures*.
- H. after the word *Celsius*.
- J. after the word *gush*.

73. Given that all the choices are true, which one would LEAST effectively introduce the subject of Paragraph 4?

- A. NO CHANGE
- B. According to researchers, the environment of a cold-loving extremophile, or psychrophile, is as extreme as that of a heat-loving thermophile.
- C. Certain extremophiles, called psychrophiles, thrive in cold environments rather than hot ones.
- D. Other types of extremophiles—cold-loving psychrophiles—have been found in temperatures as low as -17 degrees Celsius.

74. The writer is considering deleting the following clause from the preceding sentence (revising the capitalization accordingly):

If life can persist in extreme environments on Earth,

Should this clause be kept or deleted?

- F. Kept, because it clarifies for readers that life in extreme environments on Earth may not exist.
- G. Kept, because it makes the connection between life on Earth and the possibility of life on other planets.
- H. Deleted, because it contradicts the essay's main point by implying that life may not exist in extreme environments.
- J. Deleted, because it misleads readers into thinking the paragraph is about life on Earth rather than life on other planets.

75. A. NO CHANGE
 B. On the other hand,
 C. However,
 D. Indeed,

END OF TEST 1

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



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

- A. -8
- B. -6
- C. -4
- D. 0
- E. 8

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?

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

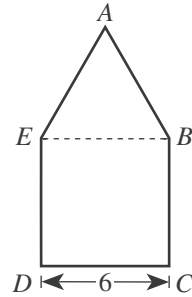
3. Vehicle A averages 14 miles per gallon of gasoline, and Vehicle B averages 36 miles per gallon of gasoline. At these rates, how many more gallons of gasoline does Vehicle A need than Vehicle B to make a 1,008-mile trip?

- A. 25
- B. 28
- C. 44
- D. 50
- E. 72

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?



- A. 18
- B. 24
- C. 30
- D. 42
- E. 45

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?

- A. 1.2
- B. 1.8
- C. 3.0
- D. 5.0
- E. 6.5

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

$$\begin{aligned} &x - 2 \\ &x - 1 \\ &x \\ &x + 1 \\ &x + 2 \\ &x + 3 \end{aligned}$$

What is the value of x ?

- F. 72
- G. 73
- H. 74
- J. 75
- K. 76

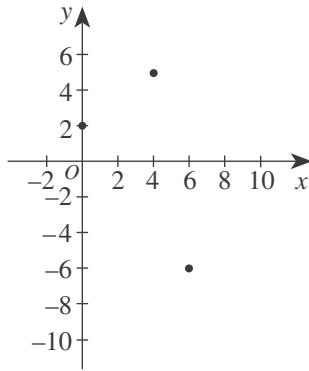
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9. In the standard (x,y) coordinate plane, point M with coordinates $(5,4)$ is the midpoint of \overline{AB} , and B has coordinates $(7,3)$. What are the coordinates of A ?

- A. $(17,11)$
- B. $(9, 2)$
- C. $(6, 3.5)$
- D. $(3, 5)$
- E. $(-3,-5)$

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 ?

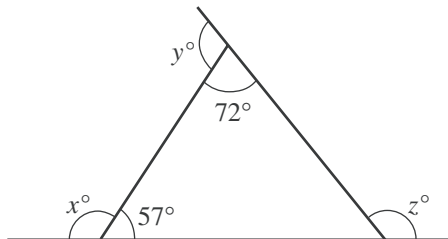


- F. $(10,-3)$
- G. $(9,-2)$
- H. $(8, 2)$
- J. $(7, 1)$
- K. $(2,-9)$

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?

$$\begin{matrix} & \begin{matrix} A & B & C \end{matrix} & & \text{Cost} \\ \begin{matrix} X \\ Y \end{matrix} & \begin{bmatrix} 100 & 200 & 150 \\ 120 & 50 & 100 \end{bmatrix} & \begin{matrix} A \\ B \\ C \end{matrix} & \begin{bmatrix} \$ 5 \\ \$10 \\ \$15 \end{bmatrix} \end{matrix}$$

- 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° , y° , and z° as shown, what is the sum of x , y , and z ?



- F. 180
- G. 231
- H. 309
- J. 360
- K. Cannot be determined from the given information

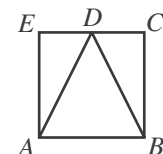
Use the following information to answer questions 13–15.

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.

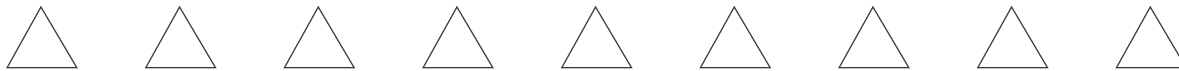
Candidate	Number of voters
Blackcloud	50
Lue	80
Gomez	40
Whitney	30

13. What percent of the voters polled chose Whitney in the poll?
- A. 15%
 - B. 20%
 - C. 25%
 - D. 30%
 - E. 40%
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?
- A. 54°
 - B. 72°
 - C. 90°
 - D. 108°
 - E. 144°

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 $\triangle ADB$?



- F. 1:1
- G. 1:2
- H. 1:3
- J. 1:4
- K. 1:8

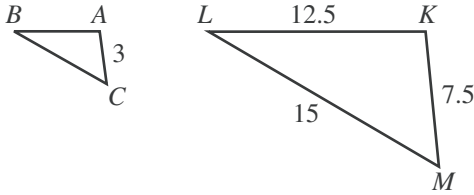


17. Which of the following is the slope of a line parallel to the line $y = \frac{2}{3}x - 4$ in the standard (x,y) coordinate plane?
- A. -4
 B. $-\frac{3}{2}$
 C. 2
 D. $\frac{3}{2}$
 E. $\frac{2}{3}$
18. Janelle cut a board 30 feet long into 2 pieces. The ratio of the lengths of the 2 pieces is 2:3. What is the length, to the nearest foot, of the shorter piece?
- F. 5
 G. 6
 H. 12
 J. 15
 K. 18
19. What is the smallest integer greater than $\sqrt{58}$?
- A. 4
 B. 7
 C. 8
 D. 10
 E. 30
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 $x^2 + 2x = 8$?
- A. -4 and 2
 B. -2 and 0
 C. -2 and 4
 D. 0 and 2
 E. 6 and 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. $\frac{1}{a^2}$
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?
-
- A. I only
 B. III only
 C. I or III only
 D. I or IV only
 E. II or IV only
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.")



- A. 12
 B. 14
 C. $21\frac{1}{2}$
 D. 35
 E. $71\frac{3}{4}$
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?

- A. 8.9
 B. 6.7
 C. 2.9
 D. 0.4
 E. 0.2

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?

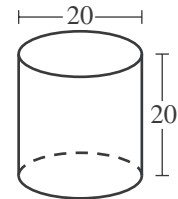
- A. 4
 B. 8
 C. 16
 D. 32
 E. 64

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?

- F. \$10,400
 G. \$12,167
 H. \$42,000
 J. \$52,000
 K. \$53,782

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?

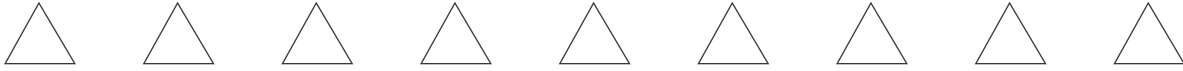
(Note: The total surface area of a cylinder is given by $2\pi r^2 + 2\pi rh$ where r is the radius and h is the height.)



