

## Form 68A

(December 2009)



2009 | 2010

In response to your recent request for Test Information Release materials, this booklet contains the test questions and conversion tables used in determining your ACT scores. Enclosed with this booklet is a report listing your answers to the ACT multiple-choice tests and the answer key.

If you wish to order a photocopy of your answer document—including, if you took the Writing Test, a copy of your written essay—please use the order form on the inside back cover of this booklet.

We hope that you will find this information helpful.

## **Useful Links:**

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- ✓ **ACT Math Tests:** <http://www.crackact.com/act/math/>
- ✓ **ACT Reading Tests:** <http://www.crackact.com/act/reading/>
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## ENGLISH TEST

45 Minutes—75 Questions

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

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

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

## PASSAGE I

*The Tale of Genji*

Murasaki Shikibu, an aristocratic Japanese woman  
1 was born in Kyoto, Japan, around AD 973. Like most  
ladies of that period who served in the court of the  
2 empress, Lady Murasaki was likely accomplished in  
both music and writing. However, her writing was not  
limited to the traditional poetry was expected of cultured  
3 women of that time. She wrote a long work of fiction,

*The Tale of Genji*, which not only is still read today and  
4 has been called the world's first great novel.

Although little is known of the events of her life,  
5 but scholars speculate that Lady Murasaki began writing  
her fiction before she came into the service of the  
Empress Akiko. Since the "grand ladies" of the court  
thought literature important, perhaps Murasaki's  
writing was the reason she was summoned to court.

Instead, she completed most of the stories of  
6 the life of Genji while both serving the empress

1. A. NO CHANGE  
B. Shikibu an aristocratic Japanese woman,  
C. Shikibu, an aristocratic Japanese woman,  
D. Shikibu an aristocratic Japanese woman
2. F. NO CHANGE  
G. that they were serving  
H. which served  
J. served
3. A. NO CHANGE  
B. expected  
C. expecting  
D. that expected
4. F. NO CHANGE  
G. while  
H. but also  
J. so it
5. A. NO CHANGE  
B. While little  
C. Even though little  
D. Little
6. Which transition word or phrase best emphasizes the limited knowledge scholars have about Lady Murasaki?  
F. NO CHANGE  
G. Apparently,  
H. On the other hand,  
J. Likewise,



and observed the activities and attitudes of court society.

7

The fifty-four-chapter book,

which takes place over almost three-quarters of a century,

8

describes the life and loves of a Prince Genji and the

lives of there children and grandchildren. Although other  
9  
fiction was written during this period, Murasaki's work  
went beyond the usual style. Instead of using the flat  
characterizations and fairy-tale predicaments of the typical  
romance, Murasaki portrayed believable people in daily  
situations. Recent critics have been astonished at the  
modern character of the tale.

In the more than one thousand years since

10

*The Tale of Genji* was written, it has been translated  
into over thirty languages and has appeared in a  
variety of formats. In the twelfth century, the tale  
was illustrated with picture scrolls; in the  
seventeenth century, books of wood-block prints

11

based on the tale was produced.

12

13 Today, Lady Murasaki's eleventh-century  
tale can even be read online at a Web site provided

7. A. NO CHANGE  
B. had observed  
C. was observing  
D. observing

8. If the writer were to delete the underlined portion, the paragraph would primarily lose:  
F. a detailed description of the setting of the book.  
G. a sense of the length of time the book's events span.  
H. information about the specific length of each character's life.  
J. a tone of mystery and suspense.

9. A. NO CHANGE  
B. our  
C. his  
D. DELETE the underlined portion.

10. F. NO CHANGE  
G. thousand years, since  
H. thousand, years since  
J. thousand years since,

11. A. NO CHANGE  
B. century, books of wood-block prints,  
C. century books, of wood-block prints  
D. century books of wood-block prints,

12. F. NO CHANGE  
G. is  
H. were  
J. are

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

It is also known that Lady Murasaki's name Shikibu was most likely based on her father's court position in the Bureau of Ceremony, or *shikibu-shō*.

Should the writer make this addition here?

- A. Yes, because it adds relevant information about Lady Murasaki's name that helps modern readers understand this paragraph.  
B. Yes, because it shows an additional way that Lady Murasaki was connected to the court.  
C. No, because it interrupts the flow of this paragraph, which is not primarily about Lady Murasaki's background.  
D. No, because it doesn't provide enough information about Lady Murasaki's father.

**GO ON TO THE NEXT PAGE.**

1

1

by the United Nations Educational, Scientific, and Cultural Organization. 14

14. Given that all the following statements are true, which one, if added here, would most effectively conclude the paragraph and support information given in the preceding sentence?
- F. Lady Murasaki's tale is still rather interesting.
  - G. Lady Murasaki had to write by hand with a pen dipped in ink.
  - H. The character of Prince Genji was probably based on several people known by Lady Murasaki.
  - J. Prince Genji is starting his second millennium with the latest technology.

Question 15 asks about the preceding passage as a whole.

15. Suppose that the writer had intended to write an essay giving an overview of the history of the development of the novel as a literary form. Would this essay accomplish that goal?
- A. Yes, because it discusses the elements of *The Tale of Genji* that make it a novel.
  - B. Yes, because it notes that *The Tale of Genji* was written over one thousand years ago.
  - C. No, because it fails to mention other novels written by Lady Murasaki.
  - D. No, because it focuses only on *The Tale of Genji*, an example of an early novel.

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## PASSAGE II

### Stars in His Eyes

Some people are starstruck at an early age, but one  
  <sup>16</sup>

such person is Neil de Grasse Tyson, whom turned his  
  <sup>17</sup>  
fascination for the star-studded sky into a career. By the

age of nine, with the knowledge that he wanted to spend  
  <sup>18</sup>  
his life exploring the universe. Today, Tyson is a  
prominent astrophysicist, writer, and educator. He is  
also the youngest person and the first African American  
to direct New York City's Hayden Planetarium.

16. F. NO CHANGE  
G. age, so one  
H. age. As a result, one  
J. age. One

17. A. NO CHANGE  
B. he  
C. who  
D. which

18. F. NO CHANGE  
G. he knew  
H. having the knowledge  
J. knowing



In his memoir, *The Sky Is Not the Limit*, Tyson tells the story of how he was first captivated by the cosmos. A close friend from his Bronx, New York, neighborhood took him to the rooftop of a building, there <sup>19</sup> Tyson was told to look up into the night sky. Through a simple pair of binoculars, Tyson viewed the Moon as an exciting new three-dimensional world that <sup>20</sup> astounded him. From that

point on, his interest in becoming a scientist was set.

<sup>21</sup>

[1] In junior high, Tyson bought his first telescope <sup>22</sup> with money he had earned walking his neighbors' dogs. [2] To further prepare for his future career, he

joined astronomy clubs, took extra mathematics courses, <sup>23</sup> and spent many hours looking up at the star-filled dome inside the planetarium that he now oversees. [3] While earning university degrees in both physics and astrophysics, he worked as a columnist for *StarDate*, an astronomy magazine. [4] In 1988, he published the first of his numerous books on astronomy and astrophysics. [5] Soon after he was appointed director of the Hayden Planetarium in 1996, Tyson spearheaded a seventy-million-dollar reconstruction project. [6] Under his leadership, the New York City landmark was transformed, one at a time, <sup>24</sup> into a high-tech glass-and-steel wonder.

19. A. NO CHANGE  
B. building and told Tyson  
C. building, then Tyson was told  
D. building, momentarily, Tyson was told
20. Given that all the choices are true, which one provides the most specific visual details of what Tyson saw?  
F. NO CHANGE  
G. world, which he later described in detail in his book.  
H. world of craters, mountains, and plains.  
J. world of remarkable features unlike those visible to the naked eye.
21. Which of the following alternatives to the underlined portion would NOT be acceptable?  
A. point,  
B. point ahead,  
C. point forward,  
D. point onward,
22. Which of the following alternatives to the underlined portion would NOT be acceptable?  
F. a telescope, his first one,  
G. himself his first telescope  
H. his first telescope for him  
J. a telescope—his first—
23. Given that all the choices are true, which one most effectively provides new and specific information?  
A. NO CHANGE  
B. joined clubs, took classes,  
C. showed an interest in astronomy  
D. made a point of learning relevant information
24. F. NO CHANGE  
G. transformed, for instance,  
H. transformed, before you know it,  
J. transformed

1



1

[7] Visitors to the planetarium's Space Theater can now view the marvels of the cosmos through a dramatic <sup>25</sup>

virtual tour. <sup>26</sup>

Tyson recognizes the possibilities of his <sup>27</sup>

position he always makes himself available to <sup>28</sup>  
children who visit the planetarium. Committed to  
being a leader in the field of science education, he  
has achieved what for many would be a dream come true. <sup>29</sup>

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

- A. a spectacular
- B. a striking
- C. an overemotional
- D. a sensational

26. The writer wants to divide the preceding paragraph into two in order to separate information about Tyson's background and early accomplishments in science from information about his work with the Hayden Planetarium. The best place to begin the new paragraph would be at the beginning of Sentence:

- F. 3.
- G. 4.
- H. 5.
- J. 6.

27. A. NO CHANGE  
B. possesses the recognition of  
C. acknowledges the recognition of  
D. has recognition and awareness of

28. F. NO CHANGE  
G. position and  
H. position, which he  
J. position, for which he

29. The writer would like to end the essay by offering a sense of Tyson's passion for astronomy and his desire to see others succeed. Given that all the choices are true, which one best accomplishes the writer's goal?

- A. NO CHANGE
- B. is knowledgeable about star formation, dwarf galaxies, and the structure of the Milky Way.
- C. has an important message for everyone he meets: "Reach for the stars."
- D. knows more about the night sky now than he did when he first looked at the Moon through binoculars.

Question 30 asks about the preceding passage as a whole.

30. Suppose the writer's goal had been to write a brief essay describing a prominent astrophysicist. Would this essay accomplish that goal?

- F. Yes, because it explains that Tyson reluctantly chose a career in astrophysics by following in the path of his best friend.
- G. Yes, because it offers a profile of a well-known astrophysicist who became the head of the Hayden Planetarium.
- H. No, because it focuses on the importance of astrophysics to children who visit the Hayden Planetarium.
- J. No, because it provides more information about Tyson's family life than about his career in astrophysics.

## PASSAGE III

The following paragraphs may or may not be in the most logical order. Each paragraph is numbered in brackets, and question 45 will ask you to choose where Paragraph 1 should most logically be placed.

## The Three Sisters

[1]

Three plants together known collectively  
31

as the “Three Sisters” have long been an important  
32 source of sustenance for many Native American  
nations. Being experienced and effective horticulturists,  
it was indigenous peoples who knew that planting  
33 corn, beans, and squash together made good nutritional  
and agricultural sense.

[2]

The technique is ingenious. Several kernels of corn are planted in a circle in a hill of soil. 34 When the corn is about six inches high, pole bean and squash seeds are planted around the young stalks. As the three plants grow,

the corn stalks support the bean tendrils, while the beans  
35 fix nitrogen in the soil, which fertilizes the corn. The broad leaves of the squash plants provide shade for the other two plants’ root systems and help retain soil  
36 moisture while discouraging weed growth.

31. A. NO CHANGE  
B. known together and  
C. known together  
D. known
32. F. NO CHANGE  
G. has been for a long time  
H. was for a long time  
J. has long been
33. A. NO CHANGE  
B. indigenous peoples knew  
C. it was known by indigenous peoples  
D. the knowledge was possessed by indigenous peoples
34. If the writer were to delete the preceding sentence, this paragraph would primarily lose information that:  
F. illustrates how the Three Sisters benefit each other.  
G. provides unnecessary details about the planting of corn.  
H. identifies the first step in planting the Three Sisters.  
J. proves that corn is the most important of the Three Sisters.
35. A. NO CHANGE  
B. tendrils. While  
C. tendrils; while  
D. tendrils,
36. F. NO CHANGE  
G. plant’s root system’s  
H. plants’ root system’s  
J. plant’s root systems



[3]

Eaten together, the three foods provide balanced nutrition. Corn, in particular, is high in carbohydrates. Although corn and beans are both good sources of protein, each food provides two essential amino acids that the other lacks. Squash yields both vitamins from the fruit and healthful, delicious oil from the seeds is yielded also.

37

[4]

Equally and equivalently important is the

38

moral lesson that the Three Sisters impart.

39

Many Native peoples see the three plants as

a model of cooperation and harmony, each

40

plant benefiting from their growth.

