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ENGLISH TEST
45 Minutes—75 Questions

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

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

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

PASSAGE I

The Greening of Winter

I love to snowboard, and, like most snowboarders and skiers, I love to be outdoors during winter. However, busy ski resorts can take a toll on the environment. The clear-cutting of trees to create new ski runs on mountainsides, though, a one-time event,
<u>   </u>
1

1. A. NO CHANGE
 B. mountainsides, though
 C. mountainsides though,
 D. mountainsides though

<u>devastate</u> fragile ecosystems and destroys
2
wildlife habitats. The effects don't stop there.

2. F. NO CHANGE
 G. have devastated
 H. are devastating
 J. devastates

People often drive—or in many cases fly—to their favorite ski resorts. Long-distance travel generates CO_2 emissions, <u>which, in turn,</u> compound global warming.
3
Once at the resort, skiers and snowboarders rely on extensive networks of energy-hungry chairlifts—gondolas and high-speed quads—<u>to whisk</u> them up to the top of
4

3. A. NO CHANGE
 B. it's these that, in turn,
 C. in turn,
 D. DELETE the underlined portion.

4. F. NO CHANGE
 G. who whisk
 H. whisked
 J. whisk

the mountain. Often, <u>on the other hand,</u> the very snow
5
they relish on the trip back down the mountain has been artificially made using powerful snow cannons that suck

5. A. NO CHANGE
 B. nonetheless,
 C. however,
 D. DELETE the underlined portion.

GO ON TO THE NEXT PAGE.

water from creeks and streams. Due to some of the effects

of global warming in recent years, even more snow must

arrive to keep the slopes covered. This process further
6

degrades local ecosystems.

[1] We've joined a growing number of skiers and
7

snowboarders here in Colorado who take safety classes

and participate in a type of backcountry skiing nicknamed

"earn your turns." [2] Rather than visit a nearby ski resort,
8

I strap my snowboard and gear on my back. [3] The hike

can last for two hours or more, just so I can get in one

run down a slope. [4] But I enjoyed the slow climb up
9

the mountain almost like they're the fast turns on the
10

way down. [5] I then step into a pair of snowshoes and

hike up into remote areas. ⬚11

Even in the middle of winter, the sun, high in a

blue sky, keeps me warm. Like me, wildlife avoids the
12

ski resorts; I spot tracks made by elk, coyote, fox, and
13

even the endangered lynx. Hiking up through the forest,

and seeing fresh snow bunched on pine boughs, reinforces

my effort to make snowboarding a little greener. And

my reward at the end of the slow climb for two hours?
14

6. Which choice best characterizes the preceding sentence's description of how ski resorts' slopes often become covered in snow?
   F. NO CHANGE
   G. be manufactured
   H. be accumulated
   J. fall

7. A. NO CHANGE
   B. People will have
   C. They have
   D. I've

8. If the writer were to delete the underlined portion, the sentence would primarily lose:
   F. an indication that the writer prefers skiing in Colorado over other places to ski.
   G. a clarification that the writer is primarily discussing ski resorts.
   H. a suggestion that the writer lives close to ski resorts in Colorado.
   J. an allusion to where the writer takes vacations.

9. A. NO CHANGE
   B. did have enjoyment of
   C. had enjoyed
   D. enjoy

10. F. NO CHANGE
    G. as much as
    H. equally to
    J. as

11. For the sake of the logic and coherence of this paragraph, Sentence 5 should be placed:
    A. where it is now.
    B. after Sentence 1.
    C. after Sentence 2.
    D. after Sentence 3.

12. F. NO CHANGE
    G. them,
    H. we,
    J. I,

13. A. NO CHANGE
    B. resorts but
    C. resorts,
    D. resorts

14. F. NO CHANGE
    G. climb that takes at least two hours?
    H. slow, two-hour (or so) climb?
    J. climb?
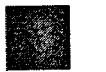
Flying <u>down the mountain through,</u> untouched snow! I

15

can't imagine buying a chairlift ticket anytime soon.

15. A. NO CHANGE
    B. down, the mountain, through
    C. down the mountain through
    D. down, the mountain through

PASSAGE II

Ashley Bryan: A Shining Life

Ashley Bryan, winner of numerous prizes,

including the Coretta Scott King Book Award, has

created more than thirty books for children. Born in

New York City in 1923, this now-retired art professor

<u>began his career drawing on the walls, floors, and even</u>

16

<u>the bedsheets in his parents' house.</u>

16

16. Given that all the choices are true, which one ends the paragraph with the strongest indication that Bryan was enthusiastic about art at an early age?
    F. NO CHANGE
    G. has traveled all over the world during a long and prolific career that spans many decades.
    H. lives on an island off the coast of Maine, where he makes stained glass art, puppets, and books for children of all ages.
    J. makes appearances all over the country, showing great enthusiasm, in particular, for educating and inspiring young people.

Some of Bryan's most celebrated books retell

folktales from around the <u>world</u> Japan, India, Nigeria, and

17

17. A. NO CHANGE
    B. world and
    C. world.
    D. world,

Zambia are only some of the countries <u>who's stories make</u>

18

it into his pages. For instance, *Beautiful Blackbird* relates

a Zambian folktale that explains how birds of various

colors pleaded with the blackbird to grace them with

distinguishing markings, such as stripes on their tails

or rings around their necks. <u>Amazing, right?</u> In *The Story*

19

18. F. NO CHANGE
    G. stories of whom makes
    H. whose stories make
    J. whom stories make

19. A. NO CHANGE
    B. Who knew?
    C. Could it be?
    D. DELETE the underlined portion.

of Lightning and Thunder, <u>Bryan, an award winner,</u> shares

20

20. F. NO CHANGE
    G. Bryan, who has won many awards,
    H. Bryan, whose awards are many,
    J. Bryan

a Nigerian legend about a mother sheep and her <u>only</u> son.

21

21. Given that all the choices accurately reflect the story as told by Bryan, which one most clearly suggests what it is about the son that results in the fate of both sheep?
    A. NO CHANGE
    B. troublemaking
    C. growing
    D. beloved

GO ON TO THE NEXT PAGE.

The two are ultimately banished by the king to live in the sky after the son's youthful pranks <u>were to end in disaster</u> for the villagers.

[1] *Ashley Bryan's ABC of African American Poetry* honors twenty-five poems and one spiritual, "the root of Black song and poetry," Bryan writes <u>in</u> the introduction. [2] Each page spotlights one poem and one letter of the alphabet. [3] The work—celebrating poets Lucille Clifton, Countee Cullen, Langston Hughes, and <u>others,</u> invites readers to be enriched by their own heritage or that of another group, as the case may be. [4] Though his books delve at times into somber subject matter—<u>be it</u> slavery, the loss of a harvest, or a misunderstanding between friends—each one emerges as an affirmation of life. [5] That perspective is perhaps most <u>explicitly in evidence to be perceived in his</u>

2007 work <u>the name of it is</u> *Let it Shine; Three Favorite Spirituals.* [6] Here, in forty pages flooded with color, Bryan leaves traces of tragedy. [7] However, the overwhelming messages in the text and the images are to embrace life, to honor oneself and others, and freely <u>giving</u> to a larger world. [8] The "retired" Bryan continues to do just that. "Each time I finish something," says the artist, "I can't wait to start again and do something even better." 29

22. **F.** NO CHANGE
    G. how they ended
    H. but ending
    J. end

23. **A.** NO CHANGE
    B. in which
    C. that is
    D. DELETE the underlined portion.

24. **F.** NO CHANGE
    G. others—
    H. others:
    J. others

25. **A.** NO CHANGE
    B. for example, it was
    C. it will be
    D. it was

26. **F.** NO CHANGE
    G. explicitly expressed to be noted
    H. prominently explicit for readers
    J. explicit

27. **A.** NO CHANGE
    B. by Ashley Bryan, it's called
    C. the title of the book is
    D. DELETE the underlined portion.

28. **F.** NO CHANGE
    G. to give freely
    H. given freely
    J. a free gift

29. The writer wants to divide this paragraph into two so that the first paragraph focuses exclusively on Bryan's book combining poetry and illustrations of the alphabet. The best place to begin the new paragraph would be at the beginning of Sentence:

    A. 4.
    B. 5.
    C. 6.
    D. 7.

Question 30 asks about the preceding passage as a whole.

30. Suppose the writer's goal had been to write an essay about an artist with a long and successful career. Would this essay accomplish that goal?

F. Yes, because it focuses on an artist and states that his most popular books are based on his childhood memories.
G. Yes, because it focuses on an artist with decades of experience and many books, including award winners, to his credit.
H. No, because even though it focuses on a successful artist, it does not provide the exact publication dates for each of his books.
J. No, because it focuses on what inspired a particular artist but does not indicate whether he was successful.

PASSAGE III

Edward Hopper: The Artist Who Painted Light

The American realist painter Edward Hopper (1882–1967) loved light, in the 1920s, Hopper painted
pictures of cities and New England coastal regions in which he captured varieties and intensities of light ranging from brilliant afternoons to dusks to sinister nights. 32

Hopper once stated that human figures interested him less than the light in a scene he believed light was the
dramatic element that conveyed vitality and immediacy in a painting. "What I really want to do," he said, "is to paint sunlight on the side of a house." In his *Sun in an Empty Room* (1963), light coming from a single window creates large rectangles that seems to inhabit the room.

31. A. NO CHANGE
    B. light during
    C. light, during
    D. light. In

32. If the writer were to delete the phrase "ranging from brilliant afternoons to dusks to sinister nights" (placing a period after the word *light*), the paragraph would primarily lose:

F. a sense of the variety of Hopper's depictions of light.
G. a hint at why Hopper painted few people.
H. an explanation for why Hopper appreciated light.
J. several examples of how mood affected Hopper's work.

33. A. NO CHANGE
    B. scene, he
    C. scene. He
    D. scene that he

34. F. NO CHANGE
    G. seem
    H. appears
    J. appeared
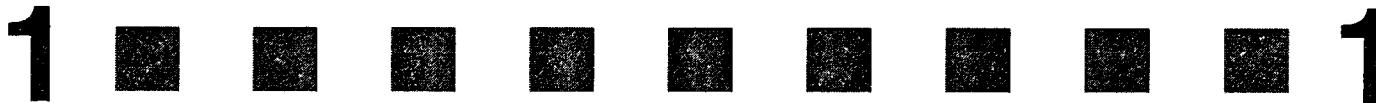
The <u>light itself,</u> takes on as much presence as a human
₃₅
figure might. Light also seems to become a character

in *Rooms by the Sea* (1951). From an open door

facing the <u>sea, which</u> intense light
₃₆

<u>pours</u> into a hotel room.
₃₇

    In *Nighthawks*, Hopper's best-known painting, the

viewer takes on the role of an outsider looking through a

window into a well-lighted diner. The artificial light that

shines down on three <u>customers and a waiter,</u> sets off the
₃₈

dark world outside. ☐39

    Sunlight attracts human figures in many of

Hopper's paintings. In *Cape Cod Morning*, a woman

bending forward from the waist seems to embrace the

light outside her bay window. <u>In other paintings people</u>
₄₀
sit in light streaming through restaurant or hotel windows.

Perhaps the <u>artistic rendering of colored matter on canvas</u>
₄₁
that best depicts a person experiencing light is *Morning*

Sun. A <u>woman, with legs drawn up sits</u> on a bed facing an
₄₂
open window. Her expression of concentration on the light

conveys a feeling of absolute serenity.

---

35. A. NO CHANGE
    B. light, itself,
    C. light, itself
    D. light itself

36. F. NO CHANGE
    G. sea, where
    H. sea as
    J. sea,

37. Which choice best reinforces the notion that the light was intense?
    A. NO CHANGE
    B. comes
    C. drifts
    D. files

38. F. NO CHANGE
    G. customers and, a waiter,
    H. customers, and a waiter
    J. customers and a waiter

39. Which of the following true statements, if added here, would draw a conclusion most consistent with the information presented in this paragraph?
    A. Landscapes were another interesting type of painting that Hopper created.
    B. This contrast dramatizes the alienation and solitude of people in a large city.
    C. Sunlight was also an important element in Hopper's landscapes.
    D. Other Hopper depictions of urban scenes include *Early Sunday Morning* and *Sunlight in a Cafeteria*.

40. F. NO CHANGE
    G. (Do NOT begin new paragraph) Nevertheless, in
    H. (Begin new paragraph) Nevertheless, in
    J. (Begin new paragraph) In

41. A. NO CHANGE
    B. painting
    C. colorful, hand-rendered work of art
    D. thing

42. F. NO CHANGE
    G. woman, with legs drawn up sits,
    H. woman, with legs drawn up, sits
    J. woman with legs drawn up, sits

At the age of eighty-three, just two years before he died, Hopper painted *Two Comedians*, but it depicts a male and female clown on a stage, figures that represent him and his wife. Hopper couldn't resist showing the clowns portraying the two of them.

43. **A.** NO CHANGE
 B. however, it
 C. which
 D. and

44. Given that all the choices are true, which one is most consistent with the main focus of the essay?

 F. NO CHANGE
 G. representing his happy life.
 H. wearing funny costumes and makeup.
 J. walking toward the sunlight.

> Question 45 asks about the preceding passage as a whole.

45. Suppose the writer were interested in conveying a source of Hopper's inspiration. Would this essay successfully fulfill the writer's goal?

 A. Yes, because the essay describes the central role of light in Hopper's paintings.
 B. Yes, because the essay includes some biographical information on Hopper.
 C. No, because the essay only gives a few examples of portraits of individuals.
 D. No, because the essay focuses more on Hopper's painterly technique than on his subjects.

PASSAGE IV

Mary Lease—Populist Activist

The daughter of a Pennsylvania farmer, Mary Elizabeth Lease possessed a natural sympathy for farmers, which made her a powerful champion in their fight for political reform in the late 1800s. After struggling financially in the Depression of 1873, she and her husband, moved to a farm in

Kansas attempting to regain financial security.

46. **F.** NO CHANGE
 G. her and her husband,
 H. she and her husband
 J. her husband and her

47. **A.** NO CHANGE
 B. Kansas, here they attempted
 C. Kansas, which attempted
 D. Kansas in an attempt

There, they experienced firsthand the difficulties that plagued farmers at that time, such as high mortgage rates and the railroads' inflated fees to ship agricultural goods. [48]

These conditions prompted Lease to become politically involved. By 1888, Lease
<u>49</u>

begun delivering speeches for the emerging Populist
<u>50</u>
Party, a political group that sought to represent the interests of farmers and workers. Party leaders, mindful of Lease's persuasive speaking ability, officially invited Lease to "stump" for them in the 1890 congressional election campaigns. Lease accepted the invitation and, during that year, delivered over 160 speeches for the party.

