December 2014

ACT Form 72G

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

Of Whalebones and Bonnets

Over the centuries, different cultures have used different methods to iron wrinkles from clothing and household fabrics such as curtains and tablecloths, each culture has performed the task on some kind of flat surface. For example, although ancient Koreans and Vikings had different types of irons, both used smooth surfaces to iron their clothes. On the other hand, the Koreans used stone slabs. The Vikings used whalebone.

If the idea of ironing on these surfaces seems prehistoric, maybe they shouldn't. The modern ironing board—the type that has legs and can be folded and neatly stored—wasn't patented in the United States until the 1860s. Before their invention, Americans ironed on makeshift tables, which could sometimes be easily taken apart after use.

1. **A.** NO CHANGE
   B. tablecloths, each and every
   C. tablecloths that each
   D. tablecloths, but each

2. **F.** NO CHANGE
   G. Be that as it may, the
   H. By now, the
   J. The

3. **A.** NO CHANGE
   B. those
   C. it
   D. DELETE the underlined portion.

4. **F.** NO CHANGE
   G. its
   H. its'
   J. it's

5. Given that all the choices are true, which one most specifically describes what was sometimes used to create temporary ironing boards?
   A. NO CHANGE
   B. surfaces that might be used for other household projects after the ironing chores were completed.
   C. often laying a plank across two chairs to form a literal ironing board.
   D. making do with whatever they could find around the house.

GO ON TO THE NEXT PAGE.

Some types of wood were considered better suited to the job then others.[6] In her 1841 book, *Cottage Comforts*, Esther Copley writes, "No wood does so well as deal [pine or fir] for an ironing board; the heat draws out a stain from any other kind."

Accustomed to their traditional boards, 1860s Americans weren't quick to adopt new, often mass-produced, ironing boards. As a result, inventors began to craft more specialized boards that weren't so general.[7]

Patents emerged for newly designed[8] ironing boards intended exclusively[9] for difficult-to-iron attire, like bonnets.

[1] Of the numerous ironing board inventors, of which there were many,[10] Sarah Boone is credited by the US Patent and Trademark Office, turning[11] the tide against homemade boards. [2] Boone, a former slave, patented an ironing board that had a tapered end in 1892[12] so that anyone could iron a sleeve easily and quickly. [3] Her board had collapsible legs and was reversible, allowing the user to iron one side of a sleeve and then the other without having to move the shirt at all. [4] Popular for its efficiency and convenience, Boones'[13] invention pushed the modern ironing board into the American domestic mainstream while simultaneously obscuring its long, homemade history. [14]

6. **F.** NO CHANGE
   G. than others.
   H. than another.
   J. then another.

7. **A.** NO CHANGE
   B. that weren't the same as the others had been.
   C. that they made.
   D. DELETE the underlined portion and end the sentence with a period.

8. **F.** NO CHANGE
   G. newly designed,
   H. newly, designed
   J. newly, designed,

9. **A.** NO CHANGE
   B. most exclusively
   C. more exclusive
   D. exclusive

10. **F.** NO CHANGE
    G. who spent time coming up with new objects,
    H. invention being a good thing,
    J. DELETE the underlined portion.

11. **A.** NO CHANGE
    B. Office, it was she who turned
    C. Office with turning
    D. Office she turned

12. Which of the following placements of the underlined portion most clearly indicates that Boone patented her ironing board design in 1892?
    F. Where it is now
    G. After the word *slave* (and before the comma)
    H. After the word *board*
    J. After the word *could*

13. **A.** NO CHANGE
    B. Boone's
    C. Boones's
    D. Boones

14. For the sake of the logic and coherence of this paragraph, Sentence 4 should be placed:
    F. where it is now.
    G. before Sentence 1.
    H. after Sentence 1.
    J. after Sentence 2.

GO ON TO THE NEXT PAGE.

Question 15 asks about the preceding passage as a whole.

15. Suppose the writer's goal had been to write a brief essay explaining some of the history behind a common household object. Would this essay accomplish that goal?
    - A. Yes, because it describes precursors to Boone's ironing board, which the essay shows became a common household item in the United States.
    - B. Yes, because it explains that Boone developed the first ironing board that was used in US households.
    - C. No, because it indicates that Boone's ironing board design was just one of many that became popular in the United States.
    - D. No, because it focuses instead on Boone's many inventions, only some of which were used for household work.

PASSAGE II

Meriwether Lewis: Botanist by Request

[1]

In 1803, Meriwether Lewis, private secretary to President Jefferson, [16] was commissioned by the president to lead a newly formed Corps of Discovery [17] and travel west to the Pacific Ocean. [A] Lewis was expected to record "with great pains and accuracy" the "growth and vegetable production" of the country the Corps passed through. [18] Jefferson hoped the information would provide a key to the agricultural and commercial possibilities of the western territory.

16. If the writer were to delete the underlined portion (adjusting the punctuation as needed), the paragraph would primarily lose:
    - F. a comment that begins the essay's discussion of the various professions Lewis held.
    - G. a detail that, in part, explains Lewis's connection to Jefferson.
    - H. a claim about Lewis that shifts the focus of the paragraph away from Jefferson.
    - J. an aside that introduces the two men who are the main focus of the essay.

17. A. NO CHANGE
    - B. a, newly formed, Corps of Discovery
    - C. a newly, formed Corps of Discovery
    - D. a newly formed, Corps of Discovery,

18. The use of quotation marks around two phrases in the preceding sentence is most likely intended to:
    - F. suggest the task of cataloging plants would be one Lewis would have to struggle to accomplish.
    - G. distinguish Jefferson's exact words from the essay writer's paraphrase of the directive.
    - H. emphasize that the words were directed only to Lewis and not to the rest of the Corps.
    - J. add drama to what would otherwise be a dry historical narrative.

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[2]

Lewis might of seemed to be an odd choice. He
19
was no botanist but rather an army officer with only a few years of schooling. Lewis had, however, grown up in the presence of an expert. His mother, Lucy Meriwether Lewis Marks, was a respected herbal doctor in Virginia. [B] From her, Lewis had learned to identify which plants
20
were beneficial and the ones that weren't to avoid. He had
20
a catalog of medicinal herbs committed to memory and a talent for observation.

[3]

Prior to setting out with William Clark, Lewis spent two years learning the principles of preserving and cataloging botanical specimens. [C] His mentor was the countries most prominent botanist,
21
Benjamin Smith Barton. [22] During what could be summarized an apprenticeship, Lewis perfected
23
his ability to dry a specimen between pages of blotting paper and methodically keeping notes.
24

19. **A.** NO CHANGE
B. could seemingly been
C. might have seemed
D. could seem being

20. **F.** NO CHANGE
G. which plants were beneficial and which were to be avoided.
H. which plants were beneficial and avoiding the ones that weren't.
J. the beneficial plants and the ones that weren't should be avoided.

21. **A.** NO CHANGE
B. country's most prominent
C. countries' more prominent
D. country's most prominently

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

> As a young man, Barton had gone to Scotland, intending to complete his study of medicine at Edinburgh University.

Should the writer make this addition here?

F. Yes, because it establishes the scientific qualifications of Lewis's mentor.
G. Yes, because it indicates that Barton was accustomed to studying in distant places.
H. No, because it doesn't indicate whether Barton was still at Edinburgh University at the time.
J. No, because the information doesn't pertain to Lewis's preparations for the trip.

23. **A.** NO CHANGE
B. exclaimed
C. called
D. cited

24. **F.** NO CHANGE
G. had been keeping
H. had kept
J. keep

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On the expedition, he would meticulously describe, in writing and through sketches, each plant, including: details about how it
25

tasted, smelled, seemed, and handled.
26

[4]

Lewis diligently collected seeds and brought back over 150 specimens, at least half of which had been previously unknown to botanists. [D] He more than fulfilled Jefferson's directive despite the fact that his own botanical skills were, as he put it, "slender."
27

[5]

Declared a national hero, the collection of
28
botanical specimens became one of the richest legacies of the expedition. Among the plants were species that would become official state flowers. Your state flower may be one of them.
29

25. A. NO CHANGE
B. including details about how it:
C. including details about: how it
D. including details about how it

26. F. NO CHANGE
G. appeared, and touched.
H. looked, and felt.
J. saw, and sensed.

27. The writer is considering deleting the underlined portion (adjusting the punctuation as needed). Should the underlined portion be kept or deleted?
A. Kept, because it serves as the only indication that it was Lewis himself who described his botanical skills as lacking.
B. Kept, because it emphasizes how unqualified Lewis was to lead the Corps of Discovery.
C. Deleted, because it presents Lewis in an unflattering light.
D. Deleted, because it weakens the essay's point that Lewis performed an extraordinary task.

28. F. NO CHANGE
G. An impressive contribution to science,
H. Regardless of his minimal expertise,
J. Better known as an explorer,

29. Which choice provides the most logical conclusion to the paragraph?
A. NO CHANGE
B. flowers: Idaho, Montana, and Oregon.
C. flowers. None of them were states yet, of course.
D. flowers, although Lewis couldn't have known it at the time.

Question 30 asks about the preceding passage as a whole.

30. The writer plans to add the following sentence to the essay:

The president's directive was clear.

This sentence would most logically be placed at Point:
F. A in Paragraph 1.
G. B in Paragraph 2.
H. C in Paragraph 3.
J. D in Paragraph 4.

Responsible Ecotourism

[1]

When ecotourism first became popular during the 1970s, people were excited by its goal touring natural habitats while affecting them as little as possible. Taking an ecotour, by definition, meaning minimizing the environmental impact of the trip. It was inevitable, therefore, that an increase in any sort of tourism in a natural environment would impact those in some way. [A] People throughout the world have had to confront unintended consequences of the growing popularity of ecotourism. Now, guides are striving to preserve the original goal, of low-impact tours, of the natural world.

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[2]

[B] Ecotourism guides in heavily visited locales must take great care in monitoring their clients to minimize their effect on the natural environment. When leading hiking tours, for example, guides must be vigilant that groups don't trample native plants or disturb wild animals. [C]

[3]

Equally important, you need to be wise advisors and diplomats for their clients. [D] For instance, when helping travelers make lodging arrangements, guides should recommend accommodations that comply with environmentally sustainable practices, such as conserving energy and water. Ecotourists have tended to seek out natural beauty in remote locations, where there may not have been an active tourist industry previously.

31. A. NO CHANGE
B. goal: touring
C. goal. To tour
D. goal. Touring

32. F. NO CHANGE
G. meant minimizing
H. meaning to minimize
J. meant that minimizing

33. A. NO CHANGE
B. however,
C. for instance,
D. thus,

34. F. NO CHANGE
G. it
H. them
J. these

35. A. NO CHANGE
B. goal, of low-impact tours
C. goal of low-impact tours,
D. goal of low-impact tours

36. F. NO CHANGE
G. vigilant. That
H. vigilant, that
J. vigilant that,

37. A. NO CHANGE
B. we
C. I
D. guides

Some areas have suddenly become burdened by the needs of travelers. It's not uncommon for overeager ecotourists to trespass on private land, sometimes they (38) build campfires using wood that's integral to the local environment. [39] Responsible ecotourism guides know what areas and resources are available for tourists use (40) and they advise their clients accordingly.

[4]

Teaching tourists how to minimize their impact on the environment, it (41) is essential to responsible ecotourism. With redoubled commitment to this goal, ecotourism can continue to foster maximum enjoyment (42) of nature with minimum disruption, even as the number of tourists grows. (43)

38. F. NO CHANGE
G. land
H. land or
J. land sometimes they

39. If the writer were to delete the preceding sentence, the paragraph would primarily lose:
A. examples of ways that some ecotourists have burdened communities and environments.
B. examples of steps ecotourism guides have taken to minimize the environmental impact of hikers.
C. reasons that there hasn't been much of a tourist industry in certain areas.
D. reasons that ecotourists seek out natural beauty in remote locations.

40. F. NO CHANGE
G. tourists' use,
H. tourist's use,
J. tourist's use

41. A. NO CHANGE
B. environment
C. environment that which
D. environment, it is this which

42. F. NO CHANGE
G. the most maximum enjoyment
H. the most maximum enjoyment and pleasure
J. maximum enjoyment and pleasure

43. Which choice most effectively concludes the sentence and the essay by referring to a specific problem mentioned early in the essay?
A. NO CHANGE
B. while the world makes efforts to combat global warming.
C. while many tourists prefer other ways of traveling.
D. even though some people don't enjoy activities like hiking and camping.

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Questions 44 and 45 ask about the preceding passage as a whole.

44. Upon reviewing the essay and finding that some information has been left out, the writer composes the following sentence incorporating that information:

> In some cases, guides must spread out hikers to avoid unintentionally trampling down a new path.

If the writer were to add this sentence to the essay, the sentence would most logically be placed at Point:

F. A in Paragraph 1.
G. B in Paragraph 2.
H. C in Paragraph 2.
J. D in Paragraph 3.

45. Suppose the writer's goal had been to write a persuasive essay arguing that more people should take ecotours. Would this essay accomplish that goal?

A. Yes, because it provides compelling reasons to preserve natural habitats.
B. Yes, because it describes the beauty of the natural world.
C. No, because it focuses instead on efforts ecotourism guides must take to reduce the environmental impact of tourists.
D. No, because it focuses instead on the reasons why ecotourism is a faulty idea that should be abandoned.

PASSAGE IV

Crossing an Icon

Shortly after its completion in 1883, the recently completed [46] Brooklyn Bridge was dubbed the Eighth Wonder of the World and became a symbol both of American industry, of [47] modernism, and the rise of New York City. [48] They want to cross the bridge because it's beautiful. And because it's big. And so they can say, "I did it." As for me, a native New Yorker, I recently walked across the Brooklyn Bridge for the first time for the same reasons.

Stepping onto the elevated promenade that serves as the bridge's pedestrian walkway and bicycle path, I began my trek to Brooklyn. Though Frank Sinatra had sang about the bridge's [49] "lovely views from Heaven," my first view, consequently, [50] was far from heavenly.

46. **F.** NO CHANGE
G. around that time, the
H. soon thereafter, the
J. the

47. **A.** NO CHANGE
B. both of American industry, and
C. of: American industry,
D. of American industry,

48. Which of the following sentences, if added here, would provide the most logical transition from the preceding sentence to the rest of the paragraph?

F. Most tourists who cross the mile-long suspension bridge, however, don't know all that.
G. Some tourists don't even know that Manhattan and Brooklyn are separate boroughs.
H. Unlike the tourists, I know a lot about the history of cities on the eastern seaboard.
J. Many tourists come to New York to see Ellis Island and the Statue of Liberty.

49. **A.** NO CHANGE
B. has sang about the bridge's
C. had sung about the bridges
D. sang about the bridge's

50. **F.** NO CHANGE
G. view, furthermore,
H. view, otherwise,
J. view

Tourists, joggers, cyclists: each were jostling on the
51

promenade, an elevated walkway overlooking the bridge's
52

six-lane highway. Looking past the crowds and out toward
53

the East River through the bridge's steel cables made you
54

dizzy.

I began to enjoy the views, for example, as I walked
55

under the Gothic archway of the bridge's first tower and inched my way to the bridge's midpoint. Beyond the tourists in their floppy foam Statue of Liberty hats stood the real statue in the harbor. Looking back toward Manhattan, I could appreciate the tininess of the island, a seventeenth-century city bearing the weight of a modern superstructure.

"Watch out!" The warning cry of a speeding cyclist brought my attention back to the promenade, where I had edged into the bicyclists' lane. [56] Though

some tourists near the bridge's second tower paused to take
57

pictures of the views, the press of the crowd reinforced my desire to keep moving.

51. A. NO CHANGE
B. was each
C. all were
D. was all

52. F. NO CHANGE
G. elevated promenade, which serves as a walkway and bicycle path, overlooking
H. promenade, which is elevated and overlooks
J. promenade overlooking

53. A. NO CHANGE
B. Looking passed
C. To look passed
D. Past

54. F. NO CHANGE
G. make you
H. make one
J. made me

55. A. NO CHANGE
B. in other words,
C. otherwise,
D. however,

56. If the writer were to delete the preceding two sentences, the paragraph would primarily lose:
F. a reference to an incident that momentarily interrupts the narrator's enjoyment of the view.
G. a description of an event that illustrates the narrator's dissatisfaction with the view of Manhattan.
H. a contrast between the calm of the promenade's pedestrian walkway and the crowded conditions of the bicyclists' lane.
J. an explanation of how the press of the crowd inadvertently forced the narrator into the bicyclists' lane.

57. A. NO CHANGE
B. some—tourists near the bridge's second tower,
C. some, tourists near the bridge's second tower
D. some tourists, near the bridge's second tower

[1] Finally, approaching Brooklyn, the (58)

cities low quiet architecture came into focus. (59)

[2] But I had already crossed it once. [3] Now, at dusk, the lights on the bridge's cables snapped on. [4] Turning around, I could see the illuminated bustle of Manhattan. [5] Hesitating, I contemplated a return crossing. [6] The bridge was beautiful and definitely an icon. [7] I was taking the subway home. [60]

58. F. NO CHANGE
G. Finally, as I approached
H. Finally, to approach
J. Approaching

59. A. NO CHANGE
B. city's low, quiet,
C. city's low, quiet
D. cities low, quiet

60. For the sake of the logic and coherence of this paragraph, Sentence 2 should be placed:
F. where it is now.
G. after Sentence 3.
H. after Sentence 4.
J. after Sentence 6.