41

What the early horticulturists knew, the  
three grow best when they grow together. Many  
tribes have legends of three intertwined sisters  
who can never be parted, siblings who live together,  
eat together, and celebrate together. At harvesttime,

42

43

37. A. NO CHANGE  
B. is also yielded.  
C. is yielded.  
D. DELETE the underlined portion and end the sentence with a period.
38. F. NO CHANGE  
G. important  
H. important, that is, of equal weight,  
J. important and key
39. At this point, the writer is considering adding the following true statement:  
The name Three Sisters has also been used to refer to a range of mountains in the Canadian Rockies.  
Should the writer make this addition here?  
A. Yes, because the concept of the Three Sisters is a central theme of the essay, and this statement elaborates on that theme.  
B. Yes, because the names of crops and the names of mountains both evoke a sense of the importance of nature in our daily lives.  
C. No, because it does not explain why the mountains are known as the Three Sisters, which readers would want to know.  
D. No, because it distracts the reader from the focus of the essay and does not logically fit into the essay at this point.
40. F. NO CHANGE  
G. cooperation and harmonious,  
H. cooperative and harmonious,  
J. being cooperative and harmony,
41. A. NO CHANGE  
B. its  
C. his or her  
D. the others'
42. F. NO CHANGE  
G. Which  
H. How  
J. As
43. A. NO CHANGE  
B. whom can never be parted, siblings whom  
C. who can never be parted, siblings whom  
D. whom can never be parted, siblings who

1 [REDACTED]

ceremonies are held to thank the sisters for growing abundantly and feeding the people.

[5]

**44** And as sustainable agriculture becomes more widely recognized as a necessity, the Three Sisters provide one example of how food can be grown with very little strain on natural resources—an ecosystem of plants that thrive when they are grown together.

44. Which of the following true statements, if added here, would most effectively introduce the subject that some modern gardeners are using the planting technique described in the essay?

- F. The idea of planting several types of plants near each other is strange to some modern-day gardeners.
- G. Many gardeners are discovering the benefits of this sort of companion planting, as it is sometimes known.
- H. People who enjoy gardening often also enjoy talking about their gardens and showing their gardens to friends.
- J. Gardening is an activity that can be enjoyed by many types of people, young and old, male and female.

Question 45 asks about the preceding passage as a whole.

45. For the sake of the logic and coherence of the essay, Paragraph 1 should be placed:

- A. where it is now.
- B. after Paragraph 2.
- C. after Paragraph 3.
- D. after Paragraph 4.

#### PASSAGE IV

The following paragraphs may or may not be in the most logical order. Each paragraph is numbered in brackets, and question 59 will ask you to choose where Paragraph 4 should most logically be placed.

#### “Operation Vittles”

[1]

It was 1948. A humanitarian and political drama

<sup>46</sup>

of lasting importance was about to unfold under

<sup>47</sup>

46. F. NO CHANGE  
G. 1948, a  
H. 1948, for a  
J. 1948; but a

47. Which of the following alternatives to the underlined word would be LEAST acceptable?

- A. take place
- B. show up
- C. be played out
- D. occur



the homely name "Operation Vittles." [48]

[2]

Since the end of World War II three years earlier, the victorious Allies had divided defeated Germany into four sectors. The United States, Great Britain, and France had combined their portions into West Germany, while the Soviet Union had installed a separate government in East Germany.<sup>49</sup>

[3]

Berlin—the capital of Germany, was similarly<sup>50</sup>

divided into four sectors. However, the city's location<sup>51</sup> deep inside East Germany gave a strategic advantage to Soviet leader Joseph Stalin, who wanted control over the entire city, not just the one Soviet sector.

Stalin planned to use a tactic of warfare dating back to medieval times. He cut off all ground access into West Berlin—the part of the city he did not already control.<sup>52</sup> Threatening to starve the 2.5 million residents of West

Berlin he thought,<sup>53</sup> might force the other three countries to cede the whole city to him.

[4]

Stalin's siege might have been successful in an era of castles and knights. But this was the aeronautical age, and Stalin's antagonists on ground transportation<sup>54</sup> did not have to rely to move food and supplies into West Berlin.

48. At this point, if the writer wished to emphasize the massive effort put forth in this undertaking, which of the following true statements would best accomplish that goal?
- F. U.S. President Harry Truman made the decision to carry out this operation, which was led by General William Turner.
  - G. Planes flew into Berlin from West Germany at regular intervals throughout each day.
  - H. Humanitarian work often goes unnoticed, even though it saves thousands of lives every year in many countries throughout the world.
  - J. Before the operation was over, hundreds of planes and thousands of soldiers would deliver millions of pounds of food to people in need.
49. Which of the following alternatives to the underlined portion would NOT be acceptable?
- A. Germany; on the other hand, the Soviet Union
  - B. Germany; the Soviet Union, for example,
  - C. Germany, but the Soviet Union
  - D. Germany; the Soviet Union, in contrast,
50. F. NO CHANGE  
G. Berlin, the capital of Germany,  
H. Berlin, the capital of Germany—  
J. Berlin the capital of Germany
51. A. NO CHANGE  
B. city's location,  
C. cities' location  
D. cities' location,
52. Given that all the choices are true, which one would be the best transition between the first and last parts of this paragraph?
- F. NO CHANGE
  - G. had met with leaders of the United States and Britain to divide the postwar world.
  - H. first came to power when he became secretary general of the Communist Party in 1922.
  - J. adopted the name "Stalin," which means "Man of Steel," when he was a young revolutionary.
53. A. NO CHANGE  
B. Berlin, he thought  
C. Berlin he thought  
D. Berlin, he thought,
54. The best placement for the underlined portion would be:
- F. where it is now.
  - G. after the word *rely*.
  - H. after the word *food*.
  - J. after the word *Berlin* (and before the period).

What resulted from this siege was one of the largest humanitarian efforts to date pilots who had bombed

55

Berlin relentless during the war were now called upon to deliver food—"vittles"—as part of the Berlin

56

Airlift. [57] "Operation Vittles" needed to operate around the clock, with a C-54 aircraft landing in Berlin every three minutes to keep the residents from starving. About 3,500 tons of food, medical supplies, and fuel arrived at Tempelhof Airfield daily.

[5]

The Soviets tried to thwart the operation by bugging and harassing pilots with blinding spotlights, near misses by Soviet planes, and radio interference. These tactics failed. After fifteen months, Stalin relented, the roads to West Berlin were reopened, and "Operation Vittles" came to a successful conclusion.

Questions 59 and 60 ask about the preceding passage as a whole.

59. For the sake of the logic and coherence of this essay, Paragraph 4 should be placed:

- A. where it is now.
- B. after Paragraph 1.
- C. after Paragraph 2.
- D. after Paragraph 5.

60. Suppose the writer had intended to write a brief essay focusing on the important humanitarian efforts during the period following World War II. Would this essay accomplish that goal?

- F. Yes, because it focuses on many humanitarian programs, which it succeeds in presenting as a representative group of such humanitarian efforts.
- G. Yes, because it focuses on one example of a humanitarian program that is described in detail and carefully linked to other humanitarian efforts that immediately followed World War II.
- H. No, because it focuses on only one example of a humanitarian program and neglects to treat it as representative of other post-World War II humanitarian efforts.
- J. No, because it devotes too much emphasis to World War II itself, rather than focusing on humanitarian efforts around that time.

1

1

## PASSAGE V

## Innovation and Prior Discoveries

The philosopher, John Stuart Mill wrote that “all good  
<sup>61</sup>

things which exist are the fruits of originality.” However,  
<sup>62</sup>

Mill probably also understood that the fact is that  
<sup>63</sup>  
 no human invention is absolutely original. Every  
 innovation—whether scientific or artistic—is  
 influenced by prior discoveries.

Albert Einstein is often considered the most  
 original scientist of the modern age. Therefore, he  
<sup>64</sup>  
 acknowledged his reliance on the work of others,  
 such as mathematician Emmy Noether—who herself  
 relied on prior discoveries. The mathematical  
 theorem that now bears her last name <sup>65</sup> helped

lie the foundation for quantum physics and allowed  
<sup>66</sup>  
 Einstein to formulate his theory of general relativity.

In literature, author Gertrude Stein epitomized  
 originality. Her writing initially shocked readers because  
 it departed from conventional grammar, storytelling, and  
 style. Stein separated words from their fixed meanings.  
 She used words not as representations of reality but

61. A. NO CHANGE  
 B. philosopher John Stuart Mill,  
 C. philosopher, John Stuart Mill,  
 D. philosopher John Stuart Mill
62. Which of the following alternatives to the underlined portion would NOT be acceptable?  
 F. Nevertheless,  
 G. On the other hand,  
 H. Instead,  
 J. Still,
63. A. NO CHANGE  
 B. it's a fact that  
 C. as a matter of fact  
 D. DELETE the underlined portion.
64. F. NO CHANGE  
 G. Even he, though,  
 H. In the meantime, he  
 J. He
65. At this point, the writer is considering adding the following true parenthetical information:  
 (known as Noether’s theorem)  
 Should the writer make this addition here?  
 A. Yes, because it supports the main point of this sentence.  
 B. Yes, because it offers evidence of Noether’s innovative thinking.  
 C. No, because it merely restates information already provided.  
 D. No, because it fails to note that the theorem is in the field of mathematics.
66. F. NO CHANGE  
 G. lay the foundation on  
 H. lie the foundation on  
 J. lay the foundation for



as pure forms, as if they were musical notes. Yet, as  
67

innovative as she was, borrowed from the world of  
68

visual art, particularly from the Cubist painters.  
69

Stein remarked, that she was doing in writing  
70  
what Pablo Picasso was doing in painting.

It's often difficult to trace an innovation as a single  
71  
origin. Modern peanut butter, with its smooth, creamy

texture and long shelf life, emerged in 1922 when  
72  
Joseph L. Rosefield began selling his peanut butters  
in California. However, George A. Bayle, Jr., sold a

peanut paste as early as 1890, and others are known to  
73  
have used ground or crushed peanuts centuries earlier.

Although Mill praised originality, his own work drew  
on that, of fellow utilitarian philosopher Jeremy Bentham.  
74  
Mill and Bentham both advocated striving for the greatest  
good for the greatest number of people. Mill, however,  
will argue that people should seek the highest quality—not  
75  
only quantity—of pleasure. Mill, then, made an important  
contribution to philosophy—regardless of how original his  
ideas were.

67. A. NO CHANGE  
B. as  
C. it was as though  
D. DELETE the underlined portion.
68. E. NO CHANGE  
G. who borrowed  
H. she borrowed  
J. borrowing
69. A. NO CHANGE  
B. most particular  
C. in particularly  
D. particular
70. F. NO CHANGE  
G. remarked that:  
H. remarked that,  
J. remarked that
71. A. NO CHANGE  
B. to  
C. through  
D. into
72. Which of the following placements for the underlined phrase would NOT be acceptable?  
F. Where it is now  
G. After the word *life* (and before the comma)  
H. After the word *when* (placing commas around the phrase)  
J. After the word *California* (and before the period)
73. The writer is considering replacing the underlined word with the following phrase:  
Africans, the Chinese, and the Inca  
Given that the revision would create a true statement,  
should the writer make this revision here?  
A. Yes, because it adds details that help support the claim made in the paragraph's opening sentence.  
B. Yes, because it proves the paragraph's point that Bayle's peanut paste was appreciated by people around the world.  
C. No, because it creates a digression from the paragraph's focus on peanut butter.  
D. No, because it undermines the paragraph's claim that Bayle sold a peanut paste as early as 1890.
74. F. NO CHANGE  
G. that of fellow, utilitarian, philosopher  
H. that, of fellow utilitarian philosopher,  
J. that of fellow utilitarian philosopher
75. A. NO CHANGE  
B. argued that  
C. argued with  
D. argues with

**END OF TEST 1**

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

**2** **2**

## 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.  $|4 - 1| - |1 - 4| = ?$

- A. -6
- B. -3
- C. -2
- D. 0
- E. 6

**DO YOUR FIGURING HERE.**

2. When  $y = 2x + 1$  and  $y = 3$ , which of the following is the value of  $x$ ?

- F. 2
- G. 1
- H. -1
- J. -2
- K. -5

3. To attend an annual banquet, members pay \$16 per ticket while nonmembers pay \$22 per ticket. What is the total amount, in dollars, from the sale of 80 member tickets and  $n$  nonmember tickets?

- A.  $22n + 16(80)$
- B.  $22(n + 80)$
- C.  $22(n + 16)$
- D.  $(22 + 16)n$
- E.  $n + 80$

4. What is 150% of 50?

- F. 51.5
- G. 57.5
- H. 65
- J. 75
- K. 125

2



2

DO YOUR FIGURING HERE.

5. A box contains several marbles. Bill draws a marble at random from the box, notes that it is blue, and places the marble back in the box. Then Aiko draws a marble at random from the box, notes that her marble is blue, and places it back in the box. Which of the following is necessarily true?

