Form 67F

(April 2011)

The **ACT**® 2010/2011

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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

Taking Wing

The view must have been a thrill each time: everything below so tiny and perfect, an eagle's-eye view of the landscape. From her wooden seat in the cramped cockpit. Facing the fuel gauges and compass that helped
<u>   </u>
1
her plot her course, Amelia Earhart was on top of the world. In her goggles and leather flight cap, she must have grinned every time she banked the wings and headed into a cloud, on her way toward new records and destinations.

[1] Born in Kansas in 1897, Earhart broke what were
<u>   </u>
2
then the rules for girls right from the start. [2] She was considered a tomboy and belly flopped downhill on sleds, climbed trees, and hunted. [3] Before long she was taking lessons and then <u>her first plane had been bought.</u> [4] By
                                        3
1928 she had become the first woman to cross the Atlantic

1.
A. NO CHANGE
B. cockpit; facing
C. cockpit. She faced
D. cockpit, facing

2.
F. NO CHANGE
G. Following being born
H. After her mother gave birth to her
J. After having been born

3.
A. NO CHANGE
B. bought her first plane.
C. buys her first plane.
D. her first plane is bought.

GO ON TO THE NEXT PAGE.

Ocean in an airplane. [5] She went on to set record after record, showing what a person from Kansas could do.
4

[6] She became fascinated with flying as a young

woman whom she took her first flight—with a stunt
5

pilot. 6

In 1937 she sat about from Miami, Florida, with
7
her copilot, hoping to become the first woman to circumnavigate the globe by airplane. They had reached New Guinea and completed three-quarters of their flight because the outside world lost contact with them on July 2,
8
1937, as they were en route to their next island destination.

[A] In contrast, the U.S. Navy searched the Pacific for the
9
plane and its occupants for weeks before giving up.

[B] Rumor's have abounded ever since: perhaps Earhart
10
was on a spy mission for President Roosevelt, or perhaps she crashed and lived for years undiscovered on an island. 11 It is most commonly assumed that she ran out

4. Given that all the choices are true, which one best summarizes this paragraph's description of how Earhart "broke what were then the rules"?
   F. NO CHANGE
   G. graduating from high school in 1915.
   H. defying expectations and shattering gender stereotypes.
   J. having seen her first airplane when she was only ten years old.

5. A. NO CHANGE
   B. woman that
   C. woman when
   D. woman, however,

6. For the sake of the logic and coherence of this paragraph, Sentence 6 should be placed:
   F. where it is now.
   G. between Sentences 1 and 2.
   H. between Sentences 2 and 3.
   J. between Sentences 3 and 4.

7. A. NO CHANGE
   B. set about
   C. sat out
   D. set out

8. F. NO CHANGE
   G. when
   H. while
   J. after

9. A. NO CHANGE
   B. However, the
   C. The
   D. Furthermore, the

10. F. NO CHANGE
    G. Rumors
    H. Rumors'
    J. Rumor

11. Which of the following true statements, if it were to be added here, would best develop the point being made in the preceding sentence?
    A. A Coast Guard cutter, the *Itasca*, was stationed in the Pacific to receive Earhart's radio transmissions.
    B. After Earhart's first flight across the Atlantic, she had been met with a ticker tape parade in New York City.
    C. Still another theory is that Earhart landed on a volcanic island that later sank into the sea.
    D. Earhart's previous attempt to fly around the world had started in Oakland, California.

of fuel and was lost at sea. [C] Amelia Earhart passed into
history, and from there into myth. The legend of her
achievements and of her mysterious disappearance still
captivates us. [D] Her much-photographed face, with its
chiseled cheekbones and daring eyes, remains a familiar
image. We may never know what happened to her, but in

our imaginations she continues to be very cool high above

the earth. 15

12. F. NO CHANGE
   G. past into
   H. passed over
   J. past over

13. A. NO CHANGE
   B. image, we
   C. image we
   D. image, while we

14. F. NO CHANGE
   G. still soars
   H. continues to manifest her aviation skills
   J. still exhibits expertise in monitoring her altitude and velocity, using various cockpit gauges

15. The writer wants to divide the preceding paragraph into two, so that the first paragraph discusses Earhart's final trip and speculates about what may have happened, while the second focuses on how she is remembered. The best place to begin the second paragraph would be at Point:
   A. A.
   B. B.
   C. C.
   D. D.

PASSAGE II

Edmonia Lewis and Her Marble Cleopatra

In 1988, during a routine inspection of a salvage yard in the Chicago area, firefighter Harold Adams made a discovery that helped solve a 100-year-old mystery. Amid the debris, he came face to face with a monumental statue of a queen in the salvage yard. The work of art had such a commanding presence that he felt compelled to bring it to

the attention of people who might be able to identify, repair, and permanently protect it.

16. Given that all the choices are true, which one adds new information about the physical appearance of the statue?
   F. NO CHANGE
   G. as he looked around.
   H. during his rounds.
   J. on her throne.

17. Given that all the choices are true, which one provides the most specific information?
   A. NO CHANGE
   B. appropriate individuals that he could identify in the hope of making a difference.
   C. persons with knowledge pertaining to the relevant subject at hand.
   D. others with expertise in their professional fields, like he was a professional, but in a different field.

Eventually, the statues identity emerged. The
_____
18
woman depicted was none other than the Egyptian ruler

Cleopatra. The artist was Edmonia Lewis, born in 1840
_____
19
to an Ojibway mother and African American father. As

a young person, Lewis had studied at Oberlin College

before moving to Boston and later Rome, where she

joined a community of American sculptors living

abroad. Carving Italian marble by hand, Lewis
_____
20

portrayed Cleopatra taking, her last breath. *The Death*
_____
21
of Cleopatra was hailed by many critics as the most

impressive sculpture at the 1876 Centennial Exposition in

Philadelphia, the event for which it had been created. |22|

Shortly after the exposition, the statue

fell into mysterious circumstances that frustrated

the art lovers who tried over the years to locate it.
_____
23

Decades passed before the story of it's journey
_____
24

were pieced together. For a while, the marble
____
25

queen had resided in a Chicago saloon. Later, it
_____
26
marked the grave of a racehorse named Cleopatra. By

the time Adams stumbled upon the two-ton statue, it was

18. F. NO CHANGE
   G. statues' identity
   H. statue's identity
   J. identity of the statues

19. A. NO CHANGE
   B. artist,
   C. artist, whose name was
   D. artist

20. The writer would like to provide information here about the method used by the artist to create the sculpture. Given that all the choices are true, which one best accomplishes the writer's purpose?
   F. NO CHANGE
   G. An experienced and accomplished artist,
   H. Though others had depicted the Egyptian queen in marble,
   J. To complete her worthwhile project,

21. A. NO CHANGE
   B. Cleopatra, taking her last
   C. Cleopatra taking her last
   D. Cleopatra taking her last,

22. The writer is considering deleting the phrase "the 1876 Centennial Exposition in Philadelphia," from the preceding sentence. Should the phrase be kept or deleted?
   F. Kept, because it indicates where the statue was made.
   G. Kept, because it identifies the event referred to in the sentence.
   H. Deleted, because it repeats information that is already provided in the sentence.
   J. Deleted, because it provides information that shifts the focus away from the sculpture.

23. A. NO CHANGE
   B. in an effort to
   C. to attempt to
   D. regarding efforts that would

24. F. NO CHANGE
   G. its'
   H. its
   J. whose

25. A. NO CHANGE
   B. was
   C. were to be
   D. would of been

26. F. NO CHANGE
   G. queen had resided,
   H. queen, had resided
   J. queen, had resided,

chipped, cracked, and covered with graffiti. Until it could

be <u>shipped</u> to restoration experts, Lewis's masterpiece was
27

stored—alongside paper turkeys, tinsel streamers, and

half-empty cans of paint—in <u>a back room somewhere.</u>
28

  The Death of Cleopatra returned to the limelight in

the 1990s when, after being meticulously restored, the

sculpture went on display at the National Museum of

American Art in Washington, D.C. <u>Where it continues to</u>
29

inspire renewed <u>appreciation all over again</u> for a bold and
30

gifted American artist, Edmonia Lewis.

27. Which of the following alternatives to the underlined portion would be LEAST acceptable?
  A. sent
  B. delivered
  C. transported
  D. evacuated

28. Given that all the choices are true, which one provides information that is new and specific?
  F. NO CHANGE
  G. at a shopping mall.
  H. until it could be repaired.
  J. with assorted objects.

29. A. NO CHANGE
  B. When
  C. There
  D. The point that

30. F. NO CHANGE
  G. admiration and positive appreciation
  H. attention to its worth again
  J. appreciation

A Peachy Winter Game

  One <u>winteringly</u> New England day in 1891, a
31

Massachusetts YMCA teacher <u>puzzled over how to handle</u>
32

a difficult situation. Outside, the air was <u>frigid inside,</u> the
33
students were bursting with energy and ignoring their

lessons. They were, <u>however,</u> being quite disruptive.
34

  The teacher, James Naismith, was a physical

education <u>instructor and an ordained minister. He</u>
35

31. A. NO CHANGE
  B. wintering
  C. wintry
  D. winterishly

32. F. NO CHANGE
  G. puzzled, over how to handle
  H. puzzled over, how to handle
  J. puzzled, over how to handle,

33. A. NO CHANGE
  B. frigid inside
  C. frigid, inside,
  D. frigid. Inside,

34. F. NO CHANGE
  G. as the case may be,
  H. in fact,
  J. regardless of time,

35. Which of the following alternatives to the underlined portion would NOT be acceptable?
  A. instructor. Naismith was also
  B. instructor, he was also
  C. instructor; he was also
  D. instructor. In addition, Naismith was

believed that exercising the body was as important

as exercising <u>the mental capacities of the mind.</u>
₃₆

<u>Both, in his opinion</u> nourished the human spirit
₃₇
and built character.

Aware of Naismith's philosophy, a supervisor

challenged the instructor to <u>invent</u> an indoor game
₃₈
that would encourage the use of mental and

physical skills. He gave Naismith fourteen days

to accomplish this task. In tackling his assignment,

<u>popular ball game elements were borrowed</u> of the day.
₃₉

<u>The decision of his to start the competition</u> in the center
₄₀
of the playing territory, as in polo. He would place a goal

at each end, as in football. A referee would return out-of-

bounds balls to the <u>players,</u> as in rugby.
₄₁
Naismith wanted the goals placed high above the

players. This setup would require the players to throw the

ball in an arc to make a goal. A janitor gave Naismith two

large wooden peach baskets to use as goals. Naismith

attached the baskets to a running track elevated ten feet

above the gymnasium floor.

Before the start of the first game, Naismith developed

thirteen rules to encourage <u>competition the rules reward</u>
₄₂

both physical ability and strategic planning. <u>Instead, he</u>
₄₃
created an indoor game people could play vigorously and

competitively, one that exercises body and mind.

36. F. NO CHANGE
    G. the thinking apparatus of
    H. the mental attributes pertaining to
    J. DELETE the underlined portion.

37. A. NO CHANGE
    B. Both, in his opinion,
    C. Both in his opinion;
    D. Both in his opinion,

38. Which of the following alternatives to the underlined portion would be LEAST acceptable?
    F. design
    G. come up with
    H. develop
    J. bring forth

39. A. NO CHANGE
    B. elements from popular ball games were borrowed
    C. Naismith borrowed elements from popular ball games
    D. Naismith's borrowing of elements from popular ball games

40. F. NO CHANGE
    G. He decided the competition would start
    H. Making the decision to start the competition
    J. His decision, starting the competition,

41. A. NO CHANGE
    B. player's,
    C. players'
    D. player's

42. F. NO CHANGE
    G. competition and reward
    H. competition, and he also made those rules to reward
    J. competition. Rewarding it with

43. A. NO CHANGE
    B. Nevertheless, he
    C. On the other hand, he
    D. He

With excitement in the air, Naismith divided his class

into two teams. In a historic moment, he tossed the ball

straight up at center court. Players then dribbled the ball,

aimed at the baskets, and scored points and his students

44

loved the new sport. What had started as a challenge on a

winter day had quickly evolved into the first game of

45

basketball.

44. F. NO CHANGE
G. points and obviously his
H. points and that day his
J. points. His

45. A. NO CHANGE
B. day, had quickly evolved
C. day had quickly evolved,
D. day; had quickly evolved

PASSAGE IV

An Evening Walk in Washington

During the day, Washington, D.C., bustles with

visitors, but even after sundown many people gather at

they're famous buildings and monuments. I'd heard that

46

the city's attractions appear even more impressive after

dark, not only the historic monuments but also the

47

excellent museums.

47

ı

Beams of light enlightened the exterior of the

48

White House, and every window glowed as the work

49

of governing continued into the night. Tourists peered

through the fence, pointing when they saw a figure passing

by one of the windows. Could that be the president?

Families from all over the world—speaking in a wonderful

50

variety of languages and dialects—posed for photographs

with the brightly lit White House as the backdrop.

46. F. NO CHANGE
G. there
H. it's
J. its

47. Given that all the choices are true, which one most
effectively leads readers into the rest of the essay?
A. NO CHANGE
B. and it's one of the most historic cities in the
United States.
C. so one evening I took a walk to see if this was
true.
D. the city having no skyscrapers to obstruct the
view.

48. F. NO CHANGE
G. illuminated
H. irradiated
J. inflamed

49. A. NO CHANGE
B. which
C. who's
D. DELETE the underlined portion.

50. Which of the following alternatives to the underlined
portion would NOT be acceptable?
F. communicating
G. conversing
H. talking
J. saying

A few blocks away, in the National Mall, I climbed
the long flight of marble stairs to the portico of the Lincoln
Memorial, located here even though Abraham Lincoln is
                                                    51
buried in Illinois. The statue appeared to gaze down on the
     51
Reflecting Pool, where a little girl watched as her father
twirled a flashlight to make its beam dance across the still

water. 52

[1] Across from the Lincoln Memorial, I joined a
group of visitors heading toward the Korean War Veterans
                       53
Memorial. [2] Spotlights near the soldiers' feet, lit up the
                                    54
men's faces, showing expressions of fatigue, concern, and
determination. [3] The surrounding darkness enhanced the
drama of the scene. [4] The memorial featured nineteen
statues of soldiers arranged in a triangular formation. 55

---

51. Given that all the choices are true, which one provides
information most relevant to the essay's purpose and
links the sentence most effectively to the paragraph's
concluding sentence?
   A. NO CHANGE
   B. which was authorized by Congress in 1911 and
dedicated on May 30, 1922.
   C. where spotlights shone on the enormous statue of
Abraham Lincoln.
   D. which, like other monuments on the Mall, is
administered by the National Park Service.