PASSAGE V

Researching "Frozen Smoke"

[1]

Nicknamed "frozen smoke" because their semitransparent (61) when formed into bricks—silica aerogel is the lightest solid (62) material known. Approximately 99 percent air by volume, considering (63) silica aerogel has a density only three times that of air. The dry, spongelike substance is created by scientists who apply heat and pressure to silica gel until all the liquid has been removed. Only a solid, 3-D framework of dried-out gel, consisting mostly of empty space that will be filled with air, remains.

61. A. NO CHANGE
B. its semitransparency
C. it's semitransparent
D. its semitransparent

62. F. NO CHANGE
G. bricks;
H. bricks,
J. bricks

63. A. NO CHANGE
B. given this characteristic
C. and
D. DELETE the underlined portion.

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[2]

The structure of silica aerogel—air trapped in a highly porous web of dried gel—makes it an ideal insulator and soundproofing material. It's thirty-seven times more effective as an insulator than the widely used insulating material called fiberglass. Researchers claim that a one-inch-thick window of silica aerogel has the insulating properties of a ten-inch-thick system of glass windows. [A] The use of silica aerogel to insulate buildings would discharge huge energy savings through reduced heating and cooling costs.

[3]

So far, silica aerogel has rarely been used in building construction or other industries isolating small applications, such as to insulate skylights. Large-scale use has been limited by the high cost of processing *tetraethyl orthosilicate*, the type of silica most commonly used to create aerogel.

For years, though Dr. Halimaton Hamdan of Malaysia, has been researching a way to lower aerogel manufacturing costs. [B]

64. F. NO CHANGE
G. also for use as a
H. additionally a
J. and for

65. A. NO CHANGE
B. relinquish
C. yield
D. emit

66. F. NO CHANGE
G. the exception to which is a use in
H. exempting
J. except in

67. Given that all the choices are accurate, which one provides information that is most relevant at this point in the essay?
A. NO CHANGE
B. though aerogels made out of aluminum oxide are being considered by NASA for use in capturing dust in space.
C. which creates an aerogel that isn't as resistant to compression as aerogel created from vanadium oxide.
D. which creates an aerogel that has a blue cast.

68. F. NO CHANGE
G. though, Dr. Halimaton Hamdan of Malaysia
H. though, Dr. Halimaton Hamdan, of Malaysia
J. though Dr. Halimaton Hamdan, of Malaysia,

[4]

Hamdan's findings that discarded rice husks (69) offer a nearly limitless supply of silica. [C] Rice husks, which are 20 percent silica, by weight (70) are readily available from Malaysian farmers, who (71) must find a way to dispose of great quantities of the husks after harvest. Although (72) the husks are cheap to obtain, Hamdan claims that using them as raw material could reduce silica aerogel production costs by 80 percent. [D] Hamdan hopes her process, when perfected, (73) will make silica aerogel affordable to a variety of industries for the first time, with energy-saving benefits to follow.

69. **A.** NO CHANGE
B. Hamdan has found that discarded rice husks
C. Hamdan, having found that discarded rice husks
D. Discarded rice husks are Hamdan's findings that

70. **F.** NO CHANGE
G. silica, by weight,
H. silica by weight,
J. silica by weight

71. **A.** NO CHANGE
B. which
C. whom
D. that

72. **F.** NO CHANGE
G. Since
H. Until
J. Unless

73. The writer is considering revising the underlined portion to the following:

process

If the writer were to make this revision, the sentence would primarily lose:

A. a tone of admiration for Hamdan and her focus on a new method for making silica aerogel.
B. a hint regarding the types of experimental trials Hamdan has designed to test her silica aerogel.
C. the suggestion that Hamdan's method for making silica aerogel is still being fine-tuned.
D. nothing at all, because the underlined portion as written creates a redundancy.

Questions 74 and 75 ask about the preceding passage as a whole.

74. The writer is considering adding the following sentence to the essay:

> The only by-products of processing rice husks to make aerogel are alcohol and water, so Hamdan's method also offers a pollution-free means of disposing of the husks.

If the writer were to add this sentence, it would most logically be placed at Point:

F. A in Paragraph 2.
G. B in Paragraph 3.
H. C in Paragraph 4.
J. D in Paragraph 4.

75. Suppose the writer's primary purpose had been to explain the ways in which silica aerogel is used by industries as an alternative to fiberglass. Would this essay accomplish that purpose?

A. Yes, because it indicates that due to a decrease in the cost of creating silica aerogel, this material's use in several industries has expanded.
B. Yes, because it suggests that several manufacturers hope to create an affordable silica aerogel that will eventually replace fiberglass.
C. No, because it instead has the broader purpose of explaining what silica aerogel is and how this material might be used and made more cheaply.
D. No, because it instead focuses on describing the many areas of research of Dr. Halimaton Hamdan of Malaysia.

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.

DO YOUR FIGURING HERE.

1. Bella sells real estate. She is paid 3% of the sale price of every house she sells. What is Bella paid for selling a house at the sale price of $250,000 ?

   A. $ 300
   B. $ 2,500
   C. $ 3,000
   D. $ 7,500
   E. $75,000

2. For what value(s) of x is $(x + 3)(x - 4) = 0$ true?

   F. −3 and 4
   G. −3 only
   H. 3 and −4
   J. 3 only
   K. 4 only

3. Which of the following inequalities orders the numbers 0.1, 0.04, and $\frac{1}{6}$ from least to greatest?

   A. $0.1 < 0.04 < \frac{1}{6}$

   B. $0.04 < 0.1 < \frac{1}{6}$

   C. $0.04 < \frac{1}{6} < 0.1$

   D. $\frac{1}{6} < 0.04 < 0.1$

   E. $\frac{1}{6} < 0.1 < 0.04$

4. Given that $2x + 1 = 5$, what is the value of $(x + 3)^3$?

   F. 15
   G. 18
   H. 125
   J. 216
   K. 729

5. What vector is the result of adding the vectors $\langle 1,-2\rangle$, $\langle 2,3\rangle$, and $\langle -4,2\rangle$?

DO YOUR FIGURING HERE.

A. $\langle -8,-12\rangle$
B. $\langle -1, \ 3\rangle$
C. $\langle \ 3, -3\rangle$
D. $\langle \ 7, -1\rangle$
E. $\langle \ 7, \ 7\rangle$

6. What value of x makes $\frac{2}{3}x + 5 = 11$ true?

F. 4
G. $5\frac{1}{3}$
H. 9
J. $10\frac{2}{3}$
K. 24

7. In Summit City, the daily low temperatures, in degrees Fahrenheit (°F), during the first week in December were −7, −11, 15, 23, 45, 23, and 2. To the nearest 1°F, what was the mean daily low temperature for that week?

A. 11°F
B. 13°F
C. 15°F
D. 18°F
E. 23°F

8. Assume that a, b, and c are real numbers. If $a > b$, and $(a + c) > (b + c)$, then what is true of c ?

F. c must have the same sign as a.
G. c must have the same sign as b.
H. c must be negative.
J. c must be positive.
K. c can be any real number.

9. What is the slope of the line given by the equation $2x + 7y = -12$?

A. −2
B. $-\frac{7}{2}$
C. $-\frac{2}{7}$
D. 2
E. 7

10. One leg of a right triangle is 4 meters long and the other leg is 8 meters long. The hypotenuse of the triangle is how many meters long?

F. 12
G. 16
H. 40
J. $\sqrt{24}$
K. $\sqrt{80}$

11. Students studying motion observed a cart rolling at a constant rate along a straight line. The table below gives the distance, d feet, the cart was from a reference point at 1-second intervals from $t = 0$ seconds to $t = 5$ seconds.

t	0	1	2	3	4	5
d	10	18	26	34	42	50

Which of the following equations represents this relationship between d and t ?

A. $d = t + 10$
B. $d = 8t + 2$
C. $d = 8t + 10$
D. $d = 10t + 8$
E. $d = 28t$

12. The ratio of 30 to 24 is the same as the ratio of 40 to what number?

F. 14
G. 32
H. 34
J. 46
K. 50

13. A box contains 3 red, 2 white, and 5 blue beads, each of which is a solid color. Miguel will randomly remove 1 bead from the box, record the color of the bead, and return the bead to the box. Miguel will complete this process 50 times. How many times should Miguel expect to record a bead color that is NOT white?

A. 10
B. 15
C. 25
D. 40
E. 50

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DO YOUR FIGURING HERE.

14. Whenever $3(a + 6b) - c = 0$, which of the following expressions is equal to a ?

F. $\frac{c}{3} - 6b$

G. $\frac{c}{3} - 2b$

H. $2b - \frac{c}{3}$

J. $c - 6b$

K. $3c - 6b$

15. Given that $\sqrt{2x} - 9 = 1$, $x = ?$

A. −32
B. 20
C. 25
D. 32
E. 50

16. A high school ice hockey conference that consists of 10 teams requires that every conference team must play each of the other conference teams at least once in a season. For n teams in the conference, the number of conference games played in a season must then be at least $\frac{n^2 - n}{2}$. What is the minimum number of conference games that must be played in a season for this conference?

F. 15
G. 40
H. 45
J. 50
K. 95

17. For an angle with measure α in a right triangle, $\sin \alpha = \frac{112}{113}$ and $\tan \alpha = \frac{112}{15}$. What is the value of $\cos \alpha$?

A. $\frac{15}{113}$

B. $\frac{15}{112}$

C. $\frac{15}{\sqrt{25{,}313}}$

D. $\frac{15}{\sqrt{12{,}319}}$

E. $\frac{113}{15}$

DO YOUR FIGURING HERE.

18. In isosceles triangle $\triangle ABC$, $\overline{AB}$ is congruent to $\overline{BC}$ and the measure of the vertex angle, $\angle B$, is 75°. What is the measure of $\angle A$?

F. 7.5°
G. 15°
H. 52.5°
J. 75°
K. 105°

19. *Cowling's rule* is a method of calculating a medication dosage for a child by using the child's age and the adult dosage. The rule uses the formula $d = a\left(\frac{t+1}{24}\right)$, where d is the child's dosage in milligrams, a is the adult dosage in milligrams, and t is the child's age in years. Dato is taking a 150-milligram dosage of medication that has an adult dosage of 300 milligrams. According to this rule, which of the following values is closest to Dato's age in years?

A. 9
B. 11
C. 12
D. 13
E. 19

20. Each side of a square is 3 cm long. One vertex of the square is at (4,2) on a square coordinate grid marked in centimeter units. Which of the following points on the grid could be another vertex of the square?

F. (7, 2)
G. (5, 2)
H. (2, 3)
J. (1,−3)
K. (−3, 2)

21. The Ferris wheel at a state fair has a radius of 60 feet, rotates at a constant speed, and completes 1 rotation in 4 minutes. How many degrees does the Ferris wheel rotate in 30 seconds?

A. 20°
B. 24°
C. 30°
D. 45°
E. 48°

DO YOUR FIGURING HERE.

22. At Gussie's Pizzeria, Odetta spends \$8.75 (before tax) on the purchase of 2 appetizers and 3 slices of pizza. The price of each slice of pizza is p dollars. The price of each appetizer is twice the price of a slice of pizza. Which of the following systems of equations, when solved, gives the price, a dollars, of an appetizer and the price, p dollars, of a slice of pizza at Gussie's?

F. $\begin{cases} 2a + 3p = 8.75 \\ a = 2p \end{cases}$

G. $\begin{cases} 2a + p = 8.75 \\ 3a = 2p \end{cases}$

H. $\begin{cases} 2p + a = 8.75 \\ 3p = 2a \end{cases}$

J. $\begin{cases} 3a + 2p = 8.75 \\ p = 2a \end{cases}$

K. $\begin{cases} 3p + a = 8.75 \\ a = 2p \end{cases}$

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23. The perimeter of a parallelogram is 76 inches, and the length of 1 side is 10 inches. If it can be determined, what are the lengths, in inches, of the other 3 sides?

A. 10, 10, 46
B. 10, 23, 23
C. 10, 28, 28
D. 10, 33, 33
E. Cannot be determined from the given information

24. John told Raquel that if he spent up to \$30 from his savings account, his savings account would have at least $\frac{3}{4}$ as much in it as it has now. From John's statement, Raquel can deduce that the *least* amount of money that John could have in his savings account now is:

F. \$ 30
G. \$ 40
H. \$ 90
J. \$100
K. \$120

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DO YOUR FIGURING HERE.

Use the following information to answer questions 25–27.

At East High School, the 20 cast members of the spring musical sold 2 types of tickets—student and adult—for the Friday night and Saturday night performances. The price of each student ticket was $2 and the price of each adult ticket was $3. The table below gives the number of tickets sold, by type and by night.

Ticket Sales per Performance		
Ticket type	Night of performance	
	Friday	Saturday
Student	122	100
Adult	90	110

The stem-and-leaf plot below shows the number of tickets, regardless of type, sold by each of the 20 cast members.

Stem	Leaf
0	8 9
1	0 4 4 4 4 4 5 9
2	1 2 3 4 8 9
3	3 5 8 8

Key: 1 | 4 = 14 tickets

The auditorium where the spring musical will be performed has 10 seats in the 1st (front) row. Each row behind the 1st row has 4 more seats than does the row in front of it.

25. Suppose 1 cast member will be picked at random from the 20 cast members who sold tickets to receive a prize. What is the probability of picking a cast member who sold more than 30 tickets?

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

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

C. $\frac{2}{19}$

D. $\frac{2}{17}$

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

DO YOUR FIGURING HERE.

26. For which night was the total amount collected for the tickets greater, and by how many dollars was it greater?

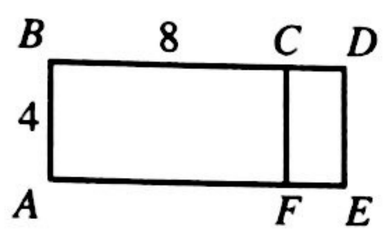
F. Friday by $5
G. Friday by $16
H. Friday by $26
J. Saturday by $16
K. Saturday by $26

27. How many seats are in the 8th row of the auditorium?

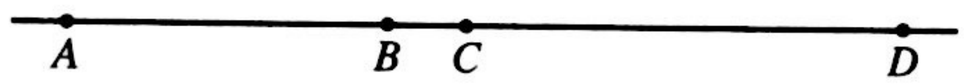
A. 38
B. 42
C. 46
D. 66
E. 74

28. In rectangle $ABDE$ shown below, C lies on $\overline{BD}$ and F lies on $\overline{AE}$ such that rectangles $ABCF$ and $CDEF$ are similar ($ABCF \sim CDEF$), the length of $\overline{AB}$ is 4 cm, and the length of $\overline{BC}$ is 8 cm. What is the area, in square centimeters, of $ABDE$?

F. 32
G. 38
H. 40
J. 42
K. 48



29. Points A, B, C, and D lie on the real number line as shown below. The coordinate of B is 0, $\overline{AC}$ is 15 units long, $\overline{BD}$ is 20 units long, and $\overline{AD}$ is 32 units long. What is the coordinate of C ?



A. 3
B. 5
C. 10
D. 12
E. 15

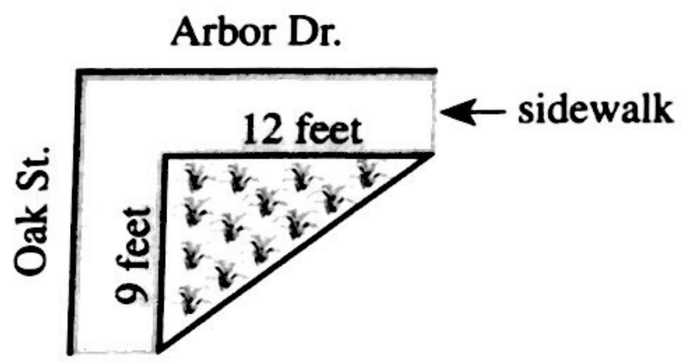
30. In a certain country, last year's population was estimated to be 3.6×10^6 people, and last year's public debt was estimated to be 1.8×10^9 dollars. Based on these estimates, what was last year's public debt per person in this country?

F. $ 0.05
G. $ 0.20
H. $ 500.00
J. $2,000.00
K. $5,000.00

DO YOUR FIGURING HERE.

Use the following information to answer questions 31–34.

A landscaper will install a triangular garden near the intersection of 2 streets. In the plan of the garden shown below, the angle nearest the intersection is a right angle. The landscaper has purchased the following materials for the garden: 1 bag of fertilizer at a price of $15.50, 50 plants at a price of $0.70 each, and 3 bags of mulch at a price of $4.00 each. An 8% sales tax was added to the total price of these materials. The landscaper will also install a water sprinkler that will be located an equal distance from the 3 vertices of the garden.



31. The landscaper calculated the area of the garden before purchasing the fertilizer, plants, and mulch. What is the area, in square feet, of the garden?

A. 21
B. 42
C. 54
D. 81
E. 108

32. What was the total cost, including sales tax, of the fertilizer, plants, and mulch that the landscaper purchased?

F. $62.50
G. $67.50
H. $70.50
J. $73.20
K. $81.20

33. The plan of the garden will be aligned in the standard (x,y) coordinate plane so that the right angle is at (0,0) and the other 2 vertices are at (12,0) and (0,–9). What coordinates give the location of the water sprinkler?

