Practice Multiple-Choice Tests

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act assessment®

Form 0359F

ACT Assessment®

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 A BALLPOINT PEN.*

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

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

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

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

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

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

ACT®

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

Notes from Underground

A lot of people hate to ride the New York City

subways, but I love them because I like to get places fast.
                                                     1
A musician balancing a cello case, two Buddhist monks

in saffron robes, and a group of stockbrokers in crisp,

charcoal gray suits get on at Wall Street. A passenger
2

placidly sews while the subway train flings and jolts. A

teenager whose holding a shoebox containing a kitten as
         3

tiny as a gingersnap smiles even if a line of girls in frilly
                            4
white communion dresses file by. About three and a half

million people a day ride the subways I think maybe
                                5

I might possibly have met them all.
6

1. At this point, the writer wants to provide one reason why she likes to ride the subways. Which choice is most relevant to the information provided in this first paragraph?
   A. NO CHANGE
   B. I never know what I'll see there.
   C. they are so much cheaper than taxis.
   D. they are places of enormous quiet and calm.

2. F. NO CHANGE
   G. charcoal gray suits,
   H. charcoal, gray suits
   J. charcoal gray, suits

3. A. NO CHANGE
   B. thats
   C. as
   D. who's

4. F. NO CHANGE
   G. as
   H. whereas
   J. such that

5. A. NO CHANGE
   B. subways, and
   C. subways, which
   D. subways actually

6. F. NO CHANGE
   G. perhaps I've
   H. I've possibly
   J. I've

Sometimes a Salvation Army volunteer boards the subway train with sandwiches and juice to give to the needy. "Put your pride to the side!" the volunteer shouts, and I've seen many people put out their hands. The
7

speaker also raises money. Its impossible to predict which
8

people will dig into their pockets or if they were to open
9
their purses, and I've stopped trying to guess.

Last week some fellow passengers and I watched an elderly man with a portable chessboard playing
10
chess against himself. Just yesterday I sat across the

aisle with a woman who was composing music
11

in pink-tinted glasses in a notebook. She tapped her foot
12
as she reviewed what she'd written and then stopped

tapping and jotted more notes as the train hurtled along.
13
Today is my mother's birthday. I decided to surprise her with lilac blooms from my backyard, so this morning, carrying a shopping bag full of the flowers, I boarded a crowded "E" train and rode it to the very last stop in the

7. A. NO CHANGE
   B. Therefore, the
   C. In conclusion, the
   D. In other words, the

8. F. NO CHANGE
   G. It's
   H. Its'
   J. That's

9. A. NO CHANGE
   B. would have opened
   C. open
   D. might be opening

10. Which of the following alternatives to the underlined portion would NOT be acceptable?
   F. who played
   G. as he played
   H. played
   J. who was playing

11. A. NO CHANGE
   B. to
   C. at
   D. from

12. The best placement for the underlined portion would be:
   F. where it is now.
   G. after the word *woman.*
   H. after the word *was.*
   J. after the word *composing.*

13. Which choice most effectively emphasizes the rapid speed of the train?
   A. NO CHANGE
   B. continued on its way.
   C. moved on down the tracks.
   D. proceeded toward the next stop.

GO ON TO THE NEXT PAGE.

Bronx. Strangers smiled and took pains not to crush the flowers, even when the train jerked to a halt. 14 I got off at an elevated station and, lifting the splendid bouquet, rushed down to my mother, feeling delighted that I'd brought the blooms all the way from Brooklyn on the subway train.

14. If the writer were to delete the preceding sentence, this paragraph would primarily lose a statement that:
F. provides physical descriptions of people on the subway train.
G. supports the opening sentence of the essay.
H. provides evidence that people can be friendly on the subway train.
J. gives an explanation for the narrator's actions.

> Question 15 asks about the preceding passage as a whole.

15. Suppose the writer had intended to write a brief essay persuading readers that the subway system is New York City's most economical means of public transportation. Would this essay fulfill the writer's goal?
A. Yes, because the essay supplies evidence of the large number of people using the subways.
B. Yes, because the essay describes people who are able to give to the needy because they have extra money in their pockets.
C. No, because the essay focuses on the kinds of people riding the subways, not on how inexpensive the subways are to ride.
D. No, because the essay focuses on the writer's love of all public transportation, not just the subways.

Navajo Code Talkers

During World War II, a group of Navajo soldiers developed a code that became one of the most successful in U.S. military history. This group, known as the Navajo
16
code talkers, took part in every assault the U.S. Marines conducted in the Pacific from 1942 to 1945, transmitting information, on tactics, troop movements,
17
orders, and other vital communications over telephones and radios.

American military officials have been using
18

cumbersome machines to encode and relay information
19
during battles. In preliminary tests under simulated combat

16. F. NO CHANGE
G. group which was
H. group was
J. group

17. A. NO CHANGE
B. transmitting information on:
C. transmitting information on
D. transmitting: information on

18. F. NO CHANGE
G. had
H. would have
J. will have

19. A. NO CHANGE
B. thorny
C. strenuous
D. gawky

16

GO ON TO THE NEXT PAGE.

conditions, the Navajo encoded, transmitted, and decoded

a three-line message in twenty seconds as the machines
                                  ——————
                                      20

required thirty minutes to perform the same job.

Nevertheless, these tests convinced the
——————————————
       21

officials of the value, of using the Navajo
——————————————————
             22
language in a code.

        The Navajo language is complex, with a structure and

sounds that makes them unintelligible to anyone without
            ——————————
                 23

extensive exposure to it. Outside Navajo communities,
                   ——
                   24

such exposure is rare, which greatly contributed to
                 ——————————
                    25

it's success.
——————
   26

        The Navajo developed and memorized the code. Since
        ——————————
             27
their language did not have words for common U.S.

military equipment, they turned to nature. They named

planes after birds and ships after fish. Dive bombers

became *gini* (chicken hawk) and destroyers were called

ca-lo (shark). The skilled Japanese code breakers remained

baffled by the Navajo language. The code was never

broken.

        Unfortunately, the code talkers sometimes faced

dangerous peril from their own side. Many code talkers
——————————
     28
needed bodyguards to protect them from other American

soldiers, some of whom mistook the Navajo for Japanese

20. F. NO CHANGE
   G. seconds so
   H. seconds,
   J. seconds, whereas

21. A. NO CHANGE
   B. Similarly, these
   C. Still, these
   D. These

22. F. NO CHANGE
   G. officials, of the value
   H. officials of the value
   J. officials, of the value,

23. A. NO CHANGE
   B. makes it
   C. make it
   D. make them

24. F. NO CHANGE
   G. from
   H. with
   J. of

25. Which of the following alternatives to the underlined portion would NOT be acceptable?
   A. rare; this
   B. rare this
   C. rare. This
   D. rare, a factor that

26. F. NO CHANGE
   G. that
   H. this
   J. the Navajo code's

27. A. NO CHANGE
   B. The Navajo, who were various heights and weights,
   C. Being of various heights and weights, the Navajo
   D. The Navajo of different sizes

28. F. NO CHANGE
   G. hazardous
   H. risky
   J. OMIT the underlined portion.

soldiers. Regardless, the Navajo were resolute and served their country courageously.

The Navajo code remained classified after the war that was later used, along with codes made from other <u>American Indian languages, in the Korean Conflict and the Vietnam War.</u> Now that the Navajo code is no longer used, the code talkers, whose <u>secret work</u> saved American lives, can finally receive public recognition for their actions.

29. **A.** NO CHANGE
    B. and which
    C. and
    D. OMIT the underlined portion.

30. **F.** NO CHANGE
    G. hush-hush actions
    H. concealed, hidden efforts
    J. doings, kept under wraps,

PASSAGE III

An American Griot

[1] When storyteller Mary Carter <u>Smith practices her art and</u> everybody listens. [2] Wearing a brightly colored African dress, a large turban, and bracelets, the seventy-eight-year-old Smith seems to inhabit each of the different characters she describes. [3] Her voice changes with each emotion she wants to evoke. [4] Her gestures fit the pace of the narrative. [5] And though many of the stories are intended to make the audience laugh, Smith is fully aware of the other values of storytelling. [6] <u>Indeed,</u> she identifies strongly with the griots of West Africa—those village storytellers <u>where they</u> use songs, poems, and narration to help preserve and transmit culture and history. [7] Clearly others recognize her as a valuable resource. [8] Smith is the official griot of both the city of Baltimore and the state of <u>Maryland; she</u> has served as griot-in-residence at

31. **A.** NO CHANGE
    B. Smith, practices her art
    C. Smith, practices her art,
    D. Smith practices her art,

32. **F.** NO CHANGE
    G. Well,
    H. However,
    J. At once,

33. **A.** NO CHANGE
    B. who
    C. whom
    D. that they

34. Which of the following alternatives to the underlined portion would NOT be acceptable?
    F. Maryland. She
    G. Maryland, and she
    H. Maryland and
    J. Maryland, she

several universities. 35

Though Smith has been interested in theater since her youth, her recognition of her own talent grew gradually. She worked for thirty years as a teacher and librarian in the field of education in Baltimore public schools. 36 She organized theater groups in her community and took several trips to Africa to study traditional cultures. All along, she was telling stories—everything from social satire to her retelling of "Cinderella" as Cindy Ellie, a
                                                    37
poor African American girl whose rags are transformed into magnificent African-style gowns. Over time, she was invited to perform in churches, libraries, and museums. 38

Smith realized the extent of her gift when her friend Alex Haley who had gathered essential material
        39
critical to writing his best-selling novel *Roots* from
    40
a griot in Gambia, began to refer to her as "my American griot," this was a revelation to Smith.
            41

35. The writer is considering deleting the phrase "at several universities" from Sentence 8. If the phrase were deleted, the essay would primarily lose:

A. an essential link to the paragraph that follows.
B. a contrast for the purpose of making a comparison.
C. information that qualifies the term *griot-in-residence.*
D. an unnecessary detail.

36. Which of the following words or phrases from the preceding sentence is LEAST necessary and could therefore be deleted?

F. thirty
G. and librarian
H. in the field of education
J. Baltimore public

37. A. NO CHANGE
B. Ellie. A
C. Ellie; a
D. Ellie, she was a

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

> In high school, Smith was a member of both the drama and speech clubs.

Should the writer make this addition here?

F. Yes, because it supports the idea that Smith was telling stories throughout her life.
G. Yes, because it supports the idea expressed earlier that Smith organized theater groups in her community.
H. No, because it contradicts the point made earlier that Smith worked for thirty years as a teacher and librarian.
J. No, because it distracts the reader from the main focus of the paragraph and does not logically fit at this point in the essay.

39. A. NO CHANGE
B. friend, Alex Haley
C. friend Alex Haley;
D. friend Alex Haley,

40. F. NO CHANGE
G. for
H. important to
J. that was essential to

41. A. NO CHANGE
B. griot" that
C. griot." This
D. griot,"

"Hearing that was like a man who has shoed horses all his
_____
42
life being told, 'You're a blacksmith!'" she recalls.
_____
42

Today, Smith's repertoire is so vast that she could

speak consecutively for twelve hours straight without
       _____
          43

running out of material. It's unlikely she would ever
                      _____
                         44
attempt such a feat, but if she did, there would be no

dull moments.

42. Given that all the choices are quotations from Mary Carter Smith, which one would best support the argument the writer is making concerning Smith's belated discovery of her own talent?
- **F.** NO CHANGE
- **G.** "You've got to reveal truths to your listeners," she says.
- **H.** "Through his novel *Roots,* Alex Haley was in some ways performing the function of a griot for America," she says.
- **J.** "I'd say that one of the most crucial moments in my development as a storyteller is the few hours I once spent listening to a griot in West Africa," she recalls.

43. A. NO CHANGE
- **B.** continuously nonstop
- **C.** perpetually
- **D.** OMIT the underlined portion.

44. F. NO CHANGE
- **G.** It's unlikely,
- **H.** Its unlikely,
- **J.** Its unlikely

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

45. Suppose the writer had intended to write a brief essay focusing on the various ways that storytelling influences community values. Would this essay successfully fulfill the writer's goal?
- **A.** Yes, because the essay indicates that Smith believes storytelling pulls a community together.
- **B.** Yes, because the essay shows that Smith's Baltimore community valued her gift as a storyteller.
- **C.** No, because the essay focuses on the griots of West Africa, not on community values.
- **D.** No, because the essay's main focus is on one storyteller and the way in which she practices her art.

PASSAGE IV

Baseballs and Butterflies

[1] Our son has started playing organized T-ball, a

beginner's version of baseball. [2] "Organized" is what

parents call it, anyway. [3] Joe is seven, living in those two

or three years when they can manage to throw a baseball a
                        _____
                           46
few feet but when what they're really interested in are

46. F. NO CHANGE
- **G.** children
- **H.** he
- **J.** some of them

things closer at hand, bugs, butterflies, dirt (if they're in
                        _____
                              47
the infield), grass (if they're in the outfield). [4] Children

of that age still think nothing of doing little dances in the

outfield, often with their backs to home plate and,

consequently, the batter. [5] It's not as if the outfielders'
                                        _____
                                         48
positions matter much, though—the ball never gets hit

hard enough to reach there. ☐49

        Since there's not much chance that a seven-year-old
        _____
         50
just learning the game can hit a pitched baseball, the

umpire puts the ball on top of a stationary tee, a piece of

flexible tubing adjusted to each batter's height. If batters

repeatedly fail to hit the ball—and lots of them do—the

umpire is patient, giving them four or five chances instead
_____
         51

of the usual three. ☐52 When a batter finally makes

contact, the ball dribbles into the infield, where the

nearest player usually ends up throwing the ball at the
                        _____
                          53
first baseman's feet or, if the fielder is precocious, over

the first baseman's head.