A shrewd speaker, Lease presented complex issues, such as interest rates, in a confident, straightforward,
<u>51</u>

manner that her audiences understand easier. She
<u>52</u>

denounced big business and bank owners who, she
<u>53</u>
believed, created disadvantages for farmers and workers

by monopolizing wealth. Lease used genuinely accurate
<u>54</u>
language to extol the Populist Party's call for election reforms, minimum wage laws, and a redistribution of wealth. Lease also ridiculed her opposition and presented

48. If the writer were to delete the preceding sentence, the paragraph would primarily lose a statement that:
F. explains how banks and railroads attempted to alleviate the economic burdens farmers faced in the late 1800s.
G. offers examples of issues that fueled farmers' desire for reform in the late 1800s.
H. describes the economic reforms that prompted the Leases to turn to farming.
J. evaluates attitudes toward farming that were prevalent at the time.

49. A. NO CHANGE
B. active and involved in participating in political events.
C. involved in the realm of politics.
D. engaged and involved in politics.

50. F. NO CHANGE
G. had begun
H. had began
J. has began

51. A. NO CHANGE
B. as interest rates, in a confident, straightforward
C. as, interest rates in a confident straightforward
D. as interest rates in a confident straightforward

52. F. NO CHANGE
G. most easily understand.
H. easily understood.
J. understood easier.

53. A. NO CHANGE
B. that of whom,
C. whom,
D. DELETE the underlined portion.

54. Which choice most strongly conveys that the language Lease used to confront her opposition was intense?
F. NO CHANGE
G. emotionally charged
H. somewhat stirring
J. clearly distinct

the Populist Party as both the logical and morally correct

choice. Thus it was that critics and supporters alike
     55

admired her ability to energize audiences. One critic
     56

even noted, "She could recite the multiplication table
                              57
and set a crowd hooting and harrahing at her will."
                              57

Such positive responses to Lease's

compelling speeches gave the Populist Party

the momentum it needed. In the fall of 1890, the

Populists elected five representatives to Congress.
     58

In the 1880s, Lease was admitted to the bar and later
                              59
practiced law in New York City.
                    59

55. A. NO CHANGE
    B. Therefore it was true that critics
    C. As it was, critics
    D. Critics

56. F. NO CHANGE
    G. that admired their
    H. admired their
    J. admiring her

57. Which of the following accurate quotations would best conclude the paragraph and create an effective transition into the next sentence of the essay?
    A. NO CHANGE
    B. "Mrs. Lease is earnest, absolutely fearless, but uppermost in all her thoughts and deeds seems to be Mrs. Lease."
    C. "Lease has been devoting altogether too much attention to raising cane in the field of Kansas politics."
    D. "Seldom, if ever, was a woman so vilified and so misrepresented by malignant newspaper attacks."

58. F. NO CHANGE
    G. Populists's
    H. Populist's
    J. Populists'

59. Given that all the choices are true, which one most effectively concludes the paragraph and the essay by maintaining the essay's focus on the power of Lease's political influence?
    A. NO CHANGE
    B. Although the Populist Party eventually faded from the political scene, the Progressive Party of 1912 preserved some of its ideals.
    C. After breaking with the Populist Party, Lease moved to New York City, where she became a political reporter.
    D. In 1892, Lease's ability to garner support helped the party place its first presidential candidate on the ballot.

Question 60 asks about the preceding passage as a whole.

60. Suppose the writer's goal had been to write an informative essay tracing the evolution of broad changes in a political party's beliefs. Does this essay accomplish that goal?

   F. Yes, because the essay clearly explains how the Populist Party was created and describes the development of its political platform.

   G. Yes, because the essay explains how Lease altered the mission of the Populist Party over the course of several years.

   H. No, because the essay focuses on Lease's involvement with the Populist Party, not on changes within the party itself.

   J. No, because the essay fails to establish the Populist Party as a legitimate political party in the late 1800s.

PASSAGE V

With a Little Help from Friends

Quino checkerspot butterflies, each a red and black flutter of stained glass, ranging along the Pacific coast
61

from Mexico to Canada. With temperatures rising in the
62
butterflies' southernmost habitats, plants that attract them are drying up, eliminating the insects' food source at the caterpillar stage.

Conservation biologist Camille Parmesan,
63
was dismayed to find that nearly three-fourths of the quino checkerspot population in southern California has vanished. On the other hand, those currently living now in the cool, wet climates
64
of northern California and Canada are faring better.

61. A. NO CHANGE
   B. glass—range
   C. glass. Range
   D. glass, range

62. F. NO CHANGE
   G. having rose
   H. raising
   J. risen

63. A. NO CHANGE
   B. biologist, Camille Parmesan,
   C. biologist Camille Parmesan
   D. biologist, Camille Parmesan

64. F. NO CHANGE
   G. living currently today
   H. currently living
   J. currently now

So, Parmesan has proposed a way to save the quarter-sized

butterflies and that doing so, maintain biodiversity. Her
_____
65

plan, however, is raising eyebrows 66 .

Parmesan, along with others, advocates the use of

"assisted migration," which is an interesting and relatively
_____
67

new idea some biologists are considering. For migrating
_____
67

checkerspots, there's an additional problem: Los Angeles

lies directly in their path should they be inclined to try
__
68

migrating to cooler climates. Parmesan is transporting

cocoons north of L.A., hoping to augment the existing

population by moving cocoons from one place to the other.
_____
69

[1] Opponents of assisted migration sight as
                                       ____
                                        70
two deterrents the cost and the likelihood that human

interference could turn a species into an invasive pest.

[2] The cocoons are portable and, consequently, cheap to

transport. [3] Parmesan, though, thinks the checkerspot is

the perfect candidate for an assisted move. [4] She also

notes that the butterfly isn't prolific enough to endanger

its adopted habitat. 71

65. A. NO CHANGE
    B. by which so doing,
    C. in which doing so,
    D. in so doing,

66. The writer is considering adding the phrase "among
    some of her colleagues" here. Should the writer make
    this addition?
    F. Yes, because it clarifies that people with similar
       expertise disagree, not just the general public.
    G. Yes, because it explains the argument biologists
       have raised against assisted migration.
    H. No, because Parmesan's colleagues are not specifi-
       cally named.
    J. No, because it abruptly changes the focus from the
       quino checkerspot butterfly to Parmesan.

67. Given that all the choices are true, which one most
    effectively introduces what might be an unfamiliar
    concept to readers?
    A. NO CHANGE
    B. in which humans transplant species to help them
       escape shifts in their environment caused by cli-
       mate change.
    C. a controversial solution to a problem that Parmesan
       has spent years studying along the Pacific coast.
    D. a solution that would cost millions of dollars if the
       species in question was difficult to transport.

68. Which choice most clearly emphasizes Los Angeles's
    size as a barrier to the butterflies' migration?
    F. NO CHANGE
    G. sprawls
    H. exists
    J. sits

69. A. NO CHANGE
    B. population by moving them to a cooler place.
    C. population by bringing them north.
    D. population.

70. F. NO CHANGE
    G. sites
    H. cite
    J. site

71. For the sake of the logic and coherence of this para-
    graph, Sentence 2 should be placed:
    A. where it is now.
    B. before Sentence 1.
    C. after Sentence 3.
    D. after Sentence 4.
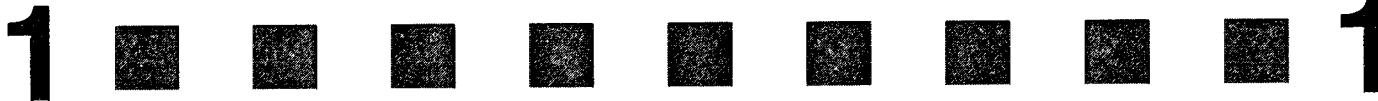
Even so, many biologists consider any assisted

migration the hubris of people who believe you had
<u>   </u>
                                   72

a right to reorganize Earth. The temptation to

interfere, says critics, is incompatible with preservation.
<u>   </u>
        73

Their caution frustrates Parmesan she believes such a
                         <u>   </u>
                                   74

mindset ignores the fact that the alternative outcome
        <u>   </u>
           75
could be extinction. Doing nothing, she insists, ultimately

outweighs any risk that comes from doing something.

72. **F.** NO CHANGE
    G. they have
    H. Parmesan has
    J. I have

73. **A.** NO CHANGE
    B. interfere says critics,
    C. interfere, say critics,
    D. interfere say critics

74. **F.** NO CHANGE
    G. Parmesan who, believing
    H. Parmesan. She believes
    J. Parmesan, she believes

75. **A.** NO CHANGE
    B. snubs
    C. pays no mind to
    D. tunes out

END OF TEST 1

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

MATHEMATICS TEST
60 Minutes—60 Questions

DIRECTIONS: Solve each problem, choose the correct answer, and then fill in the corresponding oval on your answer document.

Do not linger over problems that take too much time. Solve as many as you can; then return to the others in the time you have left for this test.

You are permitted to use a calculator on this test. You may use your calculator for any problems you choose, but some of the problems may best be done without using a calculator.

Note: Unless otherwise stated, all of the following should be assumed.

1. Illustrative figures are NOT necessarily drawn to scale.
2. Geometric figures lie in a plane.
3. The word *line* indicates a straight line.
4. The word *average* indicates arithmetic mean.

---

1. There are 42 tuna and 49 salmon in a fish tank. What is the ratio of tuna to salmon?

    A. 1:6
    B. 1:7
    C. 6:7
    D. 6:13
    E. 7:6

2. The only solution to the equation $(x - 2)(x - 10) = c$ is $x = 6$. What is c ?

    F. −16
    G. −12
    H. 16
    J. 20
    K. 24

3. Samantha, Larry, and Maria own shares of stock in the Plentiful Peanuts company. Samantha owns 50 shares, Larry owns 30 shares, and Maria owns 70 shares. Today, the value of 1 share of Plentiful Peanuts stock is $4.05. What is the total value of Samantha's, Larry's, and Maria's shares of Plentiful Peanuts stock?

    A. $154.05
    B. $190.50
    C. $405.00
    D. $605.00
    E. $607.50

4. $5p^6 \cdot 3p^2$ is equivalent to:

    F. $8p^4$
    G. $8p^8$
    H. $8p^{12}$
    J. $15p^8$
    K. $15p^{12}$

DO YOUR FIGURING HERE.

5. Simeon ordered graduation announcements from 'Nouncements & Notes. He was charged $35.00 for his announcements and was charged 8% of that amount for shipping. How much was Simeon charged for his announcements and shipping?

A. $35.08
B. $35.70
C. $36.08
D. $37.80
E. $43.00

6. A jar contains only 11 red balls, 9 yellow balls, 5 green balls, and n white balls. Each ball is a solid color. What is the probability that a ball randomly chosen from the jar is yellow?

F. $\dfrac{1}{9}$

G. $\dfrac{1}{25}$

H. $\dfrac{9}{25}$

J. $\dfrac{9+n}{25+n}$

K. $\dfrac{9}{25+n}$

7. Each of the following (x,y) coordinate planes shows the graph of a quadratic function. Only one of the functions has no real zeros. Which one?

A.

D.

B.

E.

C.
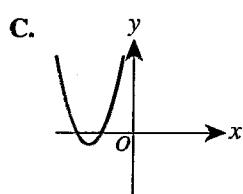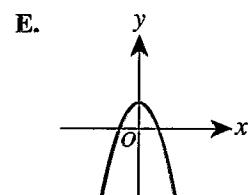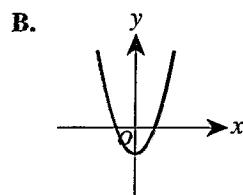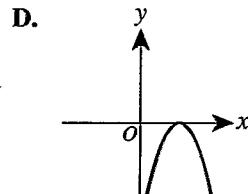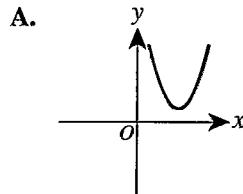
DO YOUR FIGURING HERE.

8. On a certain day in 2008, the population of the United States was estimated to be 303,488,509. Which of the following values is closest to this estimate?

   F. 3.03×10^6
   G. 3.04×10^6
   H. 3.03×10^8
   J. 3.03×10^9
   K. 3.04×10^9

9. In the figure below, $\overleftrightarrow{AB}$ is parallel to $\overleftrightarrow{CD}$, and $\overleftrightarrow{FG}$ intersects $\overleftrightarrow{AB}$ and $\overleftrightarrow{CD}$ at J and K, respectively. Which of the following equations *must* be true?

   A. $x = \frac{1}{2}y$

   B. $x = y$

   C. $x + y = 90$

   D. $x + y = 180$

   E. $x + y = 360$
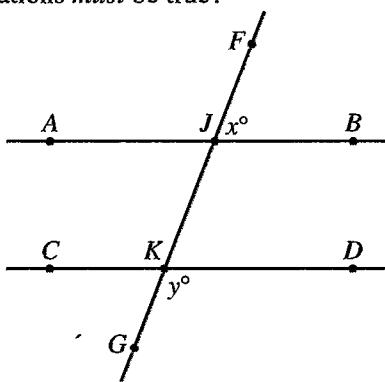
10. In the figure below, $\overline{AB}$ is congruent to $\overline{BC}$, and $\overline{AE}$ intersects $\overline{BF}$ at C. What is the measure of $\angle B$?

    F. 28°
    G. 31°
    H. 62°
    J. 118°
    K. 149°
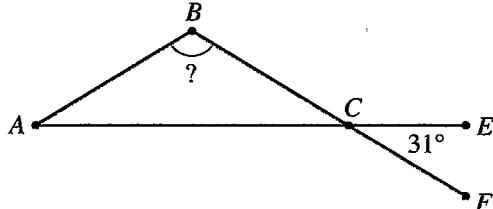
11. The expression $\dfrac{7 + \frac{1}{5}}{1 + \frac{1}{10}}$ is equal to:

    A. $3\frac{3}{11}$

    B. 4

    C. $4\frac{1}{2}$

    D. $6\frac{6}{11}$

    E. 9

GO ON TO THE NEXT PAGE.

12. Consider all products xy such that x is divisible by 6 and y is divisible by 10. Which of the following whole numbers is NOT a factor of each product xy ?

F.   2
G.   6
H.   8
J.   30
K.   60

DO YOUR FIGURING HERE.

13. Kaya rented a boat from a marina for a fee of $50, plus $3 for every gallon of gas she used. When she returned the boat, Kaya was given a bill of $98. She had kept track of her gas usage and thought that the bill was in error—specifically, that the bill was $21 more than it should have been. If Kaya was correct, how many gallons of gas did Kaya use during her rental?

A.   2
B.   7
C.   9
D.   16
E.   23

14. In the figure shown below, all angles are right angles, and the side lengths given are in meters. What is the area, in square meters, of the figure?

F.   12
G.   52
H.   68
J.   80
K.   96
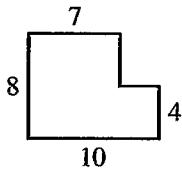
15. $|6-4| - |3-9| = ?$

A.   −8
B.   −4
C.   4
D.   8
E.   22

16. Which of the following proportions, when solved for n, gives the correct answer to the problem given below?

Find the value of n that equals 28% of 96.