A. $\left(3,-2\frac{1}{4}\right)$

B. $\left(3,-4\frac{1}{2}\right)$

C. (4,–3)

D. $\left(6,-2\frac{1}{4}\right)$

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E. $\left(6,-4\frac{1}{2}\right)$

DO YOUR FIGURING HERE.

34. The landscaper has decided to enclose the garden by installing a decorative fence of uniform height along the garden's perimeter. What is the minimum length, in feet, of fencing required to enclose the garden?

F. 15
G. 21
H. 30
J. 33
K. 36

35. Shown below are right triangles $\triangle ACD$ and $\triangle ABE$ with lengths given in inches. What is the length, in inches, of $\overline{AB}$?

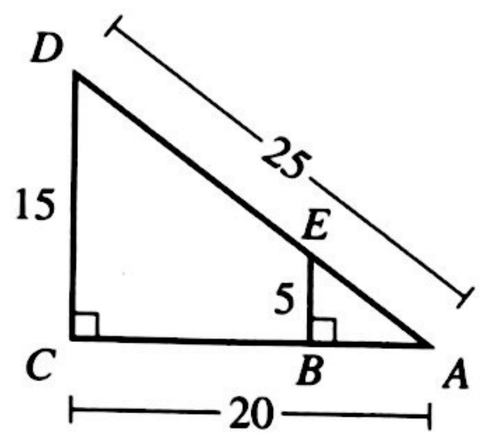
A. $5\frac{3}{5}$

B. $5\frac{3}{4}$

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

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

E. $8\frac{1}{3}$



36. The circumference of a circle is 50 cm. What is the length, in centimeters, of the diameter of the circle?

F. $\frac{25}{\pi}$

G. $\frac{50}{\pi}$

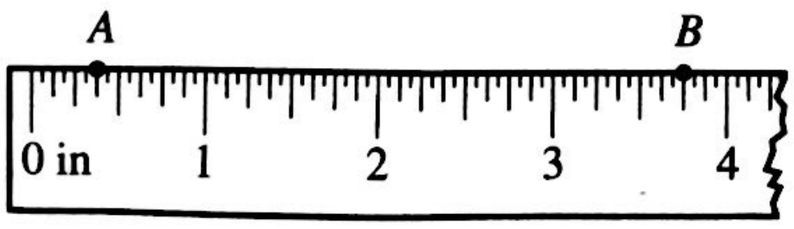
H. 50

J. 25π

K. 50π

37. Which of the following values is closest to the distance, in inches, between point A and point B on the ruler shown below?

(Note: The ruler shown is NOT actual size.)



A. $2\frac{1}{8}$

B. $3\frac{3}{16}$

C. $3\frac{3}{8}$

D. $3\frac{9}{16}$

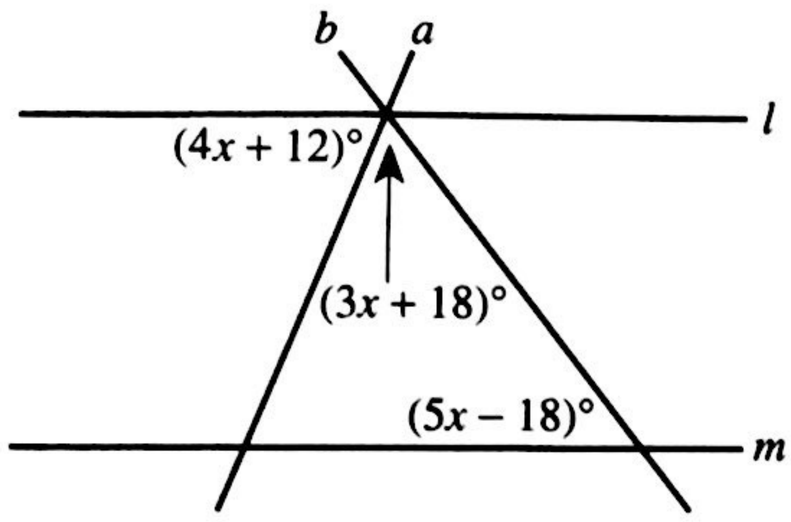
E. $3\frac{3}{4}$

DO YOUR FIGURING HERE.

38. If $r + 5 = m$ and $r + 6 = n$, what is the value of $n - m$?

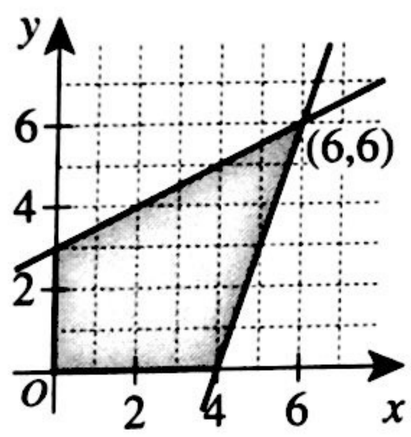
F. $2r + 1$
G. $2r + 11$
H. -1
J. 1
K. 11

39. In the figure below, lines l and m are parallel. Lines a and b intersect l at the same point. What is the value of x ?



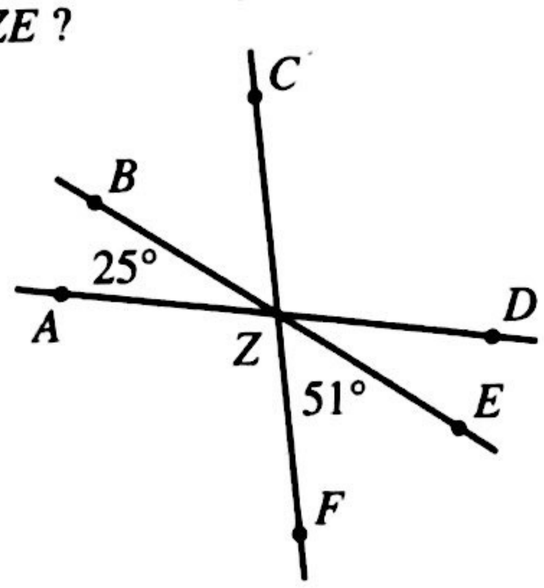
A. 6
B. 11
C. 14
D. 18
E. 30

40. The line $y = \frac{1}{2}x + 3$ and the line $y = 3x - 12$ intersect at (6,6), as shown in the standard (x,y) coordinate plane below. The shaded region is bounded by these 2 lines, the x-axis, and the y-axis. What is the area of the shaded region, in square coordinate units?



F. 18
G. 21
H. 24
J. 27
K. 42

41. In the figure below, $\overline{AD}$, $\overline{BE}$, and $\overline{CF}$ all intersect at point Z. The measures of 2 angles are given. What is the measure of $\angle CZE$?



A. 76°
B. 102°
C. 104°
D. 119°
E. 129°

DO YOUR FIGURING HERE.

42. Emma and Kristin each ran 10 laps (4,000 meters) around a 400-meter track without stopping. Emma ran at a constant speed of 250 meters per minute. Kristin ran at a constant speed of 200 meters per minute. Both Emma and Kristin began running at the same instant. How many laps did Kristin have left to run when Emma had completed her run?

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

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

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

J. 2

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

43. Three linear equations are given below.

$$y = x$$
$$y = x + 1$$
$$y = -x + 1$$

In terms of being parallel, being perpendicular, or intersecting, how are the graphs of these equations related in the standard (x,y) coordinate plane?

A. All 3 lines are parallel.
B. All 3 lines are perpendicular.
C. All 3 lines meet in a common point.
D. Exactly 2 of the lines are parallel.
E. None of the lines are parallel or perpendicular.

44. For what value of a would the following system of equations have an infinite number of solutions?

$$x - 2y = 8$$
$$3x - 6y = 4a$$

F. 2
G. 6
H. 8
J. 24
K. 32

45. Given that $x = 2$ when $y = 12$ for the proportion $\frac{x}{6} = \frac{k}{y}$, what is x when $y = 8$?

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

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

C. 3

D. 4

E. 12

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DO YOUR FIGURING HERE.

46. Two events are *independent* if the outcome of one event does not affect the outcome of the other event. One of the following statements does NOT describe independent events. Which one?

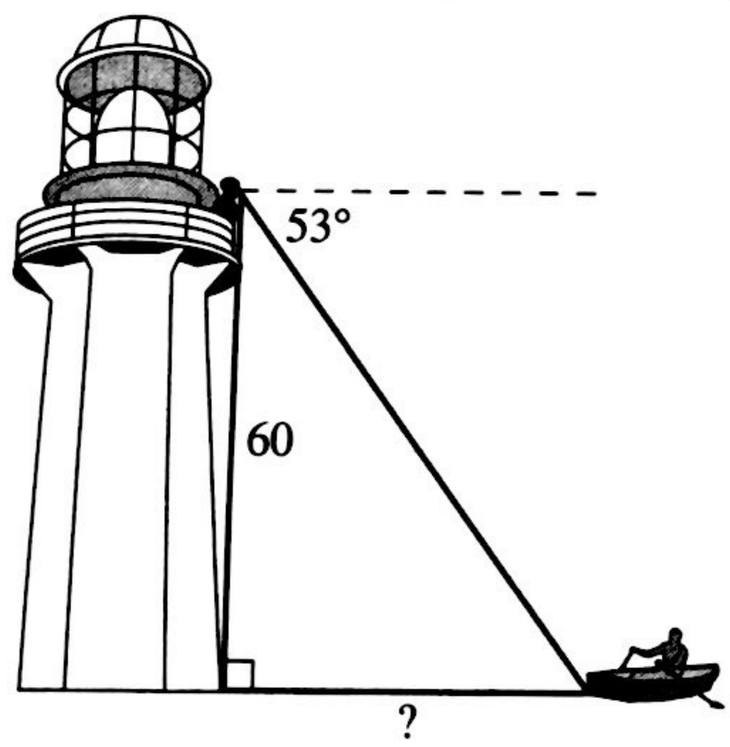
F. A coin lands heads up, then a single 6-sided die lands with a 3 faceup.
G. A king is drawn from a deck of cards, then a coin lands heads up.
H. A 4 is drawn from a deck of cards, then after replacing the card, a 4 is drawn.
J. A single 6-sided die lands with a 2 faceup, then after being rolled a second time, the die lands with a 1 faceup.
K. A 7 is drawn from a deck of cards, then without replacing the card, a 2 is drawn.

47. Which of the following binomials is a factor of $3x^2 + 11x - 4$?

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

48. The figure below shows a lighthouse keeper looking down at a rowboat on the sea through a navigational instrument. The instrument is 60 feet above sea level and indicates an angle of depression of 53° to the rowboat. Which of the following is closest to the horizontal distance, in feet, between the navigational instrument and the rowboat?

(Note: $\sin 53° \approx 0.80$, $\cos 53° \approx 0.60$, $\tan 53° \approx 1.33$)



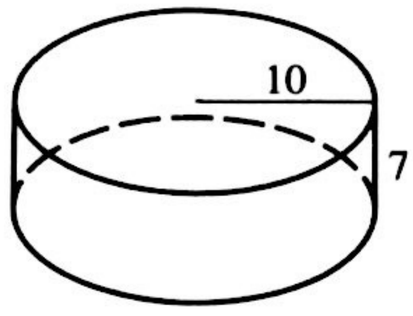
F. 36
G. 45
H. 48
J. 53
K. 80

49. Each of 20 students in a class took a test and received a whole number score. The median of the scores was 87. None of the students received a score of 87, and 30% of the students received scores of 90 or above. How many students received scores of 88 or 89 ?

A. 3
B. 4
C. 5
D. 6
E. 10

DO YOUR FIGURING HERE.

50. The radius and height of the right circular cylinder shown below are given in centimeters. Which of the following is closest to the volume, in cubic centimeters, of the cylinder?



F. 220
G. 310
H. 700
J. 1,540
K. 2,200

51. What value of x satisfies the equation below?

$$\log_{16} x = -\frac{3}{4}$$

A. -12

B. -8

C. $\frac{1}{12}$

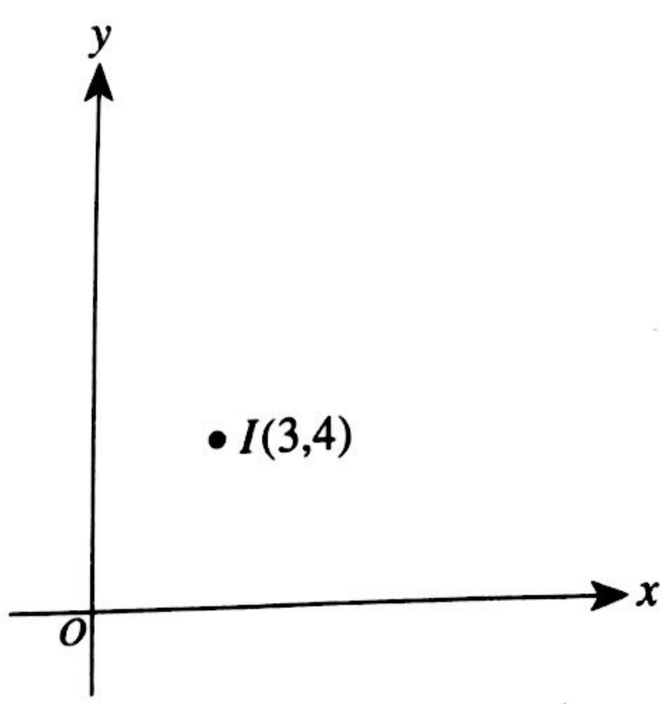
D. $\frac{1}{8}$

E. 8

52. Let x be a negative odd integer. The expression xy^3 is a positive even integer whenever y is any member of which of the following sets?

F. All integers
G. Positive odd integers
H. Positive even integers
J. Negative odd integers
K. Negative even integers

53. Point $I(3,4)$ is shown in the standard (x,y) coordinate plane below. Point I is reflected across the line $x = 7$ and, after the reflection, is labeled J. What are the coordinates of J?



A. (−1, 4)
B. (3, 1)
C. (3,10)
D. (10, 4)
E. (11, 4)

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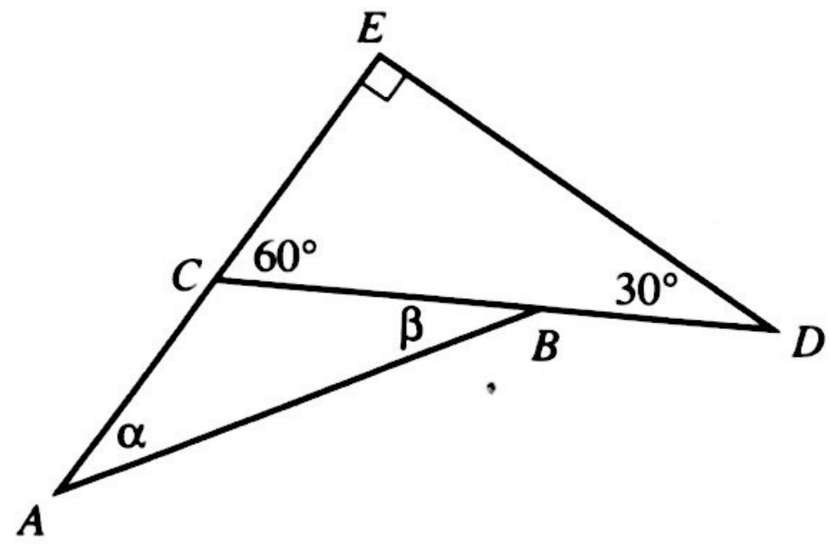
DO YOUR FIGURING HERE.

54. The angle measures of $\triangle CDE$ are shown below. Point B of $\triangle ABC$ lies on $\overline{CD}$, and point C lies on $\overline{AE}$. What is the value of $\cos(\alpha + \beta)$?

(Note: $\cos 30° = \frac{\sqrt{3}}{2}$)



F. 0

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

H. $\frac{\sqrt{2}}{2}$

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

K. 1

55. The *determinant* of any 2×2 matrix $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ is $ad - bc$. The determinant of $\begin{bmatrix} (x+3) & 7 \\ 2 & (x-2) \end{bmatrix}$ is equal to 0. What are all possible values of x ?

A. -5 and 4
B. -4 and 5
C. -3 and 2
D. -1 and 9
E. $-\sqrt{20}$ and $\sqrt{20}$

56. Which of the following inequalities is equivalent to $(|x| + 1)^2 \leq 4$?

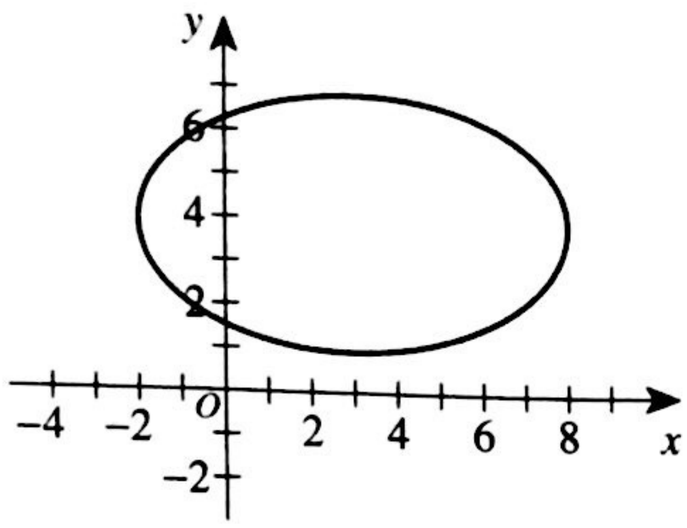
F. $-3 \leq x \leq 1$
G. $-3 \leq x \leq 3$
H. $-2 \leq x \leq 2$
J. $-\sqrt{3} \leq x \leq \sqrt{3}$
K. $-1 \leq x \leq 1$

57. Given that $2 \sin a = 2$ and $2 \cos\left(\frac{\pi}{2} - b\right) = 2$, which of the following could be a value, in radians, of $a + b$?