47. A. NO CHANGE
    B. hand, bugs, butterflies, dirt,
    C. hand: bugs, butterflies, dirt
    D. hand: bugs, butterflies, dirt,

48. F. NO CHANGE
    G. if
    H. whether
    J. as to whether

49. The writer wishes to add the following sentence in
    order to emphasize the uncertainty already expressed
    about an idea in the paragraph:

        I still have doubts.

    The new sentence would best amplify and be placed
    after Sentence:

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

50. F. NO CHANGE
    G. While
    H. Although
    J. Unless

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

    A. umpire patiently gives
    B. umpire, who is patient, gives
    C. umpire, who patiently gives
    D. patient umpire gives

52. If the writer were to delete the word *repeatedly* and the
    phrase "and lots of them do" (and the dashes) from the
    preceding sentence, the sentence would primarily lose:

    F. a tone of admiration for the work of the umpires.
    G. details about the rules of T-ball.
    H. an explanation of why children often fail to hit the
       ball.
    J. a sense of how difficult the task is for the children.

53. A. NO CHANGE
    B. accomplishes a result of
    C. attains the consequence of
    D. results in

In a T-ball league, one needs to do something to keep the score from reaching triple digits in the early going. There's a rule, therefore, that says the runner must stop
₅₄
when any fielder from the other team picks up the ball and holds it aloft. The rule might seem a good one, but the children can't remember to hold up the ball. Once
₅₅
they've picked it up, they look at it quizzically for a

while and then, look up to see what all the ruckus is about.
₅₆

What it's about a bleacher section full of parents, each
₅₇
adult frantically holding up a stiff arm. The child with the

ball wonders at the grown-up's odd, noisy behavior.
₅₈
Meanwhile, the runners continue to score. They score, that

is, if they were not to be distracted by the grown-ups—or
₅₉
the butterflies.

54. F. NO CHANGE
    G. instead,
    H. likewise,
    J. meanwhile,

55. A. NO CHANGE
    B. regulation-sized ball.
    C. ball, which is regulation sized.
    D. ball, which is the same size as a regular baseball.

56. F. NO CHANGE
    G. then, look up, to see
    H. then look up to see,
    J. then look up to see

57. A. NO CHANGE
    B. That's
    C. It's
    D. Thats

58. F. NO CHANGE
    G. grown-ups'
    H. grown-ups
    J. grown-ups,

59. A. NO CHANGE
    B. they would not have been
    C. they're not
    D. they're not to be

Question 60 asks about the preceding passage as a whole.

60. Suppose the writer had intended to write an essay describing one child's experiences playing T-ball. Would this essay accomplish the writer's goal?

    F. Yes, because it reveals that the narrator's son Joe is now playing T-ball, and then it goes on to describe Joe's experiences at one of his games.
    G. Yes, because it discusses the narrator's son Joe's T-ball skills, such as the fact that he can throw a baseball a few feet.
    H. No, because while it mentions that the narrator's son Joe plays T-ball, it also notes he is more interested in things such as dirt and bugs.
    J. No, because although the T-ball experiences of the narrator's son Joe are alluded to, it is primarily about the general features of T-ball games.

GO ON TO THE NEXT PAGE.

PASSAGE V

Fixing Raptor Feathers

Raptors, or birds of prey, cannot afford to be grounded for weeks waiting for a large number of flight feathers to regrow. They must be able to fly if they are to hunt and eat. Raptors, including eagles and hawks, therefore normally shed their feathers slowly, one or two at a time.
                                                     61

The premature loss of a flight feather to injury, then, is not an incidental matter to raptors, most of which are diurnal. If a feather
                            62
breaks off with the stub of its hollow quill shaft still in place, the bird's body mistakenly believes the feather is whole. Only when the quill socket containing the stub is
     63
empty will a new feather grow. Quills are hollow, so the
                                         64
removal of a quill stub before it is ready to be naturally
                                65
shed would be very painful to the animal. Bird rehabilitators, therefore, treat broken raptor feathers through *imping*—the implanting of a new feather into
                      66
the quill stub.

61. The writer wants to describe the way raptors shed feathers. Which choice would be most consistent with the way the feather-shedding process has been described up to this point?
  A. NO CHANGE
  B. in an all-at-once blizzard.
  C. often losing them in clumps.
  D. leaving them flightless for long periods of time.

62. F. NO CHANGE
  G. raptors.
  H. raptors, most of which are mainly active during the day—that is, diurnal.
  J. raptors, daytime-hunting creatures for the most part.

63. Which of the following alternatives to the underlined portion would NOT be acceptable?
  A. sound.
  B. complete.
  C. total.
  D. intact.

64. Given that all of the choices are true, which one most clearly provides a reason for the statement that follows in this sentence?
  F. NO CHANGE
  G. fasten deeply,
  H. break occasionally,
  J. are very light,

65. A. NO CHANGE
  B. they are
  C. those are
  D. that is

66. Which of the following alternatives to the underlined portion would NOT be acceptable?
  F. *imping,* which is the
  G. *imping:* the
  H. *imping.* The
  J. *imping,* the

The bird rehabilitator begins by determining which feather has been damaged. On each wing, all flighted birds, having ten primary flight feathers, each one shaped
67

slight different. If the left number seven feather is broken
68
off, the rehabilitator selects a number seven feather from a collection kept exclusively for imping. If necessary, a number six or eight feather can be carefully trimmed with small scissors to the shape of a number seven feather. 69
The quill of this replacement feather is trimmed so that when the replacement feather is eventually attached to the quill stub still in the bird's body, the repaired feather will

be equal in length to the original, whole feather.
70

Next, the rehabilitator whittles a bamboo chopstick
71
to duplicate the curve and slant of the complete feather shaft. He or she then inserts the carved chopstick into the quill stub. After sliding the shaft of the replacement feather over the sturdy, light bamboo stick, glue—just a touch—is applied. The raptor now
72

has a rebuilt, functional feather. Eventually, it will be
73

67. A. NO CHANGE
B. birds, by having
C. birds, which have
D. birds have

68. F. NO CHANGE
G. slight differently.
H. slightly differently.
J. slightly more different.

69. The writer is considering revising the preceding sentence to read as follows:

> If necessary, a number six or eight feather can be cut to the shape of a number seven feather.

If the writer did this, the sentence would primarily lose a sense of how:

A. limited rehabilitators' feather collections are.
B. delicate the work being described is.
C. different each of a bird's flight feathers is.
D. easy it is to replace a number seven feather.

70. F. NO CHANGE
G. be equally long
H. equal the length
J. equal in length

71. A. NO CHANGE
B. However,
C. Indeed,
D. Finally,

72. F. NO CHANGE
G. a touch of glue is applied by the rehabilitator.
H. the application of a touch of glue follows.
J. the rehabilitator applies a touch of glue.

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

A. feather; eventually, it
B. feather, eventually, it
C. feather, which eventually
D. feather that eventually

shed, allowing a new, complete feather to <u>grow in it's</u>
                                              74

place. 75

74. F. NO CHANGE
G. grow in its
H. have grow in its
J. have grow in it's

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

> This imping procedure is just one of the many responsibilities bird rehabilitators have.

Should the writer make this addition here?

A. Yes, because it reveals the relative importance of imping compared to the other work of bird rehabilitators.
B. Yes, because it reinforces the idea that imping is of great benefit to raptors.
C. No, because it goes beyond the scope of the essay, which focuses on how the feathers of certain types of birds are repaired.
D. No, because it undermines the essay's earlier claim that imping is the most important work that bird rehabilitators do.

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. Carmen is playing with blocks. She arranges stacks of blocks so that each successive level of blocks has 1 fewer block than the level below it and the top level has 1 block. Such a stack with 3 levels is shown below. Carmen wants to make such a stack with 12 levels. How many blocks would she use to build this stack?

level 1

level 2

level 3
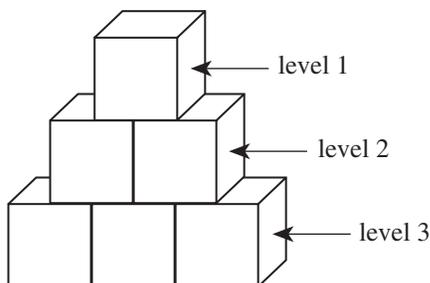
   A.   66
   B.   78
   C.   132
   D.   144
   E.   156

2. To keep up with rising expenses, a motel manager needs to raise the $40.00 room rate by 22%. What will be the new rate?

   F. $40.22
   G. $42.20
   H. $48.00
   J. $48.80
   K. $62.00

3. As a salesperson, your commission is directly proportional to the dollar amount of sales you make. If your sales are $800, your commission is $112. How much commission would you earn if you had $1,400 in sales?

   A. $210
   B. $196
   C. $175
   D. $128
   E. $ 64

4. If $7 + 3x = 22$, then $2x = $?

   F.   5
   G. 10
   H. 12
   J. 14
   K. $\frac{58}{3}$

5. The total cost of renting a car is $30.00 for each day the car is rented plus $28\frac{1}{2}$¢ for each mile the car is driven. What is the total cost of renting the car for 5 days and driving 350 miles?

   (Note: No sales tax is involved.)

   A. $ 104.75
   B. $ 159.98
   C. $ 249.75
   D. $ 300.00
   E. $1,147.50

6. In any parallelogram *ABCD*, it is always true that the measures of $\angle ABC$ and $\angle BCD$:

   F.   add up to 180°.
   G.   add up to 90°.
   H.   are each greater than 90°.
   J.   are each 90°.
   K.   are each less than 90°.

26

GO ON TO THE NEXT PAGE.

7. What is the least common denominator for adding the fractions $\frac{4}{15}$, $\frac{1}{12}$, and $\frac{3}{8}$?

- **A.** 40
- **B.** 120
- **C.** 180
- **D.** 480
- **E.** 1,440

8. The product $(2x^4y)(3x^5y^8)$ is equivalent to:

- **F.** $5x^9y^9$
- **G.** $6x^9y^8$
- **H.** $6x^9y^9$
- **J.** $5x^{20}y^8$
- **K.** $6x^{20}y^8$

9. It costs a dollars for an adult ticket to a reggae concert and s dollars for a student ticket. The difference between the cost of 12 adult tickets and 18 student tickets is \$36. Which of the following equations represents this relationship between a and s ?

- **A.** $\frac{12a}{18s} = 36$
- **B.** $216as = 36$
- **C.** $|12a - 18s| = 36$
- **D.** $|12a + 18s| = 36$
- **E.** $|18a + 12s| = 36$

10. If $x > 1$, then which of the following has the LEAST value?

- **F.** $\sqrt{x}$
- **G.** $\sqrt{2x}$
- **H.** $\sqrt{x \cdot x}$
- **J.** $x\sqrt{x}$
- **K.** $x \cdot x$

11. Charles defined a new operation, ♦, on pairs of ordered pairs of integers as follows: $(a,b) \blacklozenge (c,d) = \frac{ac + bd}{ab - cd}$. What is the value of $(2,1) \blacklozenge (3,4)$?

- **A.** −2
- **B.** −1
- **C.** 2
- **D.** 5
- **E.** 10

12. In the figure below, $\angle BAC$ measures 30°, $\angle ABC$ measures 110°, and points B, C, and D are collinear. What is the measure of $\angle ACD$?
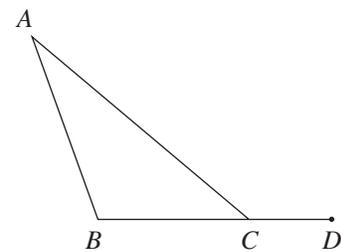
- **F.** 150°
- **G.** 140°
- **H.** 130°
- **J.** 120°
- **K.** 110°

13. In the isosceles right triangle below, $AB = 10$ feet. What is the length, in feet, of $\overline{AC}$?
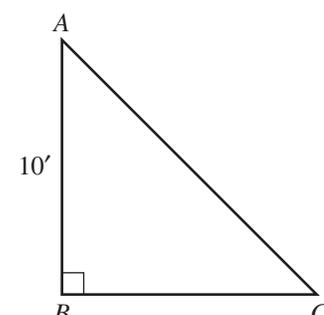
- **A.** 5
- **B.** 10
- **C.** 20
- **D.** $\sqrt{20}$
- **E.** $10\sqrt{2}$

14. In a bag of 400 jelly beans, 25% of the jelly beans are red in color. If you randomly pick a jelly bean from the bag, what is the probability that the jelly bean picked is NOT one of the red jelly beans?

- **F.** $\frac{1}{2}$
- **G.** $\frac{1}{4}$
- **H.** $\frac{3}{4}$
- **J.** $\frac{1}{16}$
- **K.** $\frac{15}{16}$
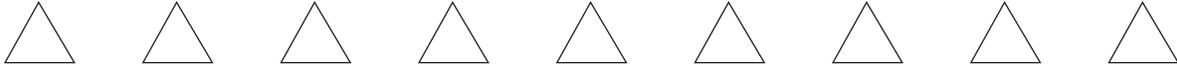
15. What polynomial must be added to $x^2 - 2x + 6$ so that the sum is $3x^2 + 7x$?