F. $\dfrac{28}{100} = \dfrac{n}{96}$

G. $\dfrac{28}{100} = \dfrac{96}{n}$

H. $\dfrac{96}{28} = \dfrac{n}{100}$

J. $\dfrac{96}{100} = \dfrac{28}{n}$

K. $\dfrac{96}{n} = \dfrac{n}{28}$

17. In the standard (x,y) coordinate plane, the point $(2,-6)$ is the midpoint of the line segment with endpoints $(8,-8)$ and:

A. $(-4,-20)$
B. $(-4, -4)$
C. $(3, -1)$
D. $(4, 4)$
E. $(5, -7)$

18. The function g is defined by $g(x) = 2x^2 - 3x$. What is the value of $g(-3)$?

F. -27
G. -21
H. -9
J. 21
K. 27

19. The graph below is that of the solution set to one of the following statements. Which one?
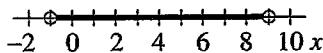
A. $x < 9$ and $x > -1$
B. $x < 9$ or $x > -1$
C. $x > 9$ and $x < -1$
D. $x > 9$ or $x < -1$
E. $x \neq 9$ and $x \neq -1$

20. The inequality $5(x + 2) > 6(x - 5)$ is equivalent to which of the following inequalities?

F. $x < -20$
G. $x < -3$
H. $x < 7$
J. $x < 37$
K. $x < 40$

21. A right triangle has legs of length 3 cm and 5 cm. The length of the hypotenuse, in centimeters, is between:

A. 2 and 3
B. 3 and 5
C. 5 and 6
D. 6 and 7
E. 7 and 9

22. Each side of a square is 5 cm long. One vertex of the square is at $(2,3)$ 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. $(7, 3)$
G. $(6, 1)$
H. $(3, 1)$
J. $(1,-1)$
K. $(-5, 3)$

DO YOUR FIGURING HERE.

23. The counselors at Riverdale High School created the Venn diagram below to show the distribution of music elective placements of 150 students. Students could request placement in 3 different music electives: Band, Orchestra, and Chorus. What is the number of students who were placed in at least 2 of these music electives?

Riverdale High School
Music Elective Placement
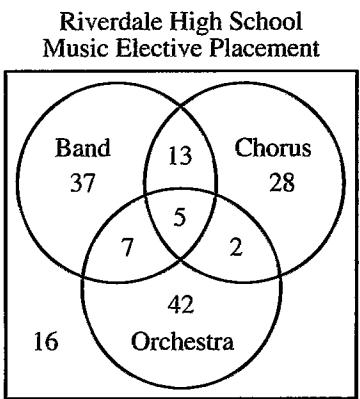
A. 5
B. 13
C. 16
D. 22
E. 27

24. The DeJong family drove 2,500 miles in 5 days from Albany, New York, to the Puye Cliff Dwellings in New Mexico. The points on the graph below show the family's cumulative distance traveled at the end of each day.
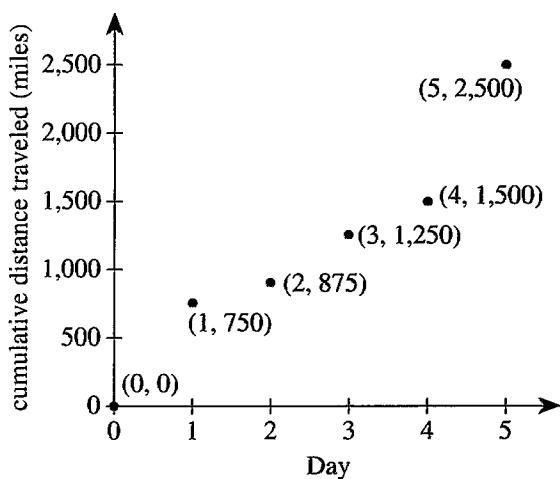
After the DeJong family began their trip, they traveled the least number of miles on which of these 5 days?

F. Day 1
G. Day 2
H. Day 3
J. Day 4
K. Day 5

ACT-71E

19

GO ON TO THE NEXT PAGE.

25. For the right triangle shown below, with the given dimensions in inches, which of the following trigonometric expressions has a value of $\frac{4}{5}$?
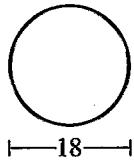
A. sin A
B. cos A
C. tan A
D. sin B
E. tan B
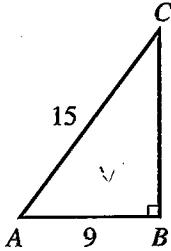
26. The expression $a^2 - 2a + 1$ is equivalent to:

F. $(a - 1)^2$

G. $(a + 1)^2$

H. $(a + 1)(a - 1)$

J. $(a - 2)\left(a + \frac{1}{2}\right)$

K. $(a + 2)\left(a - \frac{1}{2}\right)$

27. The diameter of the circle shown below is 18 centimeters. What is the circle's circumference, in centimeters?

A. 9π
B. 18π
C. 36π
D. 81π
E. 324π

├──18──┤

28. Which of the following number line graphs represents the solution set of the equation $x^2 + 2 = 3$?

F.
```
 +  +  +  +  ●──●  +  +  +
-4 -3 -2 -1  0  1  2  3  4  x
```

G.
```
 +  +  +  +  ●  ●  +  +  +
-4 -3 -2 -1  0  1  2  3  4  x
```

H.
```
 +  +  +  ●  +  +  +  +  +
-4 -3 -2 -1  0  1  2  3  4  x
```

J.
```
 +  +  +  +  +  ●  +  +  +
-4 -3 -2 -1  0  1  2  3  4  x
```

K.
```
 +  +  +  ●  +  ●  +  +  +
-4 -3 -2 -1  0  1  2  3  4  x
```

DO YOUR FIGURING HERE.

Use the following information to answer questions 29–31.

A rectangular region of grass is 50 feet long by 24 feet wide and has an area of 1,200 square feet. A gardener planted a 5-foot-wide flower border along all 4 sides of this region of grass, as shown below. The outer edge of the flower border is 60 feet long and 34 feet wide.
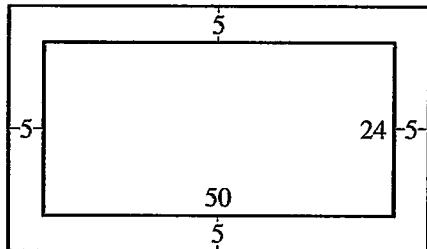
29. The gardener plans to fertilize the region of grass. The gardener can buy only full bags of fertilizer and will use at least 1 bag per 225 square feet of grass. What is the minimum number of bags of fertilizer the gardener needs to buy?

A. 1
B. 4
C. 5
D. 6
E. 9

30. How many feet of decorative fencing would be needed to enclose the flower border along its outer edge?

F. 74
G. 94
H. 148
J. 168
K. 188

31. A cement walkway will be added along one of the longest sides of the flower border and will be equal in length to that side. The top of the walkway will be a rectangle with a width of 3 feet. The walkway will be 4 inches $\left(\frac{1}{9} \text{ yard}\right)$ thick. How many cubic *yards* of cement will be needed for this walkway?

A. $1\frac{7}{27}$

B. $2\frac{2}{9}$

C. $3\frac{7}{9}$

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

E. 20

DO YOUR FIGURING HERE.

32. A fair coin has 2 sides: 1 side is heads and 1 side is tails. A fair cube has 6 sides: 2 sides are solid green, 2 sides are solid yellow, and 2 sides are solid red. The coin and the cube are each tossed once. What is the probability they will land so that the side facing up on the coin is tails and the side facing up on the cube is yellow?

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

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

H. $\frac{1}{6}$

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

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

33. The length of the rectangular prism shown below is twice the width. The height and the width are the same. The volume of the prism is 128 cubic inches. What is the length, in inches, of the prism?

A. 2
B. 4
C. 8
D. 16
E. 32
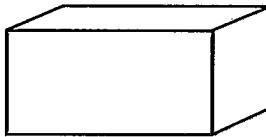
34. For what values of x is the expression $\dfrac{1}{x^2-4}$ undefined?

F. -4 and 4

G. -2 and 2

H. -1 and 1

J. $-\frac{1}{2}$ and $\frac{1}{2}$

K. $-\frac{1}{4}$ and $\frac{1}{4}$

35. Triangle $\triangle ABC$ is shown in the standard (x,y) coordinate plane below. Which of the following is an equation of $\overleftrightarrow{AC}$?

A. $x=2$

B. $y=2$

C. $y=-2x+9$

D. $y=-\frac{1}{2}x+6$

E. $y=\frac{1}{4}x+\frac{3}{2}$
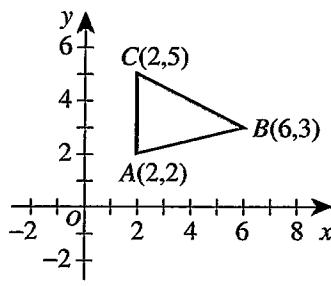
DO YOUR FIGURING HERE.

36. When a certain map is drawn in the standard (x,y) coordinate plane, one city has coordinates (5,6) and another city has coordinates (9,12). If 1 coordinate unit corresponds to 25 miles, which of the following is closest to the straight-line distance, in miles, between these 2 cities?
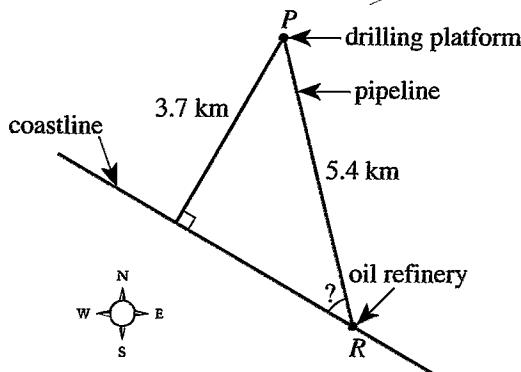
F. 100
G. 150
H. 180
J. 250
K. 500

37. In the figure below, the measures of 4 angles of pentagon $ABCDE$ are given. What is the measure of $\angle A$?

A. 100°
B. 108°
**C.** 120°
D. 140°
E. 160°
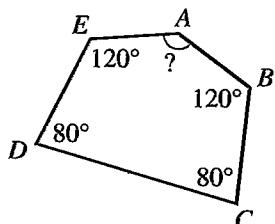
38. Engineers are building a straight underwater pipeline from a drilling platform at P to an oil refinery located at R on a straight stretch of coastline, as shown on the map below. The distance from the platform to the refinery is 5.4 km, and the distance from the platform to the coastline is 3.7 km. Which of the following expressions gives the measure of the acute angle formed by the pipeline and the coastline?

F. $\cos^{-1}\left(\dfrac{3.7}{5.4}\right)$

G. $\cos^{-1}\left(\dfrac{5.4}{3.7}\right)$

H. $\tan^{-1}\left(\dfrac{3.7}{5.4}\right)$

J. $\tan^{-1}\left(\dfrac{5.4}{3.7}\right)$

K. $\sin^{-1}\left(\dfrac{3.7}{5.4}\right)$

DO YOUR FIGURING HERE.

39. A support wire is attached to the top of a vertical pole, as shown below. The wire makes an angle of 60° with level ground at a point exactly 20 feet from the base of the pole. Approximately how many feet above the ground is the top of the pole?
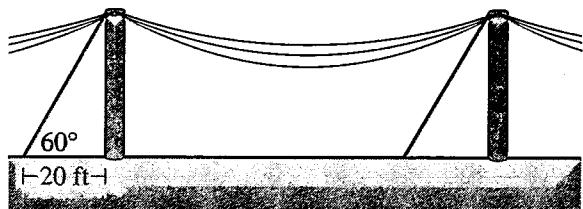

A. 20
B. 23
C. 28
D. 35
E. 40

40. Surveyors want to determine a pond's length, represented by $\overline{AB}$ in the figure below. They place stakes at points A, B, C, D, and E so that C is the intersection of $\overline{BE}$ and $\overline{AD}$ and so that $\overline{AB}$ is parallel to $\overline{DE}$. The distances between certain stakes are shown in the figure. What is the pond's length, in meters?

F. $46\frac{2}{3}$

G. 52

H. 56

J. 62

K. $67\frac{1}{5}$
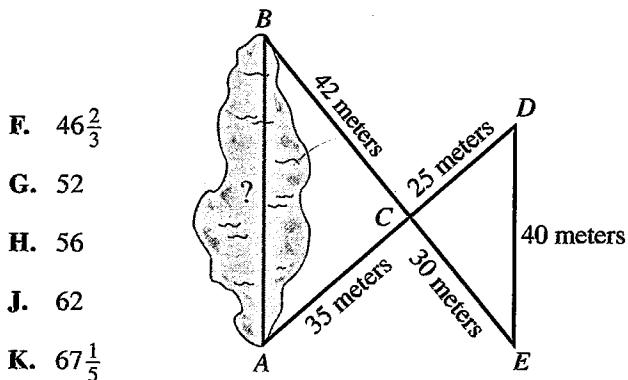
41. Given the 2 similar right triangles shown below with dimensions given in inches, what is the area, in square inches, of the smaller triangle?

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

B. 3

C. 4

D. 6

E. 12

ACT-71E

24

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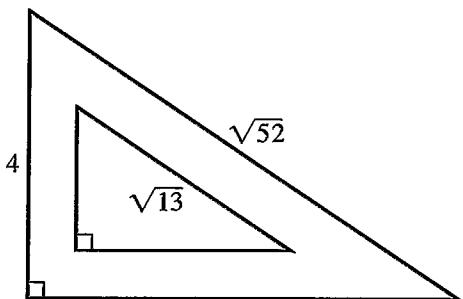
DO YOUR FIGURING HERE.

42. A band has only junior and senior band members. To raise money for new band uniforms, the members sold candy. Candy sales averaged $50 for each junior and $40 for each senior. If the ratio of juniors to seniors in the band was 3:2, candy sales averaged how many dollars per band member?

F. $43
G. $44
H. $45
J. $46
K. $47

43. One of the following values is the slope of a line of best fit for the points shown below in the standard (x,y) coordinate plane. Which value?


A. -8

B. -1

C. 0

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

E. 6
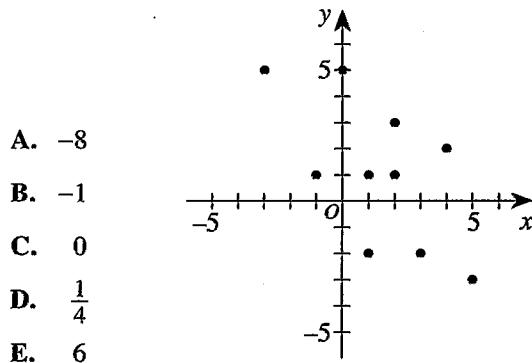
44. Min and Blanca answered the same homework question with different, yet equivalent, expressions. Min's expression was $(x + 3)^2 - x^2$. Blanca said her expression was a simplified form of Min's expression. Which of the following expressions could be Blanca's?

F. $6x + 6$
G. $6x + 9$
H. $6 + 2x - x^2$
J. $9 + 2x - x^2$
K. 9

45. Points A through F lie on the circle shown below so that the distance between any 2 adjacent points is equal. The circle has diameter $\frac{9}{2}$ inches. What is the length, in inches, of $\overline{AB}$?