- A. 300π
 B. 400π
 C. 500π
 D. 600π
 E. $1,600\pi$

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

- F. $-x^2 + 4x + 1$
 G. $x^2 + 4x - 1$
 H. $4x^2 - 7$
 J. $4x^2 - 1$
 K. $16x^2 + 8x - 1$

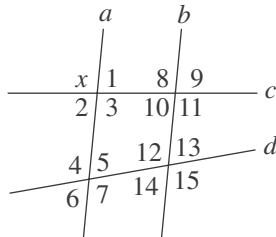


33. The table below shows the total number of goals scored in each of 43 soccer matches in a regional tournament. What is the average number of goals scored per match, to the nearest 0.1 goal?

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 $\angle x$?



- F. {1, 2}
- G. {1, 2, 5, 6}
- H. {1, 2, 9, 10}
- J. {1, 2, 5, 6, 9, 10}
- K. {1, 2, 5, 6, 9, 10, 13, 14}

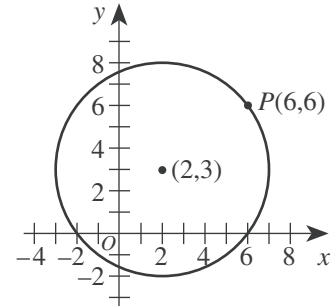
35. $(3x^3)^3$ is equivalent to:

- A. x
- B. $9x^6$
- C. $9x^9$
- D. $27x^6$
- E. $27x^9$

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

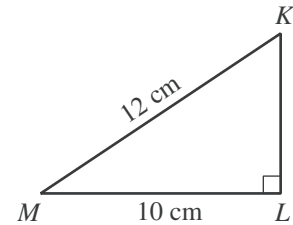
- F. $x < -6$
- G. $x > -6$
- H. $x < -2$
- J. $x > 2$
- K. $x < 6$

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° clockwise (C) about the center of the circle?



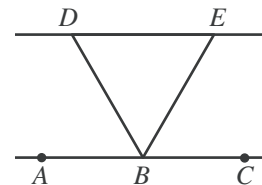
- A. (2, 3)
- B. (3, 2)
- C. (5, -1)
- D. (6, 0)
- E. (7, 3)

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



- F. $\frac{10}{12}$
- G. $\frac{12}{10}$
- H. $\frac{\sqrt{44}}{10}$
- J. $\frac{10}{\sqrt{44}}$
- K. $\frac{\sqrt{44}}{12}$

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 $\angle DBE$?



- A. 90°
- B. 60°
- C. 45°
- D. 30°
- E. Cannot be determined from the given information

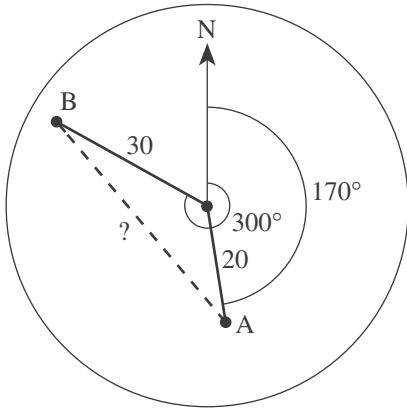
40. If there are 8×10^{12} hydrogen molecules in a volume of 4×10^4 cubic centimeters, what is the average number of hydrogen molecules per cubic centimeter?

- F. 5×10^{-9}
- G. 2×10^3
- H. 2×10^8
- J. 32×10^{16}
- K. 32×10^{48}

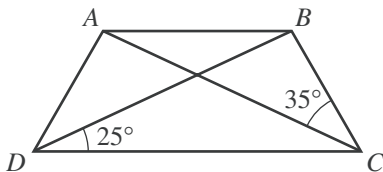


41. In the figure below, a radar screen shows 2 ships. Ship A is located at a distance of 20 nautical miles and bearing 170° , and Ship B is located at a distance of 30 nautical miles and bearing 300° . Which of the following is an expression for the straight-line distance, in nautical miles, between 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 $c^2 = a^2 + b^2 - 2ab \cos \angle C$.)

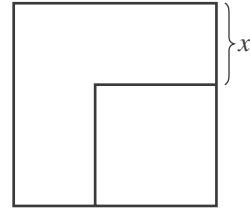


- A. $\sqrt{20^2 + 30^2 - 2(20)(30)\cos 60^\circ}$
 B. $\sqrt{20^2 + 30^2 - 2(20)(30)\cos 130^\circ}$
 C. $\sqrt{20^2 + 30^2 - 2(20)(30)\cos 170^\circ}$
 D. $\sqrt{20^2 + 30^2 - 2(20)(30)\cos 300^\circ}$
 E. $\sqrt{20^2 + 30^2 - 2(20)(30)\cos 470^\circ}$
42. What rational number is halfway between $\frac{1}{5}$ 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° , and $\angle BCA$ measures 35° . What is the measure of $\angle DBC$?



- A. 85°
 B. 95°
 C. 105°
 D. 115°
 E. 125°

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?



- F. 2
 G. $2\sqrt{2}$
 H. $4\sqrt{2}$
 J. 16
 K. 32
45. Which of the following is a rational number?

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

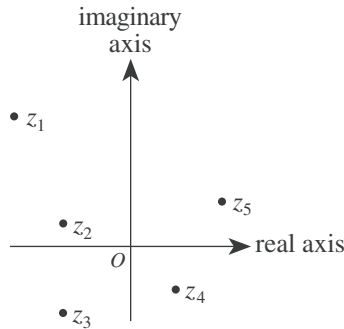
46. If $a < b$, then $|a - b|$ is equivalent to which of the following?
- F. $a + b$
 G. $-(a + b)$
 H. $\sqrt{a - b}$
 J. $a - b$
 K. $-(a - b)$

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?

- A. 90
 B. 88
 C. 82
 D. 80
 E. 79



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?

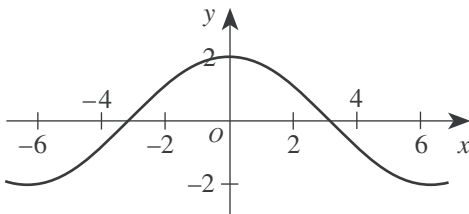


- F. z_1
G. z_2
H. z_3
J. z_4
K. z_5

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

- A. $-\frac{1}{3}$
B. $-\frac{1}{4}$
C. $-\frac{1}{8}$
D. 0
E. $\frac{1}{7}$

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



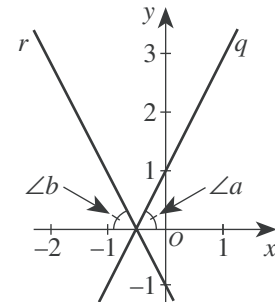
The function is:

- 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 $x = \pi$.

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?

- A. $\frac{19}{900}$
B. $\frac{81}{900}$
C. $\frac{90}{900}$
D. $\frac{171}{900}$
E. $\frac{271}{1,000}$

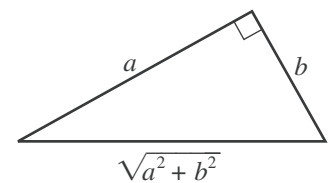
52. In the figure below, line q in the standard (x,y) coordinate plane has equation $-2x + y = 1$ and intersects line r , which is distinct from line q , at a point on the x -axis. The angles, $\angle a$ and $\angle b$, formed by these lines and the x -axis are congruent. What is the slope of line r ?