52. The writer is considering deleting the phrase "to make
its beam dance across the still water" from the preced-
ing sentence. Should this phrase be kept or deleted?
   F. Kept, because its imagery adds effectively to the
mood of the scene being described.
   G. Kept, because it provides an effective transition to
the next paragraph.
   H. Deleted, because it is irrelevant to this paragraph
about the Lincoln Memorial.
   J. Deleted, because its removal would eliminate
redundant information from the sentence.

53. Which of the following alternatives to the underlined
portion would NOT be acceptable?
   A. headed toward
   B. heading off
   C. heading to
   D. headed to

54. F. NO CHANGE
   G. soldiers' feet
   H. soldiers feet,
   J. soldiers feet

55. For the sake of the logic and coherence of this para-
graph, Sentence 4 should be placed:
   A. where it is now.
   B. before Sentence 1.
   C. after Sentence 1.
   D. after Sentence 2.

Nearby, light reflected off the polished surface of

the Vietnam Veterans Memorial's black granite wall. 56

56. If the writer were to delete the words *polished, black,* and *granite* from the preceding sentence, the paragraph would lose descriptive details that primarily:
  F. support the writer's case for improving the lighting at national monuments.
  G. describe the artistic process used to create the Vietnam Veterans Memorial.
  H. reveal the narrator's frame of mind upon viewing the wall at the Vietnam Veterans Memorial.
  J. help depict what the narrator saw at the Vietnam Veterans Memorial.

Etched with the names of fallen soldiers, visitors had
                                                    57
adorned the wall with flowers and American flags left
                         57
in remembrance.

57. A. NO CHANGE
  B. adorning the wall were flowers and American flags that visitors had left
  C. flowers and American flags adorned the wall, left by visitors
  D. the wall was adorned with flowers and American flags that visitors had left

Indeed, evening
   58

58. F. NO CHANGE
  G. Nevertheless,
  H. Furthermore,
  J. Lastly,

proved as an excellent time
   59
to visit the White House and the Mall.

59. A. NO CHANGE
  B. proven to be
  C. proved to be
  D. proven

Many of the city's most important historic sites
                         60
are located in this area. What remained visible were the
              60
buildings and monuments that represented some of the

most significant events of this nation.

60. Given that all the choices are true, which one provides the best transition from the opening sentence of this paragraph to its final sentence?
  F. NO CHANGE
  G. Darkness drew much of the landscape into the background.
  H. This allowed me to visit other parts of Washington during the day.
  J. One must actually walk around Washington to appreciate it.

PASSAGE V

Drought—In My Front Yard

My house in Santa Fe, New Mexico, was shaded by

an enormous blue spruce. It was a tall, elegant tree that

kept the house cool in summer, if a bit chilly in winter.
                         61
The tree was not native to the city; rather, it had been

transplanted from the mountains east of the city.

61. Which of the following alternatives to the underlined portion would NOT be acceptable?
  A. summer, even so
  B. summer and even
  C. summer, though
  D. summer, while

Santa Fe is in one of the most arid regions in the United States, but last year conditions were so dry that a drought emergency was declared. We were on strict water rationing, and there was a ban on outdoor watering. 62 By spring the needles of the blue spruce started to turn

brown and were dropped off. I watered it with every
                    ‾‾‾‾‾‾‾‾‾‾‾
                        63
precious drop of water I could find. I carried dirty dishwater to the tree. I kept a plastic bucket in the shower and watered the tree in there. All my
                                  ‾‾‾‾‾‾‾‾
                                     64

efforts failed the tree died.
‾‾‾‾‾‾
   65

The dead tree was a horrific depressing
                        ‾‾‾‾‾‾‾‾‾
                           66

sight, it continued to shed its dry needles all over
‾‾‾‾
 67
the yard. I called an arborist. In my neighborhood, you couldn't simply chop a tree down and yell "Timber!" as it fell. The tree would have to be "topped"—a delicate job. 68 The arborist came and shook his head. "I feel like

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

> Some cities restrict outdoor watering to "low demand times" as an alternative to a complete ban.

Should the writer make this addition here?

F. Yes, because it provides an explanation of the terms used in the preceding sentence.
G. Yes, because it suggests a method that could have prevented the event described later in this paragraph.
H. No, because it contradicts the point made earlier that this city was under a "drought emergency."
J. No, because it creates a digression that may distract the reader from the main focus of this paragraph.

63. A. NO CHANGE
    B. drop
    C. dropping
    D. are dropping

64. F. NO CHANGE
    G. from that.
    H. in that.
    J. DELETE the underlined portion and end the sentence with a period.

65. A. NO CHANGE
    B. failed but the
    C. failed. The
    D. failed then the

66. F. NO CHANGE
    G. horrified
    H. horrible
    J. horribly

67. A. NO CHANGE
    B. sight
    C. sight, therefore
    D. sight, as

68. If the writer were to delete the quotation marks around the word *topped* in the preceding sentence, the sentence would primarily lose an indication that the narrator is:

F. using a technical term.
G. making a sarcastic comment.
H. feeling angry about losing the tree.
J. directly quoting a neighbor.

an undertaker," he said. "Trees are dying all over town."

Then he cut off a section at a time and dropped the pieces
                                                          69
onto the yard, climbing the old spruce. He counted the
                                                        69
rings and told me the tree was fifty years old. Santa Fe's

last fifty years had been unusually wet; the next fifty

promised not to be.

      Without the tree, the front yard changed. [70] Some

cacti, which I'd never given much attention to went
                                                71
wild, blossoming in crimson flowers. Four little piñon

trees—trees more better suited to the conditions of
                                               72

drought—volunteered where the spruce had grown.
        73
Best of all was the effect on a dwarf peach tree that had

struggled to grow. In the shade of the spruce, it had borne

two or three peaches a season. Now in full sunlight, I
                                                     74
produced forty. Each peach was succulent—a welcome

harvest in a dry season.

---

69. A. NO CHANGE
   B. Then he climbed the old spruce and cut off a section at a time, dropping the pieces onto the yard.
   C. Dropping the pieces onto the yard, he then cut off a section at a time and climbed the old spruce.
   D. Dropping the pieces onto the yard, he climbed the old spruce and then cut off a section at a time.

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

    I expected the changes would all be for the worse, but pleasantly they weren't.

Should the writer make this addition here?

   F. Yes, because it gives evidence that, contrary to the arborist's warning, the drought was close to an end.
   G. Yes, because it provides a logical transition between the preceding sentence and the rest of the paragraph.
   H. No, because it creates a digression and therefore does not logically fit in the essay.
   J. No, because it conflicts with the narrator's feelings about the changes to the yard expressed in the rest of this paragraph.

71. A. NO CHANGE
   B. cacti, that
   C. cacti,
   D. cacti

72. F. NO CHANGE
   G. more better suitable
   H. much better suited
   J. much better suitable

73. A. NO CHANGE
   B. drought had
   C. drought, had
   D. drought

74. F. NO CHANGE
   G. they
   H. you
   J. it

Question 75 asks about the preceding passage as a whole.

75. Suppose the writer's goal had been to write a brief persuasive essay describing the devastating effects that poor drought management can have on an area's ecosystem. Would this essay accomplish that goal?

  A. Yes, because it effectively uses the example of the dying spruce tree to illustrate the greater devastation to the area.
  B. Yes, because it criticizes the Santa Fe government's response to the drought for compounding the damage to the surrounding ecosystem.
  C. No, because it connects the effects on the narrator's yard with climate conditions rather than with drought management practices.
  D. No, because it fails to connect the area's drought to the death of the blue spruce tree.

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. A group of 6 people planned to spend $10.00 each to rent a boat for an outing. At the last minute, 1 person could not go on the outing. The others then paid equally for the boat. How much did each pay?

   A. $ 8.00
   B. $ 8.33
   C. $11.67
   D. $12.00
   E. $20.00

2. A calculator has a regular price of $58.95 before taxes. It goes on sale at 20% below the regular price. Before taxes are added, what is the sale price of the calculator?

   F. $53.95
   G. $47.16
   H. $38.95
   J. $29.48
   K. $11.79

3. Melissa knows that 30 miles per hour is equivalent to 44 feet per second. If Melissa drives at a speed of 70 miles per hour, which of the following is closest to her speed in feet per second?

   A.   31
   B.   48
   C.   103
   D.   127
   E. 1,027

4. If $r = 5$, $b = 2$, and $g = -3$, what does $(r + b - g)(b + g)$ equal?

   F. −10
   G.   −4
   H.   4
   J.   9
   K.   10

DO YOUR FIGURING HERE.

5. What is the largest value of x for which there exists a real value of y such that $x^2 + y^2 = 256$?

A. 16
B. 128
C. 240
D. 256
E. 512

6. At Riverland Amusement Park, if an individual is not more than 4 feet tall, then that individual cannot ride the roller coaster. If Antoine rode the roller coaster at Riverland Amusement Park today, then which of the following may be logically concluded?

F. Antoine is at most 3 feet tall.
G. Antoine is less than 4 feet tall.
H. Antoine is exactly 4 feet tall.
J. Antoine is more than 4 feet tall.
K. Antoine is at least 5 feet tall.

7. The number, N, of students at Hamlet High School who will catch the flu through Week t of school is modeled by the function $N(t) = \frac{1,200t^2 + 10}{t^2 + 1}$. According to the model, how many students will catch the flu through Week 4 ?

A. 114
B. 1,068
C. 1,130
D. 1,835
E. 1,951

8. $3x^5 \cdot 7x^9$ is equivalent to:

F. $10x^4$
G. $10x^{14}$
H. $10x^{45}$
J. $21x^{14}$
K. $21x^{45}$

9. A bag contains 5 yellow jellybeans, 4 red jellybeans, and 3 green jellybeans, all of the same shape and size. When 1 jellybean is randomly picked from the bag, what is the probability that it is green?

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

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

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

D. $\frac{5}{12}$

E. $\frac{2}{3}$

DO YOUR FIGURING HERE.

DO YOUR FIGURING HERE.

10. What is the least common denominator for adding the fractions $\frac{4}{35}$, $\frac{1}{56}$, and $\frac{3}{16}$?

   F.   80
   G.   560
   H.   1,960
   J.   4,480
   K. 31,360

11. Marisa's design for a rectangular stained glass window with 7 triangles is shown below. The 2 white triangles are congruent ($\triangle ABC \cong \triangle DEC$) and will be a different color than the other 5 triangles. The design includes the measures of $\angle CAB$, $\angle ACB$, and $\angle DCE$. What is the measure of $\angle CED$?
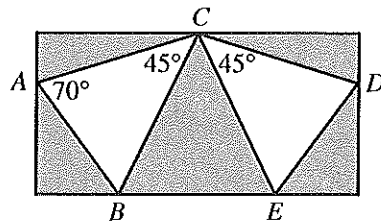
   A.   45°
   B.   65°
   C.   70°
   D.   115°
   E.   135°

12. The expression $\dfrac{8+\frac{1}{7}}{1+\frac{1}{14}}$ is equal to:

   F. $\dfrac{38}{5}$

   G. $\dfrac{855}{7}$

   H. 4

   J. 5

   K. 10

13. The sum of the real numbers x and y is 15. Their difference is 9. What is the value of xy ?

   A.   12
   B.   15
   C.   24
   D.   36
   E.   135

14. Four points, A, B, C, and D, lie on a circle having a circumference of 17 units. B is 6 units counterclockwise from A. C is 2 units clockwise from A. D is 9 units clockwise from A and 8 units counterclockwise from A. What is the order of the points, starting with A and going clockwise around the circle?

   F. A, B, C, D
   G. A, B, D, C
   H. A, C, B, D
   J. A, C, D, B
   K. A, D, C, B

DO YOUR FIGURING HERE.

15. To determine a student's overall test score for the semester, Ms. Rainwater deletes the lowest test score and calculates the average of the remaining test scores. Galen took all 5 tests and earned the following test scores in Ms. Rainwater's class this semester: 81, 83, 88, 92, and 99. What overall test score did Galen earn in Ms. Rainwater's class this semester?

   A. 88.0
   B. 88.6
   C. 90.0
   D. 90.5
   E. 91.0

16. What is the slope-intercept form of $6x - y - 2 = 0$?

   F. $y = -6x + 2$
   G. $y = -6x - 2$
   H. $y = 2x - 6$
   J. $y = 6x + 2$
   K. $y = 6x - 2$

17. What is the sum of the 2 solutions of the equation $x^2 - 3x - 28 = 0$?

   A. 7
   B. 3
   C. 0
   D. −4
   E. −28

18. $\left| 5(-4) + 3(6) \right| = ?$

   F. −2
   G. 2
   H. 10
   J. 19
   K. 38

19. Tracy is trying to find a wrench to fit a bolt. The $\frac{3}{8}$-inch wrench is too large, and the $\frac{5}{16}$-inch wrench is too small. Which of the following could be the size of the wrench that will fit the bolt exactly?