A. 0
B. $\frac{\pi}{2}$
C. 2
D. π
E. 2π

DO YOUR FIGURING HERE.

58. One of the following equations determines the graph in the standard (x,y) coordinate plane below. Which one?



F. $\frac{(x-3)^2}{25} + \frac{(y-4)^2}{9} = 1$

G. $\frac{(x-3)^2}{25} + \frac{(y+4)^2}{9} = 1$

H. $\frac{(x-3)^2}{9} + \frac{(y-4)^2}{25} = 1$

J. $\frac{(x+3)^2}{25} + \frac{(y+4)^2}{9} = 1$

K. $\frac{(x+3)^2}{9} + \frac{(y+4)^2}{25} = 1$

59. Cubes each having a side length of 0.5 cm are put together to form a rectangular solid with 8 layers. Each layer has 6 cubes. What is the volume, in cubic centimeters, of the rectangular solid?

A. 6
B. 12
C. 14
D. 24
E. 48

60. Consider the 2 functions $f(x) = 2x + 5$ and $g(x) = 3x + b$, where b is a real number. If $f(g(x)) = g(f(x))$, then $b = ?$

F. 0

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

H. 5

J. 10

K. Any real number

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 several passages in this test. Each passage is accompanied 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 novel *The Magic Keys* by Albert Murray (©2005 by Albert L. Murray).

In the passage, the term *stopgap gig* refers to a temporary position as a member of a band.

When I finally told Taft Edison about the time I had spent on the road with the band, I said, Man, it began as an incredible summer transition job that I needed because I had to get enough cash to supplement the graduate school fellowship grant I had been awarded. I said, Man, nothing like that had ever crossed my mind before. I said, Man, when I left home for college my main musical involvement beyond listening and dancing to it was humming and whistling it.

I said, Man, when Hortense Hightower told me what she told me about suggesting me as a stopgap replacement when the Bossman Himself called and just happened to mention in passing that Shag Phillips had given notice, I couldn't believe it. But she said, Don't worry about it because he doesn't go around looking for superstars. He makes his own. Not because it's a game or some kind of challenge to prove anything about his ingenuity as some kind of mentor either. She said, He hires his musicians because he has decided that he wants to find out what he can do with something he's heard them playing. And that is when she also said, Believe me when I tell you that the very fact that he remembered you as soon as I mentioned you is what counts, because that means that you did something that caught his ear—not necessarily something musically technical either, something that goes with something he's got filed away in that steel-trap mind of his. You've heard about those big-time college profs talking about those linguistic experts that can listen to half a sentence and tell you where you come from? Well, that's him when it comes to music.

I don't remember ever really touching, let alone trying to fool around with, the bass fiddle before Hortense Hightower gave me one in the spring of my junior year.

I had never thought of Taft Edison as having ever had any serious personal professional interest in dance bands. As far as I knew, none of the music school courses had anything whatsoever to do with becoming bandleaders and arrangers/composers like the Bossman Himself.

My impression of Taft Edison from the very outset was that his ambition was to create compositions based on down-home sacred and secular music, including workaday chants and hollers, that would be performed in concert halls by concert hall–type instrumental and vocal groups and philharmonic orchestras. Because when I arrived on the campus as a freshman, he was a junior who impressed me more than anybody else in the School of Music because he was the student who conducted the school's widely popular college marching band.

But although there were also two student-led dance bands on the campus at that time, I can't remember having ever seen him playing with either of them. Not that I ever got the impression that he disliked or had no interest in that kind of music, or that his attitude was one of condescension, as was the case of many conservatory-oriented students at the time. Not at all. Because when you saw him at socials and at benefit dances, he was always up-to-date on all the latest steps. And also when he stopped by the Mainstem Lounge, where you used to listen to the late-night radio broadcasts from such then famous nightspots as the Savoy Ballroom and the Cotton Club in Harlem and the Grand Terrace on the South Side of Chicago in those days, he could identify as many bands and sidemen as instantaneously as any of the dance band musicians, record collectors, and patent-leather avenue sharpies as happened to be there at the time.

So when I told him about my stopgap gig with the band, I didn't know what his response would be, but I did so because I had decided that I had better mention it myself rather than running the risk of having him find out about it just incidentally somehow and wonder why I hadn't mentioned it on my own and why I hadn't yet said anything at all about ever having played any musical instrument.

But as I should have remembered from his completely unsurprised and ever so casual response when I introduced myself to him on Fifth Avenue that day, he didn't register any surprise at all. Anyway, all he said was that he hadn't heard the band during the period between Shag Phillips and Scratchy McFatrick.

85 But, he said, I do remember hearing something about some college boy filling in for a while. So that was you! I myself would have had a hard time turning down the chance to hit the trail with that fabulous crew for a while. Man, I can just imagine it. Man, when I
90 woke up every morning and realized why I was wherever I was I would have had to pinch myself.

1. Regarding the musical education of the narrator after high school, the passage:
   A. states that he was a conservatory student focusing on music composition.
   B. states that he never took music lessons, although most of his friends did.
   C. does not specify what he studied in college but indicates his personal interest in music.
   D. does not specify what he studied in college but makes clear that he planned to study music one day.

2. The fifth and sixth paragraphs (lines 42–70) primarily serve to:
   F. reveal the narrator's impressions of Taft Edison's varied musical interests.
   G. describe Taft Edison's repeated efforts to impress the narrator with his musical knowledge.
   H. identify several venues the narrator and Taft Edison visited together as students.
   J. provide evidence for the popularity of the narrator's dance band.

3. According to the passage, how does the narrator feel about telling Taft Edison about the stopgap gig?
   A. Eager; he remembers that Edison admires the Bossman.
   B. Uncertain; he's unsure how Edison will respond but decides to tell Edison before he finds out some other way.
   C. Hesitant; he's uncertain whether Edison still cares about the Bossman's band.
   D. Anxious; he wants to tell Edison but is worried that Edison won't be able to keep the news to himself.

4. The passage indicates that when joining the Bossman's band, the narrator was replacing:
   F. Taft Edison.
   G. Hortense Hightower.
   H. Shag Phillips.
   J. Scratchy McFatrick.

5. According to the passage, the narrator's first memory of playing the bass fiddle was when:
   A. Taft Edison introduced the narrator to down-home sacred and secular music.
   B. the narrator, impressed by the marching band director, decided to pick one up.
   C. the Bossman invited the narrator to join his band as a stopgap replacement.
   D. Hortense Hightower gave the narrator a bass during his junior year of college.

6. The narrator most strongly implies that he was initially impressed by Taft Edison as a result of:
   F. what he had heard about Taft Edison from Hortense Hightower.
   G. the narrator's knowledge of what the music school courses cover.
   H. seeing Taft Edison conduct the school's marching band.
   J. listening to Taft Edison talk about music at the Mainstem Lounge.

7. The narrator suggests that Taft Edison differed from many other conservatory-oriented students in that he:
   A. played primarily with philharmonic orchestras.
   B. was more ambitious about his studies.
   C. couldn't play more than one instrument.
   D. wasn't condescending toward dance band music.

8. The narrator states that when he told Taft Edison about playing with the Bossman's band, Edison:
   F. offered a casual response.
   G. seemed angry and jealous.
   H. appeared uncomfortable.
   J. changed the topic of discussion.

9. In the context of the passage, lines 82–84 most strongly suggest that Taft Edison hadn't heard:
   A. the Bossman's band while the narrator was playing with it.
   B. Shag Phillips and Scratchy McFatrick when they played with the Bossman.
   C. the Bossman's band prior to the narrator joining the band.
   D. dance music he liked until he heard the Bossman's band.

10. The last sentence (lines 89–91) can best be described as referring to:
   F. an opportune job opening that one of the passage's characters is forced to turn down.
   G. a hypothetical opportunity that one of the passage's characters savors.
   H. a turning point in the career of one of the passage's characters.
   J. a high-profile performance at which one of the passage's characters regrets failing.

Passage II

SOCIAL SCIENCE: This passage is adapted from the article "Mutant Maps" by Peter Weiss (©2006 by Science Service).

The numerals 1623 stared out from the title page of a rare Shakespeare book. Printed in a quaint typeface, those digits left no mystery about the publication date of that prized volume.

"People want to know when ideas were developed. In the history of society in general, dates are important," says S. Blair Hedges of Pennsylvania State University.

An unexpected inspiration from genetics recently led Hedges—a biologist with a penchant for old books and maps—to develop a new way to sleuth missing dates for printed works.

His work indicates that the print quality declines with the steady aging of the blocks and plates used in the printing process, not with how often they are used, as most specialists had suspected. As biologists calculate species ages from the accumulation of genetic mutations, or molecular clocks, Hedges employs a "print clock."

There were more than 3 million books printed on hand-operated presses using woodblocks and copperplates from the 1400s to the mid-1800s, and many of those books weren't dated, Hedges notes.

About a year and a half ago, Hedges was examining copies of a 16th-century book of Caribbean-island maps printed from woodblocks. Printers from this era would often use the same woodblock or plate in each subsequent edition of a book.

This book—known as *Isolario* by Benedetto Bordone—appeared in four editions: three dated 1528, 1534, and 1547, and one without a date. For 200 years, rare-book specialists have been debating when the undated edition was printed.

As Hedges looked at the various editions, patterns of defects in the maps caught his eye. He noticed gaps here and there in the lines on the maps. "In the first edition, there were very few. The later-dated editions had progressively more breaks." Hedges recalls, "I thought these line breaks are kind of like genetic mutations."

In organisms, the genetic code changes haphazardly, or mutates, at random intervals as a result of chemical reactions or other insults, and the resulting mutations in DNA accumulate over time. Biologists can calculate the average rate of mutation over millions of years of evolutionary transformation. They can then use that average to estimate when one species diverged from others.

As Hedges pored over the *Isolario*, it occurred to him that random defects in wood blocks—like genetic mutations—may also have accumulated over the years at a constant average rate. If so, then bibliographers could exploit that rate to date documents relative to those with known publication dates.

Hedges knew that line breaks in old wood-block prints resulted from cracks in the blocks' raised ridges, which produce the lines. The underlying cause—the drying of the wood—would have taken place steadily over time.

In prints made from copperplates, Hedges observed a different pattern of change. Printmakers created designs on copperplates by engraving them. Hedges noticed that the lines of prints from a specific plate are typically thinner in later editions than in earlier ones, so the overall image in later editions appears faded.

Hedges claims a steady process of corrosion as copperplates sat in storage could account for the observed decline in print quality. When the time came to reuse a plate, the printer would have had to scrub and polish its pitted surface. Because engraved grooves narrow with depth, stripping off the top layers of the plate's surface would have made such grooves narrower and, therefore, the lines of the prints thinner.

Hedges says that his tests so far support the print-clock hypothesis. He found 23 copies of *Isolario*, including all the editions, in rare-book libraries. He then counted the number of line breaks in the 112 map prints contained in each book. When he analyzed the data, he found that a steady accumulation rate of line breaks per year matched up with the publication dates of the three successive dated editions.

He next turned to the undated copy of *Isolario*. That edition had more line breaks than any of the others. Hedges calculated that it was published in February 1565, plus or minus 16 months.

Conveniently, another characteristic of the undated *Isolario* edition—a small, intricate pattern on its title page, called the printer's mark—gave Hedges an independent way to estimate that date. He took advantage of computerized-image-analysis methods that are used by medical scientists. He applied them to high-resolution digital images of printer's marks from *Isolario* and other dated books from the same Renaissance printer. His second estimate for the undated *Isolario* was April 1565, plus or minus a year.

11. It can most reasonably be inferred from the passage that to determine the print date of an undated book using Hedges's method, a researcher must analyze:
    A. at least one edition of the book that includes a printer's mark.
    B. the woodblocks or copperplates used to print the book.
    C. modern versions of the maps or graphics printed in the book.
    D. at least a few editions of the book with different known print dates.

12. Does the passage indicate how most bibliographers have reacted to the possibility that Hedges has determined the print date of an undated edition of *Isolario* ?
    F. Yes; they're intrigued by Hedges's findings and are supportive of further testing of Hedges's hypothesis.
    G. Yes; they believe Hedges has misdated the edition, although they themselves are unsure of a way to determine the date.
    H. Yes; they believe Hedges's hypothesis is more useful for dating books printed from woodblocks than dating those printed from copperplates.
    J. No; the passage doesn't provide information about most bibliographers' reaction to Hedges's findings.

13. In the passage, *Isolario* is described as a:
    A. novel that includes several maps and is set in the Caribbean islands.
    B. series of travel drawings, essays, and poems by an Italian explorer.
    C. book of maps of the Caribbean islands.
    D. rare Shakespeare book.

14. Which of the following observations triggered Hedges's hypothesis regarding how to determine the print date of the undated edition of *Isolario* ?
    F. Noticing gaps in the lines on the printed pages, especially in later-dated editions
    G. Perceiving thin, wavy lines on several of the printed pages in the earliest-dated edition
    H. Noting skipped words on the title page in the latest-dated edition
    J. Distinguishing that the later-dated editions included fewer sketches and maps than did the earliest-dated edition

15. In the context of the passage, the ninth paragraph (lines 40–47) primarily serves to:
    A. describe one of Hedges's findings.
    B. explain in detail how new species develop as a result of millions of years of evolutionary transformation.
    C. provide a brief overview of a scientific process that Hedges uses as a point of comparison.
    D. shift the focus of the passage from finding the print date for undated books to understanding genetics.

16. The passage indicates that if copperplates were reused for printing, the copperplates would've had to have been:
    F. stored in a low-humidity room.
    G. chemically treated periodically to prevent surface corrosion.
    H. cleaned and polished prior to each new print run of a book.
    J. reengraved regularly.

17. As it is used in line 89, the word *independent* most nearly means:
    A. strong willed.
    B. voluntary.
    C. moderate.
    D. separate.

18. The author of the passage identifies Hedges as a:
    F. mapmaker who has an interest in old printing presses and printer's marks.
    G. bibliographer of old books who has an interest in genetics.
    H. biologist who has an interest in old books and maps.
    J. medical student who has an interest in computerized image analysis of old books.

19. In the passage, Hedges attributes the degradation over time of woodblocks used in printing primarily to:
    A. the wood being eaten by pests such as termites.
    B. excessive sanding by printers.
    C. warping due to high humidity.
    D. the drying of the wood.

20. In the passage, the hypothesis Hedges tested through dating an undated edition of *Isolario* is called the:
    F. line-break hypothesis.
    G. print-clock hypothesis.
    H. mutation hypothesis.
    J. rate-of-change hypothesis.

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Passage III

HUMANITIES: Passage A is adapted from the essay "Walking" by Linda Hogan (©1990 by Linda Hogan). Passage B is adapted from the essay "Cold-Comfort Farming" by Arlo Crawford (©2008 by The New York Times).

Passage A by Linda Hogan

I saw it first in early summer. It was a green and sleeping bud, raising itself toward the sun. Over the summer this sunflower grew into a plant of incredible beauty, turning its face daily toward the sun in the most subtle of ways, in community with rain, mineral, mountain air, and sand.

I was an outsider. I only watched. I had a small understanding, nothing more than a shallow observation of the flower, insects, and birds. But they knew what to do, how to live. An old voice from somewhere, gene or cell, told the plant how to evade the pull of gravity and find its way upward, how to open.

There are other summons and calls. Once a century, all of a certain kind of bamboo flower on the same day. Whether they are in Malaysia or in a greenhouse in Minnesota makes no difference, nor does the age or size of the plant. They flower. Some current of an inner language passes between them. They are all, somehow, one plant, each with a share of communal knowledge.

John Hay, in *The Immortal Wilderness*, has written: "There are occasions when you can hear the mysterious language of the Earth, in water, or coming through the trees, emanating from the mosses, seeping through the undercurrents of the soil, but you have to be willing to wait and receive."

Sometimes I hear it talking. Once, in the redwood forest, I heard a beat, something like a drum or heart coming from the ground and trees and wind. That underground current stirred a kind of knowing inside me, a kinship and longing, a dream barely remembered that disappeared back to the body.

Tonight I walk. I am watching the sky. I think of the people who came before me and how they knew the placement of stars in the sky, watched the moving sun long and hard enough to witness how a certain angle of light touched a stone only once a year.

It's winter and there is smoke from the fires. The square, lighted windows of houses are fogging over. It is a world of elemental attention, of all things working together, listening to what speaks in the blood.

Passage B by Arlo Crawford

My parents are organic farmers, but springtime makes my mother sad and anxious. In the winter, the duties are reasonable: the barn cats need food, and the eggs have to be collected. But the first sprouts are needy and will only increase their demands as the season wears on. Farming asks everything of you eventually.

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Several years ago when I was living in New York after college, I would sometimes walk through the greenmarket in Union Square. The farmers there seemed sort of desperate; vegetables are never perfect and their customers were accustomed to being picky.

Then, after three years in the same job, I watched my boss drive his business into the ground. I didn't have a lot of options, so I moved back to my parents' farm in central Pennsylvania. I was isolated and I missed my friends. But after a few months I met a girl from a nearby farm. She had blond braids and tattoos that showed between her tank top and cutoffs. A few days later she invited me over. We looked at the fields and she bragged about the soil.