- A. Bill and Aiko drew the same marble.
- B. The box contains marbles of at least 2 different colors.
- C. The box contains only blue marbles.
- D. The box contains at most 2 blue marbles.
- E. The box contains at least 1 blue marble.

6. A 21-foot-long board is cut into 3 pieces such that the first piece is twice as long as the second piece and the second piece is twice as long as the third piece. How many feet in length is the longest of the 3 pieces?

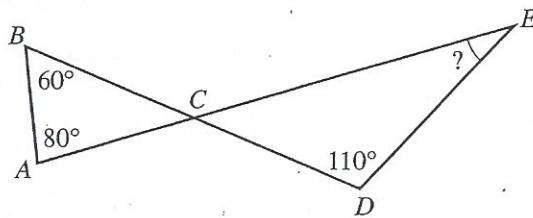
(Note: Ignore the width of the saw cuts.)

- F. 7
- G. 9
- H. 10
- J. 12
- K. 14

7. What is the perimeter, in centimeters, of a rectangle with length 8 cm and width 3 cm?

- A. 11
- B. 16
- C. 22
- D. 24
- E. 48

8. In the figure below,  $\overline{AE}$  and  $\overline{BD}$  intersect at  $C$ . What is the measure of  $\angle E$ ?

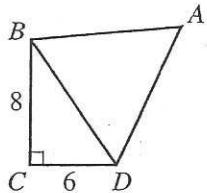


- F.  $30^\circ$
- G.  $35^\circ$
- H.  $40^\circ$
- J.  $60^\circ$
- K.  $70^\circ$

**2** **2**

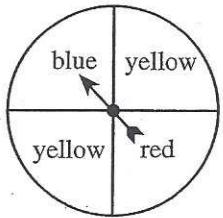
9. The diagonal  $\overline{BD}$  divides quadrilateral  $ABCD$  into a right triangle and an equilateral triangle, as shown below. The given dimensions are in centimeters. How many centimeters long is  $\overline{AD}$ ?

- A.  $\sqrt{14}$
- B. 7
- C. 10
- D. 14
- E. 28



10. The circular face of a fair spinner has a red section, a blue section, and 2 yellow sections, as shown below. After being spun, the arrow of the spinner is equally likely to be pointing to any 1 of the 4 sections. What is the probability that, after the arrow has been spun, the section the arrow is pointing to is yellow?

- F.  $\frac{1}{2}$
- G.  $\frac{1}{3}$
- H.  $\frac{1}{4}$
- J.  $\frac{3}{4}$
- K.  $\frac{1}{6}$



11. Let a square represent the value of  $x$  and a circle represent 1. Which of the following expressions accurately represents  $2(3x + 5)$ ?

- A. +
- B. +
- C. +
- D. +
- E. +

12. What is the slope-intercept form of  $5x - y - 9 = 0$ ?

- F.  $y = -5x - 9$
- G.  $y = -5x + 9$
- H.  $y = 5x - 9$
- J.  $y = 5x + 9$
- K.  $y = 9x - 5$

**DO YOUR FIGURING HERE.**

2



2

DO YOUR FIGURING HERE.

13. The points  $S(4, 10)$  and  $T(6, -2)$  lie in the standard  $(x, y)$  coordinate plane. What is the midpoint of  $\overline{ST}$ ?

- A.  $(1, -6)$
- B.  $(2, 5)$
- C.  $(3, -1)$
- D.  $(5, 4)$
- E.  $(9, 8)$

14. Kerry ordered a pizza: one half was topped with pepperoni for her brother Joel, and the other half was topped with extra cheese for herself. Kerry ate all of the half of the pizza with extra cheese. Joel ate  $\frac{3}{5}$  of the half of the pizza with pepperoni. What fraction of the whole pizza did Joel eat?

- F.  $\frac{1}{2}$
- G.  $\frac{2}{5}$
- H.  $\frac{3}{5}$
- J.  $\frac{4}{7}$
- K.  $\frac{3}{10}$

15. Given that  $a = \frac{1}{2}$  and  $b = \frac{1}{3}$ , what is the value of  $\frac{1}{2} \left( \frac{1}{a} + \frac{1}{b} \right)$ ?

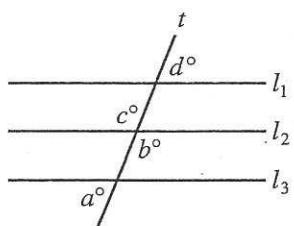
- A.  $\frac{3}{5}$
- B.  $\frac{5}{6}$
- C.  $\frac{5}{2}$
- D. 3
- E. 5

16. Guban went shopping at a department store that was having a storewide sale where every item was 10% off its marked price, including already discounted items. Guban found a sweater with an original price of \$30.00 marked with a discounted price of 15% off its original price. There was a 6% sales tax on the final price of all items. How much did Guban pay for the sweater?

- F. \$13.77
- G. \$19.50
- H. \$24.30
- J. \$24.33
- K. \$29.81

**2** ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ **2**

17. In the figure below, parallel lines  $l_1$ ,  $l_2$ , and  $l_3$  intersect transversal  $t$ . What is the value of  $a + b + c + d$ ?



- A. 180
  - B. 240
  - C. 270
  - D. 300
  - E. 360
18. Max bought several bags of organic lawn fertilizer, and each bag covers 5,000 square feet of lawn. He is fertilizing a lawn that is 50 feet wide. He pours 1 bag into the fertilizer spreader and begins fertilizing. Before he needs to refill the spreader, Max can fertilize a rectangle that is the width of the lawn and is how many feet long?

- F. 50
- G. 100
- H. 2,450
- J. 4,950
- K. 5,050

19. Which of the following variable expressions would represent the area of a rectangle if its length is represented by  $x + 2$  and its width is represented by  $x - 1$ ?

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

20. A formula often used to find the dollar value of an investment is  $A = P(1 + r)^t$ , where  $A$  is the dollar value after  $t$  years,  $P$  is the initial amount invested, and  $r$  is the annual interest rate expressed as a decimal. According to this formula, which of the following is closest to the dollar value of \$1,000 invested for 2 years at a 5% annual interest rate?

- F. \$1,050
- G. \$1,103
- H. \$2,000
- J. \$2,100
- K. \$2,250

**DO YOUR FIGURING HERE.**

2



DO YOUR FIGURING HERE.

21. A motorist traveled at an average speed of 50 miles per hour and arrived at his destination in exactly 20 minutes. Which of the following is closest to the number of miles he traveled?

- A. 10
- B. 12
- C. 17
- D. 20
- E. 25

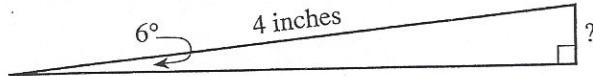
22. Inez has 20 stamps. Some of the stamps are 40¢ stamps and the others are 25¢ stamps. The value of the 20 stamps is \$6.95. How many 40¢ stamps does Inez have?

- F. 7
- G. 11
- H. 13
- J. 15
- K. 17

23. A line in the standard  $(x,y)$  coordinate plane has equation  $3x - 2y = 6$ . What is the slope of this line?

- A. 3
- B.  $\frac{3}{2}$
- C.  $\frac{2}{3}$
- D.  $-\frac{3}{2}$
- E. -3

24. The right triangle shown below has a hypotenuse of 4 inches. The measure of the angle indicated is  $6^\circ$ . Which of the following is closest to the length, in inches, of the side opposite the  $6^\circ$  angle?

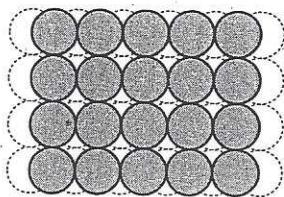


(Note:  $\sin 6^\circ \approx 0.1045$     $\sin 84^\circ \approx 0.9945$   
 $\cos 6^\circ \approx 0.9945$     $\cos 84^\circ \approx 0.1045$   
 $\tan 6^\circ \approx 0.1051$     $\tan 84^\circ \approx 9.5144$ )

- F. 0.105
- G. 0.418
- H. 0.420
- J. 3.978
- K. 38.057

2 ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ 2

25. A supermarket soup can display consists of 5 levels of stacked cans. The figure below shows an overhead view of the top level of cans (circles shaded and with solid borders) and the level of cans below it (circles with dashed borders). In the display, each level has 4 more cans than the level above it. How many cans are in the display?



- A. 60  
 B. 100  
 C. 116  
 D. 120  
 E. 140
26. Which of the following could be the value of  $\sqrt{c^2}$  for some integer  $c$ ?

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

27. The height of a triangle is 6 cm longer than the base from which the height is measured. If the area of the triangle is 80 square centimeters, what is the height, in centimeters?

- A. 4  
 B. 16  
 C. 22  
 D. 43  
 E. 77

28. For real numbers  $x$  and  $y$  such that  $x - y < 0$ , which of the following must be true?

- F.  $x = y$   
 G.  $x > y$   
 H.  $x < y - x$   
 J.  $x < -y$   
 K.  $x < y$

DO YOUR FIGURING HERE.

2



2

DO YOUR FIGURING HERE.

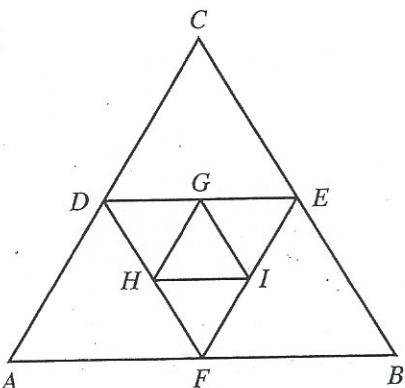
29. In the standard  $(x,y)$  coordinate plane, a triangle has vertices  $(-3,-3)$ ,  $(-4,2)$ , and  $(-1,1)$ . What will be the coordinates of the vertices after the triangle is shifted down 2 units?

- A.  $(-5,-3)$ ,  $(0,-4)$ , and  $(-1,-1)$
- B.  $(-5,-3)$ ,  $(-4,4)$ , and  $(-1,3)$
- C.  $(-3,-1)$ ,  $(4,-4)$ , and  $(3,1)$
- D.  $(-3,-5)$ ,  $(-4,4)$ , and  $(-1,3)$
- E.  $(-3,-5)$ ,  $(-4,0)$ , and  $(-1,-1)$

30. When solved for  $k$ ,  $-6 + 7k \geq 3 - 8k$  is equivalent to which of the following inequalities?

- F.  $k \geq \frac{1}{5}$
- G.  $k \geq \frac{3}{5}$
- H.  $k \leq \frac{5}{3}$
- J.  $k \leq 5$
- K.  $k \geq 9$

31. In the figure below,  $\triangle ABC$  is equilateral. Points  $D$ ,  $E$ , and  $F$  are the midpoints of the sides of  $\triangle ABC$ . Points  $G$ ,  $H$ , and  $I$  are the midpoints of the sides of  $\triangle DEF$ . A side of  $\triangle ABC$  is how many times as long as a side of  $\triangle GHI$ ?



- A. 2
- B. 3
- C. 4
- D. 8
- E. 16

32. What fraction of  $2\frac{1}{3}$  is  $1\frac{1}{6}$ ?

- F.  $\frac{1}{2}$
- G.  $\frac{2}{9}$
- H.  $\frac{1}{6}$
- J.  $\frac{1}{9}$
- K.  $\frac{1}{18}$

**2** **2**

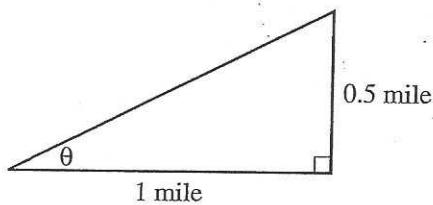
33. A greenhouse contained both 6-inch-high geraniums and 3-inch-high geraniums. The 6-inch-high geraniums were taken out of the greenhouse in early spring and grew at a rate of 1 inch per week. The 3-inch-high geraniums remained in the greenhouse and grew at a rate of  $1\frac{1}{2}$  inches per week. After the 6-inch-high geraniums were taken outside, in how many weeks were both groups of geraniums the same height?