   A. $\frac{1}{4}$-inch

   B. $\frac{9}{32}$-inch

   C. $\frac{11}{32}$-inch

   D. $\frac{25}{64}$-inch

   E. $\frac{13}{32}$-inch

20. What is the slope of the line containing the points (3,8) and (−2,10) in the standard (*x,y*) coordinate plane?

   F. $\dfrac{1}{18}$

   G. $\dfrac{12}{5}$

   H. 18

   J. $-\dfrac{5}{2}$

   K. $-\dfrac{2}{5}$

21. The expression $a + b + c + a + b + c$ is equivalent to:

   A. $6abc$
   B. $a^2b^2c^2$
   C. $6a^2b^2c^2$
   D. $a^2 + b^2 + c^2$
   E. $2a + 2b + 2c$

22. During a 5-year period, 875 houses were built in Somerville. The graph below shows how many of these houses were built in each of these 5 years. A certain percent of the 875 houses were built in 1993. Which of the following is closest to that percent?
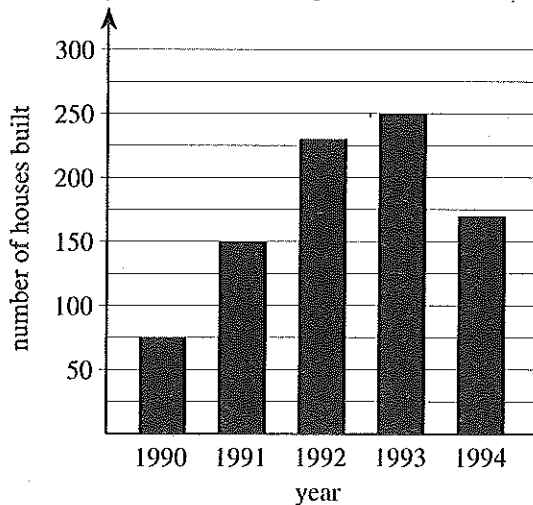
   F. 20%
   G. 25%
   H. 30%
   J. 35%
   K. 40%

23. How many terms are there between 13 and 37, exclusive of 13 and 37, in the arithmetic sequence below?

$$4, 7, 10, 13, \cdots, 37$$

A. 0
B. 7
C. 8
D. 28
E. 36

24. For $x^2 \neq 49$, $\dfrac{(x-7)^2}{x^2-49} = ?$

F. $\dfrac{x-7}{x+7}$

G. $\dfrac{1}{x-7}$

H. $\dfrac{1}{x+7}$

J. $-\dfrac{1}{7}$

K. $\dfrac{1}{7}$

25. The sides of one triangle are 12 inches, 14 inches, and 15 inches long, respectively. In a second triangle similar to the first, the shortest side is 8 inches long. To the nearest tenth of an inch, what is the length of the longest side of the second triangle?

A. 6.4
B. 9.3
C. 10.0
D. 11.0
E. 14.4

26. Which of the following is equivalent to $(x + 2)^0$ whenever $x \neq -2$?

F. $x + 2$
G. 0
H. 1
J. 2
K. 3

27. A pentagon has 1 side of length z cm, 2 sides of length $(z + 2)$ cm each, 1 side of length 5 cm, and 1 side of length $3z$ cm. What is the perimeter, in centimeters, of the pentagon?

A. $9z + 6$
B. $6z + 9$
C. $6z + 4$
D. $5z + 9$
E. $5z + 7$

28. A park has the shape and dimensions in blocks given below. A water fountain is located halfway between B and D. If you are at A, the water fountain is:
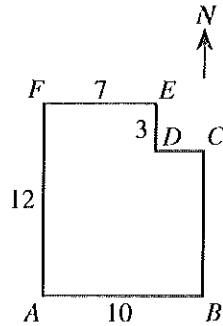
F. $4\frac{1}{2}$ blocks north and 5 blocks east.

G. $4\frac{1}{2}$ blocks north and $8\frac{1}{2}$ blocks east.

H. 6 blocks north and $3\frac{1}{2}$ blocks east.

J. 6 blocks north and 5 blocks east.

K. $7\frac{1}{2}$ blocks north and 9 blocks east.

29. If $a = 2c$ and $b = 6c$, which of the following relationships holds between a and b for each nonzero value of c ?

A. $a = 3b$

B. $a = 2b$

C. $a = b$

D. $a = \frac{1}{6}b$

E. $a = \frac{1}{3}b$

30. For a certain plant, the recommended nighttime temperature range in degrees Fahrenheit is $59° \leq F \leq 68°$. Given the formula $C = \frac{5}{9}(F - 32)$, where C is the temperature in degrees Celsius and F is the temperature in degrees Fahrenheit, what is the corresponding nighttime temperature range in degrees Celsius for the plant?

F. $0° \leq C \leq 5°$
G. $5° \leq C \leq 10°$
H. $10° \leq C \leq 15°$
J. $15° \leq C \leq 20°$
K. $20° \leq C \leq 25°$

DO YOUR FIGURING HERE.

31. In parallelogram *ABCD* below, the measure of ∠*BCD* is 98° and the measure of ∠*CDB* is 38°. What is the measure of ∠*BDA* ?
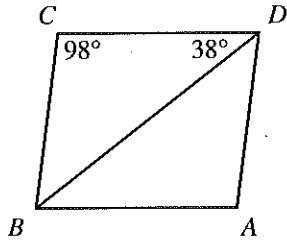
A. 38°
B. 41°
C. 44°
D. 49°
E. 52°

32. All the adjacent line segments in the figure below intersect in right angles. If each segment is 6 units long, what is the area, in square units, of the entire figure?
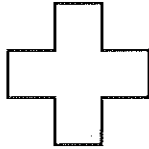
F. 72
G. 120
H. 144
J. 180
K. 324

33. Rhombus *RHOM* is shown in the figure below. If *HR* = 5 m and *HM* = 6 m, then what is the length, in meters, of $\overline{OR}$?
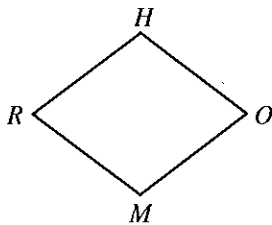
A. 3
B. 4
C. 5
D. 6
E. 8

34. Grid lines are shown at 1-unit intervals in the standard (*x*,*y*) coordinate plane below. Some of the 1-by-1 squares are shaded in the grid. What is the least number of additional 1-by-1 squares that must be shaded so the total shaded region will be symmetric about the *y*-axis?

DO YOUR FIGURING HERE.

- F. 3
- G. 5
- H. 7
- J. 11
- K. 22
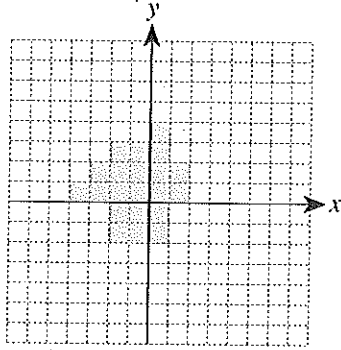
35. The ratio of the side lengths of a rectangle with an area of 80 square yards is 4:1. Which of the following is closest to the length, in yards, of the *longer* side of the rectangle?

- A. 10
- B. 16
- C. 18
- D. 32
- E. 40

36. Ms. Luciano's Algebra I class is describing the volume of geometric figures in terms of variables. She draws a rectangular prism that has a length of $(x + 2)$ meters, a width of $(x - 2)$ meters, and a height of $(x + 1)$ meters. Which of the following is an expression for the volume, in cubic meters, of the rectangular prism?

- F. $3x - 4$
- G. $3x + 1$
- H. $x^3 - 4$
- J. $x^3 + 2x^2 - 2x - 4$
- K. $x^3 + x^2 - 4x - 4$

37. A data set has 15 elements. The 15 elements in a second data set are obtained by multiplying each element in the first data set by 10. The 15 elements in a third data set are obtained by decreasing each element of the second data set by 20. The median of the third data set is 50. What is the median of the first data set?

- A. −20
- B.   7
- C. 50
- D. 70
- E. 750

DO YOUR FIGURING HERE.

38. Jamal sees a tree on the shore directly across a lake and wonders what the distance is across the lake to the tree. He turns 90° to the right and walks in a straight line for 100 meters. Jamal turns to face the tree and finds the angle between his line of sight and his path measures 25°, as shown below. Which of the following is closest to the distance, in meters, from Jamal's initial position to the tree?

(Note: $\sin 25° \approx 0.42$, $\cos 25° \approx 0.91$, $\tan 25° \approx 0.47$)
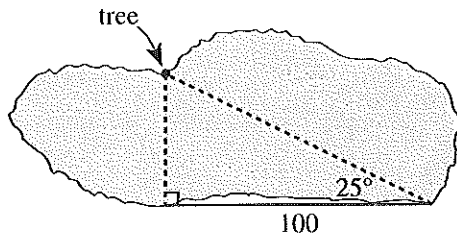
F.   42
G.   47
H.   91
J.   213
K.   238

39. In the standard (x,y) coordinate plane, a right triangle has vertices at $(-3,4)$, $(3,4)$, and $(3,-4)$. What is the length, in coordinate units, of the hypotenuse of this triangle?

A.   3
B.   4
C.   6
D.   8
E.   10

40. Each edge of a cube is 4 inches long. Each edge of a second cube is triple the length of each edge of the first cube. The volume of the second cube is how many cubic inches bigger than the volume of the first cube?

F.   128
G.   512
H.   576
J.   1,664
K.   1,728

41. A particular circle in the standard (x,y) coordinate plane has an equation of $(x - 8)^2 + y^2 = 15$. What are the radius of the circle, in coordinate units, and the coordinates of the center of the circle?

	radius	center
A.	7.5	$(-8,0)$
B.	7.5	$(8,0)$
C.	15	$(8,0)$
D.	$\sqrt{15}$	$(-8,0)$
E.	$\sqrt{15}$	$(8,0)$

DO YOUR FIGURING HERE.

Use the following information to answer questions 42–44.

The Springfield City Council is going to create a park on some unused land the city owns. The park will be a rectangular region 60 feet by 150 feet with an area of 9,000 square feet. There will be a picnic shelter in the park that will cover a square region 30 feet by 30 feet with an area of 900 square feet. The park will be grass, except for the region where the picnic shelter is.

42. The City Council decides to put fencing around the park. What is the perimeter, in feet, of the park?

    F. 150
    G. 210
    H. 270
    J. 420
    K. 540

43. The picnic shelter must be at least 10 feet from any edge of the park. On graph paper with the distance between grid lines representing 10 feet, a city engineer makes a scale drawing of the park, as shown below. The region where the picnic shelter CANNOT be built is shown shaded. The corners of both the park and the region where the picnic shelter may be built are at the intersections of grid lines. The corners of the picnic shelter must also be at the intersections of grid lines. How many different locations in the park are possible for the placement of the picnic shelter?
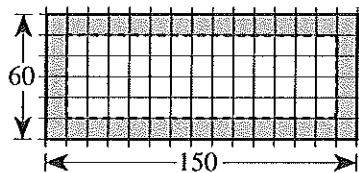
    A. 22
    B. 36
    C. 52
    D. 70
    E. 90

44. The City Council's long-term plan for the park involves doubling the area of the park. The length and width of the park will each be extended by d feet. For which of the following equations is $x = d$ a solution?

    F. $(x + 60)(x + 150) = 2(9,000)$
    G. $(x + 2(60))(x + 2(150)) = 9,000$
    H. $(x + 2(60))(x + 2(150)) = 2(9,000)$
    J. $(2x + 60)(2x + 150) = 2(9,000)$
    K. $2(x + 60)(x + 150) = 9,000$

45. The graphs of $f(x) = \cos x$ and $g(x) = \cos\left(x - \frac{\pi}{4}\right) + 1$ are shown in the standard (x,y) coordinate plane below. After one of the following pairs of transformations is applied to the graph of $f(x)$, the image of the graph of $f(x)$ is the graph of $g(x)$. Which pair is it?

DO YOUR FIGURING HERE.
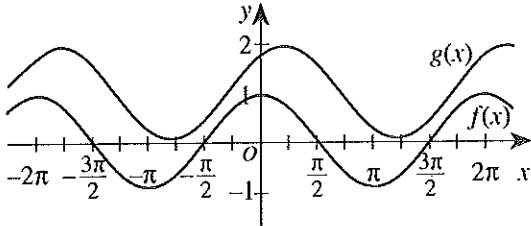
A. Shift $f(x)$ 1 unit left and $\frac{\pi}{4}$ units down.

B. Shift $f(x)$ 1 unit left and $\frac{\pi}{4}$ units up.

C. Shift $f(x)$ 1 unit right and $\frac{\pi}{4}$ units down.

D. Shift $f(x)$ $\frac{\pi}{4}$ units left and 1 unit up.

E. Shift $f(x)$ $\frac{\pi}{4}$ units right and 1 unit up.

46. Let p and q be numbers such that $0 < p < q$. Which of the following inequalities *must* be true for all such p and q ?

F. $p + 1 > q + 1$

G. $\frac{p}{q} > 1$

H. $\frac{1}{q} > \frac{1}{p}$

J. $p^2 > q^2$

K. $-p > -q$

47. If a is 25% of b, then 135% of b is what percent of a ?
A. 160%
B. 210%
C. 337.5%
D. 540%
E. 875%

48. The expression $\sin^2\theta - 4 + \cos^2\theta$ is equivalent to:
F. -5
G. -4
H. -3
J. 3
K. 5

49. Figure *ABCDEF*, shown in the standard (*x*,*y*) coordinate plane below, has been reflected across a line to figure *A'B'C'D'E'F'*. Which of the following lines of reflection would best describe this transformation?

A. $y = 0$

B. $y = \frac{1}{2}$

C. $y = -x$

D. $x = 0$

E. $x = y$
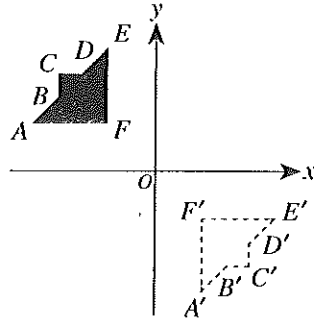
50. What is the length, in inches, of a 144° arc of a circle whose circumference is 60 inches?

F. $\dfrac{36}{\pi}$

G. 12

H. 24

J. 36

K. 12π

51. A solid, right circular cone is sliced perpendicular to its base through its vertex and the center of its base, as shown below. Which of the following best represents the plane section?

A.

D.

B.

E.

C.

CrackACT.com
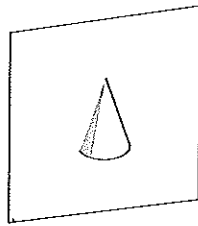
52. If b is a positive number such that $\log_b\left(\frac{1}{81}\right) = -4$, then $b = ?$

DO YOUR FIGURING HERE.

F. 3

G. 9

H. 85

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

K. $\frac{1}{9}$

53. The graph in the standard (x,y) coordinate plane below is the graph of $y = f(x)$. One of the following graphs is the graph of $y = f(x - 3) + 2$. Which one?

A.

D.

B.

E.