If my parents, with years of struggle between them, were revolutionaries, my girlfriend and I were vegetable-growing mercenaries. We were there for the thrill. I drove a stripped-down pickup truck, with a tangle of harvest knives and baling wire on the rusted-through floorboards. I stank of compost and never brushed my teeth. When we went to a restaurant, the civilians all averted their gaze. We looked at the limp parsley garnishing their plates and rolled our eyes.

Soon the season was over. Potatoes and parsnips and rutabagas were stacked in the cellars. The fields were burned over with frost. We decided to go to Peru to have an adventure. When we got back, we realized that all our pictures were of vegetables. Old men selling huge sheaves of green grain. A woman digging cassava root. Donkeys toting stiff bundles of sugar cane.

It's hard, tiring, often demoralizing work to make vegetables. When I was little, my mother would sometimes hide away in an old chicken coop at the bottom of the yard to cry. As a farmer, you can pour so much into the vegetables that you feel obsessively devoted to them. Farming isn't about communing with nature—it's just a job. But if you immerse yourself in that job and things don't work out, you cry.

A farm dies once a year. Sometimes it's a lingering sickness; sometimes a hard frost takes it all in one night. There's no mystery to it. If a farmer wondered why, he would never pick up his tools. And then no one would eat at all.

Questions 21–24 ask about Passage A.

21. Hogan mentions the flowering of a certain kind of bamboo in order to illustrate the:

A. rarity with which one species of bamboo produces a flower.
B. uncanny ability bamboo has to grow in a variety of climates.
C. benefits of growing exotic plants in a greenhouse.
D. mysterious interconnectedness of things in the natural world.

22. As it is used in line 5, the word *community* most nearly means:

F. public.
G. joint ownership.
H. fellowship.
J. related individuals.

23. Hogan refers to "an old voice" (line 10) to suggest that the sunflower had:

A. been planted by an elderly gardener.
B. bloomed every spring for decades.
C. been genetically programmed to grow.
D. welcomed the narrator every year.

24. Hogan most likely quotes from the book *The Immortal Wilderness* to support her point that:

F. Earth speaks in a language human beings simply don't hear.
G. deeply communing with Nature requires patience and attentiveness.
H. authors besides herself have written insightful books about being in the outdoors.
J. people should enjoy the outdoors before the cold of winter takes control.

Questions 25–27 ask about Passage B.

25. Based on Crawford's account, the most likely reason springtime made his mother sad and anxious was that she:

A. felt isolated and missed her friends who were preoccupied with their own farms.
B. was remembering that a farm dies once a year despite all of her best efforts.
C. didn't feel a connection to the soil the way that her husband and son did.
D. knew the season signified the beginning of hard work that sometimes ended in failure.

26. According to Crawford, the farmers in Union Square seemed sort of desperate because:

F. an underground current in the wind stirred a kind of kinship and longing inside each of them.
G. back on the farm the first sprouts needed increasingly more attention as the season wore on.
H. the vegetables sometimes spoiled while being transported from their farms to New York City.
J. their customers were picky about the quality of the vegetables.

27. Crawford elaborates on the growing season being finished by mentioning the:

A. lighted windows of the houses fogging over and the smoke from the fires.
B. types of root vegetables stacked in the cellar and the frost-covered fields.
C. rusted-through floorboards of his pickup truck that had worn out with use.
D. old chicken coop at the bottom of the yard where his mother went to cry.

Questions 28–30 ask about both passages.

28. One of the most obvious differences between Hogan's and Crawford's point of view is that Hogan:

F. doesn't have a job, so she can waste time watching a sunflower grow, while Crawford spends most of his time working for a living.
G. realizes that hearing a sound like a drum in the ground, trees, and wind was just a dream, while Crawford is literally attuned to Earth's sounds.
H. talks about the natural world with a sense of reverence and awe, while Crawford suggests a connection based largely on necessity.
J. has no memory of the people who have lived before her, while Crawford talks fondly about his parents' influence.

29. Which of the following methods of support do both authors use to convey their ideas?

A. Personal anecdotes and opinions
B. Quotations from environmental experts
C. Sarcasm and exaggerated comparisons
D. Definition of terms with illustrative examples of each one

30. Based on these two passages, which pair of phrases best compares Hogan's relationship to Nature and Crawford's relationship to Nature?

F. Aimless walker versus idle dreamer
G. Fascinated observer versus pragmatic worker
H. Casual scientist versus thoughtful landowner
J. Indifferent outsider versus sarcastic farmer

Passage IV

NATURAL SCIENCE: This passage is adapted from the article "Flotsam Science" by Sid Perkins (©2007 by Science Service).

In January 1992, a freighter crossing the Pacific ran into rough weather. As the ship heaved through the storm-tossed seas, several cargo containers—including one filled with tens of thousands of plastic tub toys—came loose, fell overboard, and broke apart. Seven months after the spill, the plastic ducks, beavers, turtles, and frogs began washing up on beaches. Scientists who track ocean currents were ecstatic.

Even today, members of the tub-toy armada occasionally make landfall. The date and place of each of the nearly 1,000 toys recovered to date provide a data point, says Curtis Ebbesmeyer, a retired oceanographer in Seattle. Most of the drifters have remained stuck in the Pacific Subarctic Gyre, a set of deep-water and surface currents spanning an area the size of the continental United States that generally flows counterclockwise around the northern Pacific Ocean.

In most of the world, the dispersal of flotsam (floating debris) isn't of major interest to researchers. But along the bustling trade routes that link eastern Asia to North America, the stuff that drops off ships is enabling scientists to fill in details of how the Pacific Subarctic Gyre works.

The ocean is teeming with a variety of scientific instruments. When measuring surface currents, however, these devices have their limitations. Probes specifically designed to ride surface currents have sensors which can quickly become obstructed by algae, barnacles, and other organisms that thrive in the sunlit portion of the ocean.

What's more, probe batteries fail within months. Generally, probes haven't traveled more than 1,000 km in that time, says Thomas C. Royer, an oceanographer at Old Dominion University in Norfolk, Va. That's only a small fraction of the path around the gyre.

"We've never had a good handle on how long it takes [floating] objects to go around the gyre, or even if they do," Royer adds.

To map the currents and clock their speeds, Ebbesmeyer, Royer, and their teammates circumvented the disadvantages of modern electronic probes by harnessing the power of floating junk. Because the Pacific is crisscrossed by major trade routes, "there's a lot of stuff out there," Ebbesmeyer notes. Many of those items can be traced back to specific spills, and if the lost objects are durable, they can drift in currents for years.

The team's oldest data points—and the most ecofriendly—result from the eruption of Alaska's Mount Katmai on June 6, 1912. Some of the pumice spewed by that volcano fell into the Gulf of Alaska. In mid-August 1914, large chunks of that frothy rock washed up on beaches of British Columbia's Queen Charlotte Islands.

Each entry in the researchers' flotsam database includes the latitude and longitude of the place where the item entered the ocean and of the site where it was discovered—in essence, a start point and an end point.

Because of the sheer volume of flotsam data, the scientists have been able to discern the typical configuration and average speed of the currents in the Pacific Subarctic Gyre, even though their overall pattern continually shows slight shifts and speed changes in response to the passage of large ocean eddies or variations in weather patterns caused by climate cycles such as El Niños.

Results of computer simulations indicate that floating objects can be swept along several paths in the Pacific Subarctic Gyre. An item following the shortest loop would make a circuit in just over 2 years, the researchers estimate, and items taking the longest route would make a lap every 3.6 years. The average trip around the gyre took 3 years. This conclusion fits with observed recoveries of items that came at intervals of several years rather than being spread evenly through time.

According to the simulations, current speeds in the gyre range between 11 and 13 cm per second, or about one-fifth the speed of a typical human swimmer.

Once the researchers came up with these answers, they analyzed long-term records of water temperature and salinity at various sites in the North Pacific. They observed 3-year-long cycles in the data—"a pattern nobody noticed until the ducks came along," says Royer.

Studying the dispersal patterns of flotsam is "interesting and creative," says Howard J. Freeland, an oceanographer at the Institute of Ocean Sciences in Sidney, British Columbia. However, he cautions, the date of recovery of an item found on a beach may not reflect when it actually washed ashore. Ebbesmeyer and his colleagues "have good measurements, but I'm not sure of what," he notes.

31. Which of the following questions does the passage NOT answer?

- **A.** About how large of an area does the Pacific Subarctic Gyre cover?
- **B.** In addition to toys, what other types of cargo fell overboard during the 1992 spill?
- **C.** Approximately how many toys have been recovered from the 1992 spill?
- **D.** Where did the flotsam that has provided the team with the oldest data points originate?

32. According to the passage, one disadvantage to using scientific probes to measure surface currents is that such probes:

F. have heavy batteries that may cause the probes to sink after a short time.
G. have sensors that are vulnerable to current-dwelling organisms.
H. interfere with scientific instruments already floating in the ocean.
J. are sensitive to the bright sunlight that hits the ocean surface.

33. If the eighth paragraph (lines 48–54) were deleted, the passage would primarily lose an example that:

A. indicates some of the flotsam scientists studied came from natural sources.
B. suggests natural sources of flotsam provide more accurate data than do artificial sources.
C. explains how natural disasters can affect ocean currents.
D. provides specific information about the location of the Pacific Subarctic Gyre.

34. The passage indicates that scientists have been able to determine the typical configuration and average speed of the Pacific Subarctic Gyre's currents despite:

F. strong storms, which make direct observation of the currents impossible.
G. ship traffic in the trade routes that interferes with the currents' flow.
H. a lack of flotsam and probes, which results in an insufficient amount of data.
J. passing ocean eddies and changing weather patterns that alter the currents.

35. In the passage, Freeland notes that a problem with the flotsam database is that:

A. the physical properties of the flotsam aren't recorded.
B. it only includes data collected from the Pacific Ocean.
C. it isn't always possible to determine when flotsam enters the water.
D. the data may not reflect when flotsam actually washes ashore.

36. Within the passage, the main purpose of the statement in lines 7–8 is to:

F. suggest the scientists' reaction to the 1992 spill was inappropriate.
G. reveal that scientists often observe ocean currents from cargo freighters.
H. transition to the discussion of the spilled toys' scientific significance.
J. introduce a conflict between researchers and the shipping industry.

37. According to the passage, what happened to most of the toys spilled in the 1992 incident?

A. They're still drifting in the Pacific Subarctic Gyre.
B. They drifted to Asia on the trade routes.
C. They washed ashore but were returned to the Pacific Subarctic Gyre for further study.
D. They washed up on the beaches of the Queen Charlotte Islands.

38. According to the passage, at what point do probes used to measure surface currents in the Pacific Subarctic Gyre usually lose power?

F. Before they reach the gyre
G. Within months after entering the gyre
H. After one trip around the gyre
J. Within two to three years after leaving the gyre

39. As it is used in line 42, the phrase "harnessing the power of" most nearly means:

A. taking advantage of.
B. reining in the influence of.
C. controlling the energy produced by.
D. exploiting the authority of.

40. The author compares the speed of the Pacific Subarctic Gyre's currents to the speed of a typical human swimmer most likely to:

F. provide a frame of reference that might help readers understand the currents' speed.
G. suggest that the currents are too powerful for the average person to swim through.
H. explain why humans are needed to obtain an accurate measurement of the currents' speed.
J. help describe the author's own attempts to swim through the currents.

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 several 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

SLEEPLESS is a fruit fly gene involved in sleep regulation. The normal form of this gene (S^+) produces *sleep factor protein*; a mutant form (S^-) does not produce the protein.

Researchers studied the sleep patterns and survival of flies of the same age that had the genotype S^+S^+, S^+S^-, or S^-S^-. Figure 1 shows the amount of sleep, and the number of sleep events, per day per fly for each genotype. Figure 2 shows the amount of *recovery sleep* (additional sleep needed following 6 hr of sleep deprivation) per day per fly for each genotype. Figure 3 shows how percent survival varied with age for each genotype.

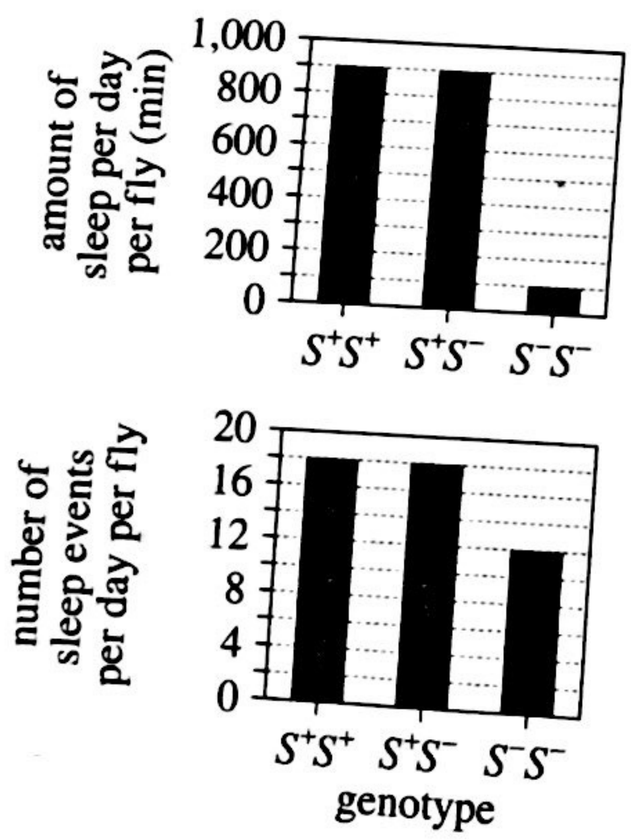


Figure 1

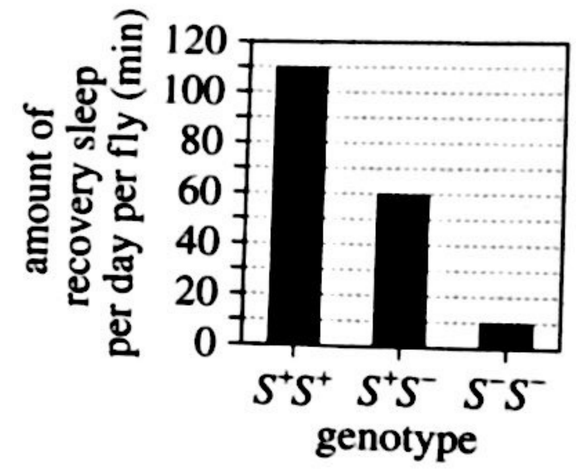


Figure 2

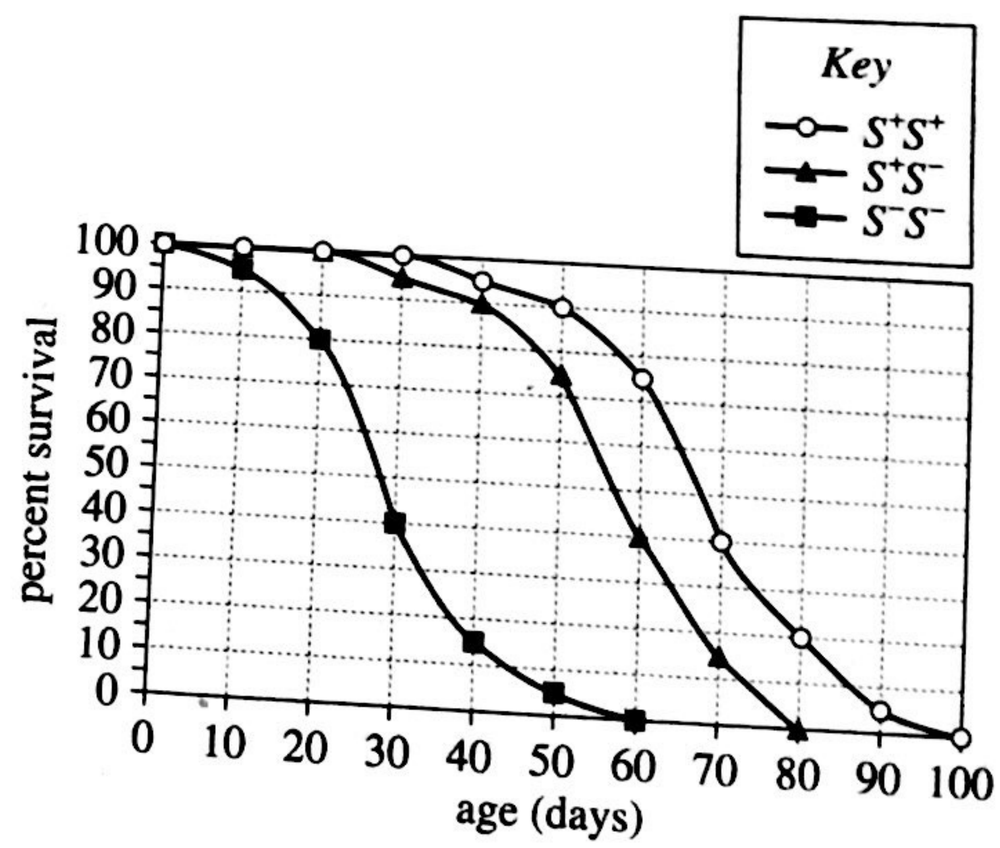


Figure 3

Figures adapted from Kyunghee Koh et al., "Identification of SLEEPLESS, a Sleep-Promoting Factor." ©2008 by the American Association for the Advancement of Science.