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

B. $\frac{9}{4}$

C. 3

D. $\frac{9\sqrt{3}}{4}$

E. $\frac{9}{2}$
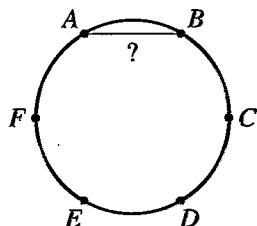
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46. Whenever $a^2b = 1$ for positive values of a and b, which of the following equations gives a in terms of b ?

   F. $a = b^2$

   G. $a = \sqrt{b}$

   H. $a = \dfrac{1}{b}$

   J. $a = \dfrac{1}{b^2}$

   K. $a = \dfrac{1}{\sqrt{b}}$

47. The slope of line l in the standard (x,y) coordinate plane is $\dfrac{2}{3}$. Which of the following is an equation of a line that is perpendicular to line l ?

   A. $3x + 2y = 5$
   B. $3x - 2y = 5$
   C. $2x + 3y = 5$
   D. $2x - 3y = 5$
   E. $-2x + 3y = 5$

48. Given that x and $\dfrac{7-x}{2}$ are integers, which of the following statements about x *must* be true?

   F. x is odd.
   G. x is even.
   H. x is prime.
   J. x is positive.
   K. x is negative.

49. Miles sells Baby Laugh dolls. The number of dolls, x, that Miles sells in 1 year depends on the price he sells them for that year, p dollars per doll. The equation $x = 52 - 2p$, where $0 < p \le 26$, gives the relationship between x and p. Miles's *revenue* is the money collected from selling x dolls. The maximum revenue Miles can make from the sale of Baby Laugh dolls in 1 year occurs at what price per doll?

   A. $13
   B. $16
   C. $20
   D. $24
   E. $26

50. A *geometric sequence* is a sequence of numbers in which each term is multiplied by a constant to obtain the following term. What is the 4th term in the geometric sequence with first 3 terms 4, 6, and 9 ?

   F. 10.5
   G. 12
   H. 13
   J. 13.5
   K. 15

Use the following information to answer questions 51–53.

The value of a used car can be modeled by the formula $V = V_0(1 - r)^t$, where V_0 is the car's purchase price, in dollars; r is the car's constant annual rate of decrease in value, expressed as a decimal; and V is the car's dollar value at the end of t years.

51. Which of the following equations shows the formula solved for r ?

A. $r = 1 - \sqrt[t]{\dfrac{V}{V_0}}$

B. $r = 1 + \sqrt[t]{\dfrac{V}{V_0}}$

C. $r = \sqrt[t]{\dfrac{V}{V_0}} - 1$

D. $r = 1 - t\log\left(\dfrac{V}{V_0}\right)$

E. $r = t\log\left(\dfrac{V}{V_0}\right) - 1$

52. A used car with a purchase price of $20,000 has a constant annual rate of decrease in value of 0.1. According to the model, what is the value of the car, to the nearest dollar, at the end of 3 years?

F. $13,122
G. $14,000
H. $14,580
J. $16,200
K. $18,000

53. A used car has a constant annual rate of decrease in value of 0.075. According to the model, which of the following expressions gives the number of years after purchase for the car to reach a value that is 50% of its purchase price?

A. $\dfrac{50}{7.5}$

B. $\dfrac{1 - 0.075}{0.5}$

C. $\dfrac{2}{1 - 0.0075}$

D. $\dfrac{\log(50)}{\log(7.5)}$

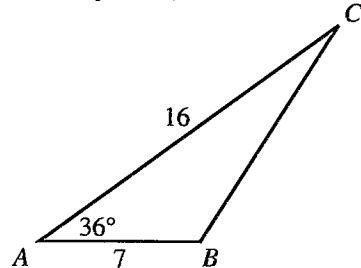E. $\dfrac{\log(0.5)}{\log(1 - 0.075)}$

DO YOUR FIGURING HERE.

54. In $\triangle ABC$ shown below, lengths given are in inches, and the measure of $\angle A$ is 36°. Which of the following values is closest to the length, in inches, of $\overline{BC}$?
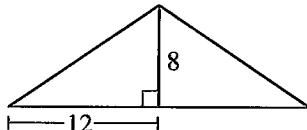
(Note: For any triangle with side lengths a, b, and c, $a^2 = b^2 + c^2 - 2bc \cos \theta$, where θ is the measure of the angle opposite the side of length a. The value of $\cos 36°$ is approximately 0.81.)
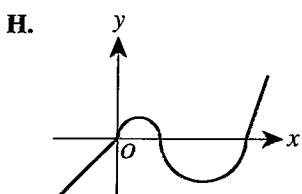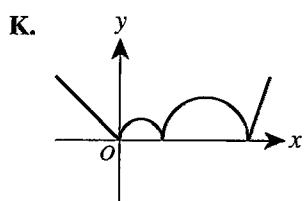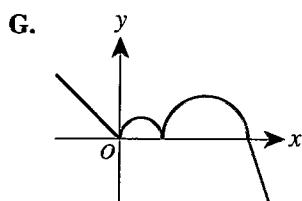
F. 11.1
G. 14.4
H. 17.5
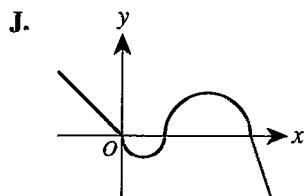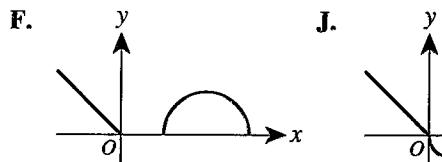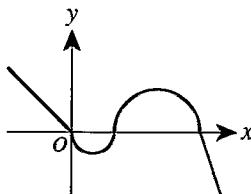J. 19.7
K. 22.1

55. The pitch of a roof is given in a rise:run ratio. An 8:12 pitch is shown below. Which of the following pitches would result in the steepest roof?

A. 1:3
B. 2:5
C. 4:6
D. 6:8
E. 10:16

56. The graph of $y = f(x)$ is shown in the standard (x,y) coordinate plane below. One of the following graphs is that of $y = \left| f(x) \right|$. Which graph is it?

F.

J.

G.

K.

H.

57. Fifteen cars containing a total of 60 people crossed a toll bridge. Each of the 15 cars contained at least 1 person but no more than 5 people. At most how many cars contained exactly 3 people?

- **A.** 3
- **B.** 5
- **C.** 7
- **D.** 8
- **E.** 10

DO YOUR FIGURING HERE.

58. Let θ be the radian angle measure that satisfies $\sin^2\theta - \sin\theta = -\frac{1}{4}$ for $0 < \theta < \frac{\pi}{2}$. What is $\cos\theta$?

- **F.** $\frac{1}{16}$
- **G.** $\frac{1}{4}$
- **H.** $\frac{1}{2}$
- **J.** $\frac{\sqrt{3}}{2}$
- **K.** $\frac{\sqrt{15}}{4}$

59. The system of equations below has multiple solutions, all of which satisfy the equation $y = \frac{4}{3}x - 2$. If it can be determined, what is the value of a ?

$$8x - 6y = 12$$
$$12x - ay = 18$$

- **A.** −6
- **B.** 9
- **C.** 14
- **D.** 18
- **E.** Cannot be determined from the given information

60. As shown in the figure below, D is the center of the circle, and right triangle $\triangle ABD$ intersects the circle at C and F. Point C is the midpoint of $\overline{BD}$, which is 12 cm long. The shaded region inside the circle and outside the triangle has an area of 32π square centimeters. What is the measure of $\angle A$?

- **F.** 40°
- **G.** 45°
- **H.** 50°
- **J.** 58°
- **K.** 67.5°
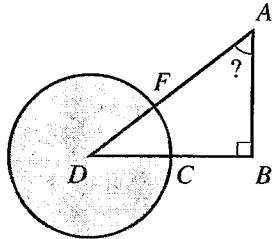
END OF TEST 2

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

DO NOT RETURN TO THE PREVIOUS TEST.

READING TEST

35 Minutes—40 Questions

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

Passage I

PROSE FICTION: This passage is adapted from the novel *The Spirit of the Place* by Samuel Shem (©2008 by Stephen J. Bergman).

"Columbia! Next stop Columbia!"

With an iron inevitability, the Hudson Highlander, northbound out of Grand Central Station, was veering from a trestle out over the Hudson River back onto
5 land. Orville glanced out the right-hand window. At the top of a hill he saw Olana, the Persian-turreted mansion built by the nineteenth-century landscape painter Frederick Church. Its limestone face was a creamy gold against the lowering sun, and he felt the bite of nostal-
10 gia. Grabbing his backpack from the overhead rack, he walked to the space between the cars. He would be home in a couple of minutes.

No he would not. The train screeched, slowed, re-screeched with a lot more oomph, shuddered, and
15 fought itself to a stop.

Orville and the other passengers waited. No information was forthcoming. The air conditioning clicked off. Figures, Orville thought, I come 4,000 miles from Orta to Milan to Zurich to Kennedy to Grand Central
20 and then up the Hudson 128 miles—a whole day's journey—and as soon as we poke up into the southern tip of this hole of a town, things break.

After another fifteen minutes Orville had had enough of the sweltering Amtrak car. Figuring it was
25 only a mile or so to town, he decided to walk. He opened the door and jumped down from the car. The wet heat smacked him in the face like a big sweaty hand. Shouldering his backpack, he walked along the cinders to the front of the train. There were two tracks.

30 Feeling good out in the unconditioned world, his shoes striking the cross ties with soft, firm thunks, Orville stretched his arms out to the dome of sky. Taking a deep breath, he let his eyes ease down the slopes of the Catskill mountains through the green,
35 shadowed foothills to the inlet at Catskill Creek with its oil tanks and red neon sign for Mike's Pizza and to the river itself.

He heard a whistle, a train coming toward him, southbound from Columbia. He moved off the inside
40 track to the track next to the river and watched it approach. The engineer was waving at him in what at first seemed a greeting, but as the train screamed past he realized it was a warning. He jerked around. The northbound train he'd just left was bearing down on
45 him, its own whistle masked by the other's. Orville jumped feet first into the river. The train thundered past, shrieking like a lunatic.

Orville found his footing in the rocky shallows, feeling the beats of hot air on his face. The train whis-
50 tles echoed back off the mountains. He was sore but okay. As he hauled himself up onto the tracks, he caught the acrid scent of creosote.

Creosote. All at once he saw himself as a six-year-old, one summer's day, lying on his back in a neglected
55 grassy field down the street from his house on Ten Broek Lane. The scent of creosote was strong from the railroad tracks running nearby. Alone, he stared up at the clouds passing across the sky and suddenly had the sense that the world as he was seeing it was only a part
60 of something else. For the first time in his life he saw himself as part of some whole, some whole world to which his own being was seamlessly connected. He felt lighter, more alive, as if something else had clicked on—or in. He leapt to his feet, making his legs go as
65 fast as they could, and ran home to tell his mother. He burst into the kitchen and blurted out his discovery as the screen door slammed—bam!—behind him.

Selma Ariel Fleischer Rose, a large, aproned shape looming over the stove, didn't respond.

70 He persisted, dragging a chair over, climbing up, and telling her again, slowly and loudly.

"Something else! Mom, I'm part of something else!"

Selma stared at him. He saw a cloud pass across
75 her gaze. She sighed. "Orville-doll, there's nothing else but this."

The boy felt a rough, twisting pain in his chest. He clenched down on it, trying to make it go away. He fought back tears.

GO ON TO THE NEXT PAGE.

80   "What's wrong, honey-bunny?"

Dread was rising, the pain was going. He felt himself numbing up, like his mouth did when he was at the dentist's. He broke eye contact. Feeling her fearful concern, he said, "Nothing." He turned and ran back out
85   the door.

Now, standing on the tracks, he realized how that moment had been one end of the thread that had unspooled all these years in a life spent running, a life restless with questions.

90   Realizing that now there would be a breakage— the train arriving, his sisters meeting it and not finding him on it—he hurried on. As he rounded Mount Pecora, the vista north opened up. There across the marsh was his hometown, Columbia.

1. Based on the passage, the fact that the northbound train passed Orville on its way to Columbia could be considered ironic because Orville had just:

A. alerted the southbound train's engineer that the northbound train had stopped.
B. decided to wait for the southbound train at a nearby station.
C. realized that he had left his backpack in the northbound train's passenger car.
D. gotten off the northbound train in order to get to town more quickly.

2. Which of the following events referred to in the passage occurred first chronologically?

F. Orville jumped feet first into a river.
G. Orville lay on his back in a grassy field.
H. Orville left Grand Central Station.
J. Orville told his mother about a discovery he had made.

3. It can most reasonably be inferred that Selma's response to Orville in lines 74–76 suggests that Selma was:

A. angered by Orville's outburst.
B. anxious to talk to Orville about his concerns.
C. worried about her other children.
D. resigned to her situation in life.

4. According to the passage, Orville realized that he had spent his life running and struggling with questions as a direct result of a:

F. revelation he had had when he was a young adult.
G. crushing declaration made by his mother.
H. strong desire to escape his hometown.
J. fascination with traveling by train.

5. Which of the following best describes the setting of the last two paragraphs (lines 86–94)?

A. In the kitchen of Orville's house
B. Alongside train tracks south of Columbia
C. At a train station in Columbia
D. In a field on Ten Broek Lane

6. What effect does the sight of the Persian-turreted mansion have on Orville in the passage?

F. It inspires a feeling of nostalgia.
G. It fills him with a sense of dread.
H. It makes him wish he was back in Orta.
J. It makes him feel as if his hometown is absurd.

7. Based on the fourth paragraph (lines 16–22), it can most reasonably be inferred that as an adult Orville regarded his hometown with a sense of:

A. pride.
B. gratitude.
C. contempt.
D. indifference.

8. Which of the following questions does the passage answer?

F. How many years have passed since Orville has seen his mother?
G. Why is Orville traveling back to his hometown?
H. Why does the engineer of the southbound train wave at Orville?
J. How old was Orville when he first left his hometown?

9. The narrator makes use of personification in describing which of the following?

A. The temperature inside the train car (lines 23–24)
B. The Catskill Creek inlet (lines 33–37)
C. The sound made by a passing train (lines 46–47)
D. Mount Pecora (lines 92–93)

10. In the passage, Orville's flashback to a summer's day when he was six was triggered by the:

F. scent of creosote.
G. sight of a grassy field.
H. sound of his mother's voice.
J. sound of the train rushing past.

Passage II

SOCIAL SCIENCE: This passage is adapted from the book chapter "The Discovery and Settlement of Polynesia" by Dennis Kawaharada (©1999 by University of Hawai'i).

Fiji, Tonga, and Samoa are islands of Polynesia.