C.
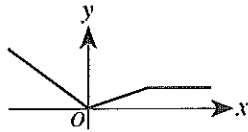
54. In the figure below, parallel lines a and b intersect parallel lines c and d. If it can be determined, what is the sum of the degree measures of $\angle 1$ and $\angle 2$?
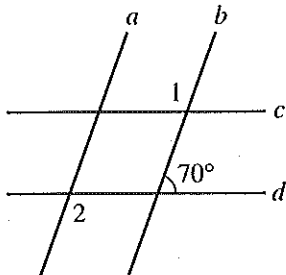
F. 220°
G. 180°
H. 140°
J. 110°
K. Cannot be determined from the given information

27

GO ON TO THE NEXT PAGE.

DO YOUR FIGURING HERE.

> Use the following information to answer questions 55–57.

Consider the set of all points (x,y) that satisfy all 3 of the conditions below:

$$y \geq 0$$
$$y \leq 2x + 4$$
$$y \leq -x + 4$$

The graph of this set is $\triangle ABC$ and its interior, which is shown shaded in the standard (x,y) coordinate plane below. Let this set be the domain of the function $P(x,y) = 4x + 3y$.
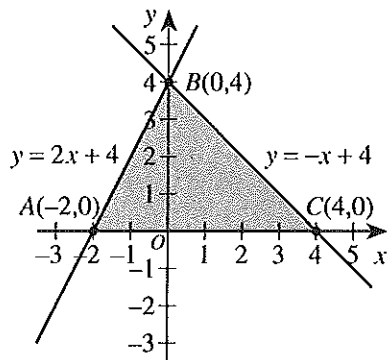
55. What is the maximum value of $P(x,y)$ when x and y satisfy the 3 conditions given?

- **A.** 4
- **B.** 8
- **C.** 12
- **D.** 16
- **E.** 28

56. The quadrants of the standard (x,y) coordinate plane are labeled in the figure below. The domain of $P(x,y)$ contains points in which quadrants?
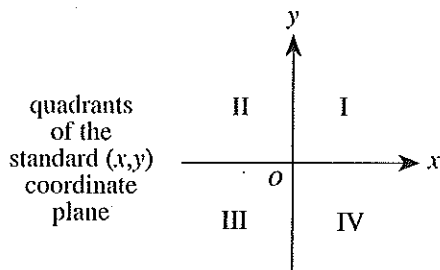
- **F.** I and II only
- **G.** I and III only
- **H.** I and IV only
- **J.** II and III only
- **K.** II and IV only

57. tan ∠BCA = ?

    A. 1

    B. $\dfrac{2}{3}$

    C. $\dfrac{\sqrt{5}}{3}$

    D. $\dfrac{3}{\sqrt{5}}$

    E. $\dfrac{3}{2\sqrt{2}}$

---

58. The function $f(x)$ is a cubic polynomial that has the value of 0 when x is 0, 3, and −5. If $f(1) = -24$, which of the following is an expression for $f(x)$?

    F. $x^3 - 25$
    G. $-2x(x-3)(x+5)$
    H. $x(x-3)(x+5)$
    J. $2x(x+3)(x-5)$
    K. $2x(x-3)(x+5)$

59. Water is considered contaminated when the level of zinc in the water reaches 5 parts of zinc per 1 million parts of water. What is this level of zinc contamination written in scientific notation?

    A. 5.0×10^{-9}
    B. 5.0×10^{-7}
    C. 5.0×10^{-6}
    D. 5.0×10^{6}
    E. 5.0×10^{9}

60. Given $a > b$ and $(a - b) > (a^2 - b^2)$, then $(a + b)$ must be:

    F. less than 1.
    G. greater than 1.
    H. greater than a.
    J. greater than $(a - b)$.
    K. equal to $(a - b)$.

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 Bonesetter's Daughter* by Amy Tan (©2001 by Amy Tan).

The setting of the passage is a small town in China during the early part of the twentieth century. The capital city of China, now known in English as Beijing, formerly was called Peking.

When I was growing up, nearly two thousand people lived in Immortal Heart. It was crowded, packed from one edge of the valley to the other. We had a brick maker, a sack weaver, and a dye mill. We had twenty-
5　four market days, six temple fairs, and a primary school that GaoLing and I went to when we were not helping our family at home. We had all kinds of peddlers who went from house to house, selling fresh bean curd and steamed buns, twisted dough and colorful candies. A
10　few coppers, that was all you needed to make your stomach as happy as a rich man's.

The Liu clan had lived in Immortal Heart for six centuries. For that amount of time, the sons had been inkstick makers who sold their goods to travelers. They
15　had lived in the same courtyard house that had added rooms, and later wings, when one mother four hundred years ago gave birth to eight sons, one a year. The family home grew from a simple three-pillar house to a compound with wings stretching five pillars each.

20　All in all, our family was successful but not so much that we caused great envy. We ate meat or bean curd at almost every meal. We had new padded jackets every winter, no holes. We had money to give for the temple, the opera, the fair. But the men of our family
25　also had ambitions. They were always looking for more. They said that in Peking, more people wrote important documents. Those important documents required more good ink. Peking was where more of the big money was. Around 1920, Father, my uncles, and
30　their sons went there to sell the ink. From then on, that was where they lived most of the time, in the back room of a shop in the old Pottery-Glazing District.

In our family, the women made the ink. We stayed home. We all worked—me, GaoLing, my aunts and girl
35　cousins, everybody. Even the babies and Great-Granny had a job of picking out stones from the dried millet we boiled for breakfast. We gathered each day in the

inkmaking studio. According to Great-Granny, the studio began as a grain shed that sat along the front
40　wall of the courtyard house. Over the years, one generation of sons added brick walls and a tile roof. Another strengthened the beams and lengthened it by two pillars. The next tiled the floors and dug pits for storing the ingredients. Then other descendants made a cellar
45　for keeping the inksticks away from the heat and cold.

Because our ink was the best quality, we had to keep the tables and the floors clean year-round. With the dusty yellow winds from the Gobi Desert, this was not easy to do. The window openings had to be covered
50　with both glass and thick paper. In the summer, we hung netting over the doorways to keep out the insects. In the winter, it was sheep hides to keep out the snow.

I can still smell the ingredients of our ink. There were several kinds of fragrant soot: pine, cassia, cam-
55　phor, and the wood of the chopped-down Immortal Tree. There was also a glue of sticky paste mixed with many oils. Then we added a sweet poisonous flower that helped resist insects and rats. That was how special our ink was, all those lasting smells.

60　We made the ink a little at a time. If a fire broke out, as it had a couple of hundred years before, all the supplies and stock would not be lost at once. Each of us had at least one part in a long list of things to do. First there was burning and grinding, measuring and
65　pouring. Then came stirring and molding, drying and carving. And finally, wrapping and counting, storing and stacking. One season I had to wrap, only that. My mind could wander, but my fingers still moved like small machines. Another season I had to use very fine
70　tweezers to pluck bugs that had fallen onto the sticks. Whenever GaoLing did this, she left too many dents. Precious Auntie's job was to sit at a long table and press the sooty mixture into the stone molds. When the ink was dry, she used a long, sharp tool to carve the
75　good-luck words and drawings into the sticks. Her calligraphy was even better than Father's.

It was boring work, but we were proud of our secret family recipe. It yielded just the right color and hardness. An inkstick of ours could last ten years or
80　more. It did not dry out and crumble, or grow soggy with moisture. And if the sticks were stored in the coolness of a root cellar, as ours were, they could last from

GO ON TO THE NEXT PAGE.

one great period of history into another. Those who used our ink said the same. It didn't matter how much
85 heat or moisture or dirt from fingers soaked into the page, their words lasted, black and strong.

1. The point of view from which the passage is told is best described as that of:

A. a child living in a small town in China.
B. an adult remembering her childhood in China.
C. an inkmaker describing the century-old production process she still uses.
D. a great-grandmother whose family makes ink.

2. According to the passage, the men in the family lived in Peking most of the time because they:

F. wanted to write important documents in the capital.
G. made pottery in the Pottery-Glazing District.
H. were ambitious salesmen in the Pottery-Glazing District.
J. produced ink in the Pottery-Glazing District.

3. According to the passage, the family's ink studio consisted of a:

A. refurbished shed, pits, and a cellar.
B. house, a courtyard, and a cellar.
C. refurbished shed, a courtyard, and a cellar.
D. storeroom, a house, and pits.

4. It can most reasonably be inferred from the passage that one ingredient being burned (lines 64–65) to make the ink was:

F. millet or another grain.
G. roots from the cellar.
H. wooden beams from the compound.
J. wood from the Immortal Tree.

5. The main purpose of the last paragraph is to:

A. explain the importance of storing inksticks in a cool place.
B. show that the family refused to share its recipe for making ink, which remained a secret.
C. illustrate the lasting quality of the Liu clan's ink.
D. indicate that Chinese history is divided into a series of "great periods."

6. As it is used in line 10, the word *coppers* most likely refers to:

F. ink-storage containers.
G. metal cooking pots.
H. police officers.
J. coins.

7. The passage makes clear that the house grew from a simple house to a compound because:

A. the family business required more and more space.
B. one mother in the family had borne many sons.
C. the storage of ink ingredients had taken up several rooms.
D. everybody in the family worked in the inkmaking studio.

8. The narrator makes clear that one mark of success for her family was:

F. eating dried millet for breakfast every day.
G. owning sheep hides to provide warmth in winter.
H. having bean curd or meat at almost every meal.
J. giving birth to a son each year for many years.

9. Which of the following does the passage suggest had happened about two hundred years earlier?

A. The family had added a secret fragrance to the ink.
B. The ink and its ingredients had been damaged or lost in a fire.
C. The family had experimented with yellow-colored ink.
D. There had been an invasion of pests that had ruined the ink.

10. Which of the following comparisons regarding calligraphy does the narrator make?

F. The narrator's calligraphy was better than GaoLing's.
G. Precious Auntie's calligraphy was better than Father's.
H. Great-Granny's calligraphy was better than the narrator's.
J. Father's calligraphy was the best of all the family members'.

Passage II

SOCIAL SCIENCE: This passage is adapted from the article "High Over Kitty Hawk, Looking for a Profit" by Paul Hoffman (©2003 by The New York Times Company).

The foggy lens of history has been kind to Wilbur and Orville Wright. We regard the boys from Dayton, Ohio, as American heroes who flew the first airplane and ushered in the age of air travel. At the time, though,
5 the brothers' achievement was barely recognized—and their motives were far from visionary.

On Dec. 17, 1903, the Wrights took turns making short ascents over the dunes of Kill Devil Hills, four miles south of Kitty Hawk, N.C., in a propeller-driven
10 biplane powered by an internal combustion engine. They each got airborne twice—with Wilbur going the farthest, 852 feet in 59 seconds—before a gust flipped the plane while it was on the ground.

But what was really so historic about the flight?
15 The Wrights were certainly not the first people to rise above the Earth. Balloonists had been doing that for more than a century. In June 1783, Joseph and Étienne Montgolfier, paper makers from Annonay, France, demonstrated in a public square the first hot-air balloon
20 capable of carrying a load as heavy as a human being.

The Wrights were also not the first to pilot a heavier-than-air craft. In 1849, Sir George Cayley, a British physicist, constructed a three-winged glider that lifted a 10-year-old child a few feet. After four years of
25 further experimentation, Cayley enlarged his "boy glider" into an adult-size craft and sent a grown man through the air for several hundred feet.

Nor were the Wright brothers the first to achieve powered flight. In 1901, a Brazilian named Alberto
30 Santos-Dumont entertained all of Paris by making a 14-mile trip over the city, including a revolution of the Eiffel Tower, in a cigar-shaped balloon powered by a car engine.

The Wrights were not even the first to leave the
35 ground in a powered plane. In 1874, Félix du Temple, a French naval officer, watched the steam-powered plane he devised speed down a ski-jump-like ramp and sputter through the air with a young sailor at the helm.

Of course, it is one thing to be hurled through the
40 air for a few fleeting moments—what aviation historians call a "hop"—and quite another to make a controlled flight under one's own power. Control is what the Wright brothers so ably and singularly demonstrated. While other aviation pioneers concentrated on
45 how to power a plane—not a difficult task by the time automobile engines had come into their own—the Wrights focused on how to stabilize it.

Many early aviation pioneers employed horizontal and vertical rudders to keep their experimental aircraft
50 from veering right or left or unintentionally diving or rising. But only the Wrights appreciated another necessity: preventing the plane from suddenly rolling because of a difference in wind on the left and right wings. They ingeniously countered roll by "wing-
55 warping"—using flexible wing tips with wire controls so that the pilot can bring the right wing into the wind at a different inclination from the left one, creating lift.

Thus while the brothers' flights were remarkable, they were hardly bolts from the blue. Rather, their
60 achievement was a vital step in a long progression toward controlled flight. And by no means did their success make them overnight celebrities: in 1903 hardly anyone heard about their flights, and those who did were not inclined to believe the tale.

65 The Wright brothers chose the Outer Banks of North Carolina not just for the favorable winds, but also for the remoteness. They wanted to fly in near secrecy because they weren't sure they could patent their plane, and wanted to profit from it before others
70 knocked off the design. Yet, they expected the press to hail them as the conquerors of the air.

But reporters were skeptical. Six days before Kitty Hawk, a crowd of official witnesses and Washington bigwigs had gathered to watch what was supposed to be
75 the maiden flight of the giant Aerodrome designed by Samuel Langley, the head of the Smithsonian Institution. The plane was catapulted from a houseboat in the Potomac but instead of rising into the air plunged into the frigid waters. News reporters could not accept that
80 two bicycle mechanics with little money had succeeded while the dean of American science, financed with government money, had failed.

The few newspapers that wrote about Kitty Hawk got everything wrong. The Dayton Daily News
85 described the Wrights' aircraft as a dirigible and planted the story under the headline "Dayton Boys Emulate Great Santos-Dumont." The first eyewitness account of their subsequent flights was published more than two years after Kitty Hawk, in an obscure maga-
90 zine called *Gleanings in Bee Culture*.

11. The point of view from which the passage is told is best described as that of:

A. a writer with a historical perspective who wants to correct misconceptions about early flight.
B. a relative of the Wright brothers who wants to build a monument in their honor.
C. an inventor who wants to illustrate how difficult it is to invent something important.
D. an observer of the initial Kitty Hawk flight who is critical of how it was reported, both then and later.