- F. -2
G. $-\frac{1}{2}$
H. $\frac{1}{2}$
J. 2
K. Cannot be determined from the given information

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

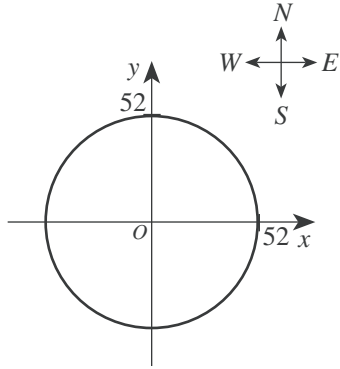
- A. $\frac{a}{b}$
B. $\frac{b}{a}$
C. $\frac{a}{\sqrt{a^2 + b^2}}$
D. $\frac{b}{\sqrt{a^2 + b^2}}$
E. $\frac{\sqrt{a^2 + b^2}}{a}$





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?

F. 2,120
G. 2,700
H. 4,250
J. 8,500
K. 16,990

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

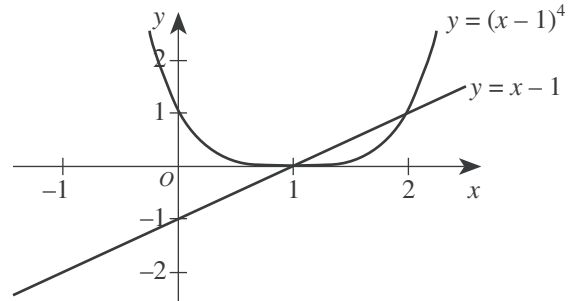
A. $x + y = 52$
B. $(x + y)^2 = 52$
C. $(x + y)^2 = 52^2$
D. $x^2 + y^2 = 52$
E. $x^2 + y^2 = 52^2$

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.)

F. 8
G. 12
H. 40
J. 44
K. 48

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

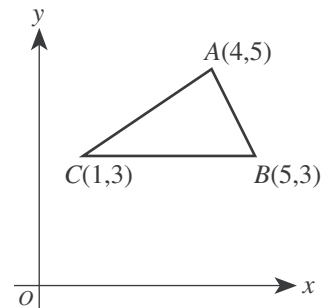


A. No real values
B. $x < 0$ and $x > 1$
C. $x < 1$ and $x > 2$
D. $0 < x < 1$
E. $1 < x < 2$

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 $\triangle ABC$?



A. 4
B. $4\sqrt{2}$
C. $4\sqrt{3}$
D. 8
E. $8\sqrt{2}$

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?

F. 25.5
G. 30
H. 169.85
J. 170
K. 199.85

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 latch or pound the knocker. But in truth, the door to that
10 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 non-sense 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
80 listeners 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 profound that it became an antidote to the blues of daily
85 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.

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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.

32. According to the fifth paragraph (lines 35–45), studies have shown that the insertion of acupuncture needles into acupoints causes nerve stimulation that results in:
- F. signals being sent to the brain and pituitary gland, which leads to the release of chemicals.
 - G. signals being sent to the spinal cord, which immediately blocks the release of chemicals.
 - H. chemicals being released that amplify signals to the spinal cord.
 - J. chemicals being released that numb the spinal cord and prevent signals being sent to the brain and pituitary gland.
33. The studies of acupuncture described in the fifth paragraph (lines 35–45) can best explain the success of acupuncture in treating which of the following conditions?
- A. Blurred vision
 - B. Nausea
 - C. Headaches
 - D. Impaired immune system
34. According to the passage, the study by Cho showed that volunteers experienced an increase in visual cortex activity when they:
- F. viewed brain activation maps.
 - G. were exposed to high concentrations of color.
 - H. received acupoint stimulation to their big toes.
 - J. underwent acupoint stimulation of the outside of the foot.
35. Information in the last paragraph indicates that acupuncture research has given results that:
- A. thoroughly explain the mechanisms by which acupuncture functions.
 - B. explain some aspects of how acupuncture functions while leaving other aspects open to further study.
 - C. explain some aspects of how acupuncture functions while questioning the methods used in previous studies.
 - D. do not explain any of the mechanisms by which acupuncture functions.
36. The passage indicates that the balance between yin and yang in a person depends on that person's:
- F. emotional state.
 - G. blood flow.
 - H. pulse.
 - J. level of qi.
37. According to the passage, a person with a yang condition might exhibit all of the following EXCEPT:
- A. pale face.
 - B. agitation.
 - C. fast pulse.
 - D. fever.
38. As it is used in line 49, the word *concentrated* most nearly means:
- F. extracted.
 - G. paid attention to.
 - H. gathered together.
 - J. directed to one topic.
39. According to the passage, Cho would have determined that volunteers had experienced a placebo effect if which of the following procedures had created increased activity in the visual cortex of the brain?
- A. Flashing a light in front of them
 - B. Stimulating one of their vision-related acupoints
 - C. Having them read an eye-examination chart
 - D. Stimulating a place that was not a visual acupoint
40. In the last paragraph, the author expresses the belief that scientists who open a new line of research on a topic are likely to:
- F. quickly discover the answers to the questions they raise.
 - G. find that new questions arise as old ones are answered.
 - H. receive answers far different than they anticipated.
 - J. learn that they have often asked the wrong questions.

END OF TEST 3

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

DO NOT RETURN TO A PREVIOUS TEST.



SCIENCE TEST

35 Minutes—40 Questions

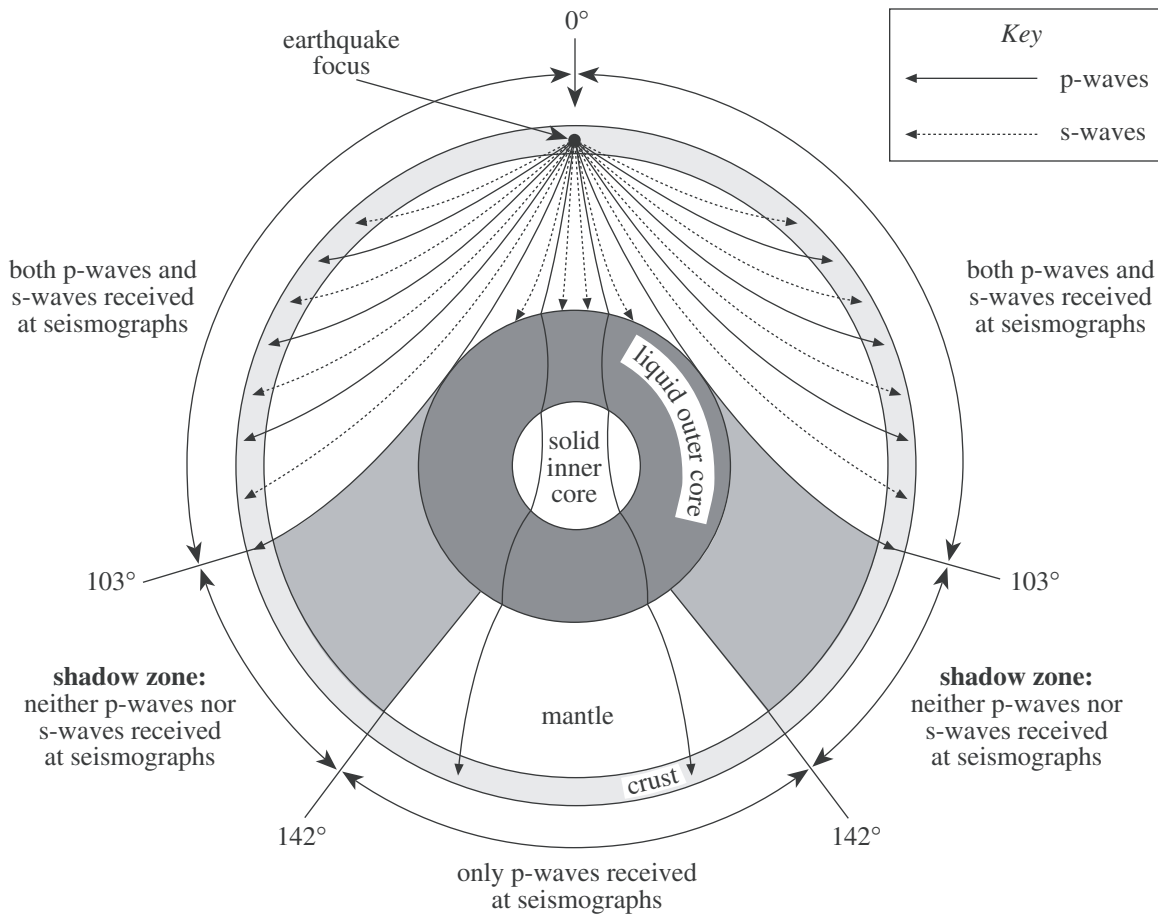
DIRECTIONS: There are seven passages in this test. Each passage is followed by several questions. After reading a passage, choose the best answer to each question and fill in the corresponding oval on your answer document. You may refer to the passages as often as necessary.