A. $4x^2 + 5x + 6$
B. $3x^2 + 9x + 6$
C. $3x^2 + 9x - 6$
D. $2x^2 + 9x - 6$
E. $2x^2 - 5x + 6$

16. What is the slope of any line parallel to the line $8x + 9y = 3$ in the standard (x,y) coordinate plane?

F. -8
G. $-\dfrac{8}{9}$
H. $\dfrac{8}{3}$
J. 3
K. 8

17. In the standard (x,y) coordinate plane, a line segment has its endpoints at $(3,6)$ and $(9,4)$. What are the coordinates of the midpoint of the line segment?

A. $(\ 3,-1)$
B. $(\ 3,\ 1)$
C. $(\ 6,\ 2)$
D. $(\ 6,\ 5)$
E. $(12,10)$

18. When $y = x^2$, which of the following expressions is equivalent to $-y$?

F. $(-x)^2$
G. $-x^2$
H. $-x$
J. x^{-2}
K. x

19. For the function $h(x) = 4x^2 - 5x$, what is the value of $h(-3)$?

A. -93
B. -9
C. 21
D. 51
E. 159

20. For all triangles $\triangle XYZ$ where side $\overline{XZ}$ is longer than side $\overline{YZ}$, such as the triangle shown below, which of the following statements is true?
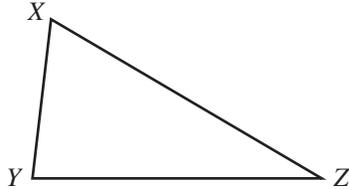
F. The measure of $\angle X$ is always less than the measure of $\angle Y$.
G. The measure of $\angle X$ is always equal to the measure of $\angle Y$.
H. The measure of $\angle X$ is always greater than the measure of $\angle Y$.
J. The measure of $\angle X$ is sometimes less than the measure of $\angle Y$ and sometimes equal to the measure of $\angle Y$.
K. The measure of $\angle X$ is sometimes greater than the measure of $\angle Y$ and sometimes equal to the measure of $\angle Y$.

21. $\left| 7(-3) + 2(4) \right| = ?$

A. -28
B. -13
C. 13
D. 28
E. 29

22. If $x > |y|$, which of the following is the solution statement for x when $y = -4$?

F. x is any real number.
G. $x > 4$
H. $x < 4$
J. $-4 < x < 4$
K. $x > 4$ or $x < -4$

23. The perimeter of a parallelogram is 72 inches, and 1 side measures 12 inches. What are the lengths, in inches, of the other 3 sides?

A. 12, 12, 36
B. 12, 18, 18
C. 12, 24, 24
D. 12, 30, 30
E. Cannot be determined from the given information

24. The lengths of the corresponding sides of 2 similar right triangles are in the ratio of 2:5. If the hypotenuse of the smaller triangle is 5 inches long, how many inches long is the hypotenuse of the larger triangle?

F. 2
G. 2.5
H. 7
J. 10
K. 12.5
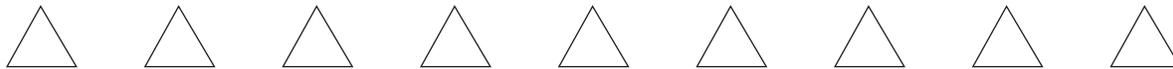
25. The sides of a square are 3 cm long. One vertex of the square is at (3,0) on a square coordinate grid marked in centimeter units. Which of the following points could also be a vertex of the square?

A. (6, 0)

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

C. (1, 2)

D. (0, –2)

E. (–3, 0)

26. In the circle shown below, M is the center and lies on $\overline{RU}$ and $\overline{ST}$. Which of the following statements is NOT true?
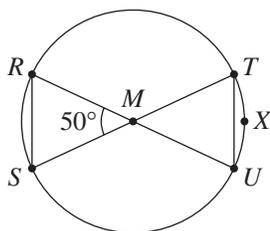
F. $\angle TUM$ measures 65°

G. $\overline{TU}$ is parallel to $\overline{RS}$

H. $\overarc{TXU}$ measures 50°

J. $\overline{RM} \cong \overline{TM}$

K. $\overline{RS} \cong \overline{SM}$

27. John Jones has decided to go into the business of producing and selling boats. In order to begin this venture, he must invest $10 million in a boat production plant. The cost to produce each boat will be $7,000, and the selling price will be $20,000. Accounting for the cost of the production plant, which of the following expressions represents the profit, in dollars, that John will realize when x boats are produced and sold?

A. 13,000x – 10,000,000

B. 27,000x – 10,000,000

C. 9,973,000x

D. 20,000x

E. 13,000x

28. If $2x^2 + 6x = 36$, what are the possible values of x ?

F. –12 and 3

G. –6 and 3

H. –3 and 6

J. –3 and 12

K. 12 and 15

29. As a class experiment, a cart was rolled at a constant rate along a straight line. Shawn recorded in the chart below the cart's distance (x), in feet, from a reference point at the start of the experiment and for each of 5 times (t), in seconds.

t	0	1	2	3	4	5
x	10	14	18	22	26	30

Which of the following equations represents this data?

A. $x = t + 10$

B. $x = 4t + 6$

C. $x = 4t + 10$

D. $x = 10t + 4$

E. $x = 14t$

30. To increase the mean of 4 numbers by 2, by how much would the sum of the 4 numbers have to increase?

F. 2

G. 4

H. 6

J. 8

K. 16

31. Meg pounded a stake into the ground. When she attached a leash to both the stake and her dog's collar, the dog could reach 9 feet from the stake in any direction. Using 3.14 for π, what is the approximate area of the lawn, in square feet, the dog could reach from the stake?

A. 28

B. 57

C. 113

D. 254

E. 283

32. Television screen sizes are the diagonal length of the rectangular screen. Hector recently changed from watching a television with a 13-inch screen to a television with a similar 19-inch screen. If a boxcar appeared 8 inches long on the 13-inch screen, how long, to the nearest inch, will it appear on the 19-inch screen?

F. 10

G. 12

H. 14

J. 16

K. 18

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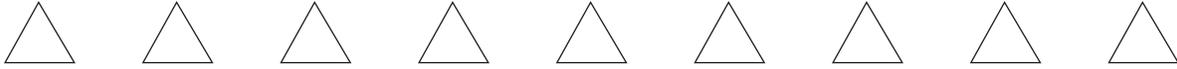
33. In the figure below, *ABCD* is a square. Points are chosen on each pair of adjacent sides of *ABCD* to form 4 congruent right triangles, as shown below. Each of these has one leg that is twice as long as the other leg. What fraction of the area of square *ABCD* is shaded?
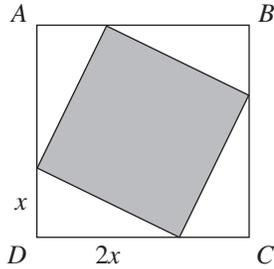
A. $\dfrac{1}{9}$

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

C. $\dfrac{4}{9}$

D. $\dfrac{5}{9}$

E. $\dfrac{8}{9}$

34. A surveyor took and recorded the measurements shown in the figure below. If the surveyor wants to use these 3 measurements to calculate the length of the pond, which of the following would be the most directly applicable?
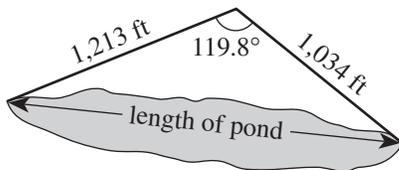
F. The Pythagorean theorem
G. A formula for the area of a triangle
H. The ratios for the side lengths of 30°-60°-90° triangles
J. The ratios for the side lengths of 45°-45°-90° triangles
K. The law of cosines: For any $\triangle ABC$, where a is the length of the side opposite $\angle A$, b is the length of the side opposite $\angle B$, and c is the length of the side opposite $\angle C$, $a^2 = b^2 + c^2 - 2bc \cos(\angle A)$

35. Which of the following is the graph of the equation $2x + y = 4$ in the standard (x,y) coordinate plane?

A.

D.

B.

E.

C.

36. Which of the following figures in a plane separates it into half-planes?

F. A line
G. A ray
H. An angle
J. A point
K. A line segment

37. What is the maximum number of distinct diagonals that can be drawn in the hexagon shown below?
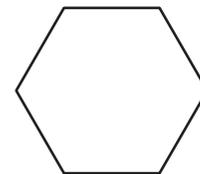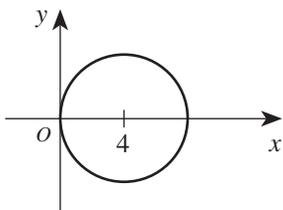

A. 4
B. 5
C. 6
D. 9
E. 12
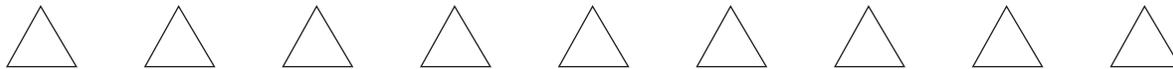
38. In the standard (x,y) coordinate plane, the center of the circle shown below lies on the x-axis at $x = 4$. If the circle is tangent to the y-axis, which of the following is an equation of the circle?

F. $(x + 4)^2 + y^2 = 4$

G. $(x - 4)^2 + y^2 = 16$

H. $(x - 4)^2 - y^2 = 16$

J. $(x - 4)^2 + y^2 = 4$

K. $x^2 + (y - 4)^2 = 16$

39. In what order should $\frac{5}{3}$, $\frac{7}{4}$, $\frac{6}{5}$, and $\frac{9}{8}$ be listed to be arranged by increasing size?

A. $\frac{9}{8} < \frac{6}{5} < \frac{5}{3} < \frac{7}{4}$

B. $\frac{9}{8} < \frac{6}{5} < \frac{7}{4} < \frac{5}{3}$

C. $\frac{7}{4} < \frac{5}{3} < \frac{9}{8} < \frac{6}{5}$

D. $\frac{6}{5} < \frac{9}{8} < \frac{5}{3} < \frac{7}{4}$

E. $\frac{5}{3} < \frac{6}{5} < \frac{7}{4} < \frac{9}{8}$

40. Mai is putting gold foil around the outside of an elliptical picture frame. The perimeter of an ellipse is given by the formula $p = \frac{\pi}{2}\sqrt{2(h^2 + w^2)}$, where h is the height and w is the width, as shown in the diagram below. If an elliptical frame has an outside height equal to 4 inches and an outside width equal to 3 inches, what is its outside perimeter, in inches?

F. $\frac{5}{2}\pi\sqrt{2}$

G. $\frac{7}{2}\pi\sqrt{2}$

H. $5\pi\sqrt{2}$

J. $\frac{\pi}{2}(4\sqrt{2} + 3)$

K. $(4\pi + 3)\sqrt{2}$
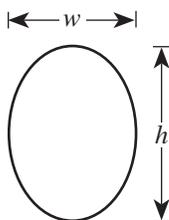
41. If $\frac{A}{30} + \frac{B}{105} = \frac{7A + 2B}{x}$ and A, B, and x are integers greater than 1, then what must x equal?

A. 9

B. 135

C. 210

D. 630

E. 3,150

Use the following information to answer questions 42–44.

Kaylee is planning to purchase a car. She will need to borrow some of the money and has a chart, shown below, to use to approximate her monthly payment. The chart gives the approximate monthly payment per $1,000 borrowed.

Monthly payment per $1,000 borrowed for various annual rates and various numbers of payments			
Annual interest rate	Number of monthly payments		
	36	48	60
5%	$29.97	$23.03	$18.87
8%	$31.34	$24.41	$20.28
10%	$32.27	$25.36	$21.24
12%	$33.22	$26.34	$22.24

42. Kaylee found a used car she is thinking about purchasing. The list price is $8,795. She calculates that she will need to borrow $6,500. Approximately what would her monthly payment be if she borrowed the money for 36 months at an annual interest rate of 10% ?

F. $164.84

G. $171.21

H. $209.76

J. $234.72

K. $283.81

43. A local dealership is having an end-of-the-model-year clearance sale and is offering 5% annual interest on new-car loans for 36, 48, or 60 months. The maximum amount Kaylee can budget for her monthly car payment is $300. Of the following loan amounts, which one is the maximum Kaylee can borrow at 5% annual interest and stay within her budget?

A. $10,000

B. $13,000

C. $14,000

**D.** $15,000

E. $20,000

44. Another dealership is offering 5-year loans with a 9% annual interest rate. Kaylee uses her chart to estimate the payment per $1,000 borrowed. Of the following, which is most likely the monthly payment per $1,000 borrowed?

F. $20.52

G. $20.76

H. $20.85

J. $21.00

K. $21.74

GO ON TO THE NEXT PAGE.

45. In △*ABC*, shown below, the measure of ∠*B* is 41°, the measure of ∠*C* is 34°, and $\overline{AB}$ is 25 units long. Which of the following is an expression for the length, in units, of $\overline{BC}$?