12. What does the passage indicate was the main difference between the Wright brothers' aircraft and the works of other inventors?

F. The Wright brothers succeeded in flying when other inventors had failed.
G. Other inventors used balloons, not heavier-than-air craft.
H. No other inventors had used both horizontal and vertical rudders.
J. The Wright brothers prevented the rolling of a plane while other inventors had concentrated on powering a plane.

13. According to the passage, what was one reason reporters were skeptical that the Wright brothers had successfully flown?

A. The first story of the Wright brothers' flight was not published for two years.
B. It was widely assumed that the Wright brothers wanted to profit from their ideas.
C. A leader in science with government funding had failed to have his own plane fly.
D. Balloonists had already been flying for more than a century.

14. The main purpose of the last paragraph is to show that the Wright brothers:

F. were successful in their attempt to fly.
G. had merely duplicated what Alberto Santos-Dumont had done earlier.
H. were originally from Dayton, Ohio.
J. were initially poorly covered by the media.

15. The main purpose of the second paragraph (lines 7–13) is to:

A. argue that more people should admire the Wright brothers for their accomplishments.
B. explain why it took two years for the first eyewitness account of the Wright brothers' initial flight to be published.
C. detail the first successful flights of the Wright brothers near Kitty Hawk.
D. clarify that it took many more years before the airplane was perfected.

16. As it is used in line 31, the word *revolution* most nearly means:

F. political rebellion.
G. radical change.
H. circular course.
J. pivotal invention.

17. The passage makes clear that it became easier for inventors to power their aircraft after:

A. the Wright brothers flew near Kitty Hawk.
B. automobile engines had been developed.
C. they started adding horizontal and vertical rudders.
D. Sir George Cayley perfected his "boy glider."

18. The statement "they were hardly bolts from the blue" (line 59) most strongly suggests that flights like the Wright brothers' were:

F. unsurprising.
G. improbable.
H. unusual.
J. remarkable.

19. The passage makes clear that one personal reason the Wright brothers had for testing their aircraft where they did was to:

A. avoid the negative publicity that would come if their plane failed to fly.
B. keep away anyone who couldn't help if something went wrong during the test flight.
C. maintain confidentiality despite the many interviews they had previously given.
D. make money from their invention by isolating it from potential imitators.

20. It can most reasonably be inferred from the tenth paragraph (lines 65–71) that the author believes:

F. the Wright brothers shouldn't have expected to be praised by the press.
G. North Carolina was too windy for flying experimental aircraft safely.
H. secrecy is necessary for inventors.
J. reporters can't be trusted to get their information correct.

Passage III

HUMANITIES: This passage is adapted from the article "The Comics" by M. Thomas Inge (©1990 by Smithsonian Institution).

Comic art has much in common with all the other forms of literary and visual communication of the twentieth century. As in fiction, the elements of narrative, characterization, and setting are important in accom-
5 plished comic art; and as in poetry, ideas must be developed within a very short period of reading time, a few seconds for a comic strip and fifteen minutes or less for a comic book story. As in drama, a story or incident must be staged before our eyes within the artificial
10 strictures of a box-like frame and with all the limitations of a play in terms of compressed time, dialogue, and plot development. As in a motion picture, such visual devices as cutting, framing, close-ups, and montage are used by the comic artist, and the point-of-view
15 is free to roam the world over to places known and fantastic.

Although the comics share a good deal with other forms of artistic expression, they differ in distinct ways and provide a method of communication which is ulti-
20 mately unique. For one thing, comics depend for their effectiveness on a balanced combination of word and picture, the one depending fully on the other for maximum effect. Thus some commentators have suggested that in comic strip art, if either the picture or the text is
25 not essential to understanding, then a proper balance is lacking.

There are other essential features of comic art, which distinguish it from other art forms. For example, comic strips appear on a daily basis in newspapers
30 delivered to homes, while comic books appear on a monthly basis in special serial publications sold at newsstands or comic book shops (and more recently a few bookstores). Both are usually printed on inexpensive paper, and while comic books generally appear in
35 color, comic strips have traditionally been in color only on Sundays.

Another distinguishing feature is that most comic strips and books feature a set of recurring characters with whom the reader becomes familiar over a period
40 of time, with an occasional retelling of their past histories in capsule form. It is the accumulative weight of familiarity over several months or years of reading experience with the characters through which the development of personality occurs, although many characters
45 remain essentially the same throughout their lifetimes. Especially in humor, a set of stock and stereotyped players is essential to the daily comic routines, formulaic repetition being one of those techniques which most often make people laugh (as in Charlie Brown's
50 unsuccessful attempt to kick the football held annually by Lucy in the *Peanuts* comic strip).

Time is also treated differently in that generally it has no effect on the lives of characters in the comics. They do not grow old chronologically (with the notable
55 exception of *Gasoline Alley* in which several generations of a family have grown old along with the readers). The dramatic narrative is open-ended and the action, whenever the reading experience begins, is always somewhere in the middle. Thus comics charac-
60 ters inhabit a world that has no beginning and no end, that remains constant and is shored up against the usual influences of change and deterioration. Only in the case of politically satiric strips, such as *Doonesbury*, *Bloom County*, or *Pogo*, are immediately contemporary events
65 and personalities reflected or depicted in the comics.

Since comics characters inhabit a world of silence, due to the restrictions of the printed page which cannot allow for motion and sound, dialogue and noise require a special set of conventions. Words are usually spoken
70 in cloud-like puffs of smoke called balloons. Because of the limited amount of space, dialogue must be kept to an absolute minimum and the joke or story told with the fewest words possible, a continual challenge to the skills of the writer of a comic. As for sounds, the comic
75 artist must resort to the poetic device of onomatopoeia, and while many traditional words such as *slam*, *bang*, *sock*, *smash*, or *bump* will serve the situation, new word coinages have proven necessary. Thus the comics have enriched American English by such contributions as
80 *wow*, *plop*, *zowie*, *bam*, and *whap*. In order to convey ideas which cannot be expressed with words, the comic artist has also developed a vocabulary of visual symbols, such as bubble balloons for silent thoughts, stars to show pain, drops of water to express labor or worry,
85 or radiating lines to convey pride or enlightenment. It is remarkable how effective these conventions are in creating the impression of a loud and noisy medium.

21. Suppose a reader had composed the following summary of the passage:

Comic art has been an important part of U.S. culture for decades, reflecting the historical and aesthetic changes within the country and its changing values.

Would this be an effective summary of the passage?

A. Yes, because the passage focuses on how comic artists have used their art to reflect the changing culture.

B. Yes, because the passage focuses on how comic artists have developed their own storytelling methods over many decades.

C. No, because the passage focuses on the established practices that comic artists have traditionally used in comic art.

D. No, because the passage focuses on the connections between comic art and film.

22. The primary purpose of the first paragraph is to:

F. compare the elements of comic art to elements of other artistic forms.
G. describe the various techniques used in a wide variety of artistic forms.
H. introduce the history and development of comic art as a form of artistic expression.
J. define the limitations of various forms of artistic expression.

23. It can reasonably be inferred from the passage that the author believes which of the following about the publication materials used in comic art?

A. High-quality paper is necessary in the publication of the best comic art.
B. The use of color in comic art enhances the distinction between pictures and words.
C. Whether color or good paper is used in comic art is irrelevant to its artistic quality.
D. The use of recyclable paper is necessary for the purest forms of comic art.

24. The passage makes all of the following points about time and the comics EXCEPT that:

F. comic strips and comic books appear in print on a regular schedule.
G. readers can slow the pace of a story line by the speed at which they read the comics.
H. the dramatic narrative is open ended and the action is always somewhere in the middle.
J. the passage of time usually has little effect on the characters' lives.

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

A. What elements do comic art and literary art share?
B. Are stock characters used in humorous comic strips?
C. How is the effect of sound created in comic art?
D. What drawing styles are most popular in comic art?

26. As it is used in lines 69 and 86, the word *conventions* most nearly means:

F. gatherings of comic artists.
G. stereotypical situations.
H. common courtesies.
J. customary practices.

27. The passage mentions which one of the following poetic devices as having been used by comic artists to create linguistic effects?

A. Rhyme
B. Onomatopoeia
C. Metaphor
D. Hyperbole

28. According to the passage, balance must be achieved in comics between:

F. word and picture.
G. humor and drama.
H. sound and silence.
J. stereotyped and original characters.

29. The passage states that the development of the personalities of characters in comic art occurs as a result of:

A. dialogue.
B. descriptive character sketches.
C. familiarity over time.
D. stereotypes.

30. According to the passage, direct references to current real-world events and personalities are found only in which type of comic?

F. Political satire
G. Family
H. Horror
J. Science fiction

Passage IV

The South American and the African weakly electric fish are quite unrelated to each other, but both live in the same kinds of waters in their respective continents, waters that are too muddy for vision to be effec-
5 tive. The physical principle that they exploit—electric fields in water—is even more alien to our consciousness than that of bats and dolphins. We at least have a subjective idea of what an echo is, but we have almost no subjective idea of what it might be like to perceive
10 an electric field. We didn't even know of the existence of electricity until a couple of centuries ago.

It is easy to see on the dinner plate that the muscles down each side of any fish are arranged as a row of segments, a *battery* of muscle units. In most fish they
15 contract successively to throw the body into sinuous waves, which propel it forward. In electric fish, both strongly and weakly electric ones, they have become a battery in the electric sense. Each segment (cell) of the battery generates a voltage. These voltages are con-
20 nected up in series along the length of the fish so that, in a strongly electric fish such as an electric eel, the whole battery generates as much as 1 amp at 650 volts. An electric eel is powerful enough to knock a man out. Weakly electric fish don't need high voltages or cur-
25 rents for their purposes, which are purely information-gathering ones.

The principle of electrolocation, as it has been called, is fairly well understood at the level of physics though not, of course, at the level of what it feels like
30 to be an electric fish. The following account applies equally to African and South American weakly electric fish: the convergence is that thorough. Current flows from the front half of the fish, out into the water in lines that curve back and return to the tail end of the
35 fish. There are not really discrete 'lines' but a continuous 'field,' an invisible cocoon of electricity surrounding the fish's body. However, for human visualization it is easiest to think in terms of a family of curved lines leaving the fish through a series of portholes spaced
40 along the front half of the body, all curving round in the water and diving into the fish again at the tip of its tail. The fish has what amounts to a tiny voltmeter monitoring the voltage at each 'porthole.' If the fish is suspended in open water with no obstacles around, the
45 lines are smooth curves. The tiny voltmeters at each porthole all register the voltage as 'normal' for their porthole. But if some obstacle appears in the vicinity, say a rock or an item of food, the lines of current that happen to hit the obstacle will be changed. This will
50 change the voltage at any porthole whose current line is affected, and the appropriate voltmeter will register the fact. So in theory a computer, by comparing the pattern of voltages registered by the voltmeters at all the portholes, could calculate the pattern of obstacles around
55 the fish. This is apparently what the fish brain does. Once again, this doesn't have to mean that the fish are

clever mathematicians. They have an apparatus that solves the necessary equations, just as our brains unconsciously solve equations every time we catch a
60 ball.

It is very important that the fish's own body is kept absolutely rigid. The computer in the head couldn't cope with the extra distortions that would be introduced if the fish's body were bending and twisting
65 like an ordinary fish. Electric fish have, at least twice independently, hit upon this ingenious method of navigation, but they have had to pay a price: they have had to give up the normal, highly efficient, fish method of swimming, throwing the whole body into serpentine
70 waves. They have solved the problem by keeping the body stiff as a poker, but they have a single long fin all the way along the length of the body. Then instead of the whole body being thrown into waves, just the long fin is. The fish's progress through the water is rather
75 slow, but it does move, and apparently the sacrifice of fast movement is worth it: the gains in navigation seem to outweigh the losses in speed of swimming. Fascinatingly, the South American electric fish have hit upon almost exactly the same solution as the African ones,
80 but not quite. Both groups have developed a single long fin that runs the whole length of the body, but in the African fish it runs along the back whereas in the South American fish it runs along the belly.

31. Which of the following questions about the South American and African weakly electric fish does the passage NOT directly answer?

   A. What do they use electrolocation for?
   B. What effect does their differing fin location have?
   C. What do the voltmeters on the fish do?
   D. Why do they swim more slowly than ordinary fish?

32. The author does all of the following in the second paragraph (lines 12–26) EXCEPT:

   F. contrast electric fish to other types of fish.
   G. compare strongly electric fish to weakly electric fish.
   H. begin to explain electrolocation.
   J. give an example of a weakly electric fish.

33. According to the author's simplified description in the passage, the flow of electric current generated by the weakly electric fish enters the water from the:

   A. tip of the tail and is reabsorbed into the head.
   B. head and is reabsorbed into the portholes.
   C. portholes and is reabsorbed into the portholes.
   D. portholes and is reabsorbed into the tip of the tail.

34. According to the passage, a weakly electric fish would know if there were a rock in its path because the:

   F. lines of current the fish generates would be in a smooth curve around the fish.

   G. fish would receive a small shock when the current it generates contacted the rock.

   H. current the fish generates would create a sound when it contacted objects.

   J. affected lines of current generated by the fish would produce detectable changes in voltage.

35. The main focus of the last paragraph is on the way weakly electric fish differ from ordinary fish in terms of:

   A. the length of their bodies.

   B. how they swim.

   C. how they use sight.

   D. the complexity of their brains.

36. The passage indicates that weakly electric fish have developed a system of navigation using electric fields because:

   F. as predators, it gives them an advantage over other fish.

   G. it helps keep them on course during lengthy migrations.

   H. they are nocturnal creatures and swim only in the dark.

   J. their habitats are muddy and therefore visibility is limited.

37. As it is used in line 14, the word *battery* most nearly refers to the:

   A. arrangement of fish muscles.

   B. electric field produced by fish muscles.

   C. energy that propels fish forward.

   D. different kinds of muscles contained in fish.

38. According to the passage, an electric eel is a type of:

   F. South American weakly electric fish.

   G. African weakly electric fish.

   H. strongly electric fish.

   J. dangerous water snake.

39. The author indicates that he chooses to describe the electric field emitted by the weakly electric fish as a "family of curved lines" (line 38) because:

   A. that is the precise scientific terminology for the phenomenon.

   B. this image is relatively easy for people to visualize.

   C. cocoons are made from curved lines.

   D. each line supports the others, like family members support each other.

40. According to the passage, successful navigation for weakly electric fish requires:

   F. frequent breaks in motion.

   G. an unobstructed swimming area.

   H. a rigid body.

   J. rapid water currents.

END OF TEST 3

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

DO NOT RETURN TO A PREVIOUS TEST.