You are NOT permitted to use a calculator on this test.

Passage I

Earthquakes produce seismic waves that can travel long distances through Earth. Two types of seismic waves are *p-waves* and *s-waves*. P-waves typically travel 6–13 km/sec and s-waves typically travel 3.5–7.5 km/sec. Figure 1 shows how p-waves and s-waves move and are

refracted (bent) as they travel through different layers of Earth’s interior. Figure 2 shows a *seismograph* (an instrument that detects seismic waves) recording of p-waves and s-waves from an earthquake. Figure 3 shows, in general, how long it takes p-waves and s-waves to travel given distances along the surface from an earthquake *focus* (point of origin of seismic waves).



Note: The figure is not to scale.

Figure 1

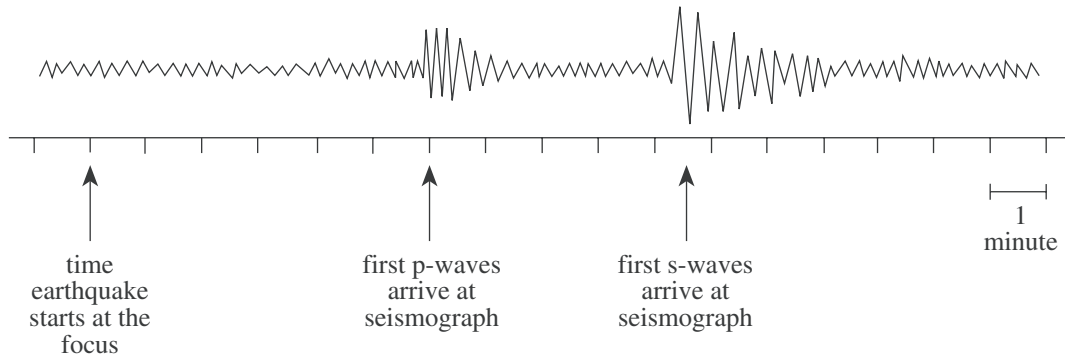
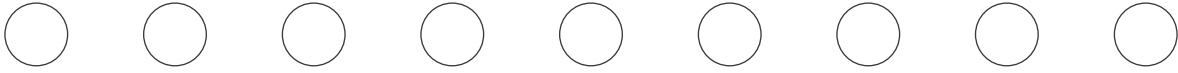


Figure 2

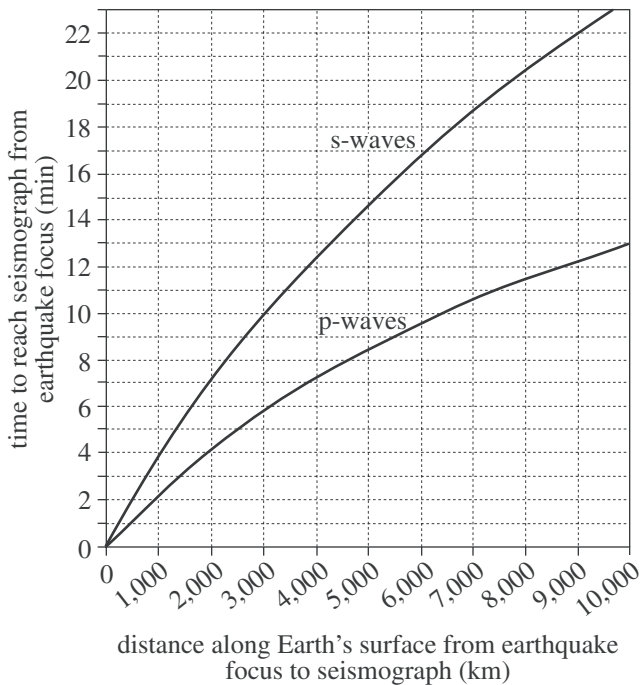


Figure 3

1. Figure 1 shows that a seismograph located at a point 125° around Earth from an earthquake's focus would receive which type(s) of seismic waves, if either, from that earthquake?

- A. P-waves only
- B. S-waves only
- C. Both p-waves and s-waves
- D. Neither p-waves nor s-waves

2. According to Figure 1, when p-waves encounter the boundary between the mantle and the core, the p-waves most likely:

- F. stop and do not continue into the core.
- G. enter the core and are refracted.
- H. change to s-waves.
- J. change to a third type of seismic wave.

3. Based on Figure 3, for a given seismograph, the time elapsed between the arrival of the first p-waves and the arrival of the first s-waves from an earthquake focus 10,500 km away would most likely be:

- A. less than 5 min.
- B. between 5 min and 7 min.
- C. between 8 min and 10 min.
- D. more than 10 min.

4. Based on the information provided, the "time earthquake starts at the focus" in Figure 2 corresponds to which of the following points on Figure 3?

- F. 0 km, 0 min
- G. 2,000 km, 5 min
- H. 5,000 km, 12 min
- J. 10,000 km, 20 min

5. According to Figure 2, which of the following statements best describes the relative amplitudes of the first p-waves to arrive at the seismograph and the first s-waves to arrive at the seismograph? The amplitude of the first p-waves to arrive at the seismograph is:

- A. smaller than the amplitude of the first s-waves to arrive at the seismograph.
- B. larger than the amplitude of the first s-waves to arrive at the seismograph.
- C. nonzero, and the same as the amplitude of the first s-waves to arrive at the seismograph.
- D. zero, as is the amplitude of the first s-waves to arrive at the seismograph.

GO ON TO THE NEXT PAGE.

Passage II

Lake Agassiz existed between 11,700 and 9,500 years ago in North America (see Figure 1). The lake was formed when a large glacier dammed several rivers. Groundwater trapped in lake and glacial sediments provides information about the climate at the time the sediments were deposited. Figure 2 shows a cross section of the sediments (lake clay and glacial till) and bedrock in the area. Figure 3 shows the $\delta^{18}\text{O}$ values of groundwater taken from samples of the top 40 m of sediment at 3 sites along the same cross section. $\delta^{18}\text{O}$ is calculated from a ratio of 2 oxygen isotopes (^{18}O and ^{16}O) in the groundwater. Smaller $\delta^{18}\text{O}$ values indicate cooler average temperatures.