(Note: The law of sines states that, for any triangle, the ratios of the sines of the interior angles to the lengths of the sides opposite those angles are equal.)
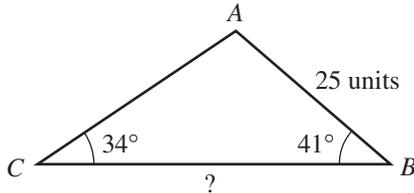

A. $\dfrac{25 \sin 105°}{\sin 41°}$

B. $\dfrac{25 \sin 105°}{\sin 34°}$

C. $\dfrac{25 \sin 75°}{\sin 41°}$

D. $\dfrac{25 \sin 41°}{\sin 105°}$

E. $\dfrac{25 \sin 34°}{\sin 75°}$

46. For $i^2 = -1$, $(4 + i)^2 = $?

F. 15
G. 17
H. $15 + 4i$
J. $15 + 8i$
K. $16 + 4i$

47. If *r* and *s* can be any integers such that $s > 10$ and $2r + s = 15$, which of the following is the solution set for *r* ?

A. $r \geq 3$
B. $r \geq 0$
C. $r \geq 2$
D. $r \leq 0$
E. $r \leq 2$

48. Which of the following expressions has a positive value for all *x* and *y* such that $x > 0$ and $y < 0$?

F. $y - x$

G. $x + y$

H. $x^3 y$

J. $\dfrac{x^2}{y}$

K. $\dfrac{x}{y^2}$

49. What is the value of $\log_2 8$?

A. 3
B. 4
C. 6
D. 10
E. 16

**50.** In the right triangle below, the measure of ∠*C* is 90°, $AB = 5$ units, and $CB = 2$ units. What is tan *B* ?
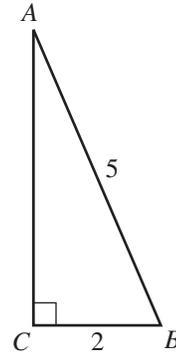
F. $\dfrac{\sqrt{21}}{2}$

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

H. $\dfrac{\sqrt{21}}{5}$

J. $\dfrac{3}{5}$

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

51. A flight instructor charges $50 per lesson, plus an additional fee for the use of his plane. The charge for the use of the plane varies directly with the square root of the time the plane is used. If a lesson plus 16 minutes of plane usage costs $90, what is the total amount charged for a lesson having 36 minutes of plane usage?

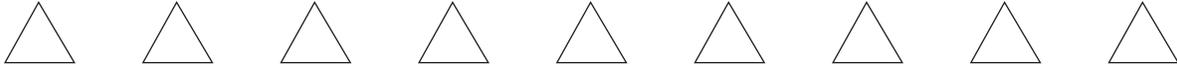**A.** $185
B. $150
C. $135
D. $110
E. $ 60

52. In △*ABD*, shown below, *C* is on $\overline{BD}$, the length of $\overline{AD}$ is 6 inches, and sin *d* = 0.8. How many inches long is $\overline{CD}$?
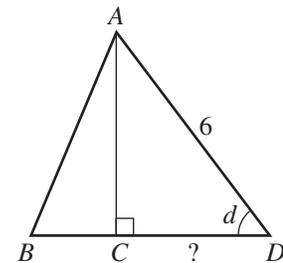
F. 1.2
G. 1.8
H. 3.6
J. 4.8
K. Cannot be determined from the given information

**53.** For real numbers *a* and *b*, when is the equation $|a + b| = |a - b|$ true?

A. Always
B. Only when $a = b$
C. Only when $a = 0$ and $b = 0$
D. Only when $a = 0$ or $b = 0$
E. Never

54. As shown below, rectangle *ABCD* is divided into 2 large squares (labeled *L*) each *x* inches on a side, 15 small squares (labeled *S*) each *y* inches on a side, and 13 rectangles (labeled *R*) each *x* inches by *y* inches. What is the total area, in square inches, of *ABCD* ?

F. $2x + 13xy + 15y$

G. $6x + 16y$
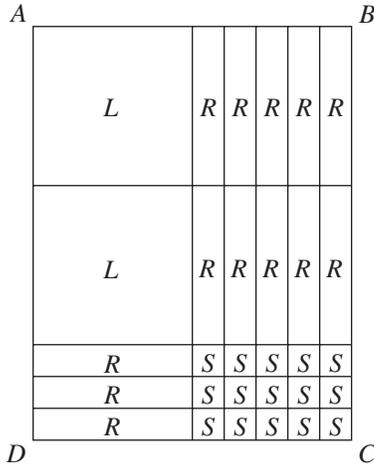
H. $2x^2 + 15y^2$

J. $2x^2 + 8xy + 15y^2$

K. $2x^2 + 13xy + 15y^2$

55. For some real number *A*, the graph of the line $y = (A + 1)x + 8$ in the standard (*x,y*) coordinate plane passes through (2,6). What is the slope of this line?

A. −4
B. −3
C. −1
D. 3
E. 7

56. The graph of the equation $h = -at^2 + bt + c$, which describes how the height, *h*, of a hit baseball changes over time, *t*, is shown below.
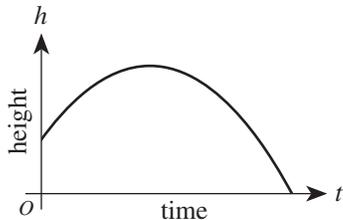

If you alter only this equation's *c* term, which gives the height at time $t = 0$, the alteration has an effect on which of the following?

  I. The *h*-intercept
  II. The maximum value of *h*
  III. The *t*-intercept

F. I only
G. II only
H. III only
J. I and III only
K. I, II, and III

57. When graphed in the standard (*x,y*) coordinate plane, the lines $x = -3$ and $y = x - 3$ intersect at what point?

A. (0, 0)
B. (0,−3)
C. (−3, 0)
D. (−3,−3)
E. (−3,−6)

58. In pentagon *ABCDE*, shown below, ∠*A* measures 50°. What is the total measure of the other 4 interior angles?
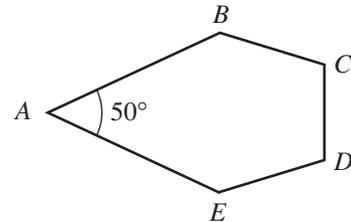
F. 130°
G. 200°
H. 310°
J. 432°
K. 490°

59. For all real numbers *b* and *c* such that the product of *c* and 3 is *b*, which of the following expressions represents the sum of *c* and 3 in terms of *b* ?

A. $b + 3$

B. $3b + 3$

C. $3(b + 3)$

D. $\dfrac{b + 3}{3}$

E. $\dfrac{b}{3} + 3$

60. Which of the following expresses the number of meters a contestant must travel in a 3-lap race where the course is a circle of radius *R* meters?

F. $3R$
G. $3\pi R$
H. $3\pi R^2$
J. $6R$
K. $6\pi R$

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 title story of *Only the Little Bone,* a collection of short stories by David Huddle (©1986 by David Huddle).

My grandfather has made crutches for me. These are sturdy crutches, just the right size. I am delighted with them and launch myself around the house on them.

And take a fall immediately. And continue falling
5 several times a day, great splatting, knocking-into-fur-niture-and-breaking-things falls that cause everyone in the family to come running. My grandfather has for-gotten to put rubber tips on the ends of my crutches. When we figure this out and buy the rubber tips and put
10 them on the crutches, I stop falling. But by then the bone-set that was coming along nicely has slipped, and the doctor has ordered me back to the wheelchair.

The missing crutch-tips are the first clue I have to this peculiar family trait, one that for lack of any better
15 term I must call "flawed competence." We Bryants are a family of able and clever people, industrious, intelli-gent, determined, and of good will. We are careful in our work. After all, my grandfather measured me on two occasions before he made the crutches. But we usu-
20 ally do something wrong.

Four years later I become increasingly aware of "flawed competence" when I develop a plan for con-verting our old grown-over tennis court into a basket-ball court. My grandfather is always interested in plans,
25 and in this planning session, we decide that he will make the hoops, and he will help me make the back-boards. Clearing the ground and smoothing the surface will be my tasks. So I rip out honeysuckle and hatchet down a few little scrub cedars. We Bryants are known
30 for setting our minds to things.

Then my grandfather delivers the hoops. They are beautifully designed and constructed, metalwork of a high order for such amateurs as my grandfather and his men. But the hoops are twice as big around as ordinary
35 basketball hoops.

I say, simply, that they are too big. I am not ungrateful, not trying to be hateful, not in my opinion being overly fastidious. I am simply describing a char-acteristic of the hoops. But my grandfather's feelings
40 are damaged. No, they can't be made smaller, and no, he's not interested in helping me with the backboards now or with any other part of my plan. He's sorry he got involved in the first place. This, too, is a corollary of "flawed competence." We are sensitive, especially
45 about our work, especially about the flawed part of our work.

At the place where I work twenty-eight years after the basketball hoops, I am given a new office, one with a view of the lake. There's a string attached, though,
50 and that is that I have to build my own bookcases. I commence planning with enthusiasm. That's another, less harmful family trait, that attraction to making plans. I measure, I look at other people's shelves, I get someone to help me attach brackets to my office walls.

55 It is while I am cutting a notch in one of the uprights to allow access to the light-switch that I sud-denly think of my grandfather and those basketball hoops. I feel a light sweat break out on my forehead. A pattern of genetic fate reveals itself to me: I'm going to
60 mess up these bookshelves just as my grandfather before me would have messed them up. No doubt I'm sawing the notch in the wrong place.

The whole time I work I wait to see where the screw-up is going to come. I imagine what my col-
65 leagues will be saying about me in the hallways. Did you know that Bryant built his shelves so they tilt? Did you know that Bryant's books rejected the color he painted his shelves? But the screw-up doesn't appear. I paint the shelves red, and they look O.K. (Granddaddy
70 Bryant once painted yellow a whole row of company houses he built.) I paint a chair blue and red, and it's a little silly-looking, but it picks up the blue of the carpet and the red of the shelves. The vision isn't nearly as impressive as I thought it would be, but then
75 what vision ever is? We plan-makers are accustomed to things turning out not-quite-as-good-as-we-had-in-mind. Our world view includes the "diminished excellence" component. Diminished excellence is a condition of the world and therefore never an occasion
80 for sorrow, whereas flawed competence comes out of character and therefore is frequently the reason for the bowed head, the furrowed brow. Three months later, when I try to turn the heat off in my office, I discover that I have placed one of the shelf uprights too close to

     GO ON TO THE NEXT PAGE.

85 the radiator to be able to work the valve. The screw-up
was there all along, but in this case I am relieved to
find it. I am my grandfather's grandson after all.

1. The passage is written from the point of view of:

   A. an unidentified narrator observing the relationship
   over time between a boy and his grandfather.
   B. two members of the same family discovering their
   shared trait through joint activities.
   C. a grown man agonizing over the mixed messages
   he received as a child from older relatives.
   D. a boy and the man he becomes considering inci-
   dents that illustrate a family trait.

2. Which of the following best describes the author's
approach to presenting the story of the narrator's dis-
covery about himself?

   F. Revealing the narrator's self-awareness about a
   trait through a blend of personal reflection and
   scenes from the narrator's youth and adulthood
   G. Starting immediately with a statement of the dis-
   covery in the narrator's voice and continuing with
   scenes that reveal how the discovery came about
   H. Describing the physical details of scenes and sum-
   marizing their significance in a concluding state-
   ment in the narrator's voice
   J. Using dialogue in the midst of scenes fraught with
   tension to indicate what the narrator is experi-
   encing internally

3. Each of the three projects described in the passage
reveals:

   A. the increasing antagonism between the grandfather
   and grandson.
   B. the errors the narrator makes and the disapproval
   they bring from others.
   C. that such incidents set the stage for the Bryant
   family traits to emerge.
   D. that the narrator is determined to avoid being
   ungrateful, hateful, or overly fastidious.

4. The boy's approach to the task of converting the tennis
court to a basketball court can best be described as:

   F. reluctant until his grandfather's plans inspire him.
   G. enthusiastic until his grandfather's error puts them
   both in an awkward position.
   H. apprehensive until he discovers his error is not a
   devastating one.
   J. thrilled until he remembers that his grandfather is
   a poor planner.

5. As he is revealed in the incident of undertaking the
construction of the basketball court, the grandfather
can best be characterized as:

   A. confidently optimistic, then childishly defensive.
   B. charmingly patient, then increasingly accusatory.
   C. consistently encouraging in spite of setbacks.
   D. vocally defensive, then quietly apologetic.

6. The question "Did you know that Bryant built his
shelves so they tilt?" (lines 65–66) helps establish that
the narrator is anxious because:

   F. his coworkers have discovered his incompetence
   and have made it the subject of office humor.
   G. his coworkers resent his having a corner office and
   punish him with their biting humor.
   H. he fears his incompetence is so glaring it will
   make him the object of ridicule among coworkers.
   J. the tilting bookshelves remind him that, like his
   grandfather, he cannot hide his mistakes.

7. Information in the second paragraph (lines 4–12)
reveals that the family's response to the grandfather's
error with the crutches is to:

   A. find a workable remedy for it.
   B. lay the blame on the narrator.
   C. praise him for more successful projects.
   D. fix what wasn't wrong in the first place.

8. It can most reasonably be inferred from the sixth para-
graph (lines 36–46) that the statement that the basket-
ball hoops "can't be made smaller" (line 40) is:

   F. a fact stated by the grandfather apologetically.
   G. an opinion stated by the grandfather indignantly.
   H. a claim the narrator makes to humiliate a relative.
   J. a conclusion the narrator reaches after hard labor.