SCIENCE TEST
35 Minutes—40 Questions

DIRECTIONS: There are 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

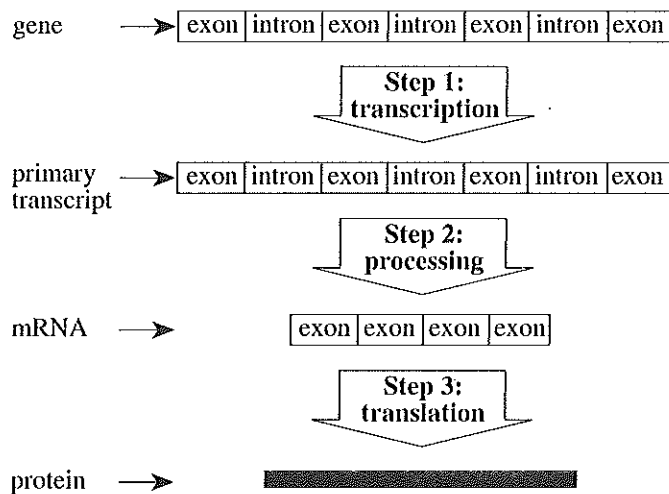Figure 1 depicts some of the steps of protein synthesis in eukaryotes.

Figure 1

In yeast, the genes that are expressed at a given time depend on environmental conditions, such as the glucose concentration in the environment.

Saccharomyces cerevisiae, a type of yeast, was grown for 12 hours on a growth medium containing glucose. The transcription rates of 4 genes (Genes 1–4) were determined. The *relative transcription rate* (*RTR*) of each gene was then calculated using the following formula:

$$RTR = \frac{\text{the gene's transcription rate at a given time}}{\text{the gene's transcription rate at time} = 0 \text{ hr}}$$

The results appear in Figure 2.
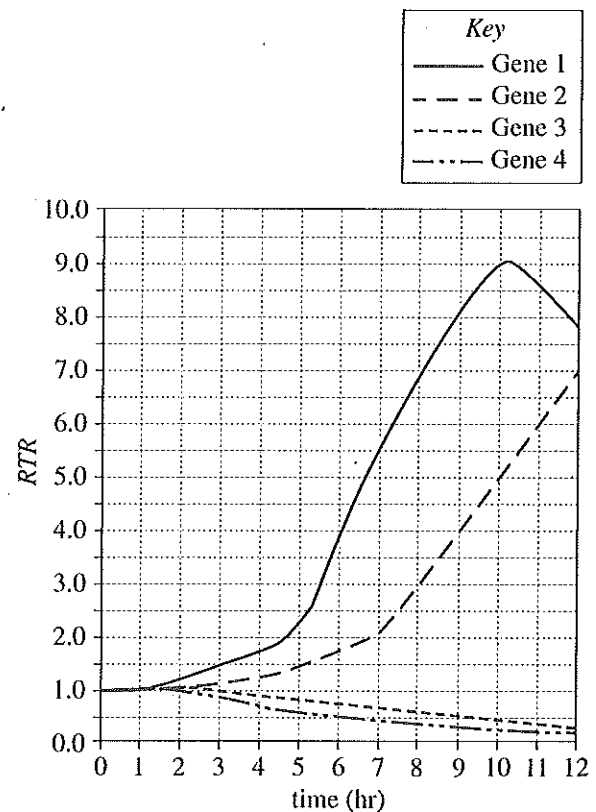
Figure 2

Figure 3 shows the glucose concentration of the medium during the experiment.
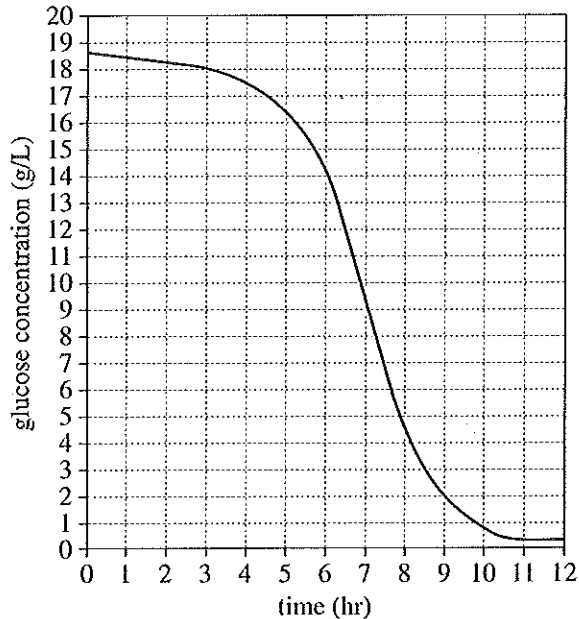
Figure 3

1. At which of the following times was the transcription rate of Gene 2 the greatest?

   A. Time = 0 hr
   B. Time = 2 hr
   C. Time = 4 hr
   D. Time = 6 hr

2. At which of the following times was the transcription rate of Gene 2 closest to 2 times the transcription rate of Gene 2 at time = 0 hr ?

   F. Time = 5 hr
   G. Time = 7 hr
   H. Time = 9 hr
   J. Time = 10 hr

3. Which of the following cellular components is most directly involved in Step 3 in Figure 1 ?

   A. Cell membrane
   B. Chloroplasts
   C. Lysosomes
   D. Ribosomes

4. Based on Figure 1, which of the following best describes what happens to introns during gene expression?

   F. Introns are transcribed and then translated.
   G. Introns are translated and then transcribed.
   H. Introns are transcribed, but not translated.
   J. Introns are translated, but not transcribed.

5. According to Figures 2 and 3, when the glucose concentration of the medium was 12 g/L, the *RTR* of Gene 4 was closest to which of the following?

   A. 0.1
   B. 0.5
   C. 0.9
   D. 1.3

GO ON TO THE NEXT PAGE.

Passage II

Some students experimentally determined g, the acceleration due to gravity.

In each trial, the students suspended a spring from a stand and measured the spring's length, L. They attached a mass to the suspended spring, allowed the spring-mass system to come to rest, and measured the length, y, of the extended spring (see Figure 1).
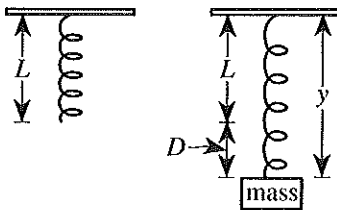
• Point R

Figure 1

Then they calculated the distance $D = y - L$.

Next, they pulled the mass down to the release point, R, and released it, allowing the mass and spring to oscillate. Using a sensor and a computer, they plotted the distance of the mass from Point R over time (see Figure 2).
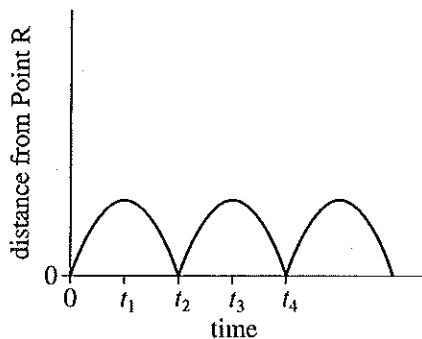

Figure 2

The measured period, P, of the spring-mass system equaled the time that elapsed from the moment the mass left Point R until the moment the mass returned to Point R. Finally, the students used D and P to calculate g.

Study 1

In Trial 1, the students tested Spring 1 with a 0.50 kg mass. (Spring 1 had a *spring constant* [stiffness], k, of 100 newtons/meter, N/m.) In Trials 2 and 3, the students replaced the 0.50 kg mass with a 1.00 kg mass and a 1.50 kg mass, respectively. The results are shown in Table 1.

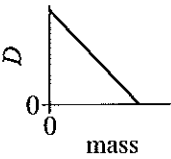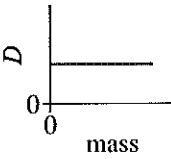| Table 1				
Trial	Mass (kg)	D (m)	P (sec)	g (m/sec^2)
1	0.50	0.049	0.444	9.8
2	1.00	0.098	0.628	9.8
3	1.50	0.146	0.767	9.8

Study 2

The students followed the procedure from Study 1, except that they substituted Spring 2 ($k = 200$ N/m) for Spring 1. The results are shown in Table 2.

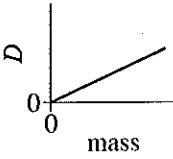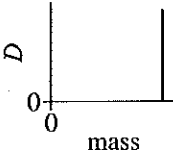| Table 2				
Trial	Mass (kg)	D (m)	P (sec)	g (m/sec^2)
4	0.50	0.025	0.315	9.9
5	1.00	0.049	0.444	9.8
6	1.50	0.073	0.544	9.7

Study 3

The students followed the procedure from Study 1, except that they substituted Spring 3 ($k = 300$ N/m) for Spring 1. The results are shown in Table 3.

Table 3				
Trial	Mass (kg)	D (m)	P (sec)	g (m/sec^2)
7	0.50	0.016	0.257	9.6
8	1.00	0.033	0.363	9.9
9	1.50	0.049	0.443	9.9

6. According to Figure 2, each mass was at Point R at which of the following 2 times?

F. t_1 and t_2
G. t_1 and t_3
H. t_2 and t_3
J. t_2 and t_4

7. Based on Trials 7–9, which of the following graphs best represents the relationship between mass and D ?

8. If, in Study 1, an additional trial had been conducted with a mass of 0.75 kg, P would most likely have been:

F. less than 0.444 sec.
G. between 0.444 sec and 0.628 sec.
H. between 0.628 sec and 0.767 sec.
J. greater than 0.767 sec.

9. Based on the introductory information, when D was equal to 0, what was the relationship between y and L ?

A. $y = L$

B. $y = 2 \times L$

C. $y = \frac{L}{2}$

D. $y = \frac{L}{4}$

10. In each trial, 2 forces acted on the mass: the force due to gravity and the force due to the spring. At the moment the spring was released at Point R, which of these forces must have been stronger?

F. The force due to gravity, because the mass moved upward from Point R.
G. The force due to gravity, because the mass moved downward from Point R.
H. The force due to the spring, because the mass moved upward from Point R.
J. The force due to the spring, because the mass moved downward from Point R.

11. Based on the 3 studies, if the students had suspended a 1.50 kg mass from a spring with $k = 400$ N/m, D would most likely have been:

A. less than 0.049 m.
B. between 0.049 m and 0.073 m.
C. between 0.073 m and 0.146 m.
D. greater than 0.146 m.

Passage III

As human life expectancy increases, people are becoming more familiar with the complex signs of aging; however, scientists still do not completely understand what causes aging at the molecular level.

Three scientists propose models to explain the human aging process.

Scientist 1

Aging is caused by the shortening of *telomeres*, specialized DNA sequences at the ends of chromosomes. Telomeres play an important role in protecting and replicating chromosome ends. Each time a cell replicates its DNA and divides, its telomeres become shorter. Eventually, the telomeres become too short to perform their necessary roles, and the cell is no longer able to divide, ultimately causing defects in cell structure and function that result in aging.

Scientist 2

Aging is caused by random DNA damage that accumulates over the lifetime of *somatic* (nonreproductive) cells. As humans age, the DNA in their somatic cells accumulates damage that is not repaired. This results in mutations that cause defects in proteins and in gene expression, leading to aging. Most DNA damage is caused by *free oxygen radicals* (oxygen species containing oxygen atoms with unpaired electrons) formed during metabolic processes. Thus, the accumulation of DNA damage can be slowed by decreasing the rate of metabolism. Although telomeres do become shorter each time a cell divides, this occurs too slowly to affect the aging process.

Scientist 3

Aging is caused by mutations present in each human at birth that usually produce defects after an individual is too old to reproduce. Because individuals with these mutations reproduce, the mutations can be passed on to the next generation and maintained in the population. Thus, aging is caused by the mutations that humans inherit from their parents. This is why closely related individuals tend to have similar life expectancies. Telomere shortening occurs too slowly to affect the aging process, and DNA damage from free oxygen radicals is easily repaired.

12. Based on the passage, would Scientist 1 or Scientist 3 be more likely to argue that the process of cell division contributes directly to aging, and why?

   F. Scientist 1, because according to Scientist 1, telomeres become shorter each time a cell divides.
   G. Scientist 1, because according to Scientist 1, telomeres become longer each time a cell divides.
   H. Scientist 3, because according to Scientist 3, telomeres become shorter each time a cell divides.
   J. Scientist 3, because according to Scientist 3, telomeres become longer each time a cell divides.

13. How does Scientist 2's model differ from Scientist 3's model? Scientist 2 claims that the mutations that cause aging:

   A. are due to telomere shortening, whereas Scientist 3 claims that the mutations that cause aging are present at birth.
   B. accumulate throughout a human's life span, whereas Scientist 3 claims that the mutations that cause aging are due to telomere shortening.
   C. accumulate throughout a human's life span, whereas Scientist 3 claims that the mutations that cause aging are present at birth.
   D. are present at birth, whereas Scientist 3 claims that the mutations that cause aging accumulate throughout a human's life span.

14. Scientist 1's model would be most weakened if which of the following observations were made?

   F. Telomeres are the same length in both young cells and old cells.
   G. The telomeres in a baby's cells are longer than the telomeres in an adult's cells.
   H. More free oxygen radicals are produced by young cells than by old cells.
   J. More free oxygen radicals are produced by old cells than by young cells.

15. All 3 scientists would most likely agree with which of the following statements about telomeres?

   A. Telomeres become shorter as a human ages.
   B. Telomeres remain the same length throughout a human's life span.
   C. Telomeres become longer as a human ages.
   D. Changes in telomere length are responsible for aging.