Figure 1

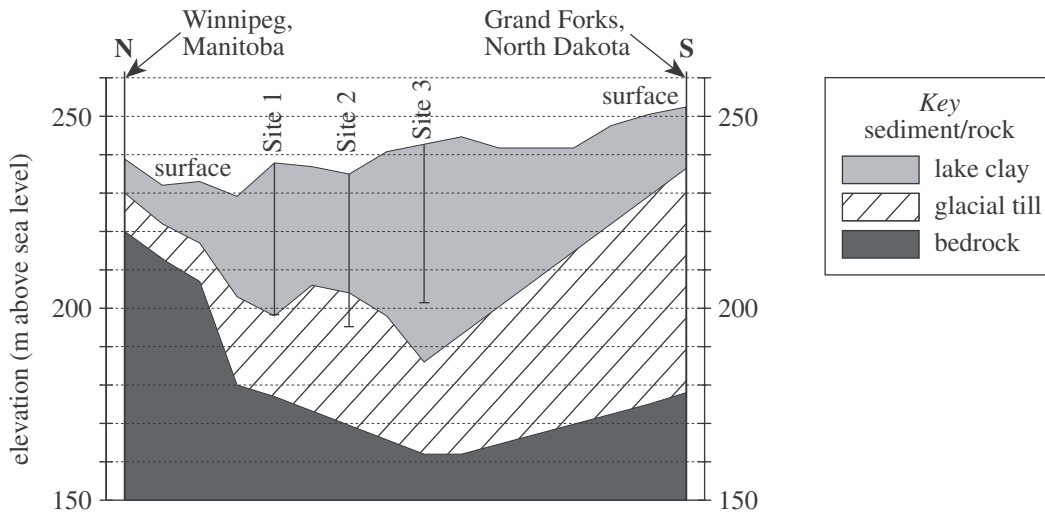
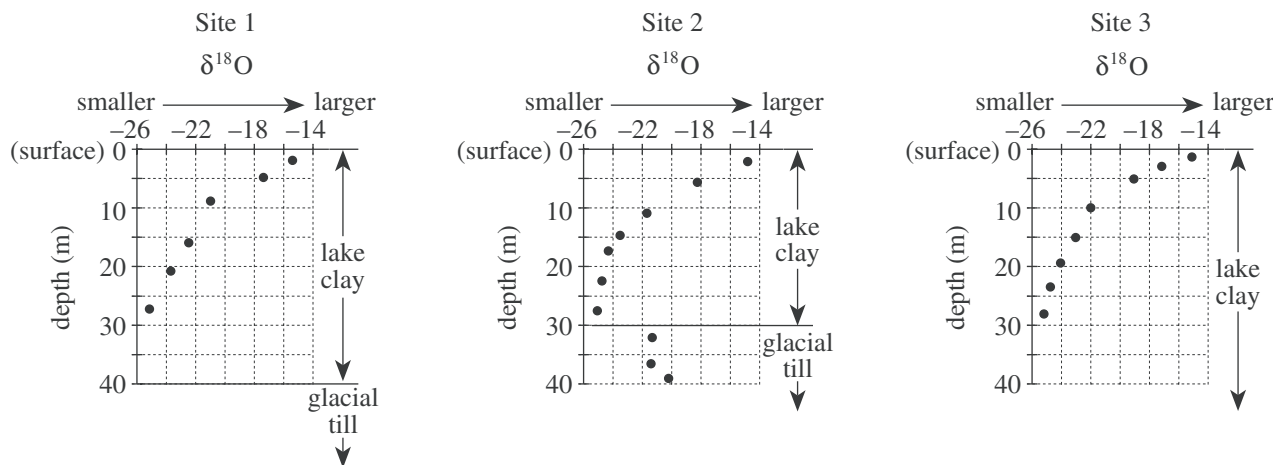


Figure 2



$$\text{Note: } \delta^{18}\text{O} = \left[\left(\frac{{}^{18}\text{O}/{}^{16}\text{O} \text{ of groundwater sample}}{{}^{18}\text{O}/{}^{16}\text{O} \text{ of standard water sample}} \right) - 1 \right] \times 1,000$$

Figure 3

Figures adapted from V. H. Remenda, J. A. Cherry, and T. W. D. Edwards, "Isotopic Composition of Old Ground Water from Lake Agassiz: Implications for Late Pleistocene Climate." ©1994 by the American Association for the Advancement of Science.

6. According to Figure 2, the lake clay deposit is thinnest at which of the following cities or sites?

- F. Winnipeg
- G. Site 1
- H. Site 2
- J. Grand Forks

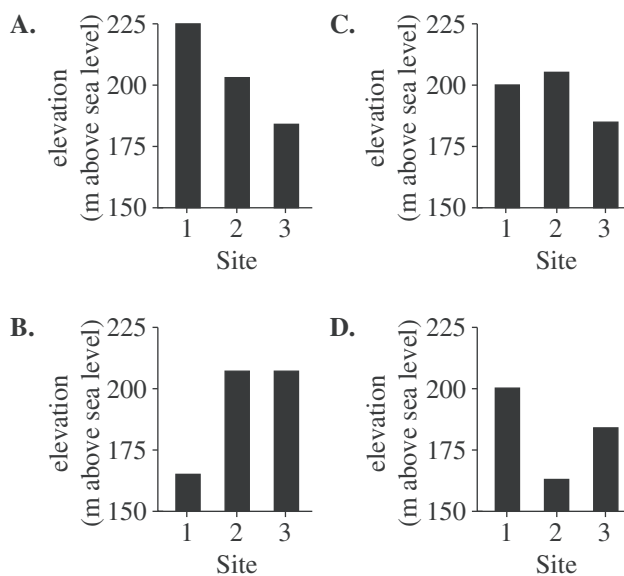
7. According to Figure 3, at Sites 1, 2, and 3, the smallest $\delta^{18}\text{O}$ value of the groundwater in the lake clay was recorded at a depth between:

- A. 0 m and 10 m.
- B. 10 m and 20 m.
- C. 20 m and 30 m.
- D. 30 m and 40 m.

8. According to Figure 2, as the thickness of the lake clay deposit increases from Grand Forks to Site 3, the thickness of the glacial till beneath it:

- F. increases.
- G. remains the same.
- H. first increases and then decreases.
- J. decreases.

9. According to Figure 2, which of the following graphs best represents the elevations, in m above sea level, of the top of the glacial till layer at Sites 1, 2, and 3?



10. Precipitation that falls at Sites 1, 2, and 3 soaks into the soil until it reaches the groundwater table about 3 m below the surface. Based on Figure 3, and assuming no alteration of the precipitation, the $\delta^{18}\text{O}$ value of present-day precipitation in the study area is closest to:

- F. -26.
- G. -23.
- H. -20.
- J. -15.

**Passage III**

Some students tested their hypothesis that the presence of bubbles in cans of various liquids would affect the *roll time* (the time it took a can to roll, without slipping, down an incline between 2 fixed points; see Figure 1).

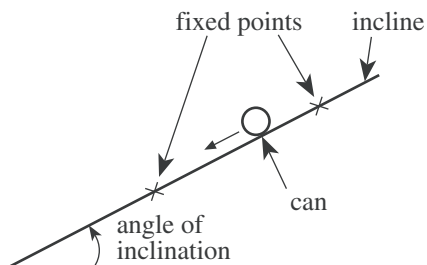


Figure 1

Identical 1.2 L aluminum cans were used in the first two experiments. The angle of inclination of the incline was 2.3° in all three experiments.

Experiment 1

The students added 1 L of a liquid—tap water containing no bubbles—to an empty can, sealed the can, and found its roll time. Next, they added 1 L of the tap water to a second empty can, sealed it, shook it, and immediately found its roll time. They repeated these procedures using soapy water containing many bubbles, and a carbonated beverage that contained no bubbles and that tasted flat, having lost most of its carbonation. The results are shown in Table 1.