9. It can most reasonably be inferred that the narrator's
discovery that an error has been made in constructing
the bookshelves is for him a source of:

   A. embarrassment in the face of coworkers who antic-
   ipated it.
   B. comfort because it reveals a trait that he shares
   with his family.
   C. frustration because it will require a remedy that
   will be tedious to carry out.
   D. relief because it gives him an excuse to seek the
   assistance of coworkers in finishing the project.

10. In the last paragraph, a comparison is made between
"diminished excellence" and "flawed competence."
From the narrator's point of view, the conditions are
different because the one is:

   F. a source of sorrow while the other is a source of
   pride.
   G. based in the family while the other is based in the
   self.
   H. inherent in the environment while the other is
   inherent in the individual.
   J. a sign that the individual can improve the world
   while the other is a sign that the individual can't.

Passage II

SOCIAL SCIENCE: This passage is adapted from Dava Sobel's book *Longitude* (©1995 by Dava Sobel).

To learn one's longitude at sea, one needs to know what time it is aboard ship and also the time at the home port or another place of known longitude—at that very same moment. The two clock times enable the
5 navigator to convert the hour difference into a geographical separation. Since the Earth takes twenty-four hours to complete one full revolution of three hundred sixty degrees, one hour marks one twenty-fourth of a spin, or fifteen degrees. And so each hour's time differ-
10 ence between the ship and the starting point marks a progress of fifteen degrees of longitude to the east or west. Every day at sea, when the navigator resets the ship's clock to local noon when the sun reaches its highest point in the sky, and then consults the home-
15 port clock, every hour's discrepancy between them translates into another fifteen degrees of longitude.

Those same fifteen degrees of longitude also correspond to a distance traveled. At the Equator, where the girth of the Earth is greatest, fifteen degrees stretch
20 fully one thousand miles. North or south of that line, however, the mileage value of each degree decreases. One degree of longitude equals four minutes of time the world over, but in terms of distance, one degree shrinks from sixty-eight miles at the Equator to virtu-
25 ally nothing at the poles.

Precise knowledge of the hour in two different places at once—a longitude prerequisite so easily accessible today from any pair of cheap wristwatches—was utterly unattainable up to and including the era of
30 pendulum clocks. On the deck of a rolling ship, such clocks would slow down, or speed up, or stop running altogether. Normal changes in temperature encountered en route from a cold country of origin to a tropical trade zone thinned or thickened a clock's lubricating oil and
35 made its metal parts expand or contract with equally disastrous results. A rise or fall in barometric pressure, or the subtle variations in the Earth's gravity from one latitude to another, could also cause a clock to gain or lose time.

40 For lack of a practical method of determining longitude, every great captain in the Age of Exploration became lost at sea despite the best available charts and compasses. Untold numbers of sailors died when their destinations suddenly loomed out of the sea and took
45 them by surprise. In a single such accident on October 22, 1707, at the Scilly Isles near the southwestern tip of England, nearly two thousand men lost their lives.

The quest for a solution to the problem of longitude persisted over four centuries and across the whole
50 continent of Europe. The British Parliament, in its famed Longitude Act of 1714, set the highest bounty of all, naming a prize equal to several million dollars in today's currency for a "Practicable and Useful" means of determining longitude.

55 English clockmaker John Harrison, a mechanical genius who pioneered the science of portable precision timekeeping, devoted his life to this quest. He accomplished what Newton had feared impossible: He invented a clock that would carry the true time from the
60 home port, like an eternal flame, to any remote corner of the world.

With no formal education or apprenticeship to any watchmaker, Harrison nevertheless constructed a series of virtually friction-free clocks that required no lubrica-
65 tion and no cleaning, that were made from materials impervious to rust, and that kept their moving parts perfectly balanced in relation to one another, regardless of how the world pitched or tossed about them. He did away with the pendulum, and he combined different
70 metals inside his works in such a way that when one component expanded or contracted with changes in temperature, the other counteracted the change and kept the clock's rate constant.

His every success, however, was parried by mem-
75 bers of the scientific elite, who distrusted Harrison's magic box. The commissioners charged with awarding the longitude prize changed the contest rules whenever they saw fit, so as to favor the chances of astronomers over the likes of Harrison and his fellow "mechanics."
80 But the utility and accuracy of Harrison's approach triumphed in the end. In 1773 he claimed his rightful reward. His followers shepherded Harrison's intricate, exquisite invention through the design modifications that enabled it to be mass produced and enjoy wide use.

85 To retrace this story in an age when a network of satellites can nail down a ship's position within a few feet in just a moment or two—is to see the globe anew.

11. The function of the first paragraph in relation to the passage as a whole is to:
   A. orient the reader to the subject of longitude by explaining how longitude is determined at sea.
   B. explain the political significance of developing an accurate way of determining longitude.
   C. establish that longitude calculations are necessary to determine time in two different places at once.
   D. introduce a discussion of how knowledge of Earth's position relative to the Sun was gained in the process of advances in timekeeping.

GO ON TO THE NEXT PAGE.

12. Which of the following best describes the way the fifth paragraph (lines 48–54) functions in the passage as a whole?

F. It puts into historical perspective the difficulty of solving the longitude problem and introduces the subject of Britain's longitude prize.

G. It translates the technical terminology used elsewhere in the passage into language that is more widely understood.

H. It sheds light on why it took longer for a solution to the longitude problem to emerge in Europe than in other parts of the world.

J. It diminishes the importance of the lives that were lost in the efforts to solve the longitude problem.

13. It can reasonably be inferred from the passage that before Harrison's efforts, other individuals trying to solve the longitude problem had failed to:

A. consider clocks as the potential instrument of calculation.

B. agree on why longitude decreases in value at increasing distances from Earth's equator.

C. improve upon the features of clocks that made them unreliable at sea.

D. understand the ways that charts and compasses could be used in connection with timepieces to calculate longitude.

14. The reference to the catastrophe at Scilly (lines 45–47) is used to illustrate the point made in the passage that:

F. charts and compasses were poorly made in the 1700s.

G. England more than other countries stood to gain from a solution to the problem of determining longitude.

H. captains were contributing to the problem of lost lives by resisting a solution to the problem of determining longitude.

J. Harrison's accomplishments addressed shortcomings of navigation whose consequences were vast in scale.

15. Information in the second paragraph (lines 17–25) establishes that one degree of longitude translates into a distance of:

A. sixty-eight miles at Earth's equator but less on either side of Earth's equator.

B. sixty-eight miles at Earth's equator but more on either side of Earth's equator.

C. one thousand miles the world over.

D. virtually nothing at Earth's equator, increasing to a maximum of sixty-eight miles at the poles.

16. Which of the following statements best describes the metals used in Harrison's clock?

F. The metals were identical so that they would respond consistently to changes in conditions at sea.

G. The metals were different so that their changes in response to conditions at sea would counteract each other.

H. The metals that remained stable in response to temperature changes were encased in metals that were impervious to rust.

J. The metals expanded and contracted in ways that were counteracted by changes in the parts made of wood.

17. The passage suggests that Harrison's principal competitors in the race to develop a means of determining longitude were:

A. the great captains in the Age of Exploration.

B. members of the British Parliament.

C. trained clockmakers with formal educations.

D. individuals in the scientific community.

18. According to the passage, there was a delay between the time when Harrison arrived at a solution to the problem of longitude and when he received his reward because his:

F. invention predated the Longitude Act of 1714.

G. clock was only one of many successful solutions to emerge simultaneously.

H. opponents obstructed his efforts to claim the prize money.

J. supporters abandoned him in order to exploit his invention for their own financial gain.

19. Lines 82–84 indicate that others took over Harrison's work in order to:

A. secure a wider range of applications for an instrument that had been used only at sea.

B. take credit for his remarkable accomplishments.

C. diminish the significance of his clock by having it mass-produced.

D. turn his design into one that could be practically produced for more users.

20. The passage indicates that instruments for determining longitude now include:

F. modified pendulum clocks.

G. satellites.

H. a network of ships.

J. barometers.

Passage III

The meter of my childhood was the rising and plunging of a sewing machine needle: rapid and smooth, like an endless distant drum roll. My mother hummed as she sewed. She guided the fabric this way
5 and that. In 1938, she had graduated from a school of costume design, and before World War II, she had her own boutique in Los Angeles. It was a time when the dream of America never seemed finer.

The Albany of my childhood was a festive place,
10 closer in spirit to the nineteenth century than to the twenty-first. Italian pushcart grocers crowded southern city blocks, crafting tiered architectural wonders from fresh produce and pungent sausage. Heavy-legged workhorses clopped along cobblestones, delivering
15 bread from German bakeries and milk from Dutch dairies. A cable car ran along streets named for trees.

Each year in early April, an annual dinner-dance was sponsored by the pharmaceutical institute where my father worked as a researcher. A ballroom was
20 rented in a downtown hotel. Musicians were hired to play big-band music. The dinner-dance was the only time when my mother would sew for herself. It was the one time when my parents went out, alone, together. I was a romantic child, dreamy and diffuse. For me, the
25 dinner-dance was an annual event: looked forward to in long anticipation and back upon with nostalgia.

Each year, on a snowy weekday evening, Father would take us window shopping. The deserted down-town streets would be a magical glaze of snow-softened
30 lights and shadowy shop displays. My mother would linger in front of the mannequins clad in evening apparel. I would follow along, drunk with wonder.

Each year before the tape had desiccated on the backs of the New Year's cards and they had fallen to
35 the floor, my mother would have decided on the design for her dinner-dance dress. Then there would be a trip to the fabric store. I would run my hands along gradu-ated rainbows of thread spools. I would watch their changing hues as they shimmered in the light.

40 As the dress took form, my parents would practice dancing.

"Slow, slow, quick, quick, slow," Father would mutter with determination as he trod unmincingly on Okaa-chan's feet and guided her into the walls.

45 "Next lady?" he gallantly would inquire. My sister Misa and I would take turns, balancing on the tops of his shoes, as Father swept us around the room.

I always thought that Dinner-Dance Eve had some of the magic of Christmas. Every year, I would perch
50 on the bathtub's edge. I would watch my father fix his tie. "See the nice dimple below the knot?" Father would turn from the mirror and bend to show me. "The dimple is very important." I solemnly would nod—the honored recipient of this arcane cultural wisdom.

55 Back in the bedroom, Okaa-chan would slide into her new dress. She would glance at her reflection with modest pleasure. When she moved, I could catch the sweet scent of face powder.

When I was seven or eight, the window shopping
60 and the dinner-dances stopped. The granite façades of the downtown stores were grimy with graffiti. Display windows were boarded with plywood. The elegant hotels had fallen into disrepair. No one danced to big-band music anymore.

65 As I grew older, my mother began to sew for wealthy women. The women lived in country homes where sunlight, reflected from swimming pools just beyond French doors, played across fine wood floors.

Once after a luncheon in the city, a woman came
70 to our house for a fitting. Standing erect in the door-way, then bowing slightly, my mother met her formally.

"Won't you please come in? May I please take your coat?"

"Here you go. Try to put it somewhere clean."

75 Like an eagle, her words slipped regally down a great distance and struck with awful ease.

After the fitting, my father was ashamed and angry.

"Actually, I do not like this work," he stormed. "You do not have to do this; we do not need this kind of
80 money." He waved his arms dismissively at Okaa-chan's sewing machine. "They come and look at our home with contempt. You kneel at their hems like a ser-vant! *Mo dame desu yo!* It is no good, I tell you!"

Okaa-chan was intractable. Eloquent in anger, she
85 blazed over the pronunciation of words that ordinarily would have left pondering pauses in her speech. "I do not care what they think of me, of our home. They cannot affect our value." My mother stepped in front of her sewing machine, as if to shield it from scorn. "My
90 work gives me happiness." She squarely faced my father. "I do not care if you speak as Husband," she said. "I am a Designer!"

21. As it is described in the passage, sewing seems most closely associated in the narrator's mind with her mother's:

  A. low wages.
  B. compassion.
  C. self-worth.
  D. thriftiness.

22. It is reasonable to infer from the passage that the narrator looks back on the dinner-dances as a time when:

F. her parents were in conflict over her mother's work.

G. the entire family was filled with excitement and anticipation.

H. she and her father had a much easier relationship with each other.

J. her mother and father had renewed hope for the future of the family.

23. It is reasonable to infer that the primary reason the author included the information in the eleventh paragraph (lines 59–64) is to:

A. contrast it with the earlier description of the family looking at shop displays on a snowy evening.

B. support the information about the trip to the fabric store, which is presented earlier.

C. compare it with the scene where the father dances with his wife and daughters.

D. contrast it with the scene presented in the last two paragraphs (lines 78–92).

24. The primary focus of lines 65–92 is:

F. the relationship between the narrator and her mother.

G. Okaa-chan's strength and integrity.

H. Albany's move toward the twenty-first century.

J. the narrator's father's stubbornness.

25. When the narrator says, "I solemnly would nod—the honored recipient of this arcane cultural wisdom" (lines 53–54), she most likely means that:

A. she felt intimidated when her father was giving her information that she did not understand.

B. her father was honored to be able to share personal information with his daughter.

C. when her father put on his tie, she pretended to be honored, even though she thought his comment was silly.

D. the information her father was giving her seemed important and made her feel valued.

26. The sentence "Like an eagle, her words slipped regally down a great distance and struck with awful ease" (lines 75–76) indicates that the narrator:

F. was not sure what her mother expected of her.

G. recognized that her mother was being demeaned.

H. wanted to distance herself from her mother.

J. was ill at ease with her position in the family.

27. Information in the passage suggests that the narrator's father disapproves of Okaa-chan's sewing business primarily because it:

A. diminishes his role as a provider.

B. means more to her than he does.

C. does not generate enough income.

D. threatens his sense of dignity.

28. Based on the last two paragraphs (lines 78–92), which of the following statements indicates what the narrator's father and mother have in common?