The Polynesian migration to Hawai'i was part of one of the most remarkable achievements of humanity: the discovery and settlement of the remote, widely scattered islands of the central Pacific. The migration
5　began before the birth of Christ. While Europeans were sailing close to the coastlines of continents before developing navigational instruments that would allow them to venture onto the open ocean, voyagers from Fiji, Tonga, and Samoa began to settle islands in an
10　ocean area of over 10 million square miles. The settlement took a thousand years to complete and involved finding and fixing in mind the position of islands, sometimes less than a mile in diameter on which the highest landmark was a coconut tree. By the time Euro-
15　pean explorers entered the Pacific Ocean in the 16th century almost all the habitable islands had been settled for hundreds of years.

The voyaging was all the more remarkable in that it was done in canoes built with tools of stone, bone,
20　and coral. The canoes were navigated without instruments by expert seafarers who depended on their observations of the ocean and sky and traditional knowledge of the patterns of nature for clues to the direction and location of islands. The canoe hulls were dug out from
25　tree trunks with adzes or made from planks sewn together with a cordage of coconut fiber twisted into strands and braided for strength. Cracks and seams were sealed with coconut fibers and sap from breadfruit or other trees. An outrigger was attached to a single
30　hull for greater stability on the ocean; two hulls were lashed together with crossbeams and a deck added between the hulls to create double canoes capable of voyaging long distances.

The canoes were paddled when there was no wind
35　and sailed when there was; the sails were woven from coconut or pandanus leaves. These vessels were seaworthy enough to make voyages of over 2,000 miles along the longest sea roads of Polynesia, such as the one between Hawai'i and Tahiti. And though these
40　double-hulled canoes had less carrying capacity than the broad-beamed ships of the European explorers, the Polynesian canoes were faster: one of English explorer Captain Cook's crew estimated a Tongan canoe could sail "three miles to our two."

45　After a visit to the Society Islands in 1774, Spanish Captain Andia y Varela described the canoes he saw: "It would give the most skilful [European] builder a shock to see craft having no more breadth of beam than three [arm] spans carrying a spread of sail so large
50　as to befit one of ours with a beam of eight or ten spans, and which, though without means of lowering or furling the sail, make sport of the winds and waves during a gale. These canoes are as fine forward as the edge of a knife, so that they travel faster than the swiftest of our
55　vessels; and they are marvellous, not only in this respect, but for their smartness in shifting from one tack to the other."

The voyaging was by no means easy. There was always a danger of swamping or capsizing in heavy
60　seas, of having sails ripped apart or masts and booms broken by fierce winds, of smashing the hulls against unseen rocks or reefs; and while there were grass or leaf shelters on the decks of voyaging canoes, the voyagers were often exposed to the wind, rain, and sun,
65　with only capes of leaves or bark-cloth wrappings for protection. A stormy night at sea, even in the tropics, can be brutally chilling. If supplies ran short during a long voyage, and no fish or rainwater replenished them, then starvation became a possibility.

70　A long voyage was not just a physical, but a mental challenge as well, particularly for a navigator without compass or chart. To navigate miles of open ocean required an extensive and intimate knowledge of the ocean and sky. Captain Cook noted that Polynesian
75　navigators used the rising and setting points of celestial bodies for directions.

To keep track of their position at sea during long sea voyages, the navigators used a system of dead reckoning—memorizing the distance and direction traveled
80　until the destination was reached. Finding islands before they could actually be seen was also part of the art of navigation. Voyagers followed the flight of landdwelling birds that fished at sea as these birds flew from the direction of islands in the morning or returned
85　in the evenings. The navigators also watched for changes in swell patterns, clouds piled up over land, reflections on clouds from lagoons, and drifting land vegetation.

11. In the context of the passage, the phrase "sometimes less than a mile in diameter on which the highest landmark was a coconut tree" (lines 13–14) primarily serves to explain why:

A. there are many islands scattered throughout the central Pacific.
B. similar vegetation exists on most islands in the central Pacific.
C. early voyagers had difficulty locating islands in the central Pacific.
D. European explorers searched for large, habitable islands in the central Pacific.

12. As it is used in line 12, the phrase *fixing in mind* most nearly means:

F. committing to memory.
G. imagining for a moment.
H. repairing with careful attention.
J. solving through mathematical equations.

GO ON TO THE NEXT PAGE.

13. The passage makes clear that, unlike voyagers from Polynesia, European explorers didn't travel into the open ocean until which of the following aids to ocean travel were developed?

A. Outriggers that could be attached to a ship's hull for stability on the ocean
B. Island landmarks that were visible on the horizon
C. Adzes, cordage, and crossbeams
D. Navigational instruments

14. The statement in lines 5–10 most nearly serves to provide a contrast between the:

F. Polynesian and European explorations of the central Pacific in the sixteenth century, on the basis of the number of square miles explored.
G. earliest navigational instruments used by Polynesian voyagers and those used by European explorers.
H. design and construction of Polynesian canoes and the design and construction of European ships.
J. extent of exploration by Polynesians and by Europeans during the same period in history.

15. The second paragraph (lines 18–33) primarily serves to provide:

A. an explanation of how an outrigger attached to a single hull increased the stability of a Polynesian canoe on the ocean.
B. a step-by-step explanation of how Polynesian builders used tree sap to repair cracks in their canoes.
C. a description of how early Polynesian voyagers observed the night sky to help determine the locations of islands.
D. an overview of several elements of the construction and navigation of canoes used by early Polynesian voyagers of the central Pacific.

16. It can most reasonably be inferred from the passage that a Polynesian canoe that could have made a journey of over 2,000 miles would likely have been:

F. double hulled.
G. eight to ten arm spans wide.
H. equipped with a means of lowering or furling the sails.
J. outfitted with sails made of bark cloth, specially designed for long-distance travel.

17. In lines 47–53, Varela is quoted as expressing amazement after a visit to the Society Islands over seeing a Polynesian canoe that featured a:

A. breadth of beam of only one arm span.
B. breadth of beam that was eight or ten arm spans, outfitted with a sail that would have better fit a much smaller ship.
C. sail of the same shape and material as sails used on many European ships.
D. sail so large that it would have fit a ship with a breadth of beam of eight or ten arm spans.

18. As it is used in line 52, the phrase *make sport of* most nearly means:

F. struggle to conquer.
G. pass through with ease.
H. avoid altogether.
J. defeat slowly and methodically.

19. Which of the following is NOT mentioned in the passage as a condition or an event that was a threat to the safety of early Polynesian voyagers of the central Pacific?

A. Starvation and lack of rainwater
B. Collisions with other ships
C. Extremely cold nights
D. Fierce winds

20. When Varela describes the Polynesian canoes he saw during a visit to the Society Islands as being "as fine forward as the edge of a knife" (lines 53–54), he most specifically means that the:

F. entire body of each canoe was the same width.
G. planks of the canoes were thin and polished.
H. front portion of each canoe was streamlined.
J. canoes were faster when paddled forward than when paddled backward.

33

GO ON TO THE NEXT PAGE.

Passage III

Sister Rosetta Tharpe, as she was professionally billed, was not supposed to be a highlight of the fall 1938 Cotton Club revue, a fast-paced variety show headlining Cab Calloway and the Nicholas Brothers,
5 young dancers who thrilled audiences with their acrobatic elegance. Originally, this emerging gospel singer was just a gamble, signed by Herman Stark for two weeks. Like other new attractions, Rosetta constituted one part of a huge supporting cast, performers who
10 largely filled time between the big numbers. Early print advertisements did not mention her name.

Yet from the outset, audiences were thrilled by Rosetta's unusual sound and style. Newspaper reporters, white and black, struggled for the right words
15 to describe her. Most used some variation of "swing" to convey the rhythmic quality of her music, calling her a "swinger of spirituals," a "spiritual swinging favorite," a "hymn swinging evangelist," and a "hymnswinger." The *Chicago Defender* called her "a swingcopated
20 manipulator of loud blue tones" and noted that "she handles the guitar rather creditably in accompaniment."

Still others compared Rosetta to Bessie Smith, the blues singer whose career was cut short by a 1937 car accident. Like Smith, Rosetta presented a compelling
25 picture of black female self-assurance and vigor when she performed. Indeed, her "gospel blues" and Smith's secular blues were not all that distinct. Musically, both sprang from sources in slave culture, and both confronted the harshness of the world with determination
30 to "make a way outta no way." For gospel singers, this "way" was through God; for blues singers, it was through self-reliance.

From October to December 1938, events of profound and lasting significance to Rosetta's career
35 occurred almost weekly. Irving Mills approached Rosetta in mid-October and soon had her signed to an "exclusive publishing contract" with Mills Music. A company with an international distribution network, Mills Music quickly published *Eighteen Original Negro
40 Spirituals*, an impressive booklet containing songs "with an original and appealing religious quality set down exactly as sung by Sister Tharpe since infancy in Negro churches all over the country." Encompassing such titles as "I Look Down the Road and I Wonder,"
45 "My Lord and I," and "That's All," *Eighteen Original Negro Spirituals* would serve as a crucial source of Rosetta's repertoire for the next thirty-five years.

Music publishing was important—as early gospel entrepreneurs well understood—but it didn't have the
50 glamour of sound recordings. Some of that glamour became Rosetta's when she signed a contract the same month with Decca Records.

Decca had recorded songs by gospel singer Mahalia Jackson in May 1937, but they did so poorly
55 that the label dropped her and didn't venture back into the gospel field until it took a chance on Rosetta seventeen months later. With her bell-like voice, winning smile, and Cotton Club notoriety, Rosetta had the combination of the musical goods and showbiz flair that
60 Mahalia had lacked. Her first records, recorded in a single session on October 31, 1938, with Rosetta accompanying herself on guitar, were instant successes. How successful they were in hard numbers is difficult to say, but successful enough to bring Rosetta back for
65 a second session in January 1939 and to keep her in Decca's employ, without interruption, until the mid-1950s.

Rosetta's first session reveals a young woman capable of finding and communicating the emotional
70 core of a song through exquisite phrasing, inventive vocal technique, and guitar playing of originality, confidence, and grace. Her years of using her gift in live performance had taught her how to make a listener *feel* a song, not just hear it, by making use of vibrato, trills,
75 enunciation, dynamic variety (variations in loudness), and melisma, a gospel hallmark in which the vocalist sings several notes within the space of a single syllable. Like a blues or jazz singer, Rosetta tended to sing around the beat rather than on top of it, allowing for
80 rhythmic complexity and improvisation. Like a blues singer, too, she was capable of covering material of enormous topical and emotional variety. Her first four cuts for Decca range widely in tone, from the sassy satire of "That's All" to the wistful contentment of "My
85 Man and I" to the extroverted exuberance of "Rock Me" and the longing of "The Lonesome Road." All bore the mark of a singer-player of extraordinary control and personality.

21. The main purpose of the passage is to:
   A. contrast the characteristics of gospel music and the characteristics of blues music.
   B. compare Tharpe's gospel sound to that of other popular gospel singers of her day.
   C. explain how the careers of several musicians inspired the work of an emerging gospel singer.
   D. describe some of the significant events that occurred early in Tharpe's musical career.

22. Based on the information in the first paragraph, the role of Cab Calloway and the Nicholas Brothers in the 1938 Cotton Club revue was most likely that of:
   F. featured performers who were central to that year's program.
   G. young performers who were critical of Tharpe's musical repertoire.
   H. new attractions who, like Tharpe, filled in time between numbers.
   J. inexperienced performers who used the show to develop new skills.

23. It can most reasonably be inferred from the second paragraph (lines 12–21) that newspaper reporters believed the quality of Tharpe's sound and style was:

   A. continually changing from one performance to another.
   B. difficult to place in a single category.
   C. widely disputed by music critics at the time.
   D. described unfavorably by reviewers familiar with the characteristics of gospel music.

24. The comparison between blues singer Bessie Smith and Tharpe in the third paragraph (lines 22–32) serves mainly to:

   F. describe how Smith's music impacted young singers like Tharpe.
   G. explain why Tharpe decided to emulate Smith's style of music.
   H. illustrate that Tharpe's gospel blues and Smith's secular blues had similar origins and themes.
   J. suggest that Tharpe was beginning to develop an original sound and style that differed from the vigor in Smith's music.

25. According to Mills Music, the songs published in *Eighteen Original Negro Spirituals* were first sung by Tharpe in:

   A. the 1938 Cotton Club revue.
   B. churches all over the United States.
   C. recording studios such as that of Decca Records.
   D. shows less well known than the Cotton Club revue.

26. According to the passage, a vocalist who sings several notes within the space of a single syllable is demonstrating:

   F. melisma.
   G. vibrato.
   H. emotional variety.
   J. dynamic variety.

27. As it is used in line 27, the word *distinct* most nearly means:

   A. visible.
   B. striking.
   C. different.
   D. understandable.

28. According to the passage, blues singers confronted the harshness of the world through:

   F. self-reliance.
   G. religious themes.
   H. rhythmic complexity.
   J. exquisite phrasing.

29. Which of the following events in the passage happened first chronologically?

   A. Decca Records recorded Tharpe's first session.
   B. Mahalia Jackson recorded songs with Decca Records.
   C. Mills Music published *Eighteen Original Negro Spirituals*.
   D. Cab Calloway and the Nicholas Brothers performed in the 1938 Cotton Club revue.

30. According to the passage, what quality did Tharpe have that Mahalia Jackson lacked?

   F. An unusual rhythmic sound
   G. An essential combination of musical talent and showbiz flair
   H. The tendency to sing around a beat, rather than on top of it
   J. The ability to communicate the emotional core of a song

Passage IV

The word *semantic* refers to the meaning a word or sentence conveys. The word *syntax* refers to the grammatical structure of a sentence.

The linguistic phenomenon in Shakespeare which is known as 'functional shift' refers to the way that Shakespeare will often use one part of speech—a noun or an adjective, say—to serve as another, often a verb,
5 shifting its grammatical nature with minimal alteration to its shape. Thus in *Lear* for example, Edgar comparing himself to the king: 'He *childed* as I *fathered*' (nouns 'child' and 'father' shifted to verbs); in *Troilus and Cressida*, '*Kingdomed* Achilles in commotion
10 rages' (noun 'kingdom' converted to adjective).

Research suggests that there is one specific part of the brain that processes nouns and another part that processes verbs: but what happens when for a microsecond there is a serious hesitation between whether, in
15 context, this is noun or verb?

With the help of my colleague in English language, Victorina González-Díaz, as well as scientists, I designed a set of stimuli—40 examples of Shakespeare's functional shift. At this very early and rather
20 primitive stage, we could not give our student-subjects undiluted lines of Shakespeare because too much in the brain would light up in too many places: that is one of the definitions of what Shakespeare-language does. So, the stimuli we created were simply to do with the noun-
25 to-verb or verb-to-noun shift-words themselves, with more ordinary language around them.

Around each of those sentences of functional shift we also provided three counterexamples which were shown on screen to the experiment's subjects in random
30 order: all they had to do was press a button saying whether the sentence roughly made sense or not. Thus, below, A ('accompany') is a sentence which is conventionally grammatical, makes simple sense, and acts as a control; B ('charcoal') is grammatically odd, like a
35 functional shift, but it makes no semantic sense in context; C ('incubate') is grammatically correct but still semantically does not make sense; D ('companion') is a Shakespearian functional shift from noun to verb, and is grammatically odd but does make sense:

40   A) I was not supposed to go there alone: you said
      you would *accompany* me.
      B) I was not supposed to go there alone: you said
      you would *charcoal* me.
      C) I was not supposed to go there alone: you said
45   you would *incubate* me.
      D) I was not supposed to go there alone: you said
      you would *companion* me.