Trial	Liquid	Roll time	
		before shaking (sec)	after shaking (sec)
1	tap water	1.75	1.75
2	soapy water	1.97	2.15
3	flat-tasting beverage	1.75	1.96

Experiment 2

The students added 1 L of the flat-tasting beverage to an empty can. They sealed the can, shook it, and set it aside. Fifteen minutes later they found the roll time of the can before and immediately after shaking it (Trial 4). Again they set the can aside. Two hours later they found the roll time of the can before and immediately after shaking it (Trial 5). The results are shown in Table 2.

Trial	Roll time	
	before shaking (sec)	after shaking (sec)
4	1.86	1.96
5	1.75	1.93

Experiment 3

The students added 1 L of the flat-tasting beverage to an empty 2 L clear plastic bottle and sealed the bottle. When they rolled the bottle down the incline, no bubbles formed. They shook the bottle, causing bubbles to form, and set the bottle aside. Fifteen minutes later, some bubbles were still visible, but after 2 hours, no bubbles could be seen.

Adapted from David Kagan, "The Shaken-Soda Syndrome." ©2001 by The American Association of Physics Teachers.

- In Experiment 3, what is the most likely reason the students used the plastic bottle rather than an aluminum can? Compared to an aluminum can, the plastic bottle:
 - rolled more rapidly down the incline.
 - made bubbles in the liquid easier to see.
 - contained a greater quantity of liquid.
 - had thicker walls and was less likely to break.
- Based on the results of Experiments 1 and 2, in which of the following trials, before shaking, were the average speeds of the cans the same?
 - Trials 1 and 2
 - Trials 2 and 3
 - Trials 2 and 4
 - Trials 3 and 5



13. In Experiment 2, a result of shaking the can of flat-tasting beverage was that the:
- A. number of bubbles in the beverage immediately decreased.
 - B. mass of the can of beverage increased.
 - C. roll time of the can of beverage decreased.
 - D. roll time of the can of beverage increased.
14. In Trial 5, is it likely that bubbles were present in large numbers immediately before the can was shaken?
- F. Yes; based on the results of Experiment 1, the bubbles produced in Trial 4 probably lasted for less than 15 min.
 - G. Yes; based on the results of Experiment 1, the bubbles produced in Trial 4 probably lasted for more than 2 hr.
 - H. No; based on the results of Experiment 3, the bubbles produced in Trial 4 probably lasted for less than 2 hr.
 - J. No; based on the results of Experiment 3, the bubbles produced in Trial 4 probably lasted for more than 3 hr.
15. Suppose that in Experiment 2, two hours after the completion of Trial 5, the students had measured the roll time of the can of liquid without first shaking the can. Based on the results of Trials 4 and 5, the roll time would most likely have been:
- A. less than 1.86 sec.
 - B. between 1.86 sec and 1.93 sec.
 - C. between 1.94 sec and 1.96 sec.
 - D. greater than 1.96 sec.
16. Based on the results of Trials 3–5 and Experiment 3, if the students had added 1 L of the flat-tasting beverage to one of the empty aluminum cans, sealed the can, and shaken it, how long would it most likely have taken for the number of bubbles in the beverage to become too few to affect the roll time?
- F. Less than 5 min
 - G. Between 5 min and 14 min
 - H. Between 15 min and 2 hr
 - J. Over 2 hr

**Passage IV**

The chemical reactions associated with photosynthesis can be summarized with the following chemical equation:

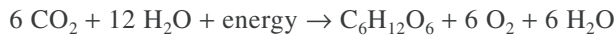


Table 1 lists wavelength ranges for visible light and the color frequently associated with each range.

Table 1	
Color	Wavelength (nm)
Violet	380–430
Blue	430–500
Green	500–565
Yellow	565–585
Orange	585–630
Red	630–750

Table 1 adapted from Neil A. Campbell, Jane B. Reece, and Lawrence G. Mitchell, *Biology*, 5th ed. ©1999 by Benjamin/Cummings.

Figure 1 shows the relative absorption of light by chlorophyll *a* and chlorophyll *b* versus the wavelength of light from 400 nm to 750 nm.

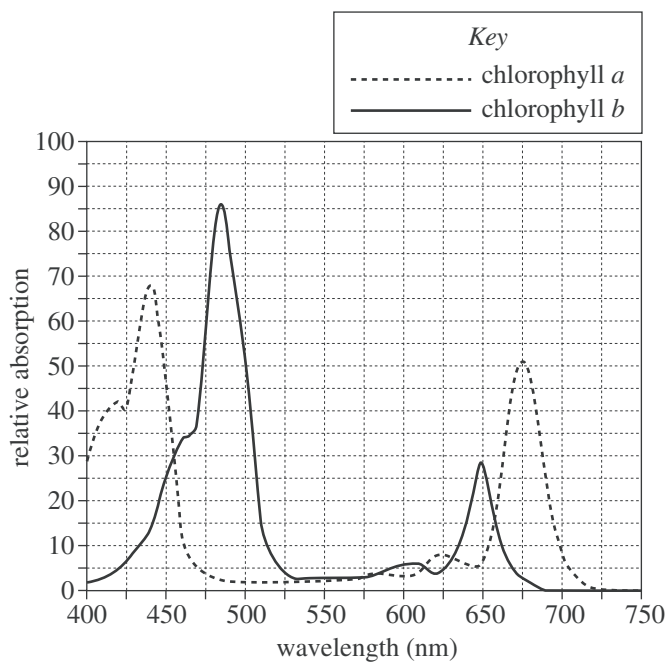


Figure 1

Figure 2 shows the average rate of photosynthesis at various wavelengths as a percent of the average rate of photosynthesis at 670 nm.

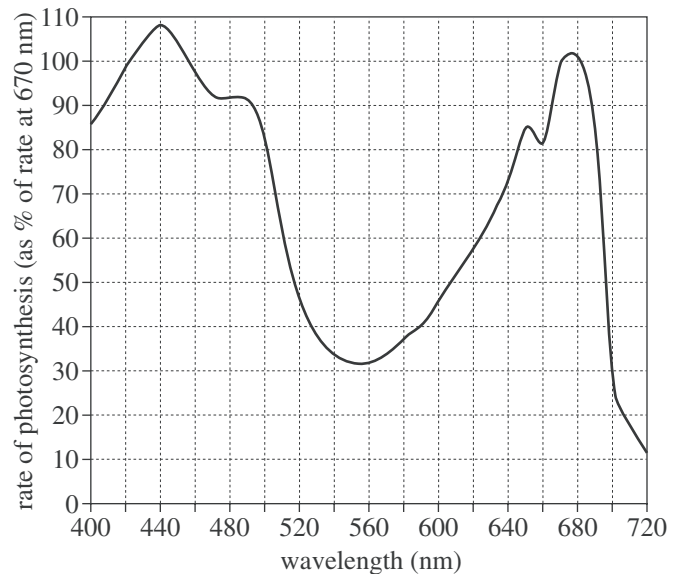


Figure 2

Figures 1 and 2 adapted from Peter H. Raven, Ray F. Evert, and Susan E. Eichhorn, *Biology of Plants*, 4th ed. ©1986 by Worth Publishers, Inc.

17. Based on Table 1 and Figure 1, which color of light is associated with the wavelength of light that results in the greatest absorption by chlorophyll *b* ?

- A. Blue
- B. Green
- C. Yellow
- D. Red

GO ON TO THE NEXT PAGE.