16. Scientist 3 proposes that the mutations that eventually cause aging are:

   F. produced when telomeres shorten.
   G. produced by metabolic products.
   H. present only in old cells.
   J. present in both young cells and old cells.

17. Scientist 2's model would be best supported by which of the following observations?

   A. There are fewer mutations in old cells than in young cells.
   B. There are fewer mutations in young cells than in old cells.
   C. Free oxygen radicals do not cause DNA damage.
   D. Telomere shortening influences the aging process.

18. Suppose studies show that consuming fewer calories can slow the aging process. How would Scientist 2 explain this result? Scientist 2 would most likely argue that consuming fewer calories:

   F. increases the rate of metabolism and increases the production of free oxygen radicals.
   G. increases the rate of metabolism and decreases the production of free oxygen radicals.
   H. decreases the rate of metabolism and increases the production of free oxygen radicals.
   J. decreases the rate of metabolism and decreases the production of free oxygen radicals.

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Passage IV

A river's *discharge* is the volume of river water flowing past a location in the river in a given amount of time. Discharge is affected by several factors, including the area of the river's *drainage basin* (the land surface that delivers the rainwater that falls on it into the river) and the spatial relationship of the river to other rivers.

Two studies examined the discharge in 3 rivers—the North River, the Jones River, and the Calm River—following a rainfall event. As shown in Figure 1, the drainage basin of the North River and the drainage basin of the Jones River are within the drainage basin of the Calm River. The area of each river's drainage basin is given in kilometers^2.
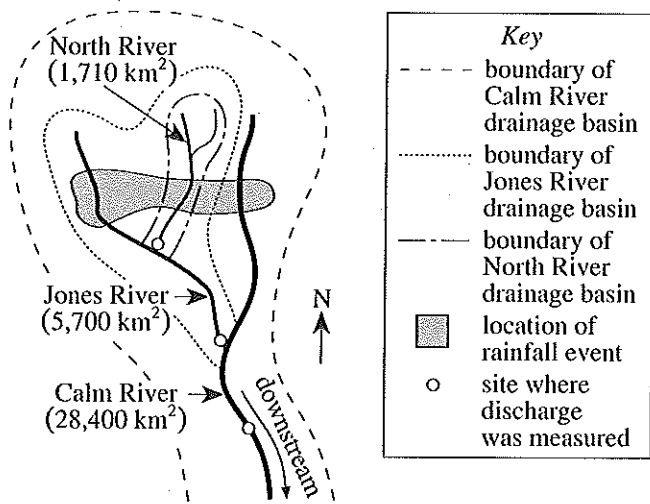

Figure 1

Study 1

The rainfall event produced 25 mm of rain. As rainwater drained into the 3 rivers, the discharges of the rivers increased. The maximum discharge measured immediately after a rainfall event is called a *flood*.

Over the 12 days following the rainfall event, as the flood caused by the rainfall moved downstream, the discharge was continuously measured, in m^3/sec, at the 3 sites shown in Figure 1. The results are shown in Figure 2. (Note: No rainfall event occurred in the Calm River drainage basin during those 12 days.)

Study 2

The *normalized discharge* over the 12 days following the rainfall event was calculated for each of the 3 rivers. The normalized discharge values allowed the flood to be studied as if the 3 rivers had identical drainage basin areas of 1 km^2. Each normalized discharge value was calculated using the following equation:

$$\text{normalized discharge} = \frac{\text{river discharge (m}^3/\text{sec})}{\text{river drainage basin area (km}^2)}$$

The value of the numerator, the river discharge, was obtained from Figure 2. The results are shown in Figure 3.
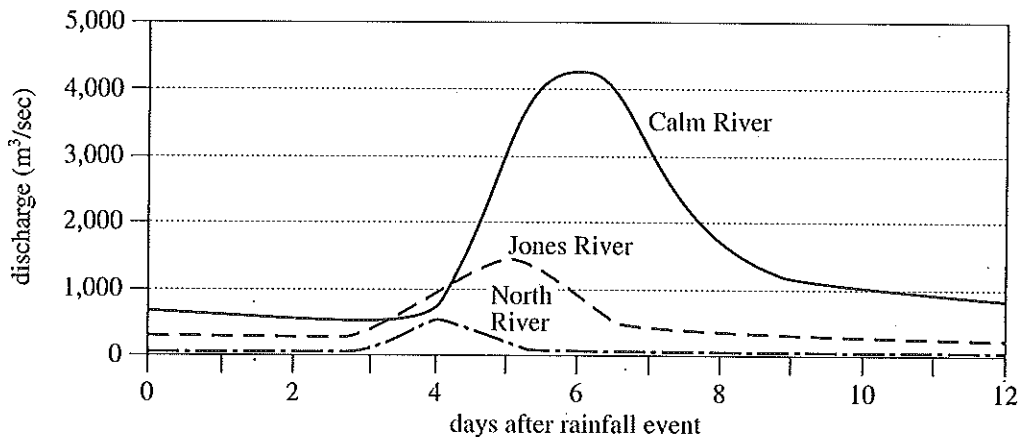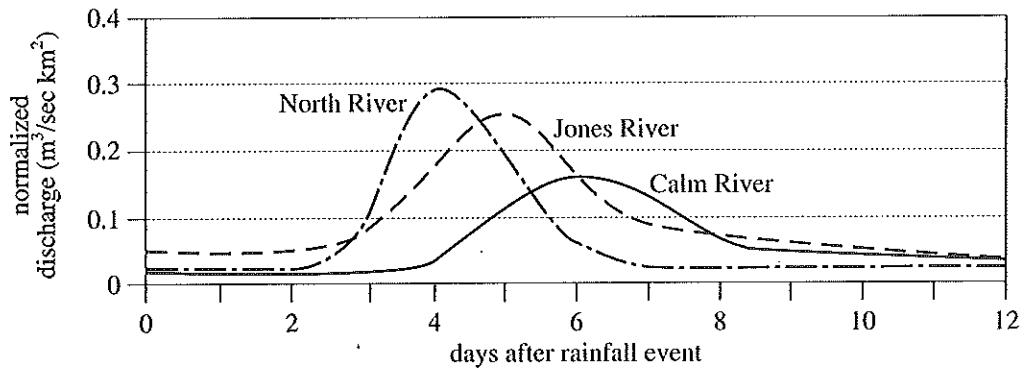

Figure 2

4 ○ ○ ○ ○ ○ ○ ○ ○ ○ 4

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Figure 3

Figures 2 and 3 adapted from George Hornberger et al., *Elements of Physical Hydrology.* ©1998 by The Johns Hopkins University Press.

19. According to Figure 2, the maximum discharge in the Jones River after the rainfall event was closest to which of the following?

A.   500 m^3/sec
B. 1,000 m^3/sec
C. 1,500 m^3/sec
D. 2,000 m^3/sec

20. According to Study 1, the Jones River and Calm River discharges were closest to the same value at which of the following times after the rainfall event?

F.   0.5 day
G.   2 days
H.   3.5 days
J.   5 days

21. The *tributary* (a smaller stream flowing into a larger stream) of the North River shown in Figure 1 would most likely have a drainage basin area of:

A.   less than 1,710 km^2.
B.   between 1,710 km^2 and 5,700 km^2.
C.   between 5,700 km^2 and 28,400 km^2.
D.   greater than 28,400 km^2.

22. A student predicted that the river with the greatest maximum discharge would also have the greatest maximum normalized discharge. Based on Figures 2 and 3, is the student's prediction correct?

F.   Yes, because the North River had both the greatest maximum discharge and the greatest maximum normalized discharge.
G.   Yes, because the Calm River had both the greatest maximum discharge and the greatest maximum normalized discharge.
H.   No, because the North River had the greatest maximum discharge but the Calm River had the greatest maximum normalized discharge.
J.   No, because the Calm River had the greatest maximum discharge but the North River had the greatest maximum normalized discharge.

23. Based on Figures 1 and 2 and the description of Study 2, the normalized discharge of the Calm River 5 days after the rainfall event was most likely calculated using which of the following expressions?

A.   3,000 km^2 ÷ 28,400 m^3/sec
B.   3,000 m^3/sec ÷ 28,400 km^2
C.   28,400 km^2 ÷   3,000 m^3/sec
D.   28,400 m^3/sec ÷   3,000 km^2

24. Suppose that discharge in the Jones River had been measured at a site north of the area where the rainfall event occurred, instead of at the site indicated in Figure 1. How would the discharge data recorded after the rainfall event have differed from that shown in Figure 2 ?

F.   No flood would have been recorded in the data for the North River.
G.   No flood would have been recorded in the data for the Jones River.
H.   The flood recorded in the data for the North River would have been greater than 700 m^3/sec.
J.   The flood recorded in the data for the Jones River would have been greater than 1,500 m^3/sec.

ACT-67F   45   **GO ON TO THE NEXT PAGE.**

Passage V

A *binary phase diagram* (BPD) shows how the phases of a mixture of 2 chemicals vary with temperature and composition at 1 atmosphere (atm) of pressure. The phases include the solid (*s*) phase of each chemical and the liquid (*l*) solution phase of the 2 chemicals. The *eutectic* is the point where all 4 regions of the BPD intersect. It indicates the conditions at which all the phases represented in the 4 regions exist in equilibrium. When a mixture is at equilibrium, no net phase change occurs. Figure 1 is a BPD for durene and biphenyl. Figure 2 is a BPD for durene and naphthalene.
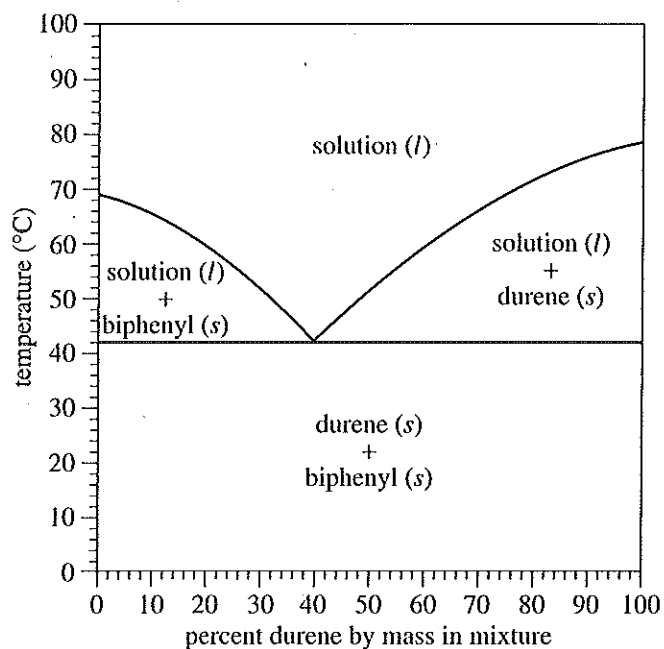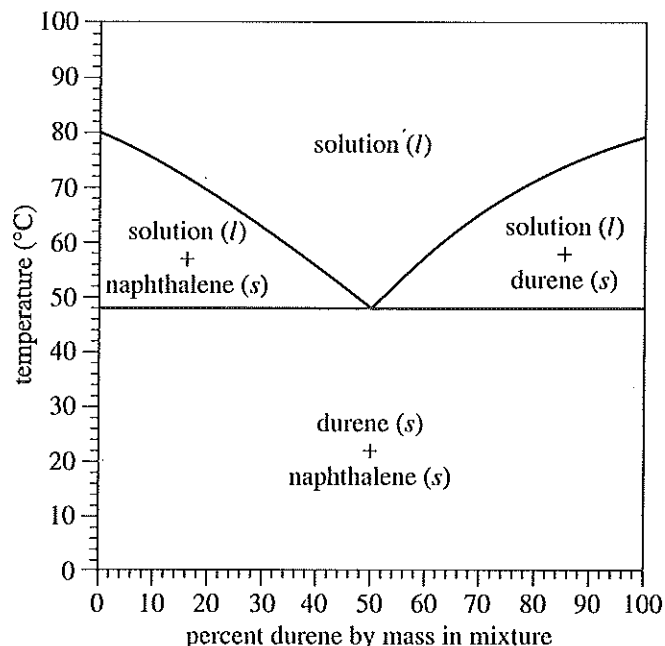

Figure 1

Figure 2

25. According to Figure 2, at 1 atm, solid will NOT be present in a durene-naphthalene mixture at 55°C that contains which of the following percents durene by mass?

   A. 30%
   B. 50%
   C. 70%
   D. 90%

26. According to Figure 1, at 1 atm, a durene-biphenyl mixture that is 70% durene by mass at 50°C will be a:

F. liquid solution only.
G. mixture of a liquid solution and solid biphenyl.
H. mixture of a liquid solution and solid durene.
J. mixture of solid durene and solid biphenyl.

27. Consider a durene-biphenyl mixture at 1 atm that is 40% durene by mass. According to Figure 1, solid durene, solid biphenyl, and a liquid solution will all be present in equilibrium at a temperature closest to which of the following?

A. 42°C
B. 52°C
C. 69°C
D. 79°C

28. A durene-biphenyl mixture that is 60% durene by mass at 90°C was slowly cooled to 20°C, then slowly heated to 70°C (all at 1 atm). Based on Figure 1, at the end of this procedure the mixture consisted of:

F. liquid solution only.
G. liquid solution and solid biphenyl.
H. liquid solution and solid durene.
J. solid durene and solid biphenyl.

29. Based on Figures 1 and 2, the melting point of durene is closest to which of the following?

A. 19°C
B. 39°C
C. 59°C
D. 79°C
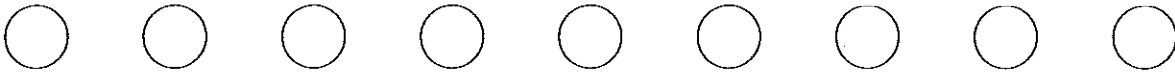
Passage VI

Students studied the rates at which various heated, solid aluminum spheres cooled in air.

Experiment 1

The students tested 3 solid aluminum spheres, A, B, and C, having different radii. The volume, V, in cm^3, and the ratio of surface area to volume, $\frac{S}{V}$, in cm^{-1}, for each sphere are shown in Table 1.