So far we have just carried out the EEG stage of experimentation. EEG works as follows in its graph-
50 like measurements. When the brain senses a semantic violation, it automatically registers what is called an N400 effect, a negative wave modulation 400 milliseconds after the onset of the critical word that disrupts the meaning of a sentence. The N400 amplitude is small
55 when little semantic integration effort is needed (e.g., to integrate the word 'eat' in the sentence 'The pizza was too hot to eat'), and large when the critical word is unexpected and therefore difficult to integrate (e.g., 'The pizza was too hot to *sing*').

60   But when the brain senses a syntactic violation, there is a P600 effect, a parietal modulation peaking approximately 600 milliseconds after the onset of the word that upsets syntactic integrity. Thus, when a word violates the grammatical structure of a sentence (e.g.,
65 'The pizza was too hot to *mouth*'), a positive wave is systematically observed.

Preliminary results suggest this:

(A) With the simple control sentence ('you said you would *accompany* me'), NO N400 or P600 effect
70 because it is correct both semantically and syntactically.

(B) With 'you said you would *charcoal* me', BOTH N400 and P600 high because it violates both grammar and meaning.

(C) With 'you said you would *incubate* me', NO P600
75 (it makes grammatical sense) but HIGH N400 (it makes no semantic sense).

(D) With the Shakespearian 'you said you would *companion* me', HIGH P600 (because it feels like a grammatical anomaly) but NO N400 (the brain will tolerate
80 it, almost straightaway, as making sense despite the grammatical difficulty). This is in marked contrast with B above.

So what? First, it meant that 'functional shift' was a robust phenomenon: that is to say, it had a distinct
85 and unique effect on the brain. Instinctively Shakespeare was right to use it as one of his dramatic tools. Second, the P600 effect continued *after* the word ('companion') that triggered it. The brain was thus primed to look out for more difficulty, to work at a
90 higher level, whilst still accepting that fundamental sense was being made.

Shakespeare is stretching us; he is opening up the possibility of further peaks, new potential pathways or developments.

31. It can most reasonably be inferred from the passage that the author's attitude toward Shakespeare's writing is one of:

A. frustration.
B. ambivalence.
C. intrigue.
D. disbelief.

32. Which of the following effects, if any, would a reader experience when encountering a functional shift in a Shakespearian play?

   F. No N400 and no P600
   G. No N400 and high P600
   H. High N400 and no P600
   J. High N400 and high P600

33. It can most reasonably be inferred from the passage that the experiment's control sentence was designed to:

   A. lack a functional shift.
   B. generate a P600 effect.
   C. consist of an undiluted line of Shakespearian prose.
   D. reveal gaps in the student-subject's understanding of grammar and syntax.

34. The main function of the first paragraph is to:

   F. define functional shifts as they appear in Shakespeare's writing.
   G. explain why Shakespeare used functional shifts.
   H. suggest that Shakespeare's use of functional shifts confuses readers.
   J. evaluate how modern readers interpret functional shifts in Shakespeare's writing.

35. It can reasonably be inferred from the passage that researchers used ordinary language in the experiment's stimuli because researchers:

   A. wanted to prove that ordinary language contains more functional shifts than does Shakespearian language.
   B. hoped to demonstrate that ordinary language would generate more brain activity in the student-subjects than would Shakespearian language.
   C. doubted that Shakespearian language contained many functional shifts.
   D. believed Shakespearian language would generate too much brain activity in the student-subjects.

36. The passage makes clear that both the N400 effect and the P600 effect are wave modulations that the researchers used to:

   F. measure the brain's response to the language in the experiment's stimuli.
   G. demonstrate that the brain can't comprehend functional shifts.
   H. show that some student-subjects processed functional shifts more quickly than others.
   J. predict how well the student-subjects could understand a particular Shakespearian play.

37. Which of the following statements best summarizes lines 54–59?

   A. The scale of the N400 effect proves that the brain disregards words that disrupt the meaning of a sentence.
   B. The scale of the N400 effect shows that the brain misreads critical words when it works quickly.
   C. The scale of the N400 effect depends on the degree to which a word disrupts the meaning of a sentence.
   D. The scale of the N400 effect is greatest when the brain encounters a sentence that is easy to comprehend.

38. According to the passage, a functional shift in Shakespeare refers to the way that Shakespeare:

   F. changes the part of speech of a word by dramatically altering its shape.
   G. changes the grammatical nature of a word by using one part of speech to serve as another.
   H. uses sentences that lack grammatical structure and meaning.
   J. uses ordinary grammar and syntax to convey complex ideas.

39. According to the passage, research suggests that the brain processes nouns and verbs in:

   A. two separate parts of the brain.
   B. an undetermined part of the brain.
   C. many different parts of the brain.
   D. a single part of the brain responsible for decoding parts of speech.

40. The last paragraph most strongly suggests that the author believes Shakespeare's language:

   F. causes the brain to interpret language more quickly but less accurately.
   G. enhances the brain's ability to work at a higher level.
   H. forces the brain to learn to reject sentences that violate the basic principles of grammar.
   J. increases the brain's likelihood of misinterpreting the meaning of a sentence.

END OF TEST 3

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

DO NOT RETURN TO A PREVIOUS TEST.

SCIENCE TEST

35 Minutes—40 Questions

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

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

Passage I

Negative cloud-to-ground (−CG) and *positive cloud-to-ground* (+CG) lightning strokes move negative charges and positive charges, respectively, from a cloud to the ground during a thunderstorm. Typically, +CG strokes are less numerous than −CG strokes. Figure 1 shows the number of −CG strokes and the number of +CG strokes during each 5 min of a 3 hr period during a thunderstorm that produced a tornado. Also shown are the time of tornado formation (TF) and the time of tornado dissipation (TD). Table 1 shows the average current and the average duration of the strokes during each 30 min period of the 3 hr.
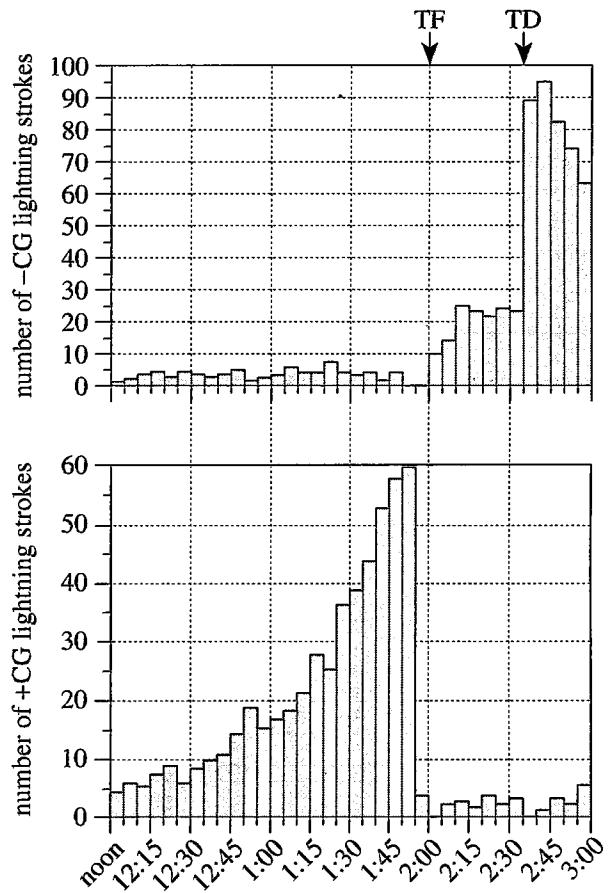

Figure 1

Figure 1 adapted from Donald MacGorman and Donald Burgess, "Positive Cloud-to-Ground Lightning in Tornadic Storms and Hailstorms." ©1994 by the American Meteorological Society.

Table 1				
	Average current (kA*)		Average duration (msec†)	
Time period	+CG strokes	−CG strokes	+CG strokes	−CG strokes
noon–12:30 p.m.	+75.2	−11.6	280	26
12:30 p.m.–1:00 p.m.	+79.4	−14.8	250	24
1:00 p.m.–1:30 p.m.	+83.7	−16.6	233	22
1:30 p.m.–2:00 p.m.	+89.5	−18.1	260	25
2:00 p.m.–2:30 p.m.	+42.2	−32.0	246	22
2:30 p.m.–3:00 p.m.	+37.1	−33.7	259	28

*kA = kiloamperes
†msec = milliseconds

1. According to Figure 1, from 1:25 p.m. to 1:55 p.m., the number of +CG strokes in a 5 min period:

   A. increased only.
   B. decreased only.
   C. increased, then decreased.
   D. decreased, then increased.

2. According to Table 1, the average duration of +CG strokes was at least 10 times greater than the average duration of −CG strokes for all the time periods EXCEPT:

   F.   noon–12:30 p.m.
   G. 1:00 p.m.–1:30 p.m.
   H. 1:30 p.m.–2:00 p.m.
   J. 2:30 p.m.–3:00 p.m.

3. Assume that the storm data in Figure 1 are typical of thunderstorms that produce tornadoes. For such thunderstorms, which type of lightning stroke, −CG or +CG, is predominant before TF and which type of lightning stroke is predominant after TF ?

	before TF	after TF
A.	−CG	−CG
B.	+CG	+CG
C.	−CG	+CG
D.	+CG	−CG

4. Is the statement "The number of −CG strokes in the 5 min period just after TD will be less than the number of −CG strokes in the 5 min period just before TD" supported by Figure 1 ?

   F. Yes; the number of −CG strokes in the 5 min period just after TD was less than half the number of −CG strokes in the 5 min period just before TD.
   G. Yes; the number of −CG strokes in the 5 min period just after TD was the same as the number of −CG strokes in the 5 min period just before TD.
   H. No; the number of −CG strokes in the 5 min period just after TD was more than twice the number of −CG strokes in the 5 min period just before TD.
   J. No; the number of −CG strokes in the 5 min period just after TD was the same as the number of −CG strokes in the 5 min period just before TD.

5. According to Table 1, from noon until 2:00 p.m., did the *magnitude* (absolute value) of the average current of the +CG strokes increase or decrease, and did the magnitude of the average current of the −CG strokes increase or decrease?

	+CG strokes	−CG strokes
A.	increase	increase
B.	decrease	decrease
C.	increase	decrease
D.	decrease	increase

Passage II

Meerkats (*Suricata suricatta*) are mammals that typically live in groups of 2 to 30 individuals. Some group members, called *helpers*, help parents care for their pups. Figure 1 shows how the percent contribution to babysitting and to pupfeeding by helpers varied with the age of the helpers, as categorized in Table 1.

A helper's food intake, as measured by *daily weight gain* (average number of grams gained by a helper per hour during a 24 hr day), can affect its contribution to pup care. Figure 2 shows how the percent contribution to babysitting and to pupfeeding by helpers older than 1 yr varied with daily weight gain.

Table 1	
Age category	Age range
Juveniles	≥ 3 mo and < 6 mo
Subadults	≥ 6 mo and < 12 mo
Yearlings	≥ 12 mo and < 24 mo
Adults	≥ 24 mo

Key
☐ female helpers
■ male helpers

Figure 1

Key
—○— female helpers
—■— male helpers
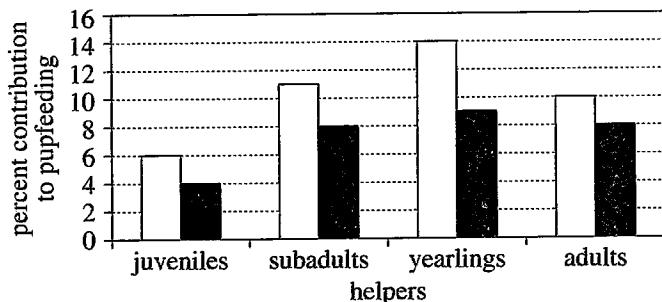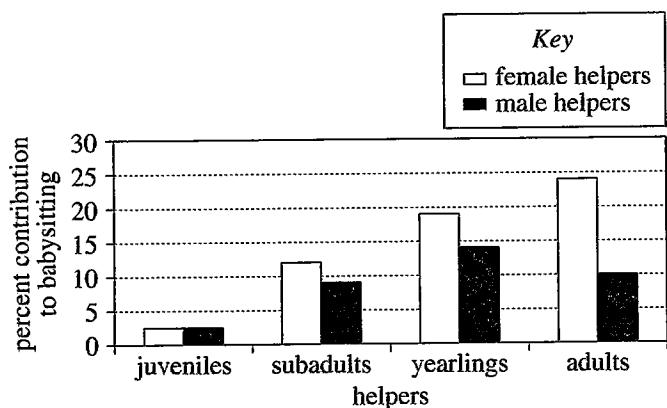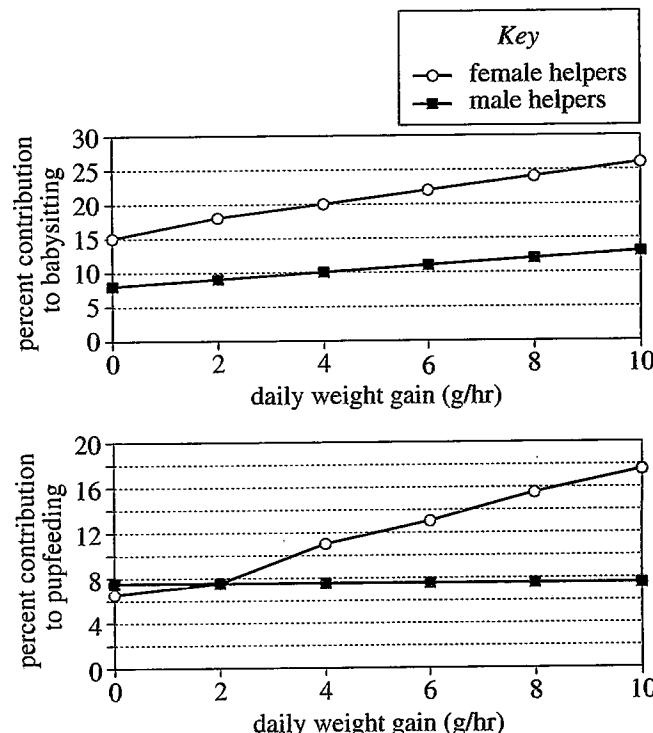

Figure 2

Figures 1 and 2 adapted from T. H. Clutton-Brock et al., "Evolution and Development of Sex Differences in Cooperative Behavior in Meerkats." ©2002 by the American Association for the Advancement of Science.