F. They both want control of the family finances.

G. They are both fighting for their self-respect.

H. They both want to teach a lesson to their children.

J. They are both angry at the woman who came for the fitting.

29. The author uses the term "architectural wonders" (line 12) to describe:

A. nineteenth-century buildings.

B. German baked goods.

C. crowded city blocks with cobblestone streets.

D. arranged layers of fruits, vegetables, and sausages.

30. Which of the following words best describes the narrator's father's dancing as he practices for the dinner-dance with Okaa-chan?

F. Skillful

G. Graceful

H. Clumsy

J. Indifferent

Passage IV

Nature's imagination, as Freeman Dyson likes to say, is richer than ours, and he speaks, marvellingly, of this richness in the physical and biological worlds, the endless diversity of physical forms and forms of life.
5 For me, as a physician, nature's richness is to be studied in the phenomena of health and disease, in the endless forms of individual adaptation by which human organisms, people, adapt and reconstruct themselves.

Defects, disorders, diseases, in this sense, can play
10 a paradoxical role, by bringing out latent powers, developments, evolutions, forms of life, that might never be seen, or even be imaginable, in their absence. It is the paradox of disease, in this sense, its "creative" potential, that forms the central theme of this book.

15 Thus while one may be horrified by the ravages of developmental disorder or disease, one may sometimes see them as creative too—for if they destroy particular paths, particular ways of doing things, they may force the nervous system into making other paths and ways,
20 force on it an unexpected growth and evolution. This other side of development or disease is something I see, potentially, in almost every patient; and it is this which I am especially concerned to describe.

Similar considerations were brought up by A. R.
25 Luria, who studied the long-term survival of patients who had cerebral tumors or had suffered brain injuries or strokes—and the ways, the adaptations, they used to survive. He also studied deaf and blind children as a very young man (with his mentor L. S. Vygotsky).
30 Vygotsky stressed the intactness rather than the deficits of such children:

A handicapped child represents a qualitatively dif-
ferent, unique type of development. . . . If a blind
child or a deaf child achieves the same level of
35 development as a normal child, then the child with
a defect achieves this *in another way, by another
course, by other means;* and, for the pedagogue, it
is particularly important to know the uniqueness of
the course along which he must lead the child.
40 This uniqueness transforms the minus of a hand-
icap into the plus of compensation.

That such radical adaptations could occur demanded, Luria thought, a new view of the brain, a sense of it not as programmed and static, but rather as dynamic and
45 active, a supremely efficient adaptive system geared for evolution and change, ceaselessly adapting to the needs of the organism—its need, above all, to construct a coherent self and world, whatever defects or disorders of brain function befell it. That the brain is minutely
50 differentiated is clear: there are hundreds of tiny areas crucial for every aspect of perception and behavior. The miracle is how they all cooperate, are integrated together, in the creation of a self.

This sense of the brain's remarkable capacity for
55 the most striking adaptations, not least in the special (and often desperate) circumstances of neural or sensory mishap, has come to dominate my perception of my patients and their lives. So much so, indeed, that I am sometimes moved to wonder whether it may not be
60 necessary to redefine the very concepts of "health" and "disease," to see these in terms of the ability of the organism to create a new organization and order, one that fits its special, altered disposition and needs, rather than in the terms of a rigidly defined "norm."

65 Sickness implies a contraction of life, but such contractions do not have to occur. Nearly all of my patients, so it seems to me, whatever their problems, reach out to life—and not only despite their conditions, but often because of them, and even with their aid.

70 The study of disease, for the physician, demands the study of identity, the inner worlds that patients, under the spur of illness, create. But the realities of patients, the ways in which they and their brains construct their own worlds, cannot be comprehended
75 wholly from the observation of behavior, from the outside.

With this in mind, I have taken off my white coat, deserted, by and large, the hospitals where I have spent the last twenty-five years, to explore my subjects' lives
80 as they live in the real world, feeling in part like a naturalist, examining rare forms of life; in part like an anthropologist, a neuroanthropologist, in the field—but most of all like a physician, called here and there to make house calls, house calls at the far borders of
85 human experience.

31. The quotation by L. S. Vygotsky in lines 32–41 is used in this passage to support the idea that:

A. children with handicaps should be studied in the same way as children defined by physicians as "normal."
B. deficits need to demonstrate intactness in order to be judged acceptable.
C. neural or sensory mishap occurs in children as well as in adults.
**D.** development of children with handicaps may proceed in positive yet quite distinctive ways.

32. The author of the passage refers to the work of A. R. Luria and L. S. Vygotsky primarily to underscore the idea that people who have:

F. disabilities or developmental disorders learn to create new selves.
G. disabilities or developmental disorders need special treatment.
H. unusual handicaps are qualitatively different.
J. neural mishaps have minutely differentiated brains.

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33. Lines 42–53 suggest that, prior to A. R. Luria's research, medical researchers had thought of the brain as:

A. dynamic.
B. unchanging.
C. paradoxical.
D. creative.

34. As it is used in line 41, the word *compensation* most nearly means:

F. payment.
G. differentiation.
H. disposition.
J. adaptation.

35. The author's main purpose in lines 54–69 is to show:

A. how he has come to think differently about the brain.
B. why sickness often causes a contraction of life.
C. when he had made new discoveries about the brain.
D. which of his subjects helped him redefine the term "norm."

36. The author of the passage makes it clear that, when it comes to understanding the effects of a disease on an individual patient, it is necessary for medical doctors to:

F. adhere to established norms of human behavior in diagnosing and treating disease.
G. quickly establish a method of treatment that will save the patient from further suffering.
H. examine the ways that people learn to live with a disease in their daily lives.
J. know each person's brain is minutely differentiated and responsible for the disease being studied.

37. The last paragraph suggests that the author's main reason for leaving the hospital to visit his patients is to allow him to:

A. feel more like a patient than a physician.
B. become a more important part of the real world.
C. understand his patients' illnesses better.
D. see if being a naturalist is like being a physician.

38. The paradox mentioned in the second paragraph (lines 9–14) is best described by which of the following statements?

F. The course of human evolution is guided by the creative potential of the static brain.
G. Serious illness can lead directly to previously unthought of yet productive developmental change.
H. Sickness may contract life, but in so doing it can maintain the physical "norm" at a similar level.
J. The long-term study of disorders and diseases brings out the creative skills of researchers.

39. As it is used in line 15, the word *ravages* most nearly means:

A. paradoxical features.
B. creative adaptations.
C. fatal nature.
D. destructive actions.

40. The word *miracle* in line 52 refers most specifically to the ways in which:

F. brain function disorders are cured.
G. unique handicaps are compensated for.
H. different areas of the brain work together.
J. the creative potential of disease is revealed.

END OF TEST 3

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**DO NOT RETURN TO A PREVIOUS TEST.**
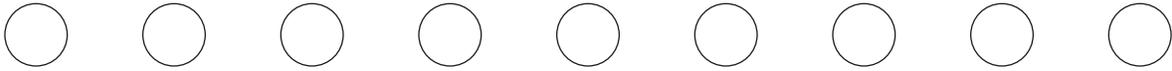
SCIENCE TEST

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

Metamorphic rocks form when temperature and/or pressure cause changes in preexisting rock. Figure 1 shows the temperature and pressure conditions in which certain *facies* (categories of metamorphic rocks) are formed.

temperature (°C)
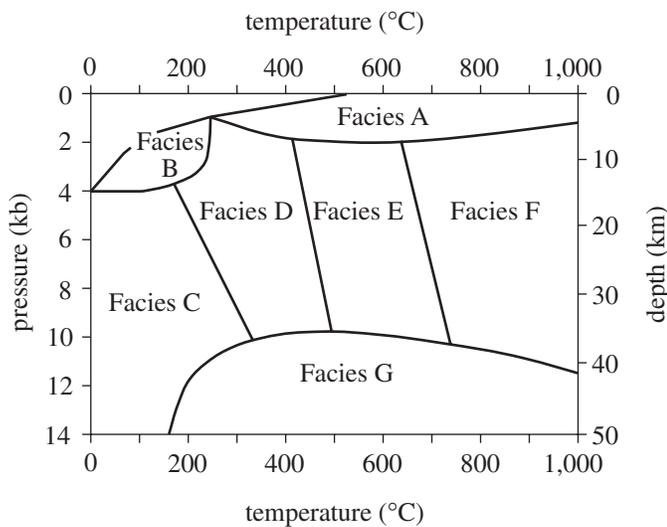
(Note: Boundaries are not actually sharp, distinct lines.)

Figure 1

Figure adapted from Sheldon Judson, Marvin Kauffman, and L. Don Leet, *Physical Geology.* ©1982 by Prentice-Hall, Inc.

A rock's *metamorphic grade* (a measure of the intensity of metamorphism) is classified on a scale of low (very similar to the original rock) to high (very different from the original rock). Table 1 lists the grades of Facies A–G from Figure 1. Figure 2 shows characteristic minerals that may be present in rocks of a given grade.

	Table 1	
Facies	Metamorphic grade*	
A	low	
B	low	
C	low to medium	
D	low to medium	
E	medium	
F	medium to high	
G	high	

*Metamorphic grade is a measure of the intensity of metamorphism.
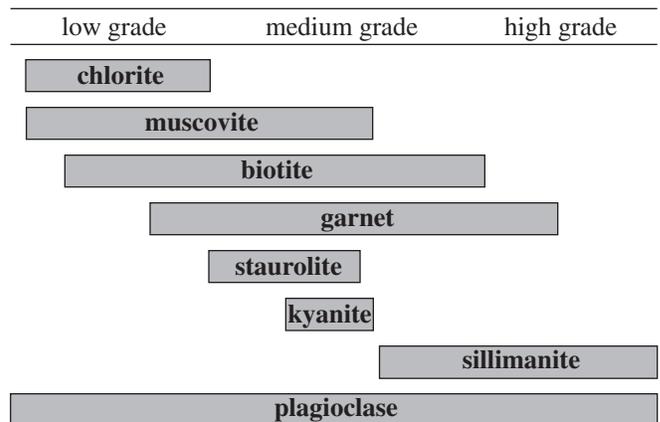

Figure 2

Figure 2 adapted from Frank Press and Raymond Siever, *Earth.* ©1986 by W. H. Freeman and Co.

1. According to Figure 2, which of the following minerals would most typically be found only in rocks of a medium grade?

   A. Muscovite
   B. Biotite
   C. Kyanite
   D. Plagioclase

2. According to Figure 1, a Facies G rock will most likely form under which of the following pressure and temperature conditions?

	Pressure	Temperature
F.	3 kb	800°C
G.	5 kb	400°C
H.	8 kb	1,000°C
J.	11 kb	600°C

3. Figure 1 indicates that as depth increases, pressure:

   A. decreases only.
   B. remains the same.
   C. increases only.
   D. increases, then decreases.

4. According to Figure 2, the presence of which of the following minerals in a metamorphic rock would be *least* helpful in determining that rock's grade?

   F. Chlorite
   G. Muscovite
   H. Staurolite
   J. Plagioclase

5. *Hornfels* is a metamorphic rock formed when *magma* (molten rock) heats sedimentary rocks on Earth's surface. According to Figure 1, hornfels is most likely a member of which of the following facies?

   A. Facies A
   B. Facies C
   C. Facies E
   D. Facies G

Passage II

In 1908, an object from outer space devastated 2,000 km² of forest in Siberia. The object was between 10 m and 100 m in diameter and traveled at a maximum speed of 15 km/sec. It exploded at an altitude of 8 km and released energy equivalent to 20 million tons of TNT. Two scientists discuss whether this object was a comet or an asteroid.

Scientist 1

The object was a comet, a body made of ices (such as frozen water or methane) and dust. Most of this cometary material is *volatile* (easily vaporized) and low in density. Friction in Earth's atmosphere heated the comet to a temperature at which it exploded, high above the ground. The majority of the ices and dust were vaporized in the explosion, which explains why no crater was formed at the site and why no large, identifiable fragments of the object were found. An asteroid would not have been completely destroyed. Intact asteroid fragments that reached the ground would have created one or more craters upon impact and left behind recoverable pieces. Evidence shows that the object decelerated rapidly before it exploded. Because of their low density, comets are capable of such rapid deceleration, whereas high-density objects, such as asteroids, are not.

Scientist 2

The object was a stony asteroid. As it entered Earth's atmosphere, its high speed created a large air pressure difference between the area just in front of the asteroid and the area just behind the asteroid. The large pressure difference eventually exceeded the structural strength of the asteroid. The asteroid flattened, decelerated rapidly due to the dramatic increase in its surface area, and fragmented before reaching the ground. This fragmentation would have appeared like an explosion. Calculations show that a comet between 10 m and 100 m in diameter would explode at an altitude much higher than 8 km, but a stony asteroid of that size would fragment at or near an altitude of 8 km. Recovery of large asteroid fragments is difficult due to the area's boggy soil; however, small, glassy fragments were recovered and are believed to be melted and resolidified pieces of the asteroid.