18. In eukaryotic organisms, the chemical reactions associated with the chemical equation shown in the passage typically occur within which of the following structures?
- F. Chloroplasts
 - G. Mitochondria
 - H. Lysosomes
 - J. Nuclei
19. In Figure 2, at which of the following wavelengths does the rate of photosynthesis exceed the rate of photosynthesis at 670 nm ?
- A. 400 nm
 - B. 430 nm
 - C. 630 nm
 - D. 700 nm
20. In the chemical equation shown in the passage, the carbon in CO_2 becomes part of which of the following types of molecules?
- F. Fat
 - G. Sugar
 - H. Protein
 - J. Nucleic acid
21. Which of the following conclusions is best supported by Figures 1 and 2 ? The wavelength that results in the highest rate of photosynthesis also results in the:
- A. lowest relative absorption by chlorophyll *a*.
 - B. lowest relative absorption by chlorophyll *b*.
 - C. highest relative absorption by chlorophyll *a*.
 - D. highest relative absorption by chlorophyll *b*.

**Passage V**

Students performed the following experiments to determine the density of common plastics.

Experiment 1

A dry 100 mL graduated cylinder was placed on an electronic balance and *tared* (the balance was reset to 0.000 g). H₂O was added to the graduated cylinder until a certain mass was obtained. Ethanol was added to the graduated cylinder until the volume of liquid was 50.0 mL. The density of the liquid was then calculated. The procedure was repeated with different amounts of ethanol and H₂O (see Table 1).

Liquid	Mass of H ₂ O (g)	Mass of ethanol (g)	Total mass (g)	Density (g/mL)
1	0	39.67	39.67	0.793
2	10.24	32.43	42.67	0.853
3	19.79	25.23	45.02	0.900
4	35.42	12.47	47.89	0.958
5	49.96	0	49.96	0.999

Experiment 2

A known mass of potassium iodide (KI) was dissolved in a known mass of H₂O. A dry 100 mL graduated cylinder was placed on the balance and tared. The solution was added to the graduated cylinder until the volume was 50.0 mL. The density of the liquid was then calculated. The procedure was repeated with different amounts of KI and H₂O (see Table 2).

Liquid	Mass of H ₂ O in solution (g)	Mass of KI in solution (g)	Mass of solution in graduated cylinder (g)	Density (g/mL)
6	97.66	7.36	52.51	1.05
7	95.41	15.52	55.70	1.11
8	94.38	20.68	57.53	1.15
9	92.18	29.08	60.63	1.21
10	87.77	41.31	64.64	1.29

Experiment 3

A solid plastic bead was placed at the bottom of a sample of each of Liquids 1–10 from Experiments 1 and 2. If the bead stayed at the bottom, “S” was recorded in Table 3. If the bead rose, “R” was recorded in Table 3. The procedure was repeated for various plastics.

Plastic	Liquid									
	1	2	3	4	5	6	7	8	9	10
Polybutylene	R	R	R	R	R	R	R	R	R	R
VLDPE	S	R	R	R	R	R	R	R	R	R
LDPE	S	S	S	R	R	R	R	R	R	R
HDPE	S	S	S	S	R	R	R	R	R	R
PA-11	S	S	S	S	S	R	R	R	R	R
PA-6	S	S	S	S	S	S	S	R	R	R
Polycarbonate	S	S	S	S	S	S	S	S	R	R
PVC	S	S	S	S	S	S	S	S	S	S

22. In Experiment 1, the density of ethanol was found to be:

- F. less than 0.793 g/mL.
- G. 0.793 g/mL.
- H. 0.999 g/mL.
- J. greater than 0.999 g/mL.

23. Based on the results of Experiments 1–3, the density of PA-11 is most likely:

- A. less than 0.793 g/mL.
- B. between 0.853 g/mL and 0.958 g/mL.
- C. between 0.999 g/mL and 1.05 g/mL.
- D. greater than 1.11 g/mL.



24. Suppose that a sixth KI/H₂O solution had been measured in Experiment 2 and the mass of the solution in the graduated cylinder was 67.54 g. The density of this solution would most likely have been closest to which of the following?
- F. 1.25 g/mL
 G. 1.30 g/mL
 H. 1.35 g/mL
 J. 1.40 g/mL
25. A plastic bead was tested as in Experiment 3 using Liquids 1–4. Which of the following is NOT a plausible set of results for the plastic?
- | Liquid | | | |
|--------|---|---|---|
| 1 | 2 | 3 | 4 |
| R | R | R | R |
| R | R | S | S |
| S | S | R | R |
| S | S | S | S |
- A. R R R R
 B. R R S S
 C. S S R R
 D. S S S S
26. In Experiments 1 and 2, the students tared the graduated cylinder in each trial so they could more easily determine:
- F. the mass of the substances added to the graduated cylinder.
 G. the density of the graduated cylinder.
 H. when the total volume of the added substances was equal to 50.0 mL.
 J. when all of the KI was dissolved in the H₂O.
27. A student claimed that polycarbonate is more dense than PA-6. Do the results of Experiments 1–3 support his claim?
- A. No, because in Liquid 8, polycarbonate stayed at the bottom and PA-6 rose.
 B. Yes, because in Liquid 8, polycarbonate stayed at the bottom and PA-6 rose.
 C. No, because in Liquid 8, polycarbonate rose and PA-6 stayed at the bottom.
 D. Yes, because in Liquid 8, polycarbonate rose and PA-6 stayed at the bottom.

**Passage VI**

Bacteria break down sugars by *fermentation*. To study 2 fermentation pathways, researchers performed 2 experiments using broth that contained either the sugar *sucrose* or the sugar *lactose*. One of the fermentation pathways produces CO_2 gas and increases the acidity (lowers the pH) of the solution. The other pathway produces acid but not CO_2 .

Experiment 1

Sucrose broth was added to 5 large test tubes. Next, *phenol red* (a pH indicator that is yellow if $\text{pH} < 7$, red if $\text{pH} \geq 7$) was added to each large test tube. A *Durham tube* (a small test tube) was placed, inverted, in each large test tube to collect CO_2 (see Figure 1).

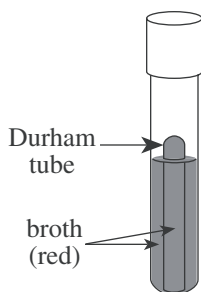


Figure 1

The large test tubes were capped, heated until the solutions were sterile, then cooled. One of 4 bacterial species (Species A–D) was added to each of 4 of the large test tubes. The procedure was repeated using lactose broth instead of sucrose broth. The 10 large test tubes (all containing solutions at a pH of 7) were then incubated at 37°C for 48 hr.

The large test tubes and Durham tubes were examined. If acid was produced, the solution was yellow. If no acid was produced, the solution remained red. If CO_2 was produced, a gas bubble was observed at the top of the Durham tube (see Table 1).

Species added	Sucrose broth		Lactose broth	
	acid	CO_2	acid	CO_2
A	–	–	–	–
B	–	–	+	+
C	+	+	–	–
D	+	–	+	–
None	–	–	–	–

Experiment 2

Synergism occurs when 2 bacterial species act together to ferment a sugar by using a pathway that neither species can use alone. To investigate synergism, Experiment 1 was repeated, except that different pairs of bacterial species were added to each large test tube (see Table 2).

Species added	Sucrose broth		Lactose broth	
	acid	CO_2	acid	CO_2
A and B	–	–	+	+
A and C	+	+	–	–
B and D	+	+	+	+
C and D	+	+	+	+

28. In Experiment 1, which of the bacterial species fermented lactose?

F. Species B only
 G. Species C only
 H. Species B and Species D only
 J. Species C and Species D only

29. Suppose that in Experiment 2 both Species B and Species C had been added to a large test tube containing sucrose broth and to a large test tube containing lactose broth. Which of the following would most likely depict the results?