- A.  $7\frac{1}{2}$
- B. 6
- C.  $4\frac{1}{2}$
- D. 3
- E.  $1\frac{1}{2}$

34.  $(x^3 - 4x^2 + 5x) - (x^2 - 3x - 6)$  simplifies to:

- F.  $x^3 - 3x^2 + 2x + 6$
- G.  $x^3 - 3x^2 + 8x - 6$
- H.  $x^3 - 5x^2 + 2x - 6$
- J.  $x^3 - 5x^2 + 8x - 6$
- K.  $x^3 - 5x^2 + 8x + 6$

35. A right triangle is shown in the figure below. Which of the following expressions gives  $\theta$ ?

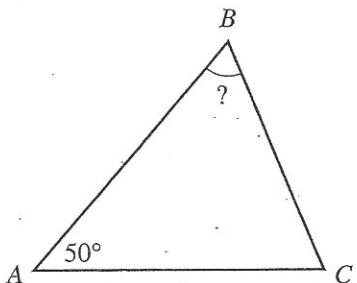


- A.  $\tan^{-1}\left(\frac{1}{2}\right)$
- B.  $\sin^{-1}\left(\frac{1}{2}\right)$
- C.  $\cos^{-1}\left(\frac{1}{2}\right)$
- D.  $\tan^{-1}(2)$
- E.  $\sin^{-1}(2)$

**DO YOUR FIGURING HERE.**

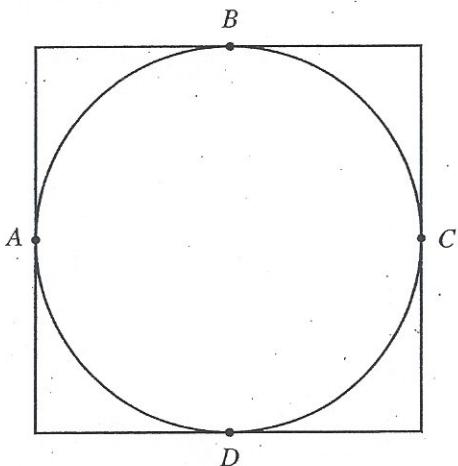
**2****2**

36. In  $\triangle ABC$  below,  $AB = AC$  and  $\angle A$  measures  $50^\circ$ . What is the measure of  $\angle B$ ?



DO YOUR FIGURING HERE.

- F.  $70^\circ$
  - G.  $65^\circ$
  - H.  $60^\circ$
  - J.  $55^\circ$
  - K.  $50^\circ$
37. The square below has an area of 64 square centimeters. The circle inscribed in the square is tangent to the square at  $A$ ,  $B$ ,  $C$ , and  $D$ . What is the area, in square centimeters, of the circle?



38. The 2 functions  $f(x)$  and  $g(x)$  are defined such that

$$f(x) = \frac{x+8}{2-x} \text{ and } g(x) = x^2 + 6x + 2. \text{ What is the value of } f(g(-2))?$$

- F. -6
- G.  $-\frac{1}{2}$
- H.  $\frac{1}{4}$
- J.  $\frac{3}{2}$
- K.  $\frac{53}{4}$

**2** **2**

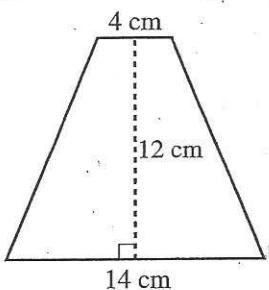
**DO YOUR FIGURING HERE.**

39. On a map of Blueville in the standard  $(x,y)$  coordinate plane, where 1 coordinate unit represents 1 block, the middle school is at  $(-8,3)$  and the high school is at  $(4,-2)$ . What is the straight-line distance, in blocks, between the high school and the middle school?

- A. 13
- B. 17
- C.  $\sqrt{7}$
- D.  $\sqrt{13}$
- E.  $\sqrt{17}$

40. What is the perimeter, in centimeters, of the isosceles trapezoid shown below?

- F. 18
- G. 30
- H. 42
- J. 44
- K. 56



41. Which of the following equations, when graphed in the standard  $(x,y)$  coordinate plane, would cross the  $x$ -axis at  $x = 2$  and at  $x = -4$ ?

- A.  $y = 2(x - 2)(x + 4)$
- B.  $y = 2(x - 2)(x - 4)$
- C.  $y = 2(x + 2)(x + 4)$
- D.  $y = 4(x - 2)(x - 4)$
- E.  $y = 4(x + 2)(x - 4)$

42. A rectangular room is 13 feet long, 10 feet wide, and 9 feet high. Not accounting for doors and windows, what is the surface area, in square feet, of the 4 walls, ceiling, and floor of the room?

- F. 337
- G. 414
- H. 544
- J. 674
- K. 1,170

43. The average of Pam's 8 test scores is 77 points. Pam takes a 9th test and earns a score of 95 points. If all 9 tests are equally weighted, what is Pam's new average?

- A. 78
- B. 79
- C. 85
- D. 86
- E. 87

2

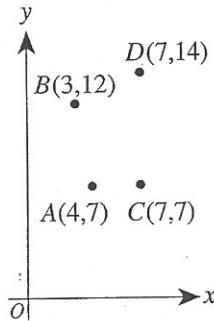


2

DO YOUR FIGURING HERE.

Use the following information to answer questions 44–46.

The points  $A(4,7)$ ,  $B(3,12)$ ,  $C(7,7)$ , and  $D(7,14)$  are shown in the standard  $(x,y)$  coordinate plane below.



44. What is the slope of  $\overleftrightarrow{BD}$ ?

- F.  $-\frac{5}{11}$
- G.  $\frac{5}{13}$
- H.  $\frac{1}{2}$
- J.  $\frac{9}{7}$
- K. 2

45. What is the cosine of the smallest angle in right triangle  $\triangle ACD$ ?

- A.  $\frac{7}{\sqrt{58}}$
- B.  $\frac{7}{10}$
- C.  $\frac{3}{\sqrt{58}}$
- D.  $\frac{3}{7}$
- E.  $\frac{\sqrt{58}}{10}$

46. How many distinct lines are there that each contain at least 2 of the 4 given points?

- F. 3
- G. 4
- H. 6
- J. 8
- K. 16

**2** **2**

47. If  $x$  is any positive integer, then the sum of  $6x$  and  $11x$  is always divisible by which of the following?

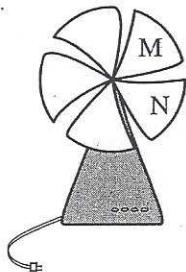
- A. 5
- B. 6
- C. 11
- D. 17
- E. 66

48. For what value of  $a$  would the following system of equations have infinitely many solutions?

$$\begin{aligned}3x - 2y &= 6 \\6x - 4y &= 3a\end{aligned}$$

- F. 2
- G. 4
- H. 6
- J. 12
- K. 18

49. A fan has 5 identical blades that are equally spaced around the center of the fan, as shown below. What is the measure of the angle of rotation that would move Blade M clockwise ( $^{\circ}$ ) to the position of Blade N?



- A.  $18^{\circ}$
- B.  $36^{\circ}$
- C.  $45^{\circ}$
- D.  $60^{\circ}$
- E.  $72^{\circ}$

50. Cans A and B are both right circular cylinders. The radius of the base of Can A is 4 times the radius of the base of Can B, and the height of Can A is 5 times the height of Can B. The volume of Can A is how many times the volume of Can B?

(Note:  $V_{\text{cylinder}} = \pi r^2 h$ )

- F. 9
- G. 20
- H. 40
- J. 80
- K. 100

51. What real value of  $a$  satisfies the equation  $16^a = \frac{1}{64^{a+1}}$ ?

- A. -3
- B. -2
- C.  $-\frac{3}{5}$
- D.  $\frac{1}{10}$
- E.  $\frac{1}{2}$

**DO YOUR FIGURING HERE.**

2



2

DO YOUR FIGURING HERE.

52. A box contains 100 cardboard circles. Written on each circle is one of the following numbers, with no numbers repeated:  $\sqrt{1}, \sqrt{2}, \sqrt{3}, \dots, \sqrt{100}$ . A circle is drawn at random from the box. What is the probability that the number on the circle is a rational number?

F.  $\frac{0}{100}$

G.  $\frac{9}{100}$

H.  $\frac{10}{100}$

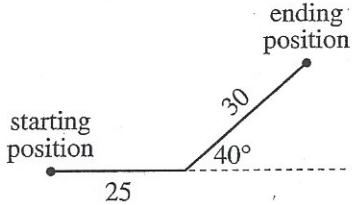
J.  $\frac{50}{100}$

K.  $\frac{74}{100}$

53. By the law of cosines,  $a^2 = b^2 + c^2 - 2bc \cos \angle A$  for a triangle with sides of lengths  $a$ ,  $b$ , and  $c$  opposite  $\angle A$ ,  $\angle B$ , and  $\angle C$ , respectively. A boat travels 25 miles due east, makes a  $40^\circ$  turn toward the north, and then travels 30 miles, as shown below. To the nearest mile, what is the straight-line distance between the boat's starting position and its ending position?

(Note:  $\cos 40^\circ \approx 0.766$ ,  $\cos(180 - \alpha) = -\cos \alpha$ )

- A. 55  
B. 52  
C. 50  
D. 31  
E. 19



54. The function  $f(x)$  is defined below. What is the value of  $f(-1)$ ?

$$f(x) = \begin{cases} |x| + 1, & \text{if } x \leq -1 \\ |x| - 2, & \text{if } x > -1 \end{cases}$$

- F. -3  
G. -1  
H. 0  
J. 1  
K. 2

55. Which of the following equations given in factored form has roots at  $\frac{1}{2}, \frac{3}{4}, i$ , and  $-i$ ?

- A.  $(2x - 1)(4x - 3)(x^2 + 1) = 0$   
 B.  $(2x - 1)(4x - 3)(x^2 - 1) = 0$   
 C.  $(2x + 1)(4x - 3)(x^2 + 1) = 0$   
 D.  $(2x + 1)(4x - 3)(x^2 - 1) = 0$   
 E.  $(2x + 1)(4x + 3)(x^2 + 1) = 0$

**2** ▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲ **2**

Use the following information to answer questions 56–58.

**DO YOUR FIGURING HERE.**

The table below shows an electric utility company's old and new rates. In the table, kWh stands for kilowatt-hour, a standard unit for measuring electrical energy.

Runion Electric Association Rates		
	Old rate	New rate
Monthly service charge	\$7.00	\$11.00
Energy-use charge		
first 1,500 kWh	6.6¢/kWh	6.7¢/kWh
kWh over 1,500	6.2¢/kWh	6.2¢/kWh

56. LaTasha is a computer programmer for the electric company. She updated the program for calculating customers' monthly bills. Which of the following is an expression that uses the new rates to calculate the bill, in dollars, of a customer who uses  $x$  kWh of electricity during the month, where  $x > 1,500$ ?

- F.  $7 + 0.062(1,500) + 0.067(x - 1,500)$
- G.  $7 + 0.066(1,500) + 0.062(x - 1,500)$
- H.  $11 + 0.062x$
- J.  $11 + 0.062(1,500) + 0.067(x - 1,500)$
- K.  $11 + 0.067(1,500) + 0.062(x - 1,500)$

57. By about what percent did the monthly service charge increase from the old rate to the new rate?

- A. 4%
- B. 36%
- C. 40%
- D. 57%
- E. 64%

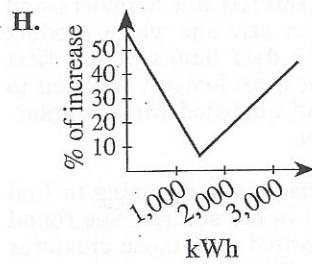
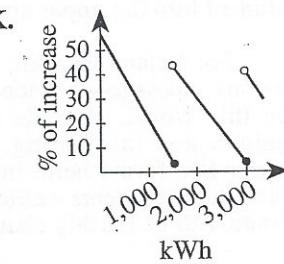
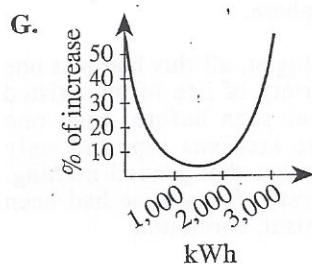
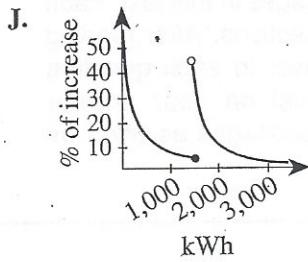
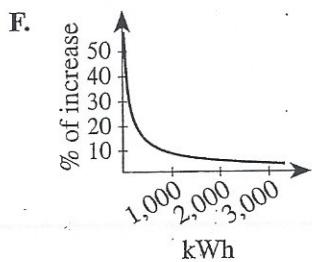
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2

DO YOUR FIGURING HERE.

58. Which of the following is the graph of the function that gives the percent of increase for electric bills calculated under the new rates compared to the bills calculated under the old rates?



59. Which of the following equations describes a line that is perpendicular to a line with equation  $5x - 6y = 30$ ?

- A.  $5x - 6y = 15$
- B.  $5x + 6y = 24$
- C.  $6x - 5y = 12$
- D.  $6x + 5y = 10$
- E.  $7x - 8y = 32$

60. In a regular pentagon, all 5 interior angles are congruent. What is the measure of each interior angle of a regular pentagon?