1. According to Figures 2 and 3, the flies with the genotype associated with the least amount of recovery sleep per day had a maximum life span of:

   A. 60 days.
   B. 70 days.
   C. 80 days.
   D. 100 days.

2. According to Figure 2, the amount of recovery sleep per day per fly for the S^+S^+ genotype was approximately how many times as great as that for the S^+S^- genotype?

   F. 2
   G. 4
   H. 6
   J. 10

3. Based on Figures 1 and 3, of the flies that had an average of 12 sleep events per day, the percent that reached 35 days of age was most likely closest to which of the following?

   A. 5%
   B. 15%
   C. 25%
   D. 40%

4. According to Figure 1, the amount of sleep per day per fly for the S^-S^- genotype was approximately what percent of the amount of sleep per day per fly for the S^+S^+ genotype?

   F. 10%
   G. 20%
   H. 30%
   J. 50%

5. Suppose that a fly with the genotype S^+S^+ is crossed with a fly with the genotype S^-S^-, resulting in 80 offspring. Based on Figure 3, the number of these offspring still alive at 50 days of age will most likely be closest to which of the following?

   A. 0
   B. 40
   C. 60
   D. 75

Passage II

An object is dropped from a height H above the top of a spring, compressing it. The top of the spring is a distance y below its initial position (see Figure 1) when the spring begins its rebound. At that moment, the object has its maximum upward acceleration, a.

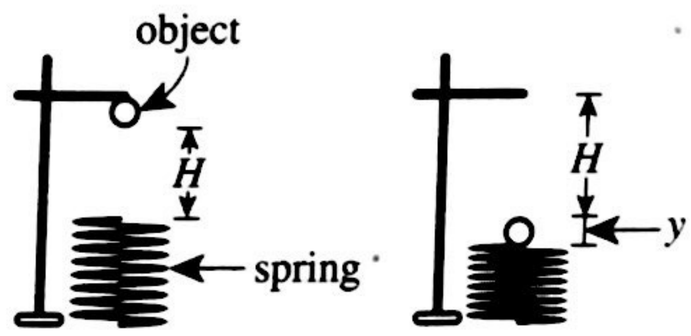


Figure 1

Figure 2 shows, for each of 3 springs—Spring X (the least stiff spring), Spring Y, and Spring Z (the stiffest spring)—a graph of the ratio $\frac{a}{g}$ versus H; g is the acceleration due to gravity.

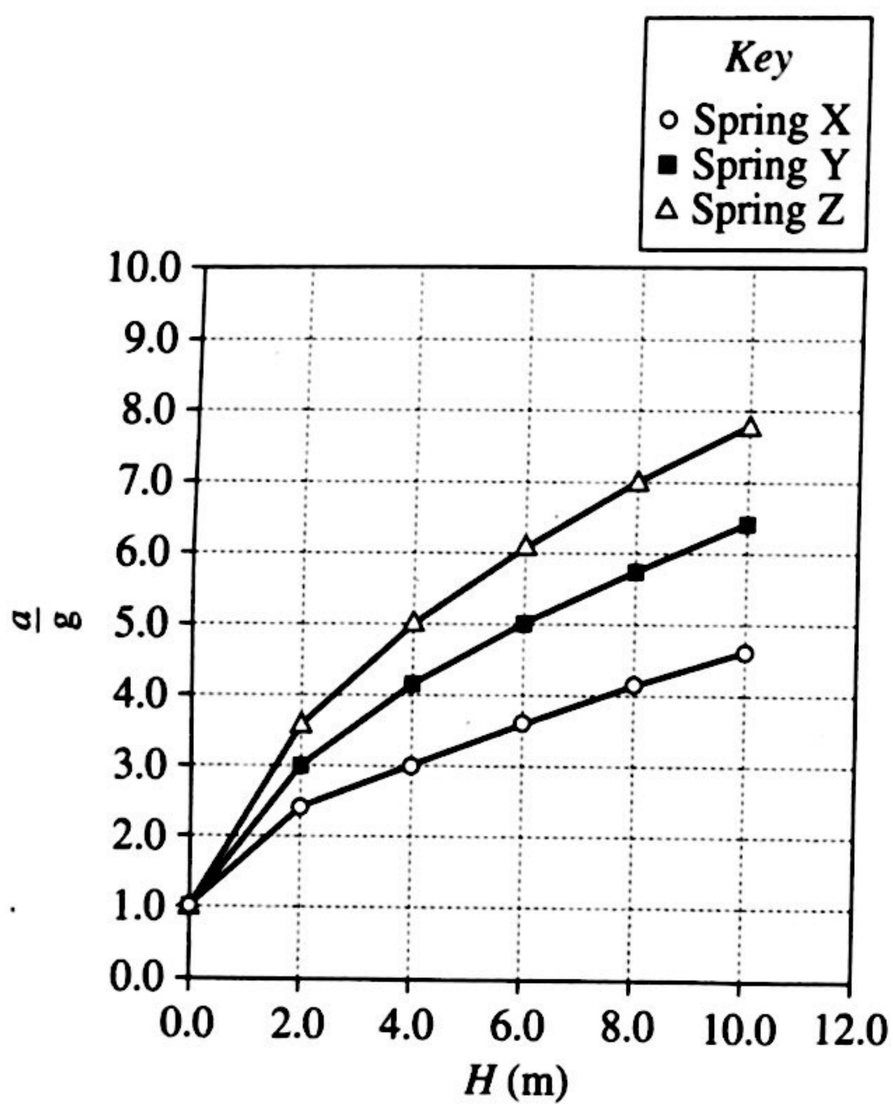


Figure 2

Figure 3 is a graph of y versus H for Spring X.

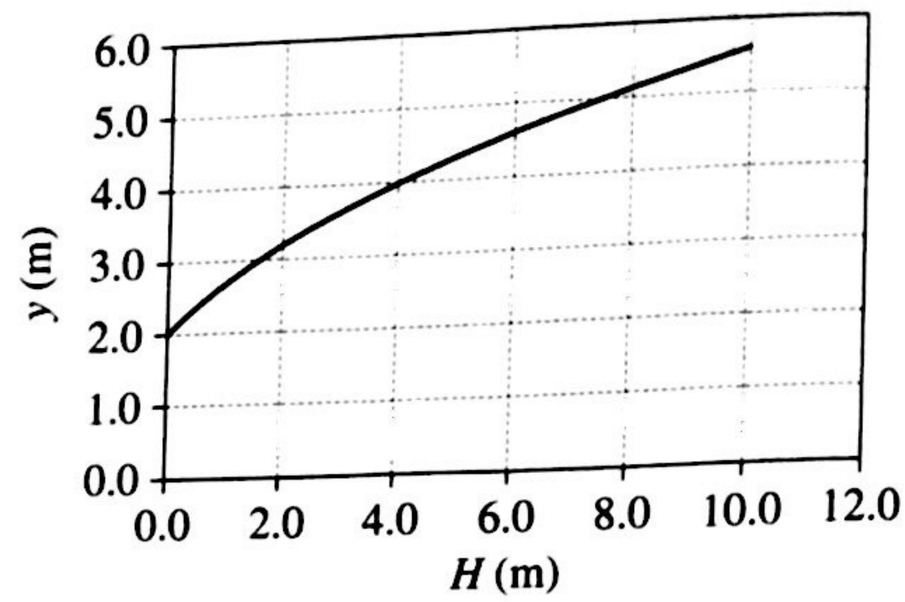


Figure 3

Figure 4 is a graph of the force, F, in newtons (N), exerted by Spring X on the object versus y.

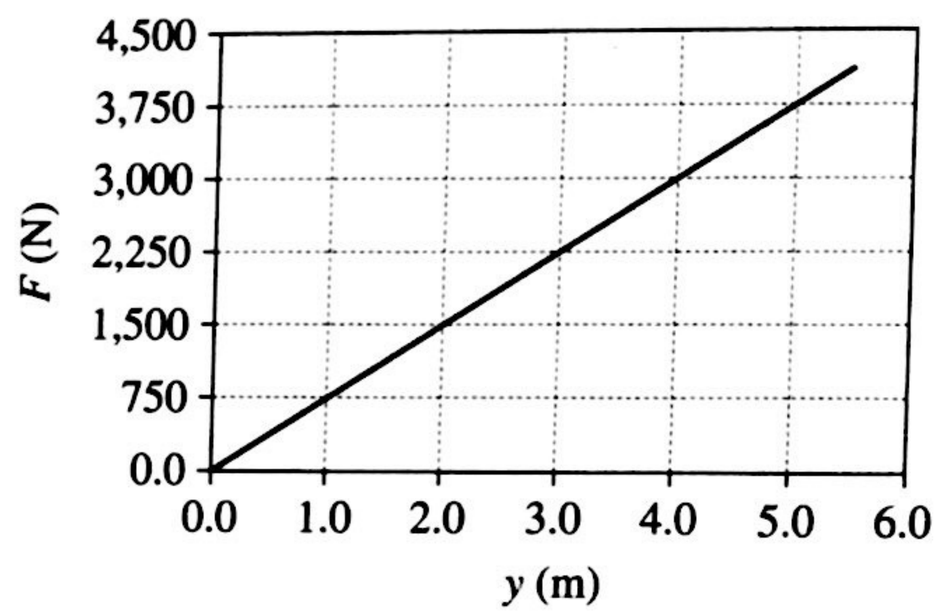


Figure 4

6. Based on Figure 3, if H equals 12 m, y for Spring X is most likely closest to which of the following?
   F. 2 m
   G. 4 m
   H. 6 m
   J. 8 m

7. Suppose that another spring, Spring W, is tested using the same procedures as those used with the other 3 springs; assume that the stiffness of Spring W is much greater than that of Spring X, Y, or Z. Based on Figure 2, for $H = 4.0$ m, $\frac{a}{g}$ will most likely be:

A. less than 3.0.
B. between 3.0 and 4.0.
C. between 4.0 and 5.0.
D. greater than 5.0.

8. Based on the data, when Spring X is compressed its maximum amount, such that the spring begins its rebound, and the force exerted on Spring X equals 3,000 N, the top of the spring is approximately how far below its original position?

F. 1.0 m
G. 2.0 m
H. 3.0 m
J. 4.0 m

9. The acceleration due to gravity is approximately 10 m/sec^2. Based on Figure 2, when H equals 8.0 m for Spring Z, what approximately is a ?

A. 10 m/sec^2
B. 30 m/sec^2
C. 50 m/sec^2
D. 70 m/sec^2

10. Why, for a given H, is the object's acceleration greatest when the top of a spring is a distance y meters below its initial position?

F. The force F is least.
G. The force F is greatest.
H. The acceleration g is least.
J. The acceleration g is greatest.

Passage III

The *tropopause* is the transition between 2 layers of Earth's atmosphere: the *troposphere* (the layer that begins at Earth's surface) and the *stratosphere* (the layer just above the troposphere). Figure 1 shows how air temperature changes with altitude at 3 latitudes (0°, 45° N, and 90° N), as well as the average tropopause altitude for each of those latitudes. Figure 2 shows, for the tropical latitudes, the monthly averages for tropopause altitude, tropopause air pressure, and tropopause air temperature determined for a particular 30-year period.

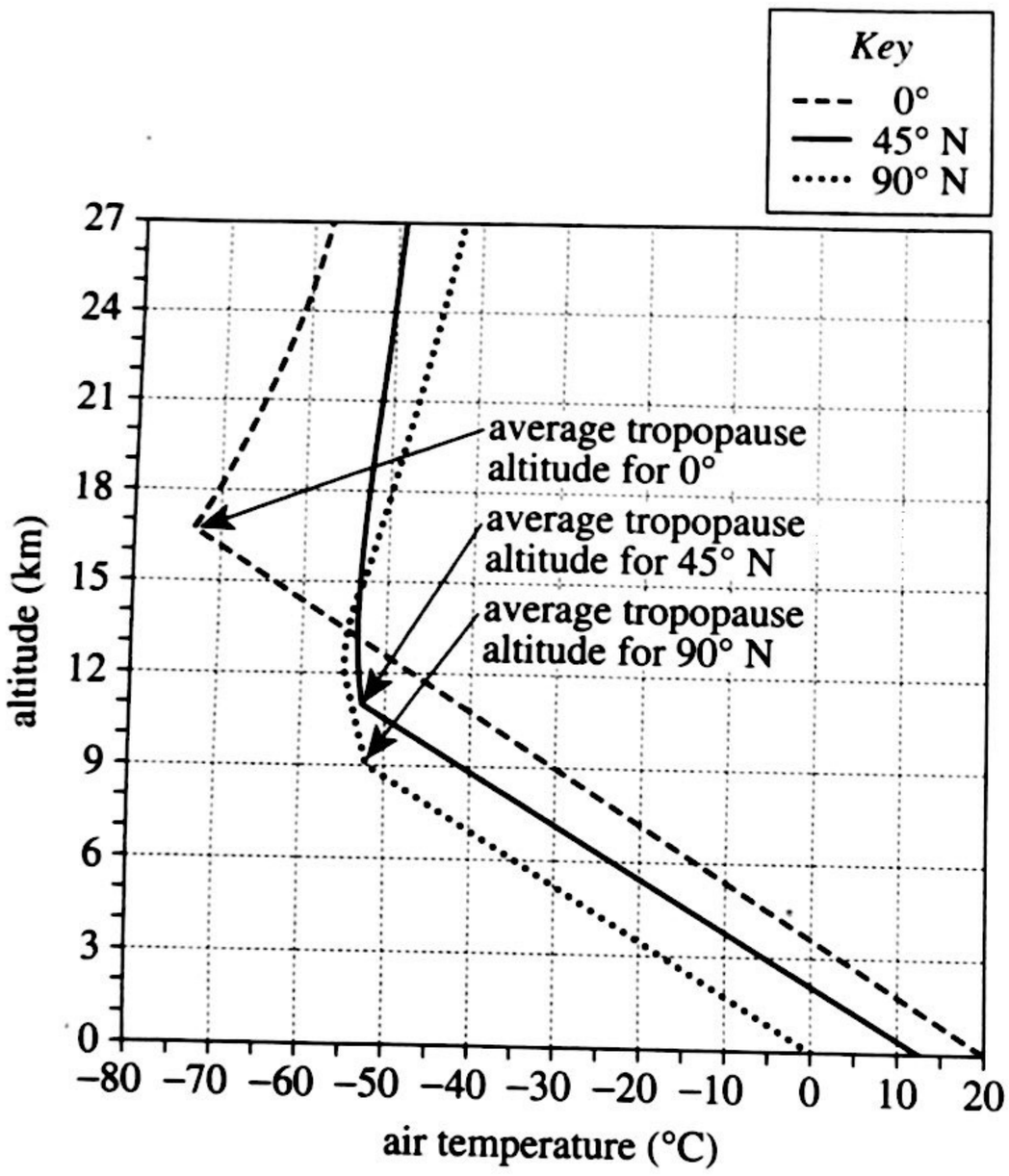


Figure 1

Figure 1 adapted from Frederick Lutgens, Edward Tarbuck, and Dennis Tasa, *The Atmosphere*, 11th ed. ©2001 by Prentice Hall.

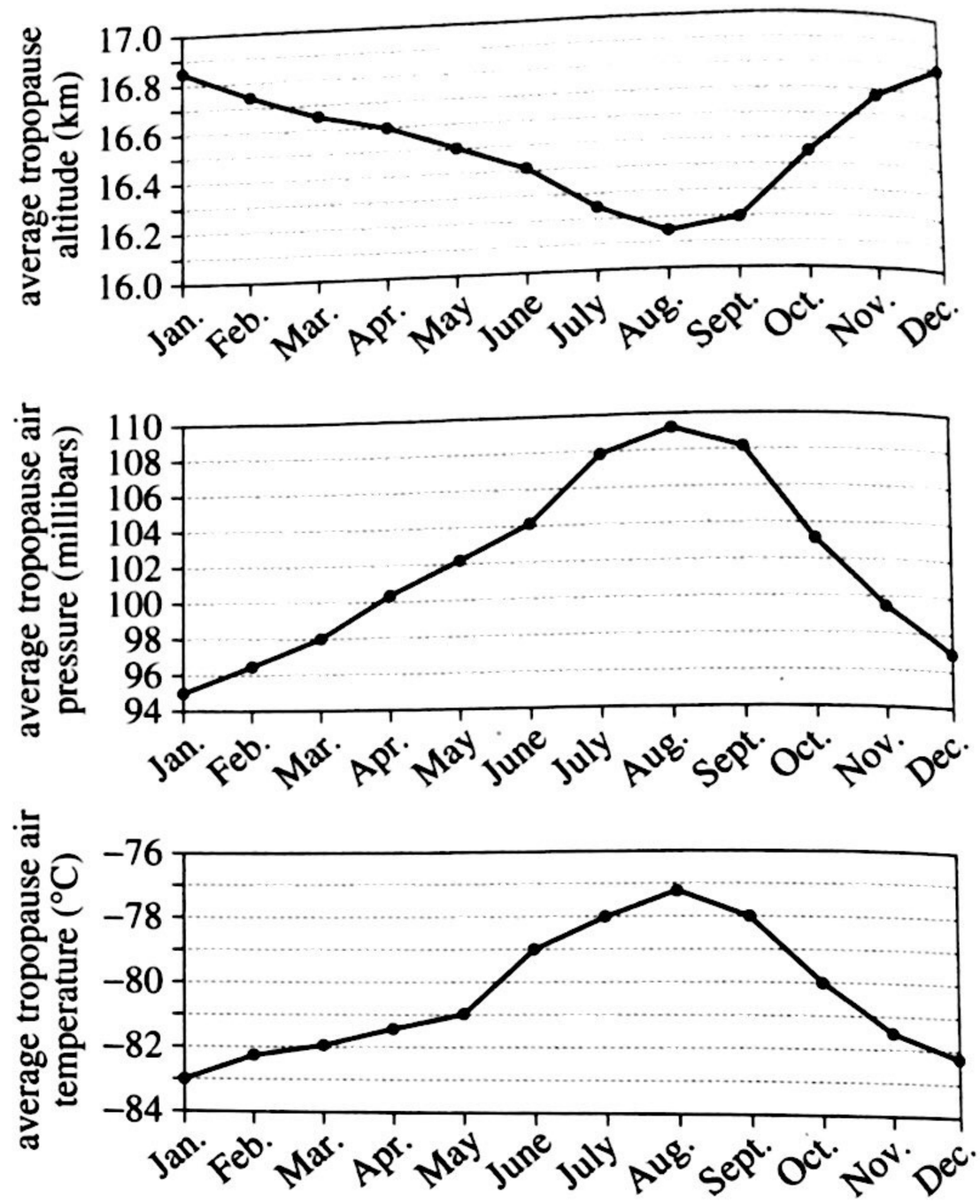


Figure 2

Figure 2 adapted from Dian Seidel et al., "Climatological Characteristics of the Tropical Tropopause as Revealed by Radiosondes." ©2001 by American Geophysical Union.