6. According to Table 1 and Figure 1, across the 4 age categories, as the age of the helpers increased, the percent contribution to pupfeeding:

F. increased only.
G. decreased only.
H. increased, then decreased.
J. decreased, then increased.

7. When food is scarce, meerkats may lose weight, causing them to have a negative daily weight gain. Based on Figure 2, if the percent contribution to babysitting by female helpers older than 1 yr with a daily weight gain of −2 g/hr had been calculated, it would most likely have been:

A. less than 15%.
B. between 15% and 20%.
C. between 20% and 25%.
D. greater than 25%.

8. Based on Table 1 and Figure 1, the greatest difference between the percent contribution by male helpers and the percent contribution by female helpers was observed for which pup care activity and which helper age range?

F. Babysitting; ≥ 6 mo and < 12 mo
G. Babysitting; ≥ 24 mo
H. Pupfeeding; ≥ 6 mo and < 12 mo
J. Pupfeeding; ≥ 24 mo

9. A student claimed that for male helpers and also for female helpers, the percent contribution to pupfeeding varies with daily weight gain. Are the results shown in Figure 2 consistent with this claim?

A. Yes; for male helpers and also for female helpers, as daily weight gain increased, the percent contribution to pupfeeding increased.
B. Yes; for male helpers and also for female helpers, as daily weight gain increased, the percent contribution to pupfeeding decreased.
C. No; for male helpers, the percent contribution to pupfeeding did not vary with weight gain.
D. No; for female helpers, the percent contribution to pupfeeding did not vary with weight gain.

10. The helpers whose contributions are recorded in Figure 2 belonged to which of the age categories listed in Table 1 ?

F. Juveniles only
G. Adults only
H. Subadults and yearlings only
J. Yearlings and adults only

Passage III

Birds have existed since at least 120 million years ago (mya), when *Jeholornis* was alive. *Jeholornis*, one of the earliest birds known from fossils, had reptilian characteristics (including teeth, a long bony tail, and claws) and bird-like characteristics (including feathers, 3 digits on each foot, hollow bones, and a beak). Two scientists discuss the origin of the first birds.

Scientist 1

The first birds appeared 150 mya. They evolved from a group of ground-dwelling, 3-toed dinosaurs known as *theropods*. Like the more recent *Jeholornis*, theropods had long bony tails, teeth, and claws. Theropods had 23 skeletal features that were identical to the corresponding skeletal features of the first birds.

Although theropods could not fly, a 225-million-year-old fossil of a feather-covered theropod has shoulder joints that show the theropod could fold its forelimbs close to its body the way a bird folds its wings. The first birds had a nearly identical shoulder joint and could fly. Fossils of other feather-covered, nonflying theropods that predated *Jeholornis* have also been discovered.

Scientist 2

The first birds appeared 220 mya. They evolved from a group of tree-dwelling reptiles known as *archosaurs* instead of from dinosaurs. Some archosaurs could glide to the ground; others could also fly. The 230-million-year-old fossil of an archosaur indicates that the archosaur had numerous elongated scales along its front limbs. Those scales had some characteristics identical to those of feathers. This archosaur could have glided from trees to the ground, as could *Jeholornis*. Theropods could not be the ancestors of birds, because theropods lived only on the ground.

The fact that some skeletal features of theropods were identical to those of the first birds is not evidence that theropods were the most recent ancestors of birds. Instead, these features are independent adaptations to similar habitats. A study matched each of the 3 digits on the feet of theropods and on the feet of the first birds to one of the 5 digits on the feet of various earlier reptiles. Theropods had the 1st, 2nd, and 3rd digits of the original 5 digits, whereas the first birds had the 2nd, 3rd, and 4th digits.

11. Consider Scientist 2's statement about why theropods could not be the ancestors of birds. That statement would be most strongly *contradicted* if it were discovered that theropods typically:

A. ate plants.
B. tended to their young.
C. climbed trees.
D. burrowed in the ground.

12. Both scientists would *disagree* with the statement that birds existed how many million years ago?

F. 75 mya
G. 150 mya
H. 175 mya
J. 250 mya

13. Scientist 1, but not Scientist 2, describes a fossil that provides evidence of a possible bird ancestor that:

A. was covered with elongated scales.
B. was covered with feathers.
C. could fly.
D. could glide.

14. Fossils of *Jeholornis* are considered very unusual because they show a characteristic of early birds that is rarely fossilized. This characteristic is most likely which of the following?

F. Claws
G. Beak
H. Leg bones
J. Feathers

15. By discussing the elongated scales indicated by the 230-million-year-old archosaur fossil, Scientist 2 is most likely implying which of the following? The elongated scales possessed by members of that group of archosaurs:

A. were used by those archosaurs to grasp prey.
B. were used by those archosaurs to climb trees.
C. evolved into the feathers of a descendant of those archosaurs.
D. evolved from the feathers of the most recent ancestor of those archosaurs.

16. Suppose further fossil evidence reveals that the digits on the feet of theropods actually corresponded to the 2nd, 3rd, and 4th digits, instead of the 1st, 2nd, and 3rd digits, on the feet of earlier reptiles. This discovery would better support the viewpoint of which scientist?

   F. Scientist 1, because this discovery would provide more evidence that the first birds and theropods are not closely related.

   G. Scientist 1, because this discovery would provide more evidence that the first birds and theropods are closely related.

   H. Scientist 2, because this discovery would provide more evidence that the first birds and archosaurs are not closely related.

   J. Scientist 2, because this discovery would provide more evidence that the first birds and archosaurs are closely related.

17. Theropods are thought to have been *endothermic* (controlling body temperature by internal means), whereas archosaurs are thought to have been *ectothermic* (controlling body temperature by external means). This information supports the viewpoint of which scientist?

   A. Scientist 1, because birds are endothermic.
   B. Scientist 1, because birds are ectothermic.
   C. Scientist 2, because birds are endothermic.
   D. Scientist 2, because birds are ectothermic.

Passage IV

A *green roof* on a building is a cover of living plants growing on several other layers of various materials (see typical green roof cross section below). Green roofs help control runoff during rain events.

cross section of a typical green roof
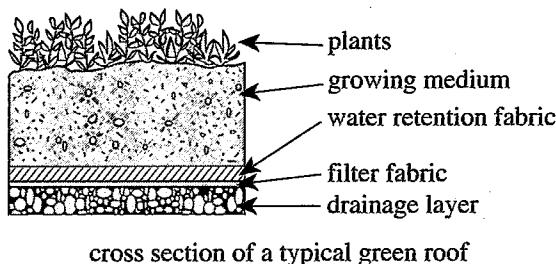
Five 2.5 m × 2.5 m platforms (1 *gravel* platform, 1 *media* platform, and 3 *vegetated* platforms) were constructed at a location on a building's roof. The gravel platform had a 2 cm layer of gravel over a waterproof fabric (a typical roof covering) and was unsloped. The media platform had all the layers as shown in the cross section except for the plants and was unsloped. The vegetated platforms had all the green roof layers as shown. One vegetated platform had a slope of 2.0%, another had a slope of 6.5%, and the third was unsloped (0% slope).

A runoff collection device was attached to each platform and a rain gauge was mounted on the roof. Two studies over a 2-month period measured the runoff from the platforms after each of 21 rain events, all lasting 60 min or more.

Study 1

For each of the 3 unsloped platforms, the amount of runoff in the collection device was recorded every 10 min for 180 min following the start of each rain event. Figure 1 shows the *cumulative* runoff from the platforms for a selected representative light, moderate, and heavy rain event. The 3 rain events produced a total rainfall of 0.5 mm, 4 mm, and 10 mm, respectively, over the 180 min.
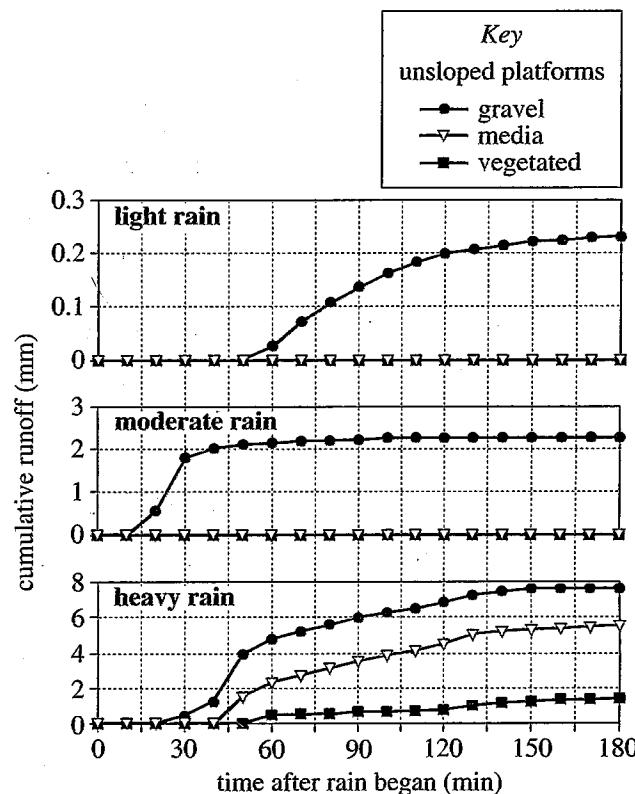

Figure 1

Study 2

For the 2 sloped vegetated platforms, the amount of runoff in the collection device was recorded every 10 min for 180 min following the start of each rain event. Figure 2 shows the cumulative runoff from the platforms for the same 3 representative rain events selected in Study 1.

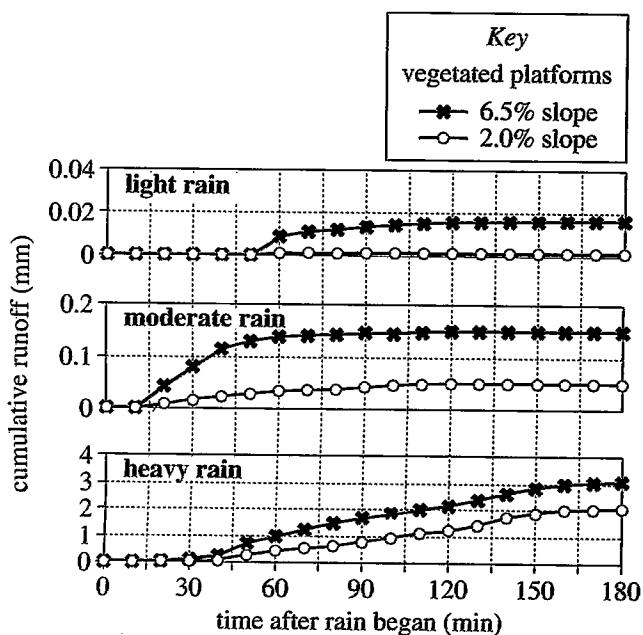*Key*
vegetated platforms
—✳— 6.5% slope
—○— 2.0% slope

Figure 2

Figures adapted from Nicholaus D. VanWoert et al., "Green Roof Stormwater Retention: Effects of Roof Surface, Slope, and Media Depth." ©2005 by the American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America.

18. According to the results of Study 1, for the heavy rain event, the cumulative runoff from the gravel platform stopped increasing at a time closest to which of the following?

F.   60 min
G.   90 min
H.   120 min
J.   150 min

19. In Study 2, as total rainfall increased, how did the cumulative runoff for the 6.5% slope platform at 180 min and for the 2.0% slope platform at 180 min, respectively, change?

	6.5% slope platform	2.0% slope platform
A.	increased	increased
B.	increased	decreased
C.	decreased	increased
D.	decreased	decreased

20. According to the results of Study 1, for the heavy rain event, what is the order of the 3 platforms, from the platform having the least cumulative runoff at 180 min to the platform having the greatest cumulative runoff at 180 min ?

F.   Gravel, vegetated, media
G.   Gravel, media, vegetated
H.   Vegetated, gravel, media
J.   Vegetated, media, gravel

21. Consider the results of the studies for the vegetated platforms during the heavy rain event. If a vegetated platform having a slope of 4.0% had been included in Study 2, the cumulative runoff at 150 min would most likely have been:

A.   less than 1.0 mm.
B.   between 1.0 mm and 1.5 mm.
C.   between 1.5 mm and 3.0 mm.
D.   greater than 3.0 mm.

22. In Study 1, which of the following factors was intentionally varied in order to determine the effect on the runoff?

F.   Amount of runoff
G.   Rate of runoff
H.   Materials on the platform
J.   Area of the platform

23. The top layer of the green roof performs which of the processes or functions listed below?

    I. Taking up water
    II. Taking in CO_2
    III. Holding growing medium in place

A.   II only
B.   I and III only
C.   II and III only
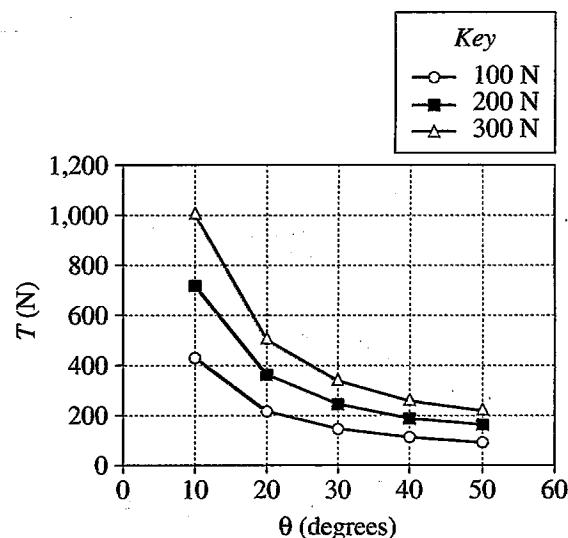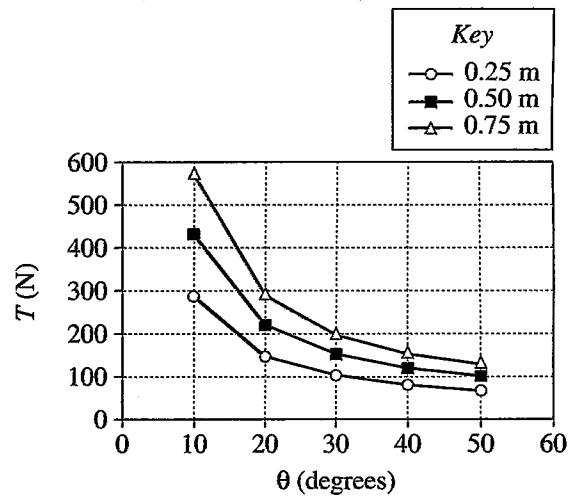D.   I, II, and III

Passage V

A store sign is to be suspended from a 1-meter-long horizontal rod. The rod is supported by a cable at one end and a bracket at the other (see Figure 1).
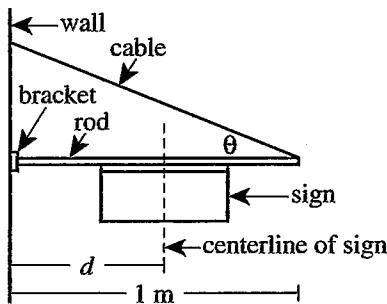
Figure 1

The sign's weight, W; the angle, θ, between the cable and the rod; and the distance, d, between the centerline of the sign and the wall will each affect the tension, T, in the cable. The cable will break if T exceeds the cable's breaking force, F.