Table 1		
Sphere	V (cm^3)	$\frac{S}{V}$ (cm^{-1})
A	3.9	3.1
B	31	1.5
C	490	0.6

Each of the spheres was fitted with a thermocouple to measure the *central temperature* (the temperature at the center) of the sphere. Then the 3 spheres were simultaneously heated. Once the temperature throughout each sphere was 100°C, the 3 spheres were immediately suspended at time = 0 min in air that was at a temperature of 20°C (see Figure 1).

Figure 1

The spheres were allowed to cool over the next 30 min while the temperature of the air was kept constant at 20°C. A graph of the central temperature of each sphere versus time over the 30 min cooling period is shown in Figure 2. For each sphere, the *cooling rate* at a given time equals the graph's slope at that time.

Figure 2

Experiment 2

The students tested 2 solid aluminum spheres, X and Y, that were identical in size. Sphere X was painted with Coating X, and Sphere Y was painted with Coating Y. Each of the spheres was fitted with a thermocouple as in Experiment 1, and then the 2 spheres were simultaneously heated. Once the temperature throughout each sphere was 120°C, the 2 spheres were immediately suspended at time = 0 min in air that was at a temperature of 20°C. The spheres were all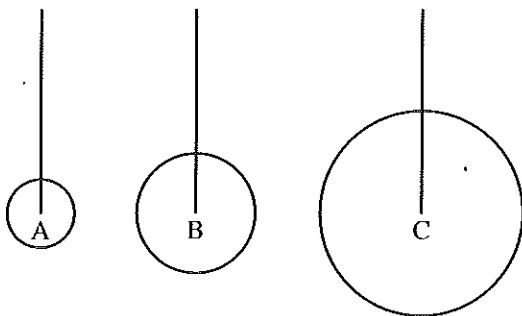owe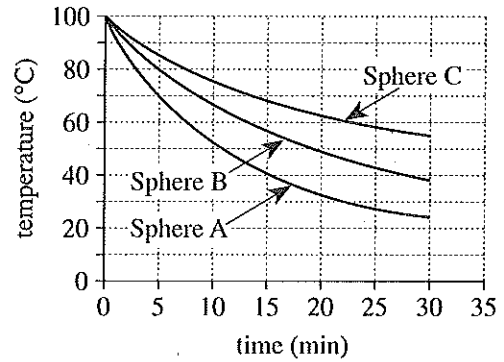d to cool over the next 55 min while the temperature of the air was kept constant at 20°C. A plot of the central temperature of each sphere versus time over the 55 min cooling period is shown in Figure 3.
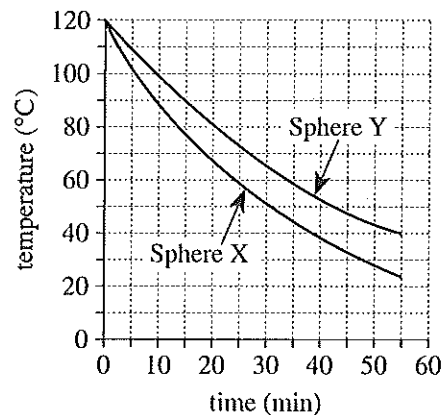

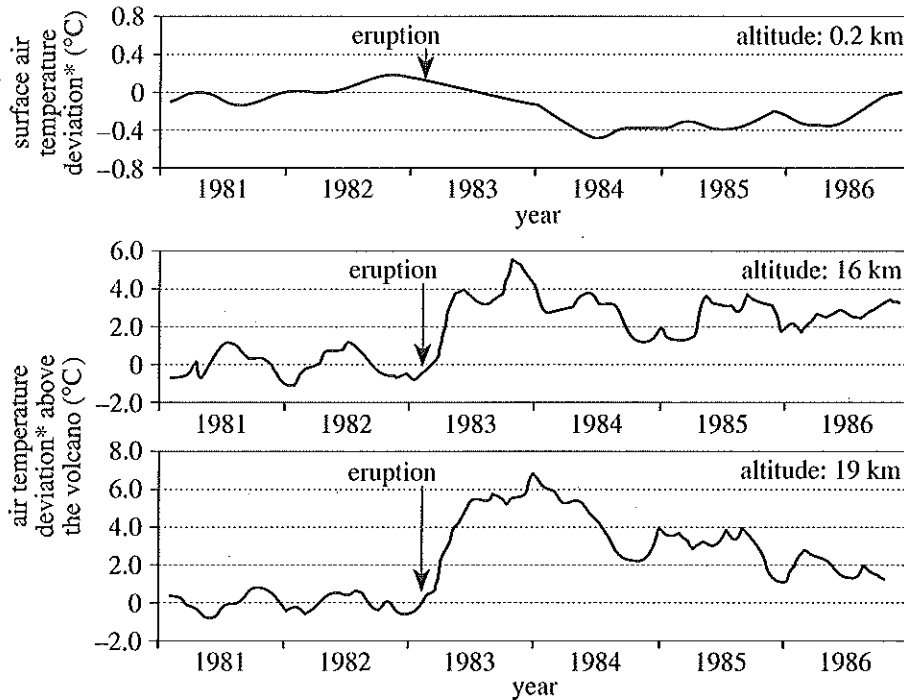Figure 3

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30. A student stated that spheres that are the same in size but that are made of different metals will cool at different rates. Do the results of Experiment 1 verify this statement?

F. Yes, because all the spheres tested in Experiment 1 were made of the same metal.
G. Yes, because all the spheres tested in Experiment 1 were made of different metals.
H. No, because all the spheres tested in Experiment 1 were made of the same metal.
J. No, because all the spheres tested in Experiment 1 were made of different metals.

31. Based on Figures 2 and 3, the unit of measurement for the cooling rate was which of the following?

A. °C/min
B. °C/cm^3
C. min/°C
D. cm^3/°C

32. Suppose that Sphere A had been allowed to continue cooling until the central temperature of the sphere stopped decreasing with the passage of time. Based on the information given, once the temperature stopped decreasing, the central temperature of the sphere would most likely have been:

F. 15°C.
G. 20°C.
H. 22°C.
J. 30°C.

33. Based on the results of Experiment 1, a solid aluminum cylinder having which of the following values for $\frac{S}{V}$ will cool the fastest?

A. 0.5 cm^{-1}
B. 1.0 cm^{-1}
C. 1.5 cm^{-1}
D. 2.0 cm^{-1}

34. In Experiment 1, to adjust the temperature throughout each sphere before the 3 spheres were suspended and allowed to begin cooling, the students most likely immersed the spheres in:

F. air at 20°C.
G. boiling water.
H. dry ice.
J. molten aluminum.

35. During the 55 min cooling period of Experiment 2, the central temperature of Sphere Y reached 40°C how much sooner or later than the central temperature of Sphere X reached 40°C ?

A. 13 min sooner
B. 13 min later
C. 17 min sooner
D. 17 min later

Passage VII

Volcanoes put sulfur into the troposphere and the stratosphere, where the sulfur reacts to form sulfate *aerosols* (liquid droplets suspended in air). For locations at 50°N latitude, aerosols present at altitudes below 11 km scatter incoming solar energy, resulting in cooler air, while aerosols present at higher altitudes absorb incoming solar energy, warming the air.

Figure 1 shows the air temperature deviation at the surface of, and at 2 different altitudes above, a particular volcano (located at 50°N latitude), before and after it erupted. Figure 2 shows the maximum surface air temperature deviation associated with the specific mass of sulfate aerosols formed in the stratosphere after each of 8 volcanoes erupted.

Note: A tick mark on the *x*-axis indicates Jan. 1 of a given year.

$$\text{*air temperature deviation at a given altitude} = \left[\begin{array}{c}\text{measured air temperature}\\\text{at the given altitude}\end{array}\right] - \left[\begin{array}{c}\text{average air temperature}\\\text{at the given altitude}\end{array}\right]$$

Figure 1

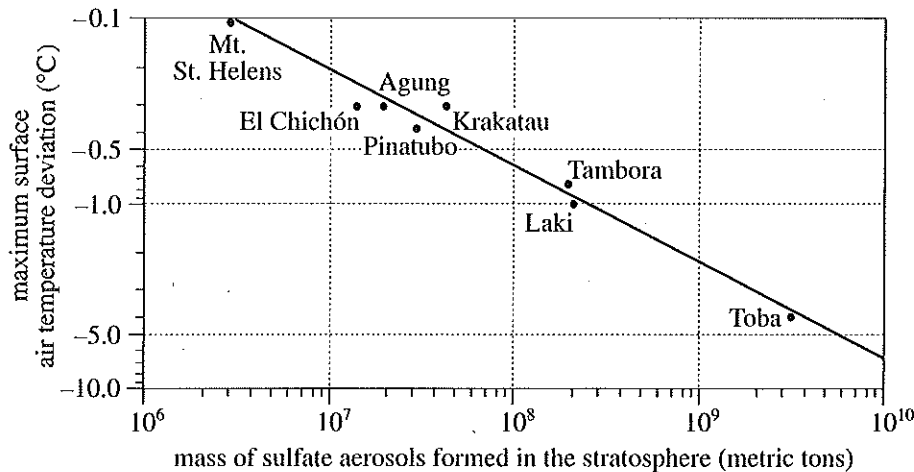Figure 2

Figure 1 adapted from Haraldur Sigurdsson, "Evidence of Volcanic Loading of the Atmosphere and Climate Response." ©1990 by Elsevier Science Publishers.

Figure 2 adapted from Michael Rampino, "Supereruptions as a Threat to Civilizations on Earth-like Planets." ©2002 by Elsevier Science (USA).

36. According to Figure 1, after the eruption, the greatest air temperature deviation at an altitude of 19 km was closest to which of the following?

F. 5°C
G. 6°C
H. 7°C
J. 8°C

37. Consider the equation provided in Figure 1 and the data point for Toba in Figure 2. After Toba erupted, the surface air temperature, when at its most extreme, was approximately:

A. 4°C above average.
B. 4°C below average.
C. 10°C above average.
D. 10°C below average.

38. According to Figure 1, after the eruption, the air temperature at 16 km altitude stayed more than 1°C above average for:

F. less than 1 year.
G. between 1 year and 2 years.
H. between 2 years and 3 years.
J. more than 3 years.

39. Consider the volcano whose data are shown in Figure 1. Suppose that the average air temperature 16 km above that volcano is −60.0°C. Based on Figure 1, on January 1, 1984, the measured air temperature 16 km above that same volcano would have been closest to which of the following?

A. −64.0°C
B. −60.0°C
C. −56.0°C
D. −4.0°C

40. In Figure 1, a value of zero for the air temperature deviation at a given altitude indicates that the measured air temperature at that altitude equaled the:

F. maximum air temperature deviation at that altitude.
G. average air temperature deviation at that altitude.
H. maximum air temperature at that altitude.
J. average air temperature at that altitude.

END OF TEST 4

STOP! DO NOT RETURN TO ANY OTHER TEST.

Form 16N
ACT® Writing Test Prompt
(April 2011)

Some students debate whether teachers should express their personal opinions about political and social issues in the classroom. Some students believe teachers should express personal opinions in the classroom because they think teachers can use their experience and knowledge to raise student awareness about important political and social issues. Other students do not believe teachers should express personal opinions in the classroom because they think students may be reluctant to participate in class discussions if they do not agree with their teacher's beliefs. In your opinion, should teachers express their personal opinions about political and social issues in the classroom?

In your essay, take a position on this question. You may write about either one of the two points of view given, or you may present a different point of view on this question. Use specific reasons and examples to support your position.

Explanation of Procedures Used to Obtain
Scale Scores from Raw Scores

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

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

ACT Test 67F — Your Scale Score

English _____

Mathematics _____

Reading _____

Science _____

Sum of scores _____

Composite score (sum ÷ 4) _____

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

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

Explanation of Procedures Used to Obtain Scale Subscores from Raw Scores

For each of the seven subscore areas, the total number of correct responses yields a raw score. Use the table below to convert your raw scores to scale subscores. For each of the seven subscore areas, locate and circle either the raw score or the range of raw scores that includes it in the table below. Then, read across to either outside column of the table and circle the scale subscore that corresponds to that raw score. As you determine your scale subscores, enter them in the blanks provided on the right. The highest possible scale subscore is 18. The lowest possible scale subscore is 1.

If you left a test completely blank and marked no items, do not list any scale subscores for that test.

Your Scale Subscore

ACT Test 67F

English
  Usage/Mechanics ____
  Rhetorical Skills ____

Mathematics
  Pre-Algebra/Elementary Algebra ____
  Intermed. Algebra/Coord. Geometry ____
  Plane Geometry/Trigonometry ____

Reading
  Social Studies/Sciences ____
  Arts/Literature ____

Raw Scores

Scale Subscore	Test 1 English		Test 2 Mathematics			Test 3 Reading	
	Usage/ Mechanics	Rhetorical Skills	Pre-Algebra/ Elem. Algebra	Inter. Algebra/ Coord. Geometry	Plane Geometry/ Trigonometry	Social Studies/ Sciences	Arts/ Literature
18	39-40	35	24	18	18	20	20
17	38	—	23		—	19	19
16	36-37	33-34	22	16-17	17	18	18
15	35	32	21	15	15-16	17	17
14	33-34	30-31	19-20	13-14	14	16	16
13	32	28-29	18	11-12	12-13	14-15	15
12	30-31	26-27	17	9-10	11	13	14
11	28-29	23-25	15-16	8	9-10	12	13
10	25-27	20-22	14	6-7	8	10-11	12
9	23-24	17-19	12-13	5	6-7	9	10-11
8	21-22	15-16	10-11	4	5	7-8	9
7	18-20	13-14	7-9	3	4	6	8
6	16-17	12	5-6	2	—	5	7
5	14-15	10-11	4	1	3	4	5-6
4	11-13	8-9	3	—	2	3	4
3	9-10	5-7	2	—	—	2	3
2	5-8	3-4	1	—	1	1	1-2
1	0-4	0-2	0	0	0	0	0

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2010–2011

(April 7–11, 2011)

Now that you have received the List Report, you may request a photocopy of your answer document for a $20 fee. If you took the Writing Test, you will also receive a copy of your written essay.

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                                                          (_____) _____
_____
ACT ID (from score report)   Telephone Number

_____
Location of test center where ACT test was taken

_____
LEGAL SIGNATURE of person whose test information is requested

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Directions

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

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

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

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

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

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

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

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

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

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