11. According to Figure 1, at 45° N latitude, the air temperature at Earth's surface is closest to which of the following?

A. −5°C
B. 0°C
C. 12°C
D. 20°C

12. According to Figure 1, the air temperature at 0° latitude is the same as the air temperature at 45° N latitude at an altitude closest to which of the following?

F. 11 km
G. 13 km
H. 15 km
J. 17 km

13. Based on Figure 1, the average tropopause altitude for 30° N latitude would most likely be:

A. less than 9 km.
B. between 9 km and 11 km.
C. between 11 km and 17 km.
D. greater than 17 km.

14. Based on Figure 2, was the average tropopause air pressure inversely related or directly related to the average tropopause altitude?

F. Inversely, because from January to December, as altitude decreased, air pressure decreased, and as altitude increased, air pressure increased.
G. Inversely, because from January to December, as altitude decreased, air pressure increased, and as altitude increased, air pressure decreased.
H. Directly, because from January to December, as altitude decreased, air pressure decreased, and as altitude increased, air pressure increased.
J. Directly, because from January to December, as altitude decreased, air pressure increased, and as altitude increased, air pressure decreased.

15. According to Figure 1, at 0° latitude, how does the air temperature in the troposphere change with increasing altitude from Earth's surface to the tropopause, and how does the air temperature in the stratosphere change with increasing altitude from the tropopause to 27 km ?

	troposphere	stratosphere
A.	increases only	increases only
B.	increases only	decreases only
C.	decreases only	decreases only
D.	decreases only	increases only

GO ON TO THE NEXT PAGE.

Passage IV

Companies W–Z were suspected of diluting pure (100%) honey before packaging it for sale. Students investigated each company's product by using the process of *osmosis*. During osmosis, H_2O flows across a *semipermeable membrane* (such as dialysis tubing) from a solution having a lower solute concentration into one with a higher solute concentration. Smaller molecules (such as H_2O) can pass through tiny pores in the dialysis tubing, but larger molecules (such as sugars) cannot.

Experiment 1

Two mL of 100% honey was mixed with 8 mL of H_2O to form a 20% honey solution. A 40%, a 60%, and an 80% honey solution were also made. A sample of 1 of the 4 solutions, 100% honey, or pure H_2O was added to each of 6 bags made of dialysis tubing. Air was pressed out of the bags, the bags were sealed, and the initial mass of each bag plus its contents was measured. Each bag was fully submerged in a separate beaker of pure H_2O at 25°C for 2 hr. The bags were then removed and dried off, and the final mass of each bag plus its contents was measured (see Table 1).

Table 1

Sample	Initial mass (g)	Final mass (g)	Percent change in mass
20% honey	11.2	13.4	20
40% honey	11.6	15.3	32
60% honey	12.2	17.7	45
80% honey	13.6	24.1	77
100% honey	14.5	28.3	95
Pure H_2O	10.2	10.2	0

Experiment 2

A sample of each company's product was added to a separate bag and tested as in Experiment 1 (see Table 2).

Table 2

Sample from Company	Initial mass (g)	Final mass (g)	Percent change in mass
W	14.1	27.6	96
X	13.8	26.9	95
Y	13.1	24.3	85
Z	13.9	25.0	80

Tables adapted from *Don't Blame the Bees: Teacher's Guide*. ©2000 by Carolina Biological Supply Company.

Experiment 3

A sample of Company Z's product was added to 5 bags. The samples were tested as in Experiment 1, except that the bags were submerged in separate beakers containing, respectively, 20%, 40%, 60%, 80%, or 100% honey. The mass of the bag plus its contents increased for 4 of the bags, but decreased for 1 of the bags.

16. Suppose that in Experiment 1 the students had also tested a 70% honey solution. Based on the results of Experiment 1, the percent change in mass would most likely have been between:

F. 20% and 32%.
G. 32% and 45%.
H. 45% and 77%.
J. 77% and 95%.

17. When the students added the samples to the bags in Experiments 1–3, they only partially filled the bags. The most likely reason for this is that the students wanted to allow room for:

A. H_2O to enter the bag.
B. H_2O to exit the bag.
C. the sugar molecules in the honey to enter the bag.
D. the sugar molecules in the honey to exit the bag.

18. In Experiment 1, to make the 60% honey solution, the students most likely mixed which of the following?

F. 4 mL of 100% honey with 4 mL of H_2O
G. 4 mL of 100% honey with 6 mL of H_2O
H. 6 mL of 100% honey with 4 mL of H_2O
J. 6 mL of 100% honey with 6 mL of H_2O

19. According to the results of Experiment 1, for the 40% honey solution, did the mass of the solution in the bag increase or decrease as a result of the bag having been submerged, and why?

A. Increase, because the sample had a lower solute concentration than did the H_2O.
B. Increase, because the sample had a higher solute concentration than did the H_2O.
C. Decrease, because the sample had a lower solute concentration than did the H_2O.
D. Decrease, because the sample had a higher solute concentration than did the H_2O.

20. Based on the results of Experiments 1 and 2, the concentration of honey in the sample from Company Y was most likely:

F. greater than 40% but less than 60%.
G. greater than 60% but less than 80%.
H. greater than 80% but less than 100%.
J. 100%.

21. In Experiment 3, the mass of 1 of the bags plus its contents decreased. This bag had most likely been submerged in the beaker containing:

A. 40% honey.
B. 60% honey.
C. 80% honey.
D. 100% honey.

Passage V

When an electrical current flows through a metal strip in a magnetic field, a magnetic force is exerted on some electrons in the strip. These electrons are pushed to an edge of the strip, making that edge negatively charged (see Figure 1).

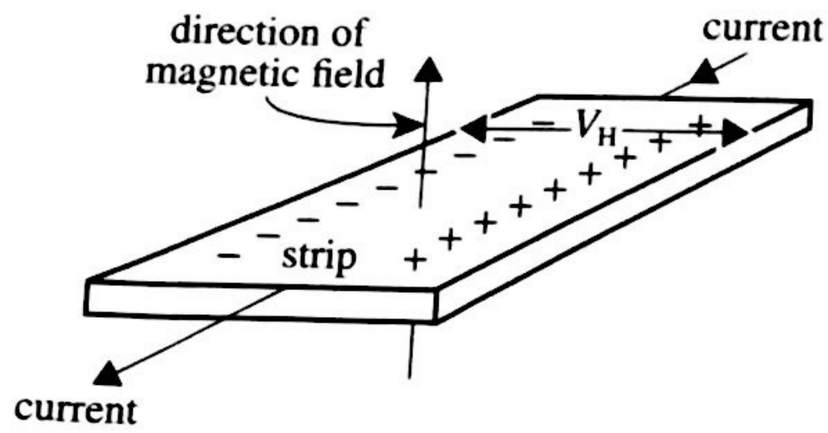


Figure 1

The opposite edge of the strip, which develops a shortage of electrons, becomes positively charged, and so a voltage, V_H, develops between these 2 edges of the strip.

A physics class conducted 3 studies of this phenomenon, called the *Hall effect*.

In each trial of the studies, an aluminum strip having a thickness d was clamped to a ring stand. The 2 ends of the strip were connected to an electrical circuit containing a DC power supply, and the 2 edges of the strip were connected to a voltmeter (see Figure 2).

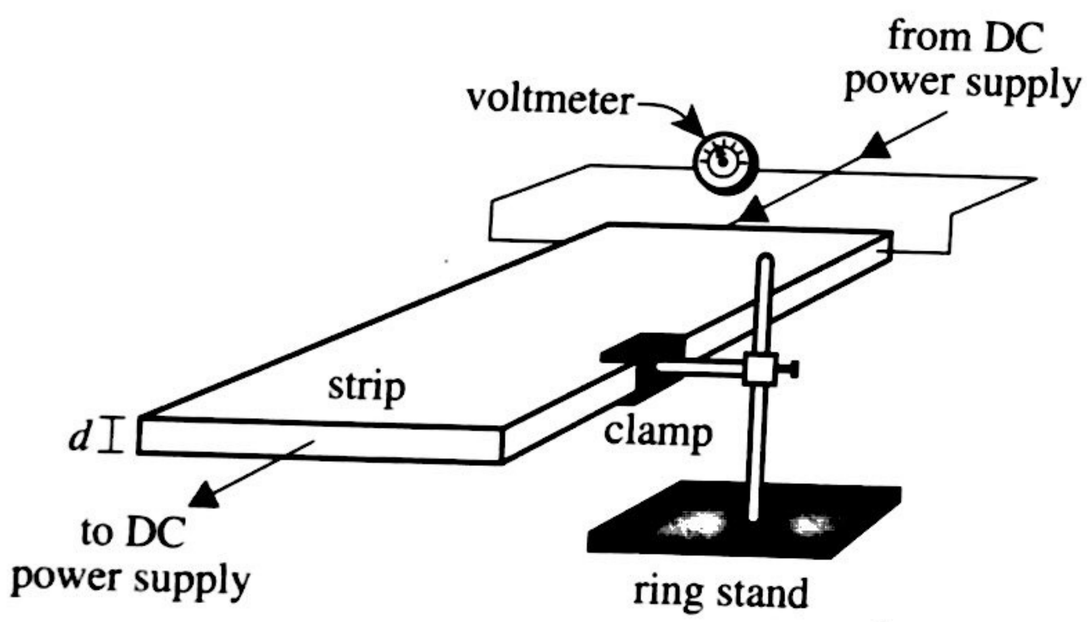


Figure 2

The strip was also positioned horizontally between the poles of an electromagnet (see Figure 3).

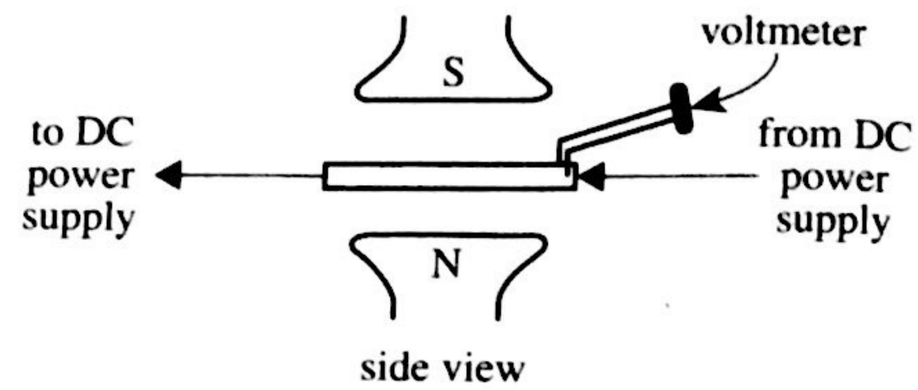


Figure 3

The students adjusted the power supply output as needed so that the desired current, I, flowed through the strip. Finally, the students adjusted the electromagnet as needed to produce the desired magnetic field strength, B, and recorded the resulting V_H.

Study 1

With d equal to 15 mm and B equal to 0.6 tesla (T), the students found V_H, in nanovolts (nV; 1 nV = 10^{-9} V), for various I, in amperes (A) (see Table 1).

Table 1

Trial	I (A)	V_H (nV)
1	10	13
2	15	19
3	20	25
4	25	32

Study 2

With d equal to 15 mm and I equal to 25 A, the students found V_H for various B (see Table 2).

Table 2

Trial	B (T)	V_H (nV)
5	0.2	11
6	0.4	21
7	0.8	42
8	1.0	53

Study 3

With B equal to 0.6 T and I equal to 25 A, the students found V_H for various d (see Table 3).

Table 3

Trial	d (mm)	V_H (nV)
9	3	160
10	6	79
11	9	53
12	12	40

22. In Study 1, as I was increased, the number of electrons that were pushed to one edge of the strip:
    F. increased only.
    G. decreased only.
    H. varied, but with no general trend.
    J. remained the same.

23. The clamp that fastened a strip to the ring stand was electrically insulated from the strip. This insulation was most likely needed to:
    A. promote the flow of electrons between the clamp and the strip.
    B. prevent the flow of electrons between the clamp and the strip.
    C. ensure that the strip remained at room temperature.
    D. ensure that the strip did not reach room temperature.

24. In Study 1, which variable was independent, and which variable was dependent?

	independent	dependent
F.	I	B
G.	I	V_H
H.	V_H	I
J.	B	I

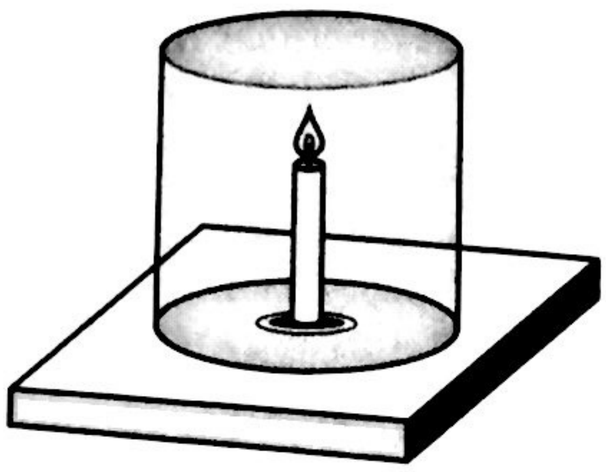
25. Suppose a new trial were conducted using the procedure from Trial 1, except that $B = 0.2$ T. Based on the results of Study 2, V_H for this trial would most likely be:
    A. less than 13 nV.
    B. between 13 nV and 19 nV.
    C. between 19 nV and 25 nV.
    D. greater than 25 nV.

26. Based on the information given, the letter N in Figure 3 identifies:
    F. a nanometer.
    G. a new aluminum strip.
    H. the north pole of the electromagnet.
    J. the negative electrode of the power supply.

27. Based on the results of the studies, which of the following equations correctly relates V_H to I, B, and d? (Note: k is a constant.)
    A. $V_H = k\frac{I}{Bd}$
    B. $V_H = k\frac{B}{Id}$
    C. $V_H = k\frac{Bd}{I}$
    D. $V_H = k\frac{IB}{d}$

Passage VI

A science teacher lights a new wax candle (which, if left undisturbed, would burn for several hours) in her classroom. She then shows her students a glass jar and asks them to predict what will happen if she places the jar over the lit candle, completely sealing off the candle from the surrounding atmosphere (see figure).



Four students give their viewpoints about why the candle burns and about what will happen to the burning candle once it is under the jar.

Student 1

The candle's flame results from a combustion reaction. When the candle is lit, the flame that lights the candle heats the candle, which causes the candle to give off fumes of wax. The wax fumes act as a fuel that reacts with the O_2 present in the air. The reaction gives off energy, which heats the surrounding air, producing a flame. If the jar is placed over the lit candle, the candle will soon stop burning because the O_2 in the air under the jar will be quickly used up.

Student 2

Student 1 is correct except that the fuel reacts with the N_2, not with the O_2, in the air.

Student 3

None of the components of air are involved in the burning of the candle. When the candle is lit, the energy from the flame causes the fuel (candle wax fumes) to spontaneously decompose. The heat from the decomposition reaction causes the reaction to continue. Thus, if the jar is placed over the lit candle, the candle will continue to burn until all of the fuel is used up.

Student 4

When the candle is lit, the energy from the flame causes the fuel (candle wax fumes) to spontaneously decompose into a massless substance called *heat*. None of the components of air chemically react with the fuel, but the O_2 present in air is necessary for the sustained decomposition reaction. The O_2 is needed because as the heat is produced, the heat must be absorbed for the reaction to continue, and O_2 is the only component of air that absorbs heat. When O_2 absorbs heat, the O_2 is not chemically altered. If the jar is placed over the lit candle, the candle will soon stop burning because the O_2 in the air under the jar will quickly become saturated with heat.

28. Which of the students, if any, claim(s) that when the jar is placed over the lit candle, the candle's flame will go out instantly?