6. Which of the following phrases best describes the major point of difference between the 2 scientists' hypotheses?
   F. The location of the event
   G. The speed the object was traveling
   H. The density of Earth's atmosphere
   J. The type of object that entered Earth's atmosphere

7. According to Scientist 2's viewpoint, compared to the altitude at which a stony asteroid would have exploded in Earth's atmosphere, a comet of similar size would most likely have exploded at:
   A. the same altitude.
   B. a higher altitude.
   C. a slightly lower altitude.
   D. a much lower altitude.

8. Scientist 1's viewpoint indicates that when the materials that compose most of a comet are sufficiently heated, they change to:
   F. solids.
   G. gases.
   H. liquids.
   J. a vacuum.

9. Which of the following statements best describes how Scientist 2 would explain why no large, identifiable fragments of the object have been recovered?
   A. Any large, identifiable fragments that reached the ground have been removed from the area by erosion.
   B. Any large, identifiable fragments were thrown hundreds of kilometers from the site.
   C. No large, identifiable fragments of the object reached the ground.
   D. No large, identifiable fragments of the object have been recovered due to the soil conditions in the area.

10. How would the behavior of the asteroid differ from that described in Scientist 2's viewpoint if the asteroid had not been flattened by the air pressure difference? The asteroid would:

   F. not have entered Earth's atmosphere.
   G. have struck another planet in the solar system.
   H. have decelerated more gradually.
   J. have frozen.

11. Which of the following statements would both scientists most likely use to explain the damage to the forest caused by the object's explosion? Energy from the explosion:

   A. traveled rapidly down to Earth's surface.
   B. dissipated in the upper atmosphere.
   C. was released less than 1 km above Earth's surface.
   D. was released as the object struck Earth's surface.

12. Scientist 1's viewpoint would be *weakened* by which of the following observations about comets, if true?

   F. Comets are composed mainly of frozen materials.
   G. Comets are much larger than 100 m in diameter.
   H. Comets often pass close enough to Earth to intersect Earth's atmosphere.
   J. Comets orbit the Sun.

Passage III

The seeds of some plants attract ants with a nutritious structure called an *elaiosome*. The ants carry the seeds to their nests, eat the elaiosomes, and then leave the seeds in a waste pile, where some seeds *germinate* (begin to grow). Three studies were conducted to examine this process.

Study 1

For 2 plant species (A and B), seed mass per seed in milligrams (mg), elaiosome mass per seed (mg), and percentage of seed mass composed of elaiosome were recorded (see Table 1).

	Table 1		
Species	Seed mass (mg)	Elaiosome mass per seed (mg)	Percentage of seed mass composed of elaiosome
A	6.8	0.420	6.2
B	14.9	0.924	6.2

Study 2

Three study sites were established in order to determine the rate of seed collection by a single species of ant for the plants used in Study 1. In Site 1, Species A plants were absent; in Site 2, Species B plants were absent. Both plants were absent in Site 3.

Two seed dishes were placed in each site: 1 containing 20 Species A seeds and 1 containing 20 Species B seeds. The dishes were left out for 48 hours and the number of seeds taken from each dish was recorded. The results appear in Table 2.

	Table 2		
	Plant species absent	Number of seeds removed from seed dishes containing:	
Site		Species A	Species B
1	A	13	3
2	B	2	12
3	A and B	8	9

Tables 1 and 2 adapted from Brent H. Smith et al., "Frequency-Dependent Seed Dispersal by Ants of Two Deciduous Forest Herbs." ©1989 by the Ecological Society of America.

Study 3

The researchers planted 2,550 seeds from a third species, Species C. They also observed 2,550 Species C seeds that were planted by ants in similar environments. All seeds were observed for 2 years. Table 3 presents the results.

	Table 3	
	Results from:	
Maturation of Species C seeds	hand-planted seeds	ant-planted seeds
Seeds that germinated	26	39
Plants alive after 1 year	9	20
Plants alive after 2 years	4	13
Seeds produced per plant after 2 years	2,187	2,163

Table 3 adapted from Frances M. Hanzawa, Andrew J. Beattie, and David C. Culver, "Directed Dispersal: Demographic Analysis of an Ant-Seed Mutualism." ©1988 by The University of Chicago.

13. Based on the results of Study 3, one could generalize that compared to hand-planting of seeds, ant-planting of seeds results in:

A. increased seed germination.
B. increased seed production per plant.
C. decreased plant survival after 1 year.
D. decreased plant survival after 2 years.

14. Which of the following variables was controlled in the design of Study 2 ?

F. The number of ants in each site
G. The number of seed dishes placed in each site
H. The mass of the elaiosome of each seed
J. The type of seeds taken by the ants in each site

15. According to the results of the studies, Species A and Species B are most similar in that their:

A. seed masses are the same.
B. germination rates on ant waste piles are the same.
C. percentages of elaiosome mass per seed are the same.
D. rates of production of seeds after 1 year are the same.

16. In Study 2, Site 3 was used to study the:

    F. preference of a different ant species for the seeds of both plant species.

    G. seed preference of ants in an area in which both plant species were absent.

    H. growth and survival of both plant species in an area where ants were not present.

    J. effects of elaiosome mass on the seed preference of ants.

17. Which of the following is a weakness of the design of Study 2 ?

    A. Some plants were not present at each site.

    B. Some seeds were not present at each site.

    C. The seeds may have been removed from the dishes by animals other than ants.

    D. The plants may have been eaten by animals other than ants.

18. The results of Study 2 suggest that which of the following factors most affects the seed preference of ants?

    F. Seed mass

    G. Elaiosome mass

    H. Percentage of seed mass composed of elaiosome

    J. Abundance of a plant in a given area

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Passage IV

Some students conducted experiments using different brands of adhesive tape, one kind each of paper and plastic, a board, and a spring scale.

Experiment 1

A student stuck one end of a piece of tape onto the edge of a board that was wrapped with paper. The other end of the tape was clamped to a spring scale, as shown in Figure 1.
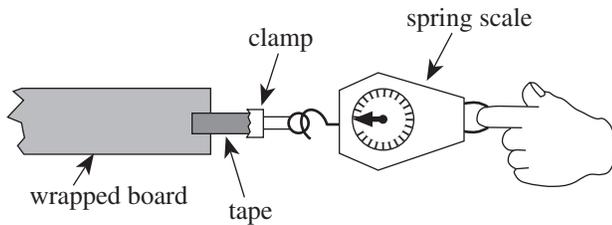

Figure 1

While one student held the board, a second student pulled the spring scale until the tape came off the paper wrapping; a third student recorded the force in newtons, N, indicated on the spring scale at the moment the tape came off the paper wrapping.

The procedure was repeated for 3 different brands of tape; each brand of tape came in many different widths, of which 2 or 3 were tested. The results are shown in Table 1.

Tape brand	Tape width (cm)	Force (N) to remove tape:			
		Trial 1	Trial 2	Trial 3	Average
X	1.0 2.0 3.0	1.6 3.9 6.0	1.9 3.7 5.6	2.2 4.1 5.8	1.9 3.9 5.8
Y	2.0 2.5	4.0 5.4	4.5 5.1	4.3 5.7	4.3 5.4
Z	1.0 2.0	2.2 4.1	1.6 3.9	1.8 3.6	1.9 3.9

Table 1

Experiment 2

The students performed an experiment similar to Experiment 1, except that the paper wrapping was replaced by a plastic wrapping. The results are shown in Table 2.

Tape brand	Tape width (cm)	Force (N) to remove tape:			
		Trial 1	Trial 2	Trial 3	Average
X	1.0 2.0 3.0	1.7 3.2 5.0	1.5 3.2 5.0	1.6 3.3 5.1	1.6 3.2 5.0
Y	2.0 2.5	4.3 5.5	4.3 5.4	4.3 5.4	4.3 5.4
Z	1.5	2.8	2.8	2.9	2.8

Table 2

19. The results of the 2 experiments support the conclusion that, for a given brand of tape, as the tape's width increases, the force required to remove the tape from a given wrapping:

A. increases only.
B. decreases only.
C. remains constant.
D. varies, but with no particular trend.

20. In Experiment 2, had Brand X tape in a 4.0 cm width been tested, the force required to remove the tape from the plastic wrapping would have been closest to:

F. 5.0 N.
G. 7.0 N.
H. 9.0 N.
J. 11.0 N.

21. Based on the average results of Experiments 1 and 2, which of the following brands of tape adhered better to the paper than to the plastic?

A. Brand X
B. Brand Y
C. Brands X and Y
D. Brands Y and Z

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22. Which brand(s) of tape was/were used at only 2 different widths in both experiments?

   F. Brand X only
   G. Brand Y only
   H. Brand Z only
   J. Brands Y and Z only

23. For the students to determine the force required to remove tape from a wrapping, which of the following attractive forces had to exceed the adhesive force between the tape and the wrapping?

   A. The force between the clamp and the tape
   B. The force between the clamp and the paper or plastic wrapping
   C. The force between the Earth and the wrapping
   D. The force between the Earth and the tape

24. The students' instructor gave them a strip of tape that was 2.5 cm wide and asked them to identify the brand. The students repeated the procedures from Experiments 1 and 2 using the tape and obtained average forces of 4.9 N for paper and 4.1 N for plastic. Which of the following brands would most likely have produced these results?

   F. Brand X only
   G. Brand Y only
   H. Brands X and Y only
   J. Brands Y and Z only

Passage V

Researchers conducted an experiment to determine the factors affecting heat flow. In each trial, one or more blocks of a particular material was (were) placed between two walls at constant temperatures T_1 and T_2 in one of the configurations shown in Figure 1. Heat was transferred through the block(s) from the hotter wall to the cooler wall. This heat flow, measured in joules per second (J/sec), is shown in Table 1.

(Note: All blocks used in the experiment were identical in size and shape. In each configuration, the *contact area* was the surface area of the end of the block(s) against one wall.)

Configuration A   Configuration B

Configuration C   Configuration D
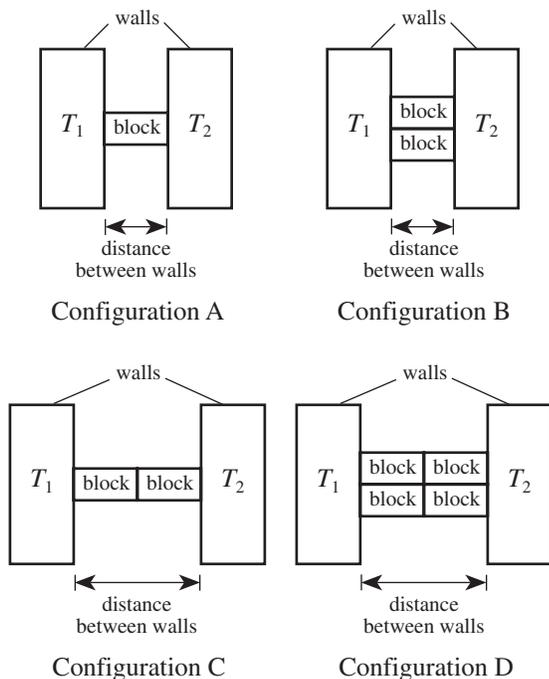
Figure 1

Trial	Block material	Configuration	T_1 (°C)	T_2 (°C)	Heat flow (J/sec)
1	glass wool	A	50	20	0.025
2	glass wool	B	50	20	0.050
3	glass wool	C	50	20	0.013
4	glass wool	D	50	20	0.025
5	glass wool	A	100	70	0.025
6	glass wool	A	20	50	0.025
7	wood	A	50	20	0.072
8	brick	A	50	20	0.500
9	concrete	A	50	20	0.540
10	steel	A	50	20	31
11	aluminum	A	50	20	140
12	aluminum	A	60	20	190
13	aluminum	A	70	20	240

Table 1

25. According to the information provided, heat flowed from the wall at temperature T_2 to the wall at temperature T_1 in which trial?

A. Trial 4
B. Trial 6
C. Trial 10
D. Trial 12

26. *Insulators* are materials that are poor heat conductors. According to Trials 7 through 10, a wall of a given thickness built of which of the following materials would provide the best insulation between a room and the outdoors?

F. Wood
G. Brick
H. Concrete
J. Steel

27. The results of Trials 1 and 5 are consistent with the hypothesis that heat flow from a hotter wall to a cooler wall is dependent on the:

A. temperature of the hotter wall only.
B. temperature of the cooler wall only.
C. sum of the wall temperatures.
D. difference between the wall temperatures.

28. Materials differ in their *thermal conductivities*: the higher the thermal conductivity, the greater the heat flow through the material. According to Trials 6 through 11, which of the following statements about relative thermal conductivities is NOT true?

F. Brick has a higher thermal conductivity than glass wool.
G. Brick has a higher thermal conductivity than wood.
H. Steel has a higher thermal conductivity than aluminum.
J. Steel has a higher thermal conductivity than concrete.

○   ○   ○   ○   ○   ○   ○   ○   ○

29. Trials 1 and 3 provide evidence that heat flow depends on which of the following factors?

    A. Distance between walls
    B. Contact area
    C. Temperature of the hotter wall
    D. Temperature of the cooler wall

Passage VI

Flameless ration heaters (FRHs) are used by combat soldiers to heat their meals in the field. The heat is produced when magnesium reacts with water:

$$Mg(s) + 2H_2O(l) \rightarrow Mg(OH)_2(s) + H_2(g) + heat$$
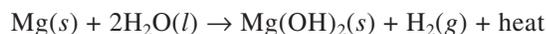
The rate of the reaction increases in the presence of iron (Fe) and sodium chloride (NaCl). The following experiments were done to determine how to design FRHs.