- F.  $36^\circ$
- G.  $60^\circ$
- H.  $72^\circ$
- J.  $108^\circ$
- K.  $120^\circ$

END OF TEST 2

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

DO NOT RETURN TO THE PREVIOUS TEST.

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## 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 science fiction novel *Another Heaven, Another Earth* by H. M. Hoover (©1981 by H. M. Hoover).

Always in those first few minutes when the shuttle left the parent ship and accelerated to clear the gravitational pull of the larger mass, Lee was sure she had made a terrible mistake. She didn't belong here; none of them did—fragile creatures set in rows in a canister shot through black space. She belonged to Earth. To be here was madness, an insane presumption, and there was no way to escape.

All she was, all she had accomplished, meant nothing in this time of desperate sanity. The fifty-odd men and women in the cabin with her were all accomplished, all experts in their fields, and all incidental.

As the shuttle turned, the cameras gave them a view of the *Kekule*, the parent ship receding in the distance. Three miles long, half a mile deep and wide, the starship was a tribute to the art of welding. It floated in deep space like a chunk of bizarre litter. The word "starship" evoked a far more poetic image than the real thing, Lee thought as she watched.

Around her, people talked and laughed. She didn't join in, nor did they try to talk to her. Past experience had taught them she was best left alone in shuttles—unless they wanted to be snapped at. In the confinement of starships individual quirks became well-known.

The planet Xilan appeared on the screen, as green as Earth was blue. From this distance it suggested an agate ball, variegated with white, shining and untouched. It had been discovered five hundred Earth years before; there were records of several landings there, but little more than basic data survived in the corporate archives. At the time of its discovery Xilan had been considered too far from Earth to make colonization profitable, too far to plunder for mineral wealth. Technology was changing that.

Hours passed. Polar ice caps and land masses came into focus. The white became clouds and then the gleam of snow-capped mountains. A wide tapering of beige suggested that desert covered the center of one

continent. Rivers veined into view. Several volcanoes plumed into the upper atmosphere.

For Leland Hamlin, biologist, all this had just one joyous message—a wide variety of life forms existed on this world, animals never seen before, each one unique and fascinating. The archives reported only lower life forms here, but to her that proved nothing. Five hundred years earlier, tests of sentience had been crude, full of Earthly chauvinism, unreliable.

Born in a ring-world colony in L<sub>5</sub>, she had grown up without ever seeing any animals but humans—and she missed animals. Her father said she was a product of a more primitive era. The data banks of her first learning center had been almost exclusively devoted to zoology. At fourteen, she had qualified for a scholarship at an Earthside university.

She had gone to her home planet expecting to find the wealth of species detailed in her studies. She found instead that humans had permitted only those creatures which served them to survive. The rest were extinct and had been for generations past. The child in her never quite forgave her ancestors for that crime.

The ancient zoologist Beebe had written, "... when the last individual of a race of living things breathes no more, another heaven and another earth must pass before such a one can come again." And so, finding Earth desolate, she searched.

It was not a quest one could go on alone, although she would have liked to. But she had learned the practical must enter into the realization of any dream, so when an employment recruiter from one of Earth's largest corporations offered her a job as a biochemist on a deep space exploration venture, she accepted.

Fifteen space years had passed since then, and five more expeditions. Study during travel time had earned her two more doctorates. Two of her trip logs had been so well written, so alive with her enthusiasm, that they sold throughout Earth's federation as popular adventure books. She had gained also in that time a devout respect for life. It was so rare a phenomenon. Entire galaxies existed without a trace of it. Billions of years passed on 80 planets while nothing ever changed but rock.

On Xilan's night side, in the lowest and last orbit, she saw a dull red glow of surface fire and something glinting in its light—lightning-struck vegetation, or molten lava? The shuttle was too close to the surface and moving too fast for its cameras to see clearly. She glanced at nearby colleagues; none seemed to have noticed anything remarkable. The belltone signaled that they were landing.

1. The main character of the passage can best be described as a:
  - A. tourist looking for adventure.
  - B. traveler gathering information for an animal story.
  - C. scientist seeking evidence for her life's work.
  - D. scientist researching an astronomy book.
  
2. The main purpose of the third paragraph (lines 13–19) is to:
  - F. refute romantic ideas about starships.
  - G. explain how space travel creates litter.
  - H. indicate that traveling in space is like writing poetry.
  - J. point out the importance of space-age welding techniques.
  
3. The main purpose of the seventh paragraph (lines 41–47) is to:
  - A. explain the difference between higher and lower life forms.
  - B. compare modern and historical scientific tests of sentience used on Xilan.
  - C. indicate Lee's great hope that earlier reports on Xilan had been inaccurate.
  - D. inform readers that archives from earlier research on Xilan existed.
  
4. In the passage, the quotation from Beebe (lines 61–64) is most likely included to make a point about the:
  - F. mechanics of breathing.
  - G. extinction of animal species.
  - H. last human being in the galaxy.
  - J. beliefs of ancient zoologists.

5. Information in the passage indicates that Lee's dream is to:
  - A. find someone to share her quest.
  - B. find a place to house the animals left on Earth.
  - C. be the first woman to travel on deep-space expeditions.
  - D. discover a place where animal life abounds.
  
6. In the context of the passage, the statement in lines 23–24 most nearly means that:
  - F. unusual individuals choose to have careers on starships.
  - G. starships are physically smaller in reality than they appear to be.
  - H. people often become claustrophobic when working on starships.
  - J. people in close proximity learn what to expect from each other.
  
7. The passage mentions Xilan having all of the following features EXCEPT:
  - A. mountains.
  - B. islands.
  - C. rivers.
  - D. volcanoes.
  
8. As it is used in line 47, the word *crude* most nearly means:
  - F. unaltered.
  - G. primitive.
  - H. vulgar.
  - J. impolite.
  
9. The passage makes clear that animals have disappeared on Earth due to the:
  - A. fulfillment of Beebe's prediction about species.
  - B. volcanic destruction of the environment.
  - C. vegetation being struck by lightning.
  - D. human selection of useful animals.
  
10. As it is used in line 79, the word *it* most nearly refers to:
  - F. the phenomenon of life.
  - G. Earth's federation.
  - H. time passing.
  - J. the night side of Xilan.

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## Passage II

**SOCIAL SCIENCE:** This passage is adapted from the article "The Social Life of Paper" by Malcolm Gladwell (©2002 by The Condé Nast Publications).

Computer technology was supposed to replace paper. But that hasn't happened. Every country in the Western world uses more paper today, on a per-capita basis, than it did ten years ago. The consumption of uncoated free-sheet paper, for instance—the most common kind of office paper—rose almost fifteen percent in the United States between 1995 and 2000. This is generally taken as evidence of how hard it is to eradicate old, wasteful habits and of how stubbornly resistant we are to the efficiencies offered by computerization. A number of cognitive psychologists and ergonomic experts, however, don't agree. Paper has persisted, they argue, for very good reasons: when it comes to performing certain kinds of cognitive tasks, paper has many advantages over computers.

The case for paper is made most eloquently in *The Myth of the Paperless Office*, by two social scientists, Abigail Sellen and Richard Harper. They begin their book with an account of a study they conducted at the International Monetary Fund, in Washington, D.C. Economists at the IMF spend most of their time writing reports on complicated economic questions, work that would seem to be perfectly suited to sitting in front of a computer. Nonetheless, the IMF is awash in paper, and Sellen and Harper wanted to find out why. Their answer is that the business of writing reports—at least at the IMF—is an intensely collaborative process, involving the professional judgments and contributions of many people. The economists bring drafts of reports to conference rooms, spread out the relevant pages, and negotiate changes with one another. They go back to their offices and jot down comments in the margin, taking advantage of the freedom offered by the informality of the handwritten note. Then they deliver the annotated draft to the author in person, taking him or her, page by page, through the suggested changes. At the end of the process, the author spreads out all the pages with comments on a desk and starts to enter them on the computer—moving the pages around, organizing and reorganizing, saving and discarding.

Without paper, this kind of collaborative, iterative work process would be much more difficult. According to Sellen and Harper, paper has a unique set of "affordances"—that is, qualities that permit specific kinds of uses. Paper is tangible: we can pick up a document, flip through it, read little bits here and there, and quickly get a sense of it. Paper is spatially flexible, meaning that we can spread it out and arrange it in the way that suits us best. And it's tailorabile: we can easily annotate it, and scribble on it as we read, without altering the original text. Digital documents, of course, have their own affordances. They can be easily searched, shared, stored, accessed remotely, and linked to other relevant material. But they lack the affordances that really matter to a group of people working together on a report.

Paper enables a certain kind of thinking. What covers many desks are piles of paper—journals, magazines, binders, postcards, videotapes, and all the other artifacts of the knowledge economy. When a group at a leading computer company studied piling behavior several years ago, they found that even the most disorderly piles usually make perfect sense to the piler. Over time, piles get broken down and resorted, sometimes chronologically and thematically; clues about certain documents may be physically embedded in the file by, say, stacking a certain piece of paper at an angle or inserting dividers into the stack.

But why do we pile documents instead of filing them? Because piles represent the process of active, ongoing thinking. The psychologist Alison Kidd, whose research Sellen and Harper refer to extensively, argues that "knowledge workers" use the physical space of the desktop to hold "ideas which they cannot yet categorize or even decide how they might use." The messy desk is not necessarily a sign of disorganization. It may be a sign of complexity: those who deal with many unresolved ideas simultaneously cannot sort and file the papers on their desks, because they haven't yet sorted and filed the ideas in their head. Kidd writes that many of the people she talked to use the papers on their desks as contextual cues to "recover a complex set of threads without difficulty and delay" when they come in on a Monday morning, or after their work has been interrupted by a phone call. What we see when we look at the piles on our desks is, in a sense, the contents of our brains.

11. The main purpose of the passage is to:
  - A. encourage readers to embrace computer technology and abandon habits that waste paper.
  - B. encourage Western countries to be more aggressive in promoting paper recycling.
  - C. acknowledge that in the modern workplace, paper still plays a vital role.
  - D. describe new technologies available to knowledge workers who prefer to work on paper.
  
12. It is most reasonable to infer from the passage that many of the ideas it contains are those of:
  - F. Sellen and Harper before their IMF study.
  - G. Sellen and Harper after their IMF study.
  - H. Kidd before she was influenced by Sellen and Harper.
  - J. the passage's author before reading the research of Sellen and Harper.

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13. Information in the passage suggests that Sellen and Harper's findings at the IMF conflict with the notion that:
- computers have become a part of the modern workplace.
  - revising documents page by page is a time-consuming process.
  - the use of paper has increased in the workplace in recent years.
  - complex reports are largely the product of solitary hours at the computer.
14. Which of the following questions is NOT directly answered by the passage?
- Who wrote *The Myth of the Paperless Office*?
  - What are some examples of "artifacts of the knowledge economy"?
  - What are some of the "affordances" of digital documents?
  - Why is uncoated free-sheet paper the most common kind of office paper?
15. According to the passage, the general but incorrect explanation for the current rate of paper use is that:
- the force of habit slows the transition to improved ways of performing work.
  - access to computer technology has increased on a global scale in recent years.
  - paper is more affordable than the software and hardware associated with digital documents.
  - the United States has lost its focus on environmental issues in recent years.
16. Which of the following best summarizes the first paragraph?
- Providing statistics on paper use around the world, it discusses the unequal access of countries to modern office technology.
  - Revealing that the views of Sellen overlap with those of Harper, it examines their ten-year collaboration at the IMF.
  - Referring to a false prediction about the effects of computers on paper use, it alludes to the reasons behind paper's persistence.
  - Focusing on the years 1995 to 2000, it reveals the widening gulf in the workplace between paper users and computer users.
17. The passage includes references to all the following professionals EXCEPT:
- knowledge workers.
  - cognitive psychologists.
  - ergonomic experts.
  - paper industry executives.
18. It is most reasonable to infer that the process described in lines 29–40 is one that the author of the passage views with:
- dismay over the inefficient practices of professionals at a prestigious institution.
  - excitement over groundbreaking approaches to document creation.
  - appreciation for the collaboration among those who produce sophisticated documents.
  - concern that document creation has become more complicated than the average worker can grasp.
19. As it is used in line 24, the phrase *awash in* most nearly means:
- disoriented by.
  - characterized by an abundance of.
  - clearing away unwanted quantities of.
  - limited by.
20. According to the passage, piling behavior in the modern workplace may indicate a worker's temporary inability to:
- spread document pages on a table.
  - categorize a document or decide on a way to use it.
  - meet with the author of a document in order to discuss possible changes to it.
  - clear space from filing cabinets.

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## Passage III

**HUMANITIES:** This passage is adapted from the essay "Lights in the Windows" by Naomi Shihab Nye (©1995 by The Assembly on Literature for Adolescents).