	Sucrose broth		Lactose broth	
	acid	CO_2	acid	CO_2

A. – – + +
 B. + + – –
 C. + + + +
 D. – – – –



30. Suppose a scientist isolates a bacterial species that is 1 of the 4 species used in Experiment 1. She adds the species to sucrose broth and observes that neither acid nor CO_2 is produced. She then adds the species to lactose broth and observes that both acid and CO_2 are produced. Based on the results of Experiment 1, the species is most likely:

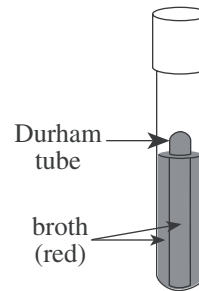
- F. Species A.
- G. Species B.
- H. Species C.
- J. Species D.

31. What is the evidence from Experiments 1 and 2 that Species C and Species D acted synergistically in Experiment 2?

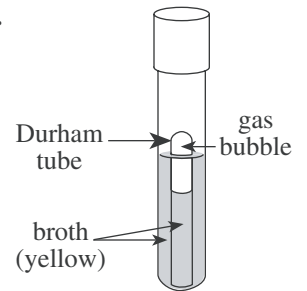
- A. No acid was produced when each species was alone in the sucrose broth, but acid was produced when the 2 species were together in the sucrose broth.
- B. No acid was produced when each species was alone in the lactose broth, but acid was produced when the 2 species were together in the sucrose broth.
- C. No CO_2 was produced when each species was alone in the sucrose broth, but CO_2 was produced when the 2 species were together in the sucrose broth.
- D. No CO_2 was produced when each species was alone in the lactose broth, but CO_2 was produced when the 2 species were together in the lactose broth.

32. Which of the following figures best illustrates the results of Experiment 1 for Species D in the sucrose broth?

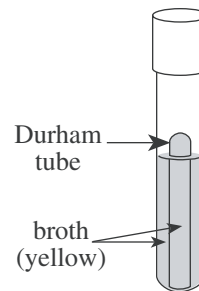
F.



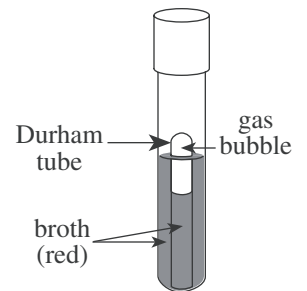
H.



G.



J.

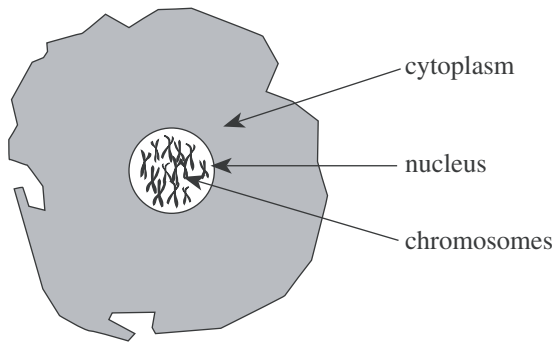


33. Is the hypothesis that Species A and Species C acted synergistically supported by the results of Experiment 2?

- A. Yes, because both acid and CO_2 were produced from sucrose.
- B. Yes, because both acid and CO_2 were produced from lactose.
- C. No, because only acid, not CO_2 , was produced from both sucrose and lactose.
- D. No, because neither acid nor CO_2 was produced from lactose.

**Passage VII**

In the 1940s, scientists thought all genetic material was contained in structures called *chromosomes* and that chromosomes had been found only in the nucleus of a cell (not in the cytoplasm):



Chromosomes are composed of 2 types of molecules, proteins and deoxyribonucleic acid (DNA). Proteins are composed of subunits called *amino acids*. DNA consists of chains of subunits called *nucleotides*. The parts of chromosomes that are responsible for the transmission of genetic information are called *genes*.

Two scientists in the 1940s debate whether genes are made of proteins or DNA.

Protein Hypothesis

Genes are made only of proteins. Proteins make up 50% or more of a cell's dry weight. Cells contain 20 different amino acids that can be arranged in a virtually infinite number of ways to make different proteins. The number and arrangement of different amino acids within a protein form the codes that contain hereditary information.

In contrast, only 4 different nucleotides make up the DNA found in cells, and they are believed to form chains only in certain ratios. As a result, the number of different combinations that DNA can carry is much smaller than the number that proteins can carry.

DNA Hypothesis

Genes are made only of DNA. DNA is found exclusively in the cell's nucleus, whereas proteins are found throughout the nucleus and cytoplasm. Additionally, the amount of protein in a cell varies from cell type to cell type, even within the same animal.

Though DNA is less abundant than proteins, the amount is consistent from cell type to cell type within the same animal, except for the *gametes* (the reproductive cells). Gametes have half the amount of DNA as other cells in the body. Gametes also have half the typical number of chromosomes. Thus, the amount of DNA in a cell is correlated with the number of chromosomes in the cell. No such correlation is found for proteins.

34. Which of the following statements is most consistent with the DNA Hypothesis? The amount of DNA will generally increase from cell type to cell type as the number of:

- F. amino acids in the nucleus increases from cell type to cell type.
- G. amino acids in the cytoplasm increases from cell type to cell type.
- H. chromosomes in the nucleus increases from cell type to cell type.
- J. chromosomes in the cytoplasm increases from cell type to cell type.

35. By referring to the observation that DNA is found exclusively in the nucleus while proteins are found throughout the cell, the scientist supporting the DNA Hypothesis implies that genes are made only of DNA because which of the following are also found only in the nucleus?

- A. Amino acids
- B. Proteins
- C. Gametes
- D. Chromosomes

36. According to the passage, a similarity between DNA and proteins is that both types of molecules:

- F. are found only in gametes.
- G. are abundant in the cytoplasm.
- H. contain 20 different amino acids.
- J. are composed of smaller subunits.

37. According to the Protein Hypothesis, which of the following observations provides the strongest evidence that genes are NOT composed of DNA ?

- A. DNA is composed of only 4 types of nucleotides.
- B. DNA is composed of smaller subunits than are proteins.
- C. DNA is abundant in both the nucleus and the cytoplasm.
- D. The concentration of DNA is generally consistent from cell to cell.

38. *Mitochondria* are organelles located in the cytoplasm that are responsible for energy transformation in a cell. After the 1940s, it was observed that mitochondria contain their own genes. This observation contradicts evidence stated in which hypothesis?

- F. The DNA Hypothesis, because if genes are made of DNA, the observation would show that DNA is present outside the nucleus.
- G. The DNA Hypothesis, because if genes are made of DNA, the observation would show that DNA is present inside the nucleus.
- H. The Protein Hypothesis, because if genes are made of proteins, the observation would show that proteins are present outside the nucleus.
- J. The Protein Hypothesis, because if genes are made of proteins, the observation would show that proteins are present inside the nucleus.

GO ON TO THE NEXT PAGE.



39. The scientist who describes the DNA Hypothesis implies that the Protein Hypothesis is *weakened* by which of the following observations?
- For a given organism, the amount of protein in the gametes is half that found in other types of cells.
 - For a given organism, the amount of protein in different types of cells is not the same.
 - Protein molecules are composed of many subunits.
 - Proteins are found only in the nucleus.

40. Which of the following illustrations of a portion of a DNA molecule is consistent with the description in the passage?

<p><i>Key</i> AA - amino acid N - nucleotide</p>
--

- F. } (AA) — (N) — (AA) — (N) }
- G. } (N) — (AA) — (AA) — (N) }
- H. } (AA) — (AA) — (AA) — (AA) }
- J. } (N) — (N) — (N) — (N) }

END OF TEST 4

STOP! DO NOT RETURN TO ANY OTHER TEST.

[See Note on page 56.]