Experiment 1

A 1.0-mole (mol) piece of Mg ribbon, 0.10 mol of Fe powder, and 0.10 mol of NaCl were added to 25 mL of H_2O at 20°C in an insulated container. The mixture was stirred constantly and its temperature was measured every 50 sec. The experiment was repeated with Mg ribbon cut into 100 pieces and with Mg powder (see Figure 1).
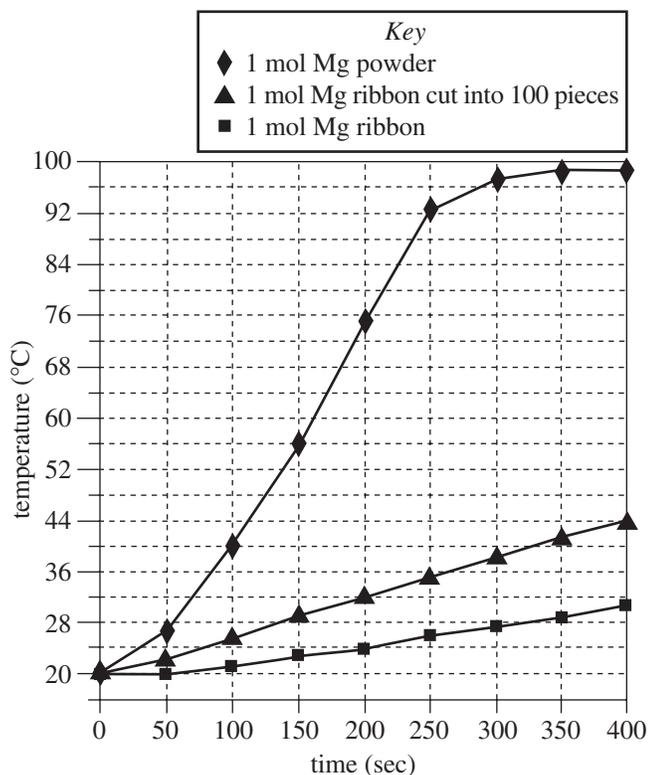
Experiment 2

Powdered Mg (0.10 mol) was mixed with 0.10 mol of NaCl. The mixture was added to 100 mL of H_2O at 20°C in an insulated container. The mixture was stirred constantly and the maximum temperature increase that occurred within 15 min was recorded. The procedure was repeated with different amounts of Fe powder added to each mixture (see Table 1).

Table 1	
Fe added (mol)	Maximum temperature increase (°C)
0	4
0.10	23
0.20	34
0.30	44
0.40	55
0.50	66
0.60	66
0.70	66

Experiment 3

Powdered Mg (0.10 mol) was mixed with 0.50 mol of Fe powder and added to 100 mL of H_2O at 20°C in an insulated container. The mixture was stirred constantly and the maximum temperature increase that occurred within 15 min was recorded. The procedure was repeated with different amounts of NaCl (see Table 2).

Table 2	
NaCl added (mol)	Maximum temperature increase (°C)
0	0
0.025	19
0.050	34
0.075	50
0.100	66
0.125	82*

*Solution was boiling.

Key
- ♦ 1 mol Mg powder
- ▲ 1 mol Mg ribbon cut into 100 pieces
- ■ 1 mol Mg ribbon

Figure 1

30. Which of the following is the most likely reason that amounts greater than 0.125 mol of NaCl were not tested in Experiment 3 ? The results showed that:

- **F.** adding more NaCl no longer increased the reaction rate.
- **G.** adding more NaCl would decrease the reaction rate.
- **H.** the boiling point was reached, so no further data could be gathered with this procedure.
- **J.** more Fe would need to be added for any greater increase in temperature to occur.

31. Based on the results of Experiment 3, one can reasonably conclude that as the amount of NaCl added increased from 0 mol to 0.100 mol, the maximum rise in temperature within 15 min of the start of the reaction:

- **A.** increased only.
- **B.** increased, then stayed the same.
- **C.** decreased only.
- **D.** decreased, then stayed the same.

32. If a trial had been done in Experiment 3 with 0.060 mol of NaCl added, the maximum temperature increase of the mixture that would have occurred within 15 min would have been closest to:

- **F.** 34°C.
- **G.** 42°C.
- **H.** 50°C.
- **J.** 62°C.

33. Which of the following factors affecting the reaction of Mg and H_2O was studied in Experiment 1, but not in Experiments 2 or 3 ?

- **A.** Reaction temperature
- **B.** Addition of NaCl
- **C.** Addition of Fe
- **D.** Surface area of Mg

34. An engineer is designing an FRH, to be used with 100 mL of H_2O, that will most rapidly generate the greatest amount of heat with the *least* amount of materials. Based on the results of Experiments 1, 2, and 3, which of the following specifications should she choose?

- **F.** 0.50 mol Fe powder, 0.125 mol NaCl, and 0.10 mol of Mg powder
- **G.** 0.50 mol Fe powder, 0.125 mol NaCl, and 0.10 mol of Mg ribbon
- **H.** 0.70 mol Fe powder, 0.125 mol NaCl, and 0.10 mol of Mg powder
- **J.** 0.70 mol Fe powder, 0.125 mol NaCl, and 0.10 mol of Mg ribbon

35. It has been observed that as Mg and H_2O react, the $Mg(OH)_2$ (magnesium hydroxide) that is produced forms an unreactive coating on the Mg surface. Which of the following models for why NaCl speeds up the reaction is most consistent with this observation and the results of the experiments?

- **A.** NaCl absorbs heat produced in the reaction, causing the $Mg(OH)_2$ to melt off of the Mg surface.
- **B.** NaCl binds with Fe to inhibit the reaction of Mg with H_2O.
- **C.** NaCl reacts with $Mg(OH)_2$ to form a stronger barrier against H_2O.
- **D.** NaCl reacts with $Mg(OH)_2$, removing the coating from the Mg, allowing more contact with H_2O.

Passage VII

Enzymes are large protein molecules that increase the rate of chemical reactions in living systems. The *substrate* is the substance that interacts with the enzyme in a reaction. The *acceleration factor* is the factor by which the enzyme increases the rate of a reaction. Figures 1–3 show the effects that changes in temperature, pH, and substrate concentration have on the rate of reaction of a substrate when Enzymes A and B are present. Figure 4 shows the effects that changes in the concentrations of Enzymes A and B have on the rates of reaction in substrate solutions of the same concentration.
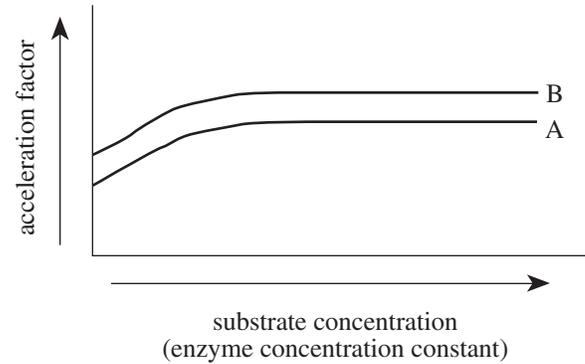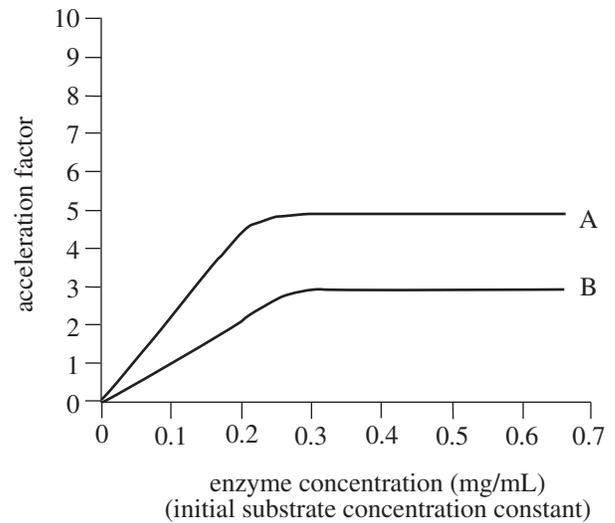

Figure 3
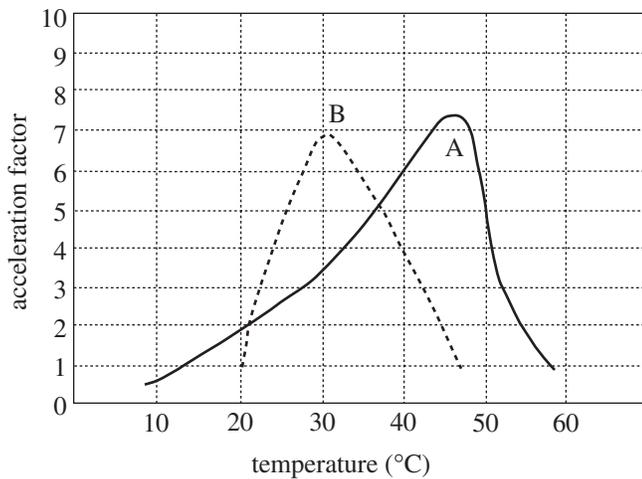
Figure 1

Figure 4

Figures adapted from Carl M. Raab, *Reviewing Biology.* ©1987 by Amsco School Publications, Inc.

Figure 2

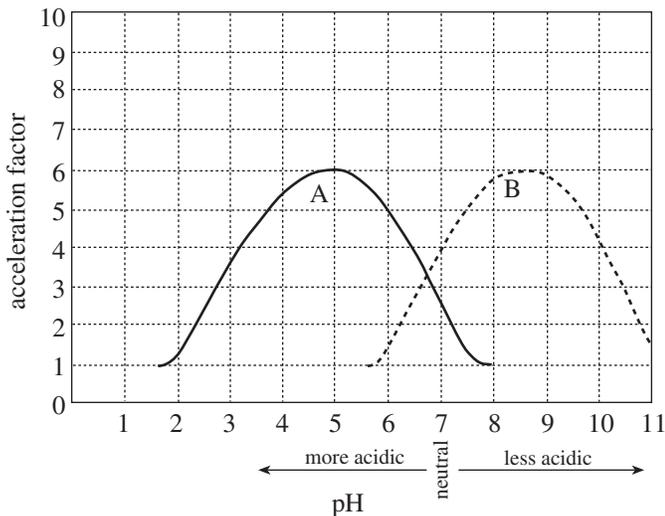**36.** According to Figure 2, Enzyme A has the fastest rate of reaction at a pH closest to:

F. 5.
G. 6.
H. 8.
J. 9.

37. Based on the data in Figure 2, at which of the following pHs, if any, do Enzymes A and B have the same acceleration factor?

A. At pH 5 only
B. At pH 6.7 only
C. At all pHs between 2 and 11
**D.** At none of the pHs shown in the figure

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38. A scientist claims that the acceleration factor of Enzyme B is dependent on both enzyme and substrate concentration. Do the data in Figures 3 and 4 support her claim?

   F. No; the acceleration factor is dependent on enzyme concentration, but not on substrate concentration.
   G. No; the acceleration factor is not dependent on either enzyme or substrate concentration.
   H. Yes; the acceleration factor is dependent on enzyme concentration, but not on substrate concentration.
   J. Yes; the acceleration factor is dependent on both enzyme and substrate concentration.

39. A scientist claims that for the conditions used to obtain the data for Figure 4, the acceleration factor of Enzyme B at a given concentration will always be greater than that of Enzyme A at the same concentration. Do the data support his conclusion?

   A. No; Enzyme B shows a lower acceleration factor at all the enzyme concentrations tested.
   B. No; Enzyme B shows a lower acceleration factor at all the substrate concentrations tested.
   C. Yes; Enzyme B shows a higher acceleration factor at all the enzyme concentrations tested.
   D. Yes; Enzyme B shows a higher acceleration factor at all the substrate concentrations tested.

40. The figure below shows the relative acceleration factors for *pepsin*, an enzyme found in the stomach, and *trypsin*, an enzyme found in the small intestine.
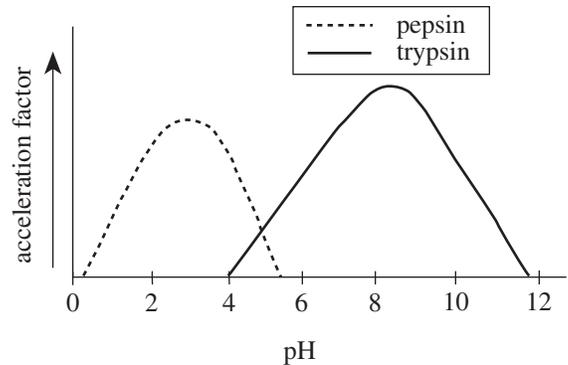
Based on this figure and Figure 2, one would best conclude that compared to the acidity of solutions in the stomach, the solutions in the small intestine are:

   F. more acidic.
   G. less acidic.
   H. equally acidic.
   J. less acidic for pepsin, but more acidic for trypsin.

END OF TEST 4
STOP! DO NOT RETURN TO ANY OTHER TEST.