The narrator is a Palestinian American and an award-winning author of poetry, fiction, and children's literature.

Years ago a girl handed me a note as I was leaving her proud town of Albany, Texas, a tiny, lovely place far in the west of our big state. "I'm glad to know there is another poemist in the world," the note said. "I 5 always knew we would find one another someday and our lights would cross."

*Our lights would cross.* That girl had not stood out to me, I realized, among the other upturned, interested faces in the classroom. How many other lights had I 10 missed? I carried her smudged note for thousands of miles.

I was fascinated with the earliest poems I read and heard that gave insight into all the secret territories of the human spirit, our relationships with one another. 15 Somehow those glimpses felt comforting, like looking through the lit windows of other people's homes at dusk, before they closed the curtains. How did other people live their lives? Just a *sense* of so many other-worlds out there, beginning with the next house on my 20 own street, gave me a great energy. How could anyone ever feel lonely? One of the first books I loved in my life was a thick, gray anthology edited by Helen Ferris, called *Favorite Poems Old and New*. Rich, intelligent voices spoke to me each time I opened its covers. I 25 found Rabindranath Tagore, Carl Sandburg, Emily Dickinson, living side by side. I imagined I was part of a much larger family.

To me the world of poetry is a house with thousands of glittering windows. Our words and images, 30 land to land, era to era, shed light on one another. Our words dissolve the shadows we imagine fall between. "One night I dreamt of spring," writes Syrian poet Muhammad al Maghut, "and when I awoke / flowers covered my pillow." Isn't this where empathy begins? 35 Other countries stop seeming quite so "foreign," or inanimate, or strange, when we listen to the intimate voices of their citizens. I can never understand it when teachers claim they are "uncomfortable" with poetry—as if poetry demands they be anything other than 40 responsive, curious human beings. If poetry comes out of the deepest places in the human soul and experience, shouldn't it be as important to learn about one another's poetry, country to country, as one another's weather or gross national products? It seems critical to me. It's 45 another way to study geography!

Anyone who feels poetry is an alien or ominous form should consider the style in which human beings think. "How do you think?" I ask my students. "Do you think in complete, elaborate sentences? In fully developed paragraphs with careful footnotes? Or in flashes 50 and bursts of images, snatches of lines leaping one to

the next, descriptive fragments, sensory details?" We *think* in poetry. But some people pretend poetry is far away.

55 Probably some of us were taught so long and hard that poetry was a thing to *analyze* that we lost our ability to find it delicious, to appreciate its taste, sometimes even when we couldn't completely apprehend its *meaning*. I love to offer students a poem now and then that I 60 don't really understand. It presents them with the immediate opportunity of being smarter than I am. Believe me, they always take it. They always find an interesting way to look through its window.

I'm reminded of a dear teacher I had in high 65 school who refused to go on to the next poem in our antiquated textbook until we had all agreed on the same interpretive vision of each poem—*her* vision. If we can offer each other a cognizance of *mystery* through the poems we share, isn't that a greater gift? Won't a sense 70 of inevitable mystery underpinning our intricate lives serve us better than the notion that we will each be given a neat set of blanks to fill in—always?

Poems respect our ability to interpret and translate 75 images and signs. Poems link seemingly disparate parts of experience—this seems particularly critical today. I have yet to meet one person in all my travels who doesn't say they are too busy, they wish they had a little more time. If most of us have lost, as some poets suggest, our meaningful, deep relationships with the world 80 of nature, poems help us to see and feel that world again, beyond our cities and double-locked doors. I have learned as much about nature from the poems of Mary Oliver as I have ever learned walking in the woods.

85 And since we now live in a world where activities in one person's woods have a direct relationship on countries far away—the disappearing rain forests in southern Mexico and Hawaii and the changing weather everywhere, for example—we need to know one 90 another. It is an imperative, not a luxury.

21. Which of the following quotations from the passage best expresses the main idea of the piece?
- "Years ago a girl handed me a note as I was leaving her proud town of Albany, Texas, a tiny, lovely place far in the west of our big state" (lines 1–3).
  - "How many other lights had I missed?" (lines 9–10).
  - "One of the first books I loved in my life was a thick, gray anthology edited by Helen Ferris, called *Favorite Poems Old and New*" (lines 21–23).
  - "Our words and images, land to land, era to era, shed light on one another" (lines 29–30).

22. It can most reasonably be inferred that the narrator includes references to several poets to make clear that she:
- F. appreciates a wide range of poetry.
  - G. usually reads poetry that was written by one of the poets mentioned.
  - H. prefers reading poetry anthologies to reading the full-length works by a single poet.
  - J. prefers Syrian poets to American poets such as Carl Sandburg or Emily Dickinson.
23. It can reasonably be inferred that the narrator's perspective on poetry is most different from that of which of the following people?
- A. A girl in Albany, Texas (lines 1–6)
  - B. Muhammad al Maghut (lines 32–34)
  - C. The teachers (lines 37–40)
  - D. The students (lines 59–63)
24. The narrator's statement in lines 18–21 most nearly means that she feels connected to people simply through:
- F. knowing the details of their family history.
  - G. conversing with them occasionally.
  - H. being aware of their existence.
  - J. teaching them about poetry.
25. As it is used in line 31, the word *shadows* most nearly means:
- A. outlines.
  - B. reflections.
  - C. spirits.
  - D. barriers.
26. As it is used in lines 53–54, the phrase *far away* most nearly means:
- F. something that they haven't read before.
  - G. a distant goal for future study and learning.
  - H. not at all a part of who they are.
  - J. only a minor, passing interest.
27. The narrator most strongly implies that when she presents her students with a poem she doesn't really understand, she invites her students to:
- A. help make the poem's single meaning clear to her.
  - B. make their own various interpretations.
  - C. analyze the poem together and as a group decide on its one true meaning.
  - D. disregard the meaning of the poem and instead study its structure.
28. The narrator's statement in lines 78–81 best supports a suggestion made earlier in the eighth paragraph (lines 73–84) that poetry:
- F. is, if it expresses our loss of nature, the most enlightening and relevant art of our time.
  - G. is often about nature, especially if it is written by Mary Oliver.
  - H. connects the many critical aspects of city people's busy lives.
  - J. links aspects of experience that seem markedly different or distant from one another.
29. The narrator states that she was intrigued by the earliest poems she experienced that gave her insight into all the secret territories of:
- A. other countries.
  - B. the human spirit.
  - C. words and images.
  - D. the world of nature.
30. The narrator proposes that some people have lost the ability to find poetry inviting as a result of a focus in classrooms on poetry:
- F. analysis.
  - G. writing.
  - H. recitation.
  - J. memorization.

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## Passage IV

**NATURAL SCIENCE:** This passage is adapted from the book *Life's Matrix: A Biography of Water* by Philip Ball (©1999 by Philip Ball).

Every day, every passing second, water is on the move. The rivers flow, the oceans perform their slow and elegant gyrations, the clouds congeal and weep. Each 3,100 years, a volume of water equivalent to all 5 the oceans passes through the atmosphere, carried there by evaporation and removed by precipitation. Yet only a thousandth of 1 percent of the planet's total water resides in the atmosphere at any moment, enough to deposit just one inch of rain if it all fell uniformly 10 throughout the world. This constant overturn of water between the reservoirs on land, in sea, and in sky is called the hydrological cycle, and it is as crucial for life on Earth as is the presence of liquid water in the first place.

15 Most of the water that falls as rain has found its way into the sky from the sea surface: the Sun's heat removes from the oceans the equivalent of three feet in depth each year—208 cubic miles in total every day. A further 38 cubic miles evaporates each day from the 20 land surface. Of course, this rate of evaporation varies widely with the seasons and with geographical location: because the tropics are warmer, the rate of evaporation there is at least four times greater than at the poles.

Evaporation from the ground and from plants (a 25 process called transpiration) removes water to the atmosphere, while precipitation, generally as rain and snow, supplies it to the land. The difference between precipitation and evaporation defines the amount of fresh water available for lakes, streams, and other 30 reserves on land. This "runoff," which is mostly returned to the oceans through rivers, adds up to about 24 cubic miles globally per day.

The various cogs of the hydrological cycle turn at a wide range of speeds. Rainfall in a river's upland 35 source region can take weeks to reach the sea, while water vapor evaporated from the sea surface typically takes about ten days to fall again as rain. For water locked up as ice (in the so-called cryosphere), the cogs may grind slowly indeed. The water at the base of the 40 polar ice sheets has typically been frozen for hundreds of thousands of years. Most mountain glaciers melt and recede by several miles every decade under present-day conditions, while the sea ice in the polar seas expands and retreats seasonally.

45 The very existence of a hydrological cycle is a consequence of water's unique ability to exist in more than one physical state—solid, liquid, or gas—under the conditions that prevail at the surface of the planet. Volcanic areas excepted, the Earth's surface never gets 50 hot enough to boil water; but it evaporates readily nonetheless, since the amount of water vapor in the air is generally well below the "saturation vapor pressure," which indicates the maximum humidity of air before

water droplets start to condense. That's why the oceans 55 are, to a greater or lesser degree, always "steaming." When moist air cools, the water vapor may condense back to the liquid state, producing the pearly billows of clouds or the dank blankets of mountain mist.

The freezing of water, meanwhile, can send it on a 60 millennia-long detour from the cycle of evaporation and precipitation. Yet the ability of water to enter the solid state is also a crucial aspect of the overall cycle. When water is frozen during the ice ages, the world's seas recede, the climate becomes drier, deserts expand, 65 and ecosystems may be utterly transformed.

The hydrological cycle emphasizes the dynamic nature of the Earth's environment: it is constantly repeating and renewing itself. Substances other than 70 water are cycled by geological and biological processes too. These cyclic sequences of chemical and biological transformation of the elements are called biogeochemical cycles.

Water is the lubricant for biogeochemical cycling. Because it is such a superb solvent, and because it is 75 itself in constant flux, it helps to convey other substances hither and thither, between different ecosystems and different climates. Carbon dioxide in the atmosphere dissolves in the surface waters of the sea to provide a carbon source for marine photosynthesis, and in 80 turn this biological growth in the ocean's upper layer drives the rest of the ocean's carbon cycle. Essential nutrients pervade the seas in soluble form: nitrate, phosphate, sulfate, and metals such as iron. The swift churning of the hydrological cycle helps to drive the 85 cycling of these other substances: rain and rivers flush inorganic nutrients out of the minerals of the rocky Earth and carry them to the sea. There is little exaggeration in saying that it is water, in the end, that makes the world go round.

31. The main idea of the passage is not only that the presence of water on Earth is crucial for life, but also that water is:

- A. supplied to land through precipitation.
- B. abundant in a liquid state.
- C. constantly in motion.
- D. a superb solvent.

32. Which of the following phrases most accurately describes how the hydrological cycle is portrayed in the passage?

- F. Intricate and vital
- G. Unpredictable and elusive
- H. Crucial but undependable
- J. Simple but mysterious

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33. The passage most strongly supports which of the following inferences about the hydrological cycle?
- It tends to progress more slowly in colder climates than in warmer climates.
  - It depends on a greater volume of water being evaporated than being returned to land as rain or snow.
  - It tends to make the deserts drier and the sea levels higher.
  - It is mainly a function of the land surface being heated by the Sun.
34. Which of the following is NOT mentioned in the passage as directly resulting from evaporation or condensation?
- Billows of clouds
  - "Steaming" oceans
  - Blankets of mountain mist
  - Sea ice in the polar seas
35. The main purpose of the last paragraph is to:
- raise questions about basic assumptions concerning the hydrological cycle.
  - introduce new theories regarding the hydrological cycle.
  - illustrate a primary function of the hydrological cycle.
  - speculate about unknown functions of the hydrological cycle.
36. According to the passage, what percent of Earth's total water is present in the atmosphere at any particular moment?
- Between 1 and 5 percent
  - About 1 percent
  - A tenth of 1 percent
  - A thousandth of 1 percent
37. As it is used in line 9, the word *uniformly* most nearly means:
- recurrently.
  - evenly.
  - simply.
  - inconspicuously.
38. According to the passage, the atmosphere acquires most of the water that later falls as rain from which of the following sources?
- Polar ice sheets
  - The sea surface
  - Land surfaces in the tropics
  - Freshwater lakes and rivers
39. Based on the passage, which of the following can most reasonably be inferred about air whose humidity has reached the saturation vapor pressure?
- It will no longer absorb additional water.
  - It will cause the oceans to stop absorbing carbon dioxide.
  - It will begin to absorb nutrients such as nitrates and phosphates.
  - It will not produce clouds or mist.
40. Based on the passage, the role of water in biogeochemical cycling can best be described as:
- competitive.
  - peripheral.
  - facilitative.
  - illustrative.

END OF TEST 3

**STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.  
DO NOT RETURN TO A PREVIOUS TEST.**

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## 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

Table 1 lists 4 genes found in *Pisum sativum* (a garden pea), the possible alleles of each gene, and the possible genotypes for each gene.

Table 1		
Gene	Alleles	Genotypes
A	<i>A, a</i>	<i>AA, Aa, aa</i>
B	<i>B, b</i>	<i>BB, Bb, bb</i>
D	<i>D, d</i>	<i>DD, Dd, dd</i>
E	<i>E, e</i>	<i>EE, Ee, ee</i>

Table 2 lists various garden pea genotypes and the phenotype associated with each genotype. Each gene affects only 1 of the 4 phenotypic traits listed.

Genotype	Phenotype			
	flower color	pod color	seed shape	stem length
<i>AABBDDEE</i>	purple	green	round	tall
<i>AABBDDEe</i>	purple	green	round	tall
<i>AABBDDee</i>	purple	green	round	short
<i>AABBdDEE</i>	purple	green	round	tall
<i>AABBddEE</i>	purple	green	wrinkled	tall
<i>AABbddEE</i>	purple	green	wrinkled	short
<i>AabbddEE</i>	purple	yellow	wrinkled	tall
<i>AabbDDee</i>	purple	yellow	round	short
<i>aabbddEE</i>	white	yellow	wrinkled	short
<i>aabBdDEE</i>	white	green	wrinkled	tall
<i>aaBBDDEE</i>	white	green	round	tall
<i>AaBbDdEe</i>	purple	green	round	tall

Table 3 lists 4 garden pea crosses, the genotypes of the parents, and the percent of offspring that displayed each phenotype for the 4 traits listed in Table 2. In each cross, each parent donated 1 allele to each offspring at each gene.

Cross*	Genotype of:		Offspring phenotype			
	female parent	male parent	flower color	pod color	seed shape	stem length
1	<i>AABBDDEE</i>	<i>AABBDDEE</i>	100% purple	100% green	100% round	100% tall
2	<i>aaBbddEe</i>	<i>aaBbddEe</i>	100% white	75% green 25% yellow	100% wrinkled	75% tall 25% short
3	<i>aaBbDdee</i>	<i>AabbddEe</i>	50% purple 50% white	50% green 50% yellow	50% round 50% wrinkled	50% tall 50% short
4	<i>AabbDdee</i>	<i>AabbDdee</i>	75% purple 25% white	100% yellow	75% round 25% wrinkled	100% short

\*For each cross, multiple matings were performed.

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1. Based on Table 2, which of the 4 genes affects seed shape?
- Gene A
  - Gene B
  - Gene D
  - Gene E
2. Based on Table 2, a *P. sativum* plant with 1 dominant allele for each of the 4 genes will have which of the following phenotypes?
- White flowers, yellow pods, wrinkled seeds, tall stems
  - White flowers, yellow pods, wrinkled seeds, short stems
  - Purple flowers, green pods, round seeds, short stems
  - Purple flowers, green pods, round seeds, tall stems
3. In 1 of the crosses listed in Table 3, for each trait, the offspring were split evenly between the 2 possible phenotypes. In this cross, the genotypes of the female parent and the male parent were, respectively:
- AABBDDEE* and *AABBDDEE*.
  - aaBbDdee* and *aaBbDdee*.
  - aaBbDdee* and *AabbddEe*.
  - aabbDdee* and *AabbddEe*.
4. Based on the information presented, all of the offspring of Cross 4 had yellow pods because each received:
- Allele *A* from its female parent and Allele *a* from its male parent.
  - Allele *b* from its female parent and Allele *b* from its male parent.
  - Allele *d* from its female parent and Allele *D* from its male parent.
  - Allele *E* from its female parent and Allele *e* from its male parent.
5. In Cross 3, what percent of the offspring had Genotype *BB*?
- 0%
  - 25%
  - 50%
  - 75%

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**Passage II**

Figure 1 shows the life cycle of the malaria parasite. *Gametocytes* and *sporozoites* are 2 forms of the parasite.

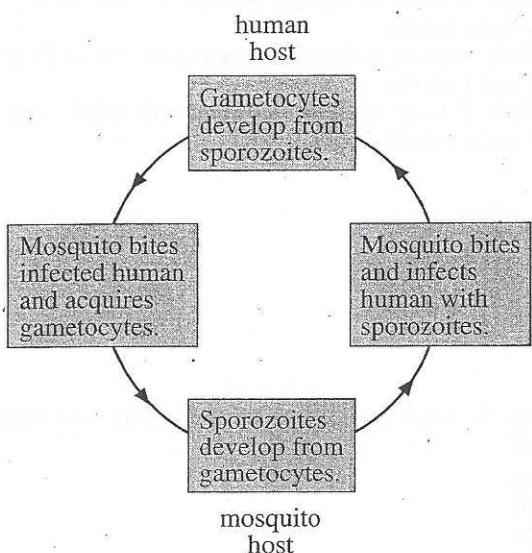


Figure 1

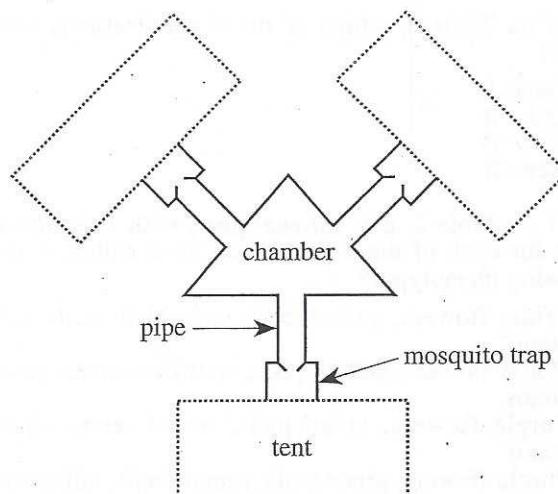
For the parasite to survive, mosquitoes must bite humans infected with gametocytes. Therefore, 2 studies were conducted to determine whether mosquitoes are most attracted to humans infected with gametocytes.

**Study 1**

Three groups (Groups X, Y, and Z), each with 12 human subjects (Subjects 1–12), were identified (see Table 1).

Table 1	
Group	Malaria infection status of subjects
X	Uninfected
Y	Sporozoites present
Z	Gametocytes present

Three subjects—one from each group—rested in separate, but identical, tents of mosquito netting attached to the same central chamber. A mosquito trap was inserted between the chamber and each tent to capture any mosquitoes trying to enter the tent (see Figure 2).



Note: Dotted lines indicate mosquito netting.

Figure 2

In the first trial 100 uninfected mosquitoes were released into the chamber. Thirty minutes later the number of mosquitoes attracted to each subject was determined. This procedure was repeated in 11 more trials until all subjects had been tested. Then, for each group, the average number of mosquitoes attracted to a subject was calculated (see Figure 3). All infected subjects were then treated to cure their sporozoite or gametocyte infections.

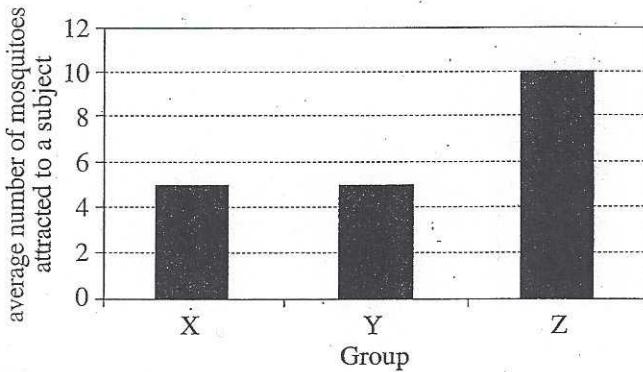


Figure 3

**Study 2**

The procedure from Study 1 was repeated with Group X subjects and the cured subjects from Groups Y and Z. Figure 4 shows the proportion of *responsive* mosquitoes (those caught in a trap) that were attracted to the Group Z subjects before treatment and after being cured of their gametocyte infections.

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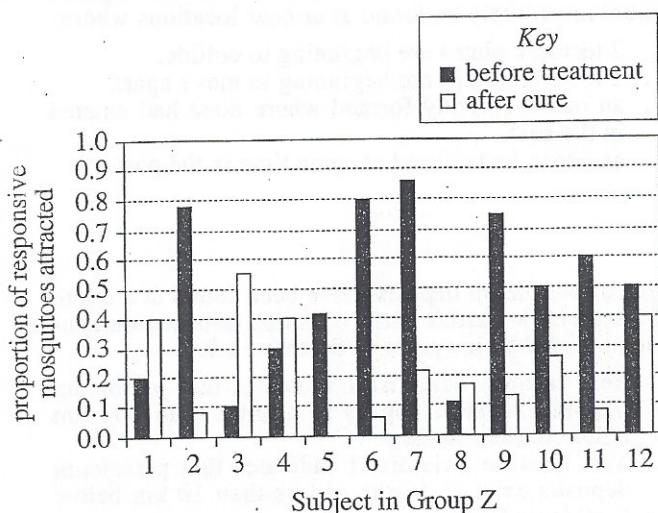


Figure 4

Figures adapted from Renaud Lacroix et al., "Malaria Infection Increases Attractiveness of Humans to Mosquitoes." ©2005 by Renaud Lacroix et al.

6. Assume that a subject's attractiveness to mosquitoes depends on body temperature. Based on Figure 4, the body temperature of which of the following Group Z subjects, with which treatment status, was most attractive to mosquitoes?
  - F. Subject 1, before treatment
  - G. Subject 1, after cure
  - H. Subject 9, before treatment
  - J. Subject 9, after cure
7. Do the results of Study 1 support the hypothesis that mosquitoes are more attracted to human subjects infected with gametocytes than to human subjects infected with sporozoites or to uninfected human subjects?
  - A. Yes; on average, more mosquitoes were attracted to subjects from Group X than to subjects from Group Y or Z.
  - B. Yes; on average, more mosquitoes were attracted to subjects from Group Z than to subjects from Group X or Y.
  - C. No; on average, more mosquitoes were attracted to subjects from Group X than to subjects from Group Y or Z.
  - D. No; on average, more mosquitoes were attracted to subjects from Group Z than to subjects from Group X or Y.

8. Based on Figure 4, how many of the subjects in Group Z attracted a greater proportion of the responsive mosquitoes *after* their infections were cured than before they were treated?
  - F. 0
  - G. 4
  - H. 8
  - J. 12
9. Which of the following is the most likely reason that subjects infected with gametocytes were tested both before and after their infections were cured?
  - A. To determine whether mosquitoes were attracted to these subjects because of the subjects' infections
  - B. To make sure that gametocytes were found in the red blood cells of the subjects
  - C. To determine how many gametocytes were present in the subjects
  - D. To make sure that the mosquitoes were not killed by the drugs used to treat malaria
10. In Studies 1 and 2, which group—Group X or Group Y—more likely served as the standard of comparison allowing the researchers to compare the results for Group Z from Study 1 to the results for Group Z from Study 2?
  - E. Group X, because the infection status of the Group X subjects was different in Study 1 and Study 2.
  - F. Group X, because the infection status of the Group X subjects was the same in Study 1 and Study 2.
  - G. Group Y, because the infection status of the Group Y subjects was different in Study 1 and Study 2.
  - H. Group Y, because the infection status of the Group Y subjects was the same in Study 1 and Study 2.
  - J. Group Y, because the infection status of the Group Y subjects was the same in Study 1 and Study 2.
11. Which of the following procedures was most likely employed to ensure that the mosquitoes were attracted to a specific subject rather than to a specific tent?
  - A. Releasing the same number of mosquitoes into each tent in each trial
  - B. Releasing a different number of mosquitoes into each tent in each trial
  - C. Assigning the subjects to tents in a random manner in each trial
  - D. Assigning the gametocyte subject to the same tent in each trial

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### Passage III

*Petroleum* (crude oil) is brought to Earth's surface from large underground deposits that are mostly 0.5–0.7 km below Earth's surface. Two scientists discuss the origin of petroleum.

#### Scientist 1

All of Earth's current supply of petroleum formed within the last 600 million years from once-living matter. Petroleum formation began when the remains of microscopic marine organisms accumulated on the seafloor over a long period. Fine-grained ocean sediments buried the remains. Beneath the ocean floor, at depths of less than 10 km below Earth's surface, heat and pressure over millions of years changed the remains into petroleum.

After forming, the petroleum migrated upward to depths where it accumulated in large deposits at specific locations in Earth's crust. Petroleum contains *biomarkers*, compounds that can be produced only through the breakdown of once-living matter. Fossils of the marine organisms that provided the raw material for petroleum are found in rocks brought to the surface from locations where petroleum is known to have formed.

Because of the unique conditions and time necessary for petroleum formation, there is a limited supply available in Earth's crust.

#### Scientist 2

All of Earth's petroleum has formed from simple, inorganic carbon compounds at depths from 100 km to 200 km below Earth's surface. Petroleum formation has been occurring constantly since shortly after Earth's formation. The process begins as water reacts with simple, inorganic carbon compounds to form simple hydrocarbons such as methane. Those simple hydrocarbons then combine under pressure to produce petroleum.

After forming, the petroleum migrates upward to much shallower depths where it accumulates in large deposits at specific locations in Earth's crust. Most petroleum deposits exist along tectonic plate boundaries, where the petroleum can rise from depths greater than 100 km through deep fractures in Earth's crust. A helium isotope, commonly found associated with petroleum, originates only at depths greater than 100 km and is brought up from those depths by the rising petroleum.

Since petroleum is constantly forming and rising toward the surface, there is an unlimited supply available.

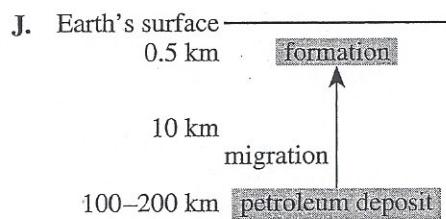
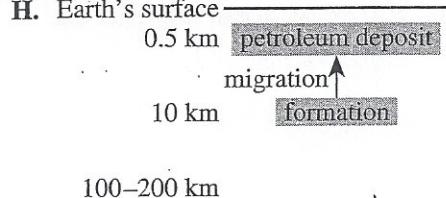
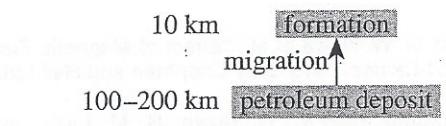
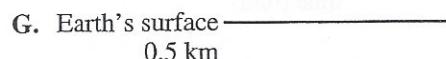
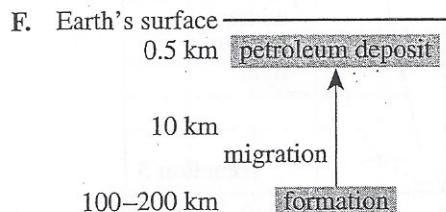
12. Based on Scientist 1's discussion, petroleum deposits would most likely be found at or near locations where:
  - F. 2 tectonic plates are beginning to collide.
  - G. 2 tectonic plates are beginning to move apart.
  - H. an ocean recently formed where none had existed in the past.
  - J. an ocean had existed at some time in the past.
  
13. Several petroleum deposits have been found at a depth of 5 km below Earth's surface. Is this information consistent with the viewpoint of Scientist 1?
  - A. Yes, because Scientist 1 indicates that petroleum deposits exist at depths of greater than 100 km below Earth's surface.
  - B. Yes, because Scientist 1 indicates that petroleum deposits exist at depths of less than 10 km below Earth's surface.
  - C. No, because Scientist 1 indicates that petroleum deposits exist at depths of greater than 100 km below Earth's surface.
  - D. No, because Scientist 1 indicates that petroleum deposits exist at depths of less than 10 km below Earth's surface.
  
14. Which scientist indicates that petroleum has formed in the higher pressure environment?
  - F. Scientist 1, because that scientist states that petroleum has formed at depths of less than 10 km below Earth's surface.
  - G. Scientist 1, because that scientist states that petroleum has formed at depths of greater than 100 km below Earth's surface.
  - H. Scientist 2, because that scientist states that petroleum has formed at depths of less than 10 km below Earth's surface.
  - J. Scientist 2, because that scientist states that petroleum has formed at depths of greater than 100 km below Earth's surface.
  
15. An experiment demonstrated that petroleum can be formed through a reaction of carbon dioxide and water. Which scientist would most likely use this demonstration to support his/her viewpoint?
  - A. Scientist 1, because it would demonstrate how marine organisms can be changed into petroleum.
  - B. Scientist 1, because it would demonstrate how simple carbon compounds can be changed into petroleum.
  - C. Scientist 2, because it would demonstrate how marine organisms can be changed into petroleum.
  - D. Scientist 2, because it would demonstrate how simple carbon compounds can be changed into petroleum.

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16. Which of the following diagrams is most consistent with Scientist 2's description of the formation and migration of petroleum? (Note: Diagrams are not to scale.)



17. Based on the scientists' discussions, which of the following statements describes the 2 physical properties of petroleum that are most important in facilitating its movement from the location at which it forms to the location at which it accumulates in a large deposit? Petroleum is a:

- A. fluid that is more dense than the material that it moves through.
- B. fluid that is less dense than the material that it moves through.
- C. solid that is more dense than the material that it moves through.
- D. solid that is less dense than the material that it moves through.

18. Based on Scientist 2's discussion, which of the following compounds is involved in the formation of petroleum?

- I.  $\text{CH}_4$
- II.  $\text{N}_2$
- III.  $\text{NaCl}$
- E. I only
- G. III only
- H. I and II only
- J. II and III only

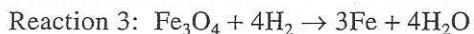
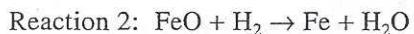
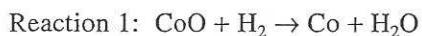
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## Passage IV

If a metal oxide sample at high temperature is exposed to a stream of H<sub>2</sub> gas, it may be converted to a pure metal. Reactions 1–3 are examples of this process for a cobalt oxide and 2 different iron oxides, respectively.



During the reaction, the H<sub>2</sub> stream carries away H<sub>2</sub>O, so the resulting sample is composed of metal oxide and pure metal only.

Figures 1–3 show how the *percent of pure metal*, % PM, in metal oxide samples changed over time as they underwent Reactions 1–3, respectively, with and without a magnetic field present.

$$\% \text{ PM} = \frac{\text{mass of metal}}{\text{mass of metal oxide} + \text{mass of metal}} \times 100$$

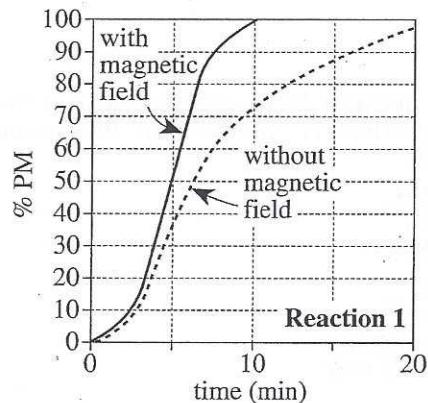


Figure 1

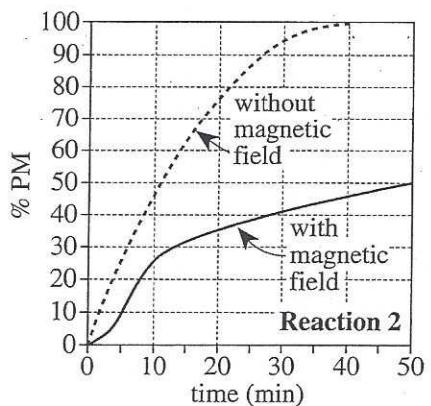


Figure 2

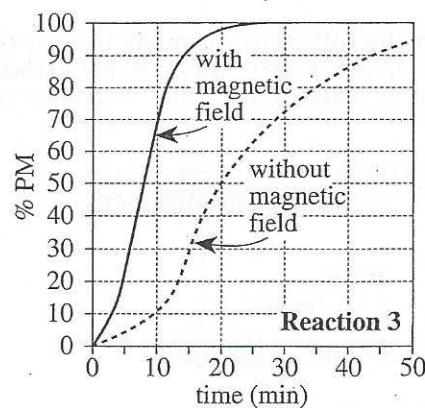


Figure 3

Figure 1 adapted from M. W. Rowe et al., "Effect of Magnetic Field on Reduction of Cobalt Oxides." ©1979 by Chapman and Hall Ltd.

Figures 2 and 3 adapted from M. W. Rowe, S. M. Lake, and R. Fanick, "Effect of Magnetic Field on Reduction of Iron Oxides: Magnetite and Wüstite." ©1977 by Macmillan Magazines Ltd.

19. According to Figure 2, during Reaction 2 without a magnetic field, the % PM at 10 min was approximately:
- 25%.
  - 35%.
  - 45%.
  - 55%.
20. Suppose that during Reaction 2 with a magnetic field, the magnetic field had been removed at time = 10 min. Five minutes later, at time = 15 min, the % PM would most likely have been:
- less than 30%.
  - between 30% and 60%.
  - between 60% and 90%.
  - greater than 90%.

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21. According to Figure 3, in Reaction 3, how did the addition of a magnetic field affect the yield of pure Fe metal? At 20 min, the yield obtained with a magnetic field was about:
- $\frac{1}{4}$  the yield obtained without a magnetic field.
  - $\frac{1}{2}$  the yield obtained without a magnetic field.
  - the same as the yield obtained without a magnetic field.
  - 2 times the yield obtained without a magnetic field.
22. A chemist claimed that the conversion of a metal oxide to a pure metal using H<sub>2</sub> gas will always occur faster with a magnetic field than without a magnetic field. Do Figures 1–3 confirm this claim?
- Yes; the % PM reached 0% sooner with a magnetic field than it did without a magnetic field in all 3 reactions.
  - Yes; the % PM reached 100% sooner with a magnetic field than it did without a magnetic field in all 3 reactions.
  - No; the % PM reached 0% sooner without a magnetic field than it did with a magnetic field in Reaction 2.
  - No; the % PM reached 100% sooner without a magnetic field than it did with a magnetic field in Reaction 2.

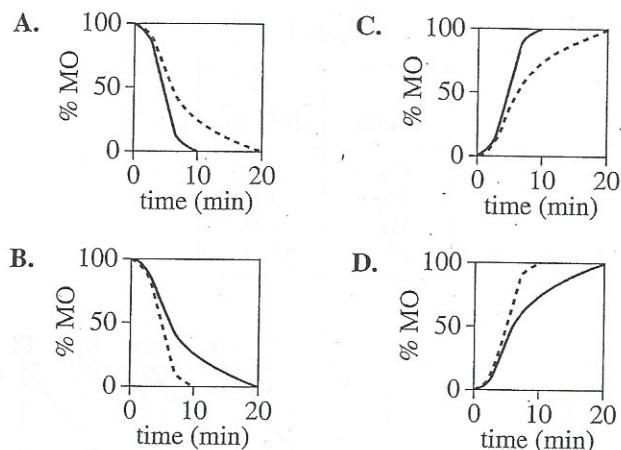
23. Suppose that Figure 1 had instead been plotted as *percent of metal oxide* (% MO) versus time:

$$\% \text{ MO} = \frac{\text{mass of metal oxide}}{\text{mass of metal oxide} + \text{mass of metal}} \times 100$$

Which of the following graphs best shows how Figure 1 would have appeared?

Key

— with magnetic field  
- - - without magnetic field



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### Passage V

For a photon to free an electron from a metal, the photon's frequency,  $f$ , must equal or exceed the *threshold frequency*,  $f_T$ , for the metal. If  $f > f_T$ , the photon has extra energy that is transferred to the electron as kinetic energy, resulting in the ejection of the electron from the metal.  $K_{\max}$  is the highest kinetic energy an ejected electron can have for a given  $f$ .

Table 1 displays  $f_T$  for the metals calcium (Ca), magnesium (Mg), mercury (Hg), and platinum (Pt). Figure 1 is a graph of  $K_{\max}$  versus  $f$  for each of the 4 metals. Figure 2 is a graph of a photon's energy versus its  $f$ .

Table 1	
Metal	$f_T$ ( $10^{14}$ Hz)
Ca	6.55
Mg	8.84
Hg	10.9
Pt	13.0

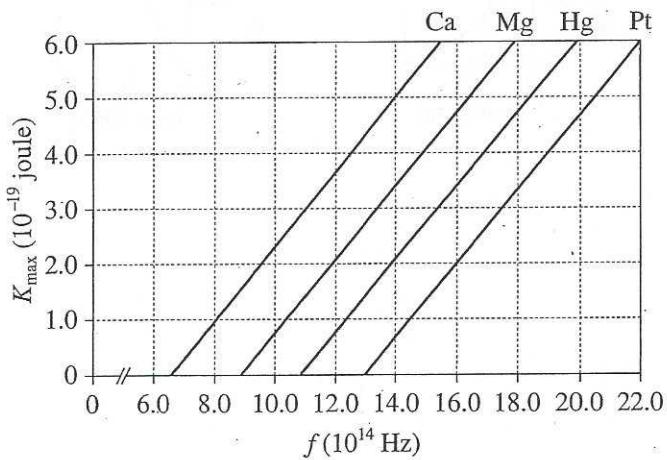


Figure 1