F. Student 2 only
G. Student 4 only
H. All of the students
J. None of the students

29. Which of the students predict(s) that after the jar is placed over the lit candle, the candle will stop burning before all the candle wax is used up?

A. Student 3 only
B. Students 1 and 2 only
C. Students 3 and 4 only
D. Students 1, 2, and 4 only

30. Which of the following unbalanced equations for the reaction that occurs when a candle is lit is most consistent with Student 1's viewpoint?

F. Wax fumes + $O_2 \rightarrow CO_2 + H_2O$
G. Wax fumes + $N_2 \rightarrow CN + H_2$
H. $CO_2 + H_2O \rightarrow$ wax fumes + O_2
J. $CN + H_2 \rightarrow$ wax fumes + N_2

31. Based on Student 2's viewpoint, how will the concentrations (in mg/L) of O_2 and N_2 in the jar vary with time, if at all, after the jar is placed over the lit candle?

	concentration of O_2	concentration of N_2
A.	decrease	decrease
B.	remain constant	decrease
C.	increase	remain constant
D.	remain constant	remain constant

32. In the 1600s, most scientists believed that when materials burned, they gave off a substance called *phlogiston*. These scientists also believed that a material would burn until the air could no longer take in more phlogiston. This theory is most similar to the viewpoint given by:

F. Student 1.
G. Student 2.
H. Student 3.
J. Student 4.

33. The most scientifically accurate viewpoint is given by:

A. Student 1.
B. Student 2.
C. Student 3.
D. Student 4.

34. Which of the students would agree with the statement "After the jar is placed over the lit candle, the mass of O_2 under the jar will *decrease*"?

F. Student 1 only
G. Students 1 and 2 only
H. Students 1 and 4 only
J. Students 1, 2, 3, and 4

Passage VII

Three studies examined how the depth of plant roots, and the soil's carbon (C) and nitrogen (N) contents, change once shrubs have replaced grasses as the dominant plant species in an area.

In one area, 3 sites (Sites X, Y, and Z) were selected. Each site consisted of 2 adjacent plots of land: one covered only with grasses (grass plot) and one that had once been covered only with grasses but was now covered only with shrubs (shrub plot). The average annual precipitation for each site is shown in Table 1.

Study 1

Five vertical soil cores were taken from each of the 2 plots at Sites X, Y, and Z. Each core was 0.06 m in diameter and 3.5 m deep, which was a few centimeters deeper than the deepest plant roots. Starting at the top, each core was cut horizontally into 10 cm sections. Each section was dried, crushed, and passed through screens so that all root material could be collected and weighed. The average *95% root mass depth* (see Figure 1) for each plot was determined (see Table 1).

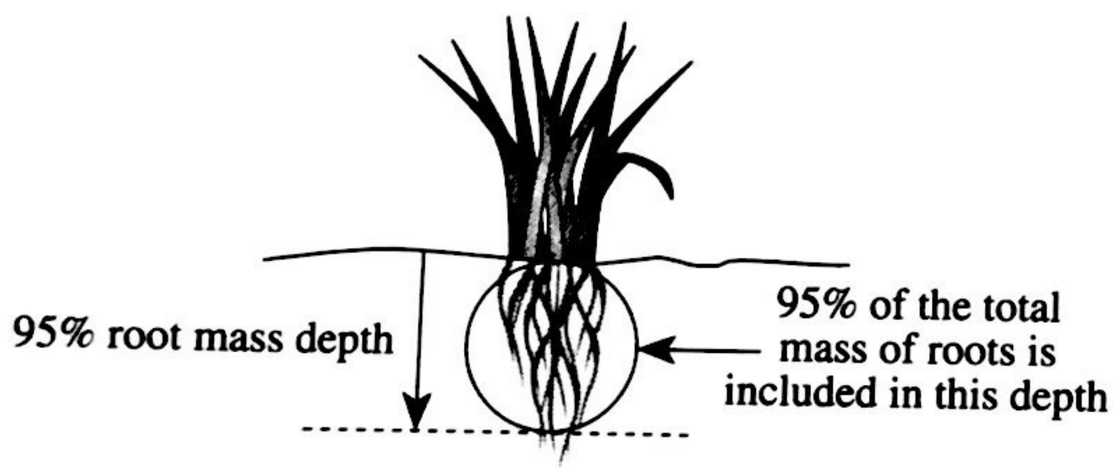


Figure 1

Table 1

Site	Average annual precipitation (mm)	Average 95% root mass depth (m)	
		grass plot	shrub plot
X	660	0.5	1.6
Y	840	0.9	2.4
Z	1,070	1.5	3.3

Study 2

For each of 5 additional soil cores taken from each plot at Site X, soil samples were taken from the top of the core, and then every 0.25 m down the core to a depth of 2.0 m. The 5 samples from a given depth and plot were thoroughly mixed. Each resulting mixture was then analyzed for C content, in percent by mass. These procedures were repeated for 5 additional cores from each plot at Site Y and for 5 additional cores from each plot at Site Z (see Figure 2).

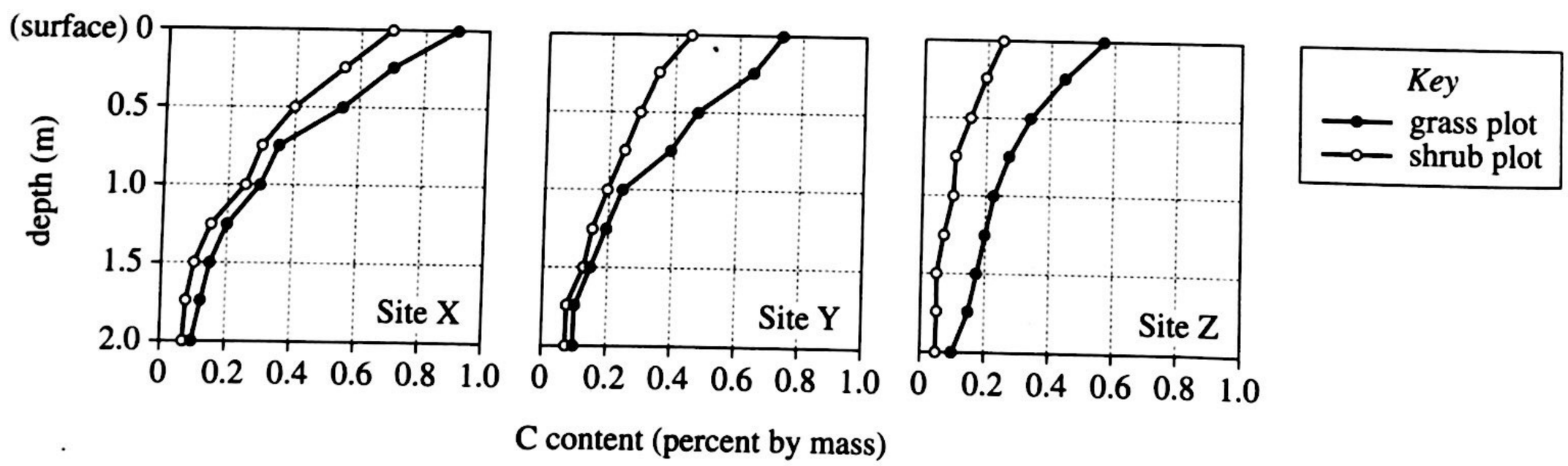


Figure 2

Study 3

Study 2 was repeated except that each mixture was analyzed for N content (see Figure 3).

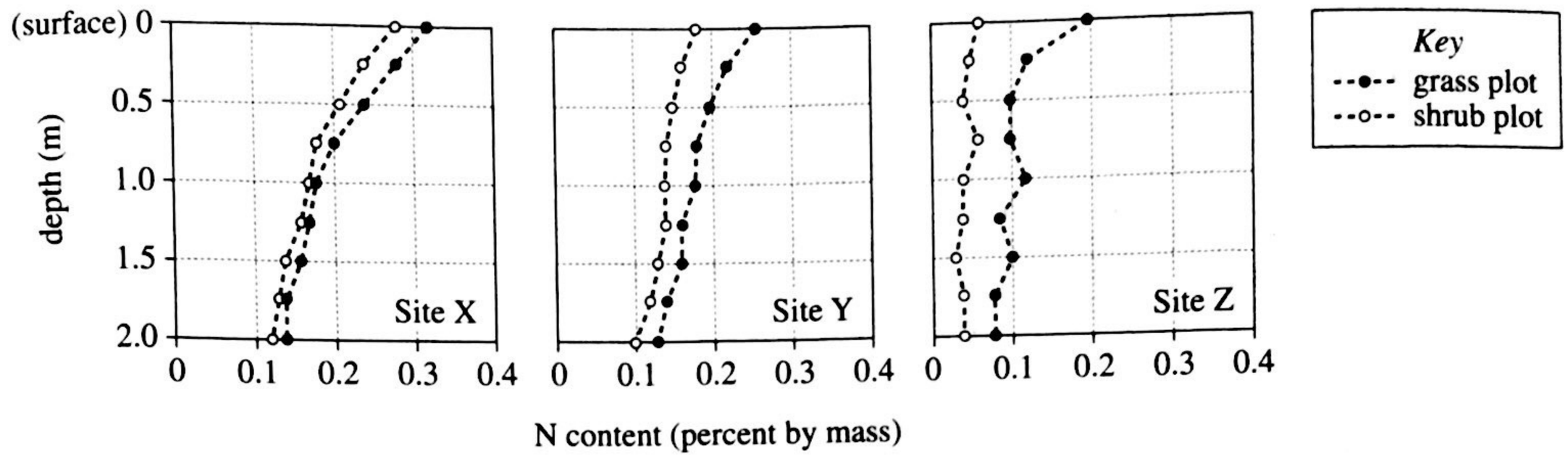


Figure 3

Table and Figures 2 and 3 adapted from Robert Jackson et al., "Ecosystem Carbon Loss with Woody Plant Invasion of Grasslands." ©2002 by the Nature Publishing Group.

35. Suppose a fourth shrub plot in the study area received an average annual precipitation of 750 mm. If that shrub plot had been included in Study 1, its average 95% root mass depth would most likely have been:

A. less than 1.6 m.
B. between 1.6 m and 2.4 m.
C. between 2.4 m and 3.3 m.
D. greater than 3.3 m.

36. Is the statement "Some shrub roots penetrated more than 1.5 m down into the soil" consistent with the results of Study 1 ?

F. No, because for all 3 sites, the average 95% root mass depth for shrubs was greater than 1.5 m.
G. No, because for all 3 sites, the average 95% root mass depth for shrubs was less than 1.5 m.
H. Yes, because for all 3 sites, the average 95% root mass depth for shrubs was greater than 1.5 m.
J. Yes, because for all 3 sites, the average 95% root mass depth for shrubs was less than 1.5 m.

37. In Study 3, which of the 3 shrub plots, if any, had the greatest N content, averaged over the top 2.0 m of soil?

A. The shrub plot at Site X
B. The shrub plot at Site Y
C. The shrub plot at Site Z
D. The averaged N contents were the same for all 3 shrub plots.

38. According to the results of Study 2, in which of the following plots did the C content change the most from a depth of 0 m to a depth of 2.0 m ?

F. The grass plot at Site X
G. The shrub plot at Site X
H. The grass plot at Site Y
J. The shrub plot at Site Z

39. The most likely reason that the soil core sections were dried before being passed through screens in Study 1 was to ensure which of the following?

A. That no C remained in the soil
B. That no N remained in the soil
C. That root material could easily be separated from the soil
D. That root material could not easily be separated from the soil

40. At each of the 3 sites, the grass plot and the shrub plot were adjacent. This arrangement ensured that which of the following variables could be assumed to be nearly identical for both plots during the studies?

F. C content of the soil
G. N content of the soil
H. Dominant plant species
J. Climate

END OF TEST 4

STOP! DO NOT RETURN TO ANY OTHER TEST.

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English				Mathematics				Readling		Science	
1	D			1	D	31	C	1	C	1	A
2	J			2	F	32	G	2	F	2	F
3	C			3	B	33	E	3	B	3	C
4	G			4	H	34	K	4	H	4	F
5	C			5	B	35	D	5	D	5	C
6	G	41	B	6	H	36	G	6	H	6	H
7	D	42	F	7	B	37	C	7	D	7	D
8	F	43	A	8	K	38	J	8	F	8	J
9	A	44	H	9	C	39	C	9	A	9	D
10	J	45	C	10	K	40	G	10	G	10	G
11	C	46	J	11	C	41	E	11	D	11	C
12	H	47	D	12	G	42	J	12	J	12	G
13	B	48	F	13	D	43	D	13	C	13	C
14	F	49	D	14	F	44	G	14	F	14	G
15	A	50	J	15	E	45	C	15	C	15	D
16	G	51	C	16	H	46	K	16	H	16	H
17	A	52	J	17	A	47	E	17	D	17	A
18	G	53	A	18	H	48	G	18	H	18	H
19	C	54	J	19	B	49	B	19	D	19	B
20	G	55	D	20	F	50	K	20	G	20	H
21	B	56	F	21	D	51	D	21	D	21	D
22	J	57	A	22	F	52	K	22	H	22	F
23	C	58	G	23	C	53	E	23	C	23	B
24	J	59	C	24	K	54	G	24	G	24	G
25	D	60	J	25	A	55	A	25	D	25	A
26	H	61	C	26	J	56	K	26	J	26	H
27	A	62	H	27	A	57	D	27	B	27	D
28	G	63	D	28	H	58	F	28	H	28	J
29	D	64	F	29	A	59	A	29	A	29	D
30	F	65	C	30	H	60	J	30	G	30	F
31	B	66	J					31	B	31	B
32	G	67	A					32	G	32	J
33	B	68	G					33	A	33	A
34	G	69	B					34	J	34	F
35	D	70	H					35	D	35	B
36	F	71	A					36	H	36	H
37	D	72	G					37	A	37	A
38	H	73	C					38	G	38	F
39	A	74	J					39	A	39	C
40	G	75	C					40	F	40	J

ACT Resource Links

ACT Online Practice Tests: https://www.crackab.com/act/

※ **ACT English Practice Tests:**

https://www.crackab.com/act/english/

※ **ACT Math Practice Tests:**

https://www.crackab.com/act/math/

※ **ACT Reading Practice Tests:**

https://www.crackab.com/act/reading/

※ **ACT Science Practice Tests:**

https://www.crackab.com/act/science/

ACT Grammar: https://www.crackab.com/act/grammar/

ACT Real Past Papers Download:

https://www.crackab.com/act-downloads/

Digital SAT & New SAT Practice Tests:

https://www.cracksat.net

Real SAT Tests Download:

http://www.cracksat.net/sat-downloads/

AP Exams Practice Tests:

https://www.crackap.com

https://www.apstudy.net

Explanation of Procedures Used to Obtain Scale Scores from Raw Scores

On each of the four tests on which you marked any responses, the total number of correct responses yields a raw score. Use the table below to convert your raw scores to scale scores. For each test, locate and circle your raw score or the range of raw scores that includes it in the table below. Then, read across to either outside column of the table and circle the scale score that corresponds to that raw score. As you determine your scale scores, enter them in the blanks provided on the right. The highest possible scale score for each test is 36. The lowest possible scale score for any test on which you marked any responses is 1.

Next, compute the Composite score by averaging the four scale scores. To do this, add your four scale scores and divide the sum by 4. If the resulting number ends in a fraction, round it off to the nearest whole number. (Round down any fraction less than one-half; round up any fraction that is one-half or more.) Enter this number in the blank. This is your Composite score. The highest possible Composite score is 36. The lowest possible Composite score is 1.

ACT Test 72G	Your Scale Score
English	_____
Mathematics	_____
Reading	_____
Science	_____
Sum of scores	_____
Composite score (sum ÷ 4)	_____

NOTE: If you left a test completely blank and marked no items, do not list a scale score for that test. If any test was completely blank, do not calculate a Composite score.

Scale Score	Raw Scores				Scale Score
	Test 1 English	Test 2 Mathematics	Test 3 Reading	Test 4 Science	
36	75	60	40	39-40	36
35	73-74	59	—	38	35
34	71-72	57-58	39	37	34
33	70	56	38	36	33
32	69	55	37	35	32
31	68	54	35-36	—	31
30	67	52-53	34	34	30
29	65-66	50-51	33	33	29
28	64	47-49	32	32	28
27	62-63	45-46	31	31	27
26	60-61	42-44	30	29-30	26
25	57-59	40-41	29	27-28	25
24	55-56	37-39	28	26	24
23	52-54	35-36	26-27	24-25	23
22	49-51	33-34	25	22-23	22
21	46-48	31-32	23-24	20-21	21
20	43-45	30	22	18-19	20
19	41-42	27-29	20-21	17	19
18	38-40	24-26	19	15-16	18
17	36-37	20-23	17-18	14	17
16	34-35	16-19	16	13	16
15	30-33	12-15	14-15	11-12	15
14	28-29	10-11	13	10	14
13	26-27	8-9	11-12	9	13
12	24-25	6-7	9-10	8	12
11	21-23	5	8	7	11
10	18-20	4	6-7	6	10
9	15-17	—	—	5	9
8	13-14	3	5	4	8
7	11-12	—	4	3	7
6	9-10	2	3	—	6
5	7-8	—	—	2	5
4	5-6	1	2	—	4
3	4	—	—	1	3
2	2-3	—	1	—	2
1	0-1	0	0	0	1