Table 1 lists F, in newtons (N), for stainless steel cable of various diameters. Figure 2 contains graphs of T (in N) versus θ for various W (in N), where $d = 0.50$ m. Figure 3 contains graphs of T versus θ for various d, where $W = 100$ N.

Table 1	
Cable diameter (mm)	F (N)
0.500	59
1.000	235
1.500	531
2.000	942

Key
- —○— 100 N
- —■— 200 N
- —△— 300 N

Figure 2

Key
- —○— 0.25 m
- —■— 0.50 m
- —△— 0.75 m

Figure 3

GO ON TO THE NEXT PAGE.

24. According to Figure 3, if $d = 0.75$ m and $W = 100$ N, the greatest change in T occurs when θ increases from:

   F. 10° to 20°.
   G. 20° to 30°.
   H. 30° to 40°.
   J. 40° to 50°.

25. Based on Figure 2, for $d = 0.50$ m and any given θ, what is the order of the sign weights, from the weight that produces the greatest cable tension to the weight that produces the least cable tension?

   A. 100 N, 200 N, 300 N
   B. 100 N, 300 N, 200 N
   C. 300 N, 100 N, 200 N
   D. 300 N, 200 N, 100 N

26. Consider the data in Figure 3 for $d = 0.25$ m and $d = 0.50$ m. For each value of d, what value of θ results in $T = 100$ N ?

	$d = 0.25$ m	$d = 0.50$ m
F.	30°	30°
G.	30°	50°
H.	50°	30°
J.	50°	50°

27. Based on Figure 2, for $d = 0.50$ m and $\theta = 10°$, the W at which $T = 600$ N would most likely be:

   A. less than 100 N.
   B. between 100 N and 200 N.
   C. between 200 N and 300 N.
   D. greater than 300 N.

28. Based on Table 1 and Figure 2, for $d = 0.50$ m and $\theta = 10°$, can the 1.500 mm diameter stainless steel cable support a sign with $W = 300$ N without breaking?

   F. Yes, because T will be greater than F.
   G. Yes, because T will be less than F.
   H. No, because T will be greater than F.
   J. No, because T will be less than F.

Passage VI

When 1-bromobutane (C_4H_9Br) and sodium iodide (NaI) are dissolved together in a solvent—acetone or acetonitrile—they react to form 1-iodobutane (C_4H_9I) and sodium bromide (NaBr):

$$C_4H_9Br + NaI \rightarrow C_4H_9I + NaBr$$
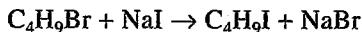
NaBr is not very soluble in either solvent, so as NaBr forms, it alone precipitates from the reaction solution. The reaction can be monitored by measuring the *conductivity* (ability to conduct electrical current) of the reaction solution because NaI is the only component that significantly contributes to the solution's conductivity.

Students did 3 experiments to study the rate of this reaction.

Experiment 1

A probe was used to measure (in millisiemens per centimeter, mS/cm) the conductivities of solutions with different NaI concentrations (in millimoles per liter, mmol/L) in acetone or in acetonitrile at 40°C (see Figure 1). This trial was repeated twice, once at 30°C and once at 20°C. The results did not significantly differ from those at 40°C.
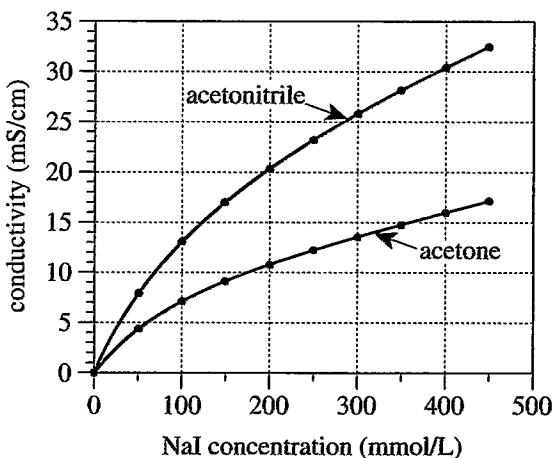

Figure 1

Experiment 2

A capped test tube containing an 800.0 mmol/L C_4H_9Br-acetone solution was mostly submerged in a water bath maintained at 40°C. Another capped test tube—containing an 800.0 mmol/L NaI-acetone solution, a magnetic stir bar, and the conductivity probe—was mostly submerged in the bath. After 10 min, the tubes were uncapped

and the C_4H_9Br solution was added to the NaI solution. The tube was capped and the solution was stirred in the bath. Conductivity readings were recorded at regular intervals. This trial was repeated twice, once at 30°C and once at 20°C (see Figure 2).

Figure 2

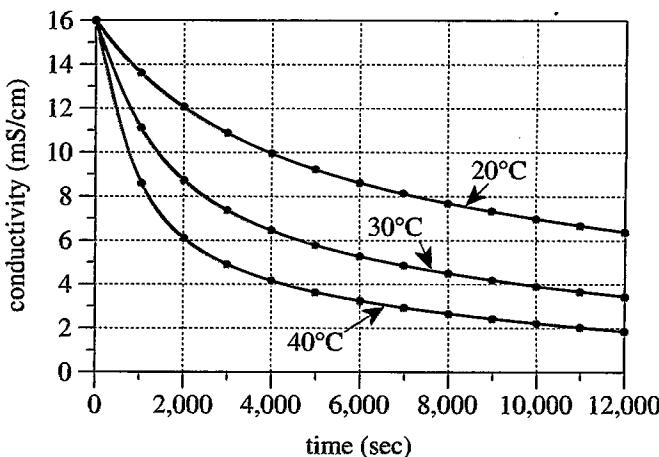### Experiment 3

The trials of Experiment 2 at 40°C and at 20°C were repeated except that the solvent was acetonitrile (see Figure 3).
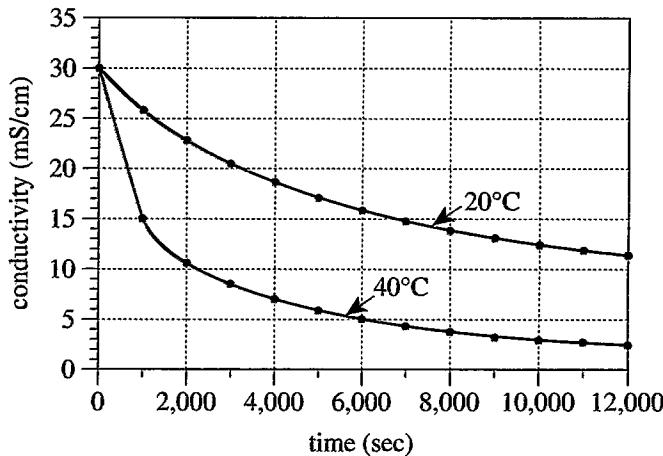

Figure 3

29. A difference between Experiments 2 and 3 was that:

  A. a different solvent was used in Experiment 2 than was used in Experiment 3.
  B. a different initial concentration of reactants was used in Experiment 2 than was used in Experiment 3.
  C. in Experiment 2 all trials were done at the same temperature, whereas in Experiment 3 each trial was done at a different temperature.
  D. in Experiment 2 each trial was done at a different temperature, whereas in Experiment 3 all trials were done at the same temperature.

30. Based on Experiment 2, if a trial had been done in Experiment 3 at 30°C, the conductivity at 6,000 sec would most likely have been:

  F. less than 5 mS/cm.
  G. between 5 mS/cm and 15 mS/cm.
  H. between 15 mS/cm and 25 mS/cm.
  J. greater than 25 mS/cm.

31. In Experiments 2 and 3, when the students were measuring the conductivity, they were directly monitoring the:

  A. increase in the NaI concentration.
  B. decrease in the NaI concentration.
  C. increase in the NaBr concentration.
  D. decrease in the NaBr concentration.

32. What is the most likely reason that in Experiments 2 and 3 the test tubes were left in the bath for 10 min before their contents were mixed?

  F. To increase the conductivity of the solution in each tube to a level that would allow the reaction to occur
  G. To decrease the conductivity of the solution in each tube to a level that would allow the reaction to occur
  H. To ensure that the bath and the solution in each tube had reached room temperature
  J. To ensure that the solution in each tube had reached the temperature of the bath

33. During each of the trials in Experiments 2 and 3, a white solid accumulated at the bottom of the test tube. What was this solid?

  A. C_4H_9Br
  B. NaI
  C. C_4H_9I
  D. NaBr

34. Suppose that at 40°C, 10 mL of a 100 mmol/L NaI-acetone solution is mixed with 10 mL of a 300 mmol/L NaI-acetone solution. Based on Experiment 1, the conductivity of the resulting solution will most likely be closest to which of the following?

  F. 11 mS/cm
  G. 16 mS/cm
  H. 21 mS/cm
  J. 30 mS/cm

GO ON TO THE NEXT PAGE.

Passage VII

The 3 primary interactions between *photons* (particles of light) and matter are:

- the *Compton effect*: A photon collides with, and gives some of its energy to, a free electron (e^-). The photon and e^- are scattered away from the collision site.

- the *photoelectric effect*: A photon is absorbed by, and gives all of its energy to, an e^- bound to an atom. The e^- is scattered away from the atom.

- *pair production*: A photon passes close to an atom and is transformed into an e^- and a *positron* (e^+, a particle with the same mass as an e^-, but the opposite charge), converting energy to mass. The e^- and e^+ are scattered away from the nearby atom.

Study 1

A slab of carbon (C) surrounded by particle detectors was bombarded by photons that each had an energy between 0.01 million electron volts (MeV) and 100 MeV. When an incident photon interacted with the slab and scattered 1 or more particles into the detectors, a *successful* event was registered. When the photon passed through the slab without interacting, an *unsuccessful* event was registered. In each successful event, the energy of the incident photon and the type(s) of scattered particle(s) were recorded. When 500,000 successful events had occurred, data from these events were then used to calculate the relative probability (P) for each known type of photon-matter interaction to occur at various incident photon energies. Plots of P versus incident photon energy for the 3 primary interactions are shown in Figure 1.
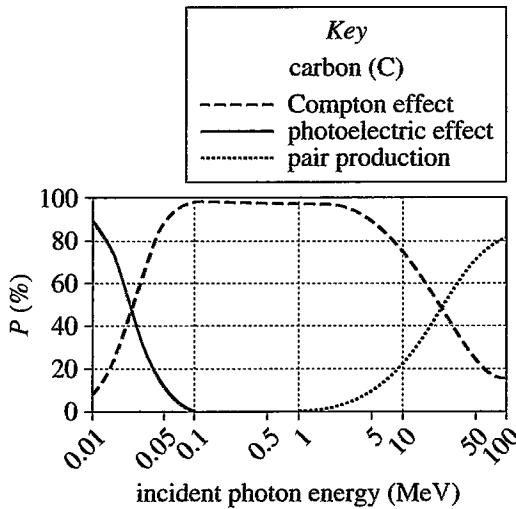

Figure 1

Study 2

The procedure of Study 1 was repeated, except a *lead* (Pb) slab was bombarded. Plots of P versus incident photon energy for the 3 primary interactions are shown in Figure 2.
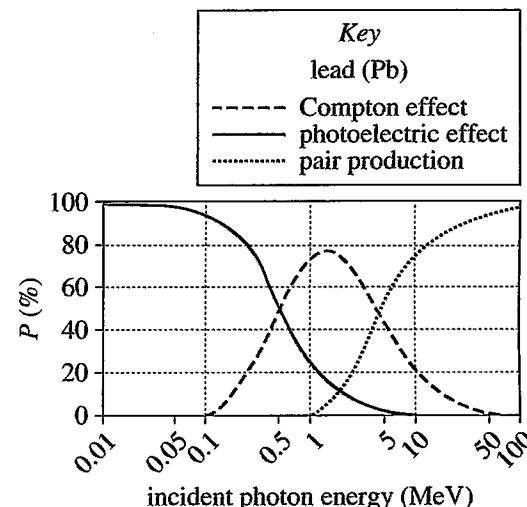

Figure 2

Figures adapted from Arthur Beiser, *Concepts of Modern Physics.*
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35. In Study 2, at approximately what incident photon energy was P for the Compton effect in Pb at its maximum value?

A. 0.02 MeV
B. 0.2 MeV
C. 2 MeV
D. 20 MeV

36. In any given event, what scattered particle(s) was(were) registered by the detectors as evidence that the Compton effect, the photoelectric effect, and pair production, respectively, had occurred?

(Note: The symbol for a photon is γ.)

	Compton effect	photoelectric effect	pair production
F.	γ, e^-	e^-	e^-, e^+
G.	γ, e^-	e^-, e^+	e^-
H.	e^-, e^+	e^-	γ, e^-
J.	e^-, e^+	γ, e^-	e^-

50

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37. Pair production cannot occur unless the incident photon has sufficient energy. Based on the results of Studies 1 and 2, the *minimum* incident photon energy for pair production is closest to which of the following values?

A. 0.1 MeV
B. 1 MeV
C. 10 MeV
D. 100 MeV

38. Which of the following questions CANNOT be answered by an analysis of Figure 2 ?

F. What is *P* for the photoelectric effect in Pb at an incident photon energy of 1 MeV ?
G. What is the probability of an event being successful in Pb at an incident photon energy of 1 MeV ?
H. Above what incident photon energy is *P* for pair production higher than 50% in Pb ?
J. At what incident photon energy are *P* for the photoelectric effect and *P* for pair production equal in Pb ?

39. Which of the following statements about the data used to generate the plots of *P* versus incident photon energy is correct? The plots shown in Figures 1 and 2 were generated using:

A. only data from successful events.
B. only data from unsuccessful events.
C. data primarily from successful events in addition to some data from unsuccessful events.
D. data primarily from unsuccessful events in addition to some data from successful events.

40. An element is considered *light* if its atomic number is less than that of iron or *heavy* if its atomic number is greater than that of iron. Based on the results of Studies 1 and 2, for 0.1 MeV photons bombarding light elements and heavy elements, respectively, which primary interaction most likely has the highest *P* ?

	light elements	heavy elements
F.	Compton effect	photoelectric effect
G.	photoelectric effect	Compton effect
H.	Compton effect	pair production
J.	pair production	photoelectric effect

END OF TEST 4

STOP! DO NOT RETURN TO ANY OTHER TEST.

Mathematics

#		#	
1	C	31	B
2	F	32	H
3	E	33	C
4	J	34	G
5	D	35	A
6	K	36	H
7	A	37	D
8	H	38	K
9	D	39	D
10	J	40	H
11	D	41	B
12	H	42	J
13	C	43	B
14	H	44	G
15	B	45	B
16	F	46	K
17	B	47	A
18	K	48	F
19	A	49	A
20	K	50	J
21	C	51	A
22	F	52	H
23	E	53	E
24	G	54	F
25	A	55	D
26	F	56	K
27	B	57	C
28	K	58	J
29	D	59	B
30	K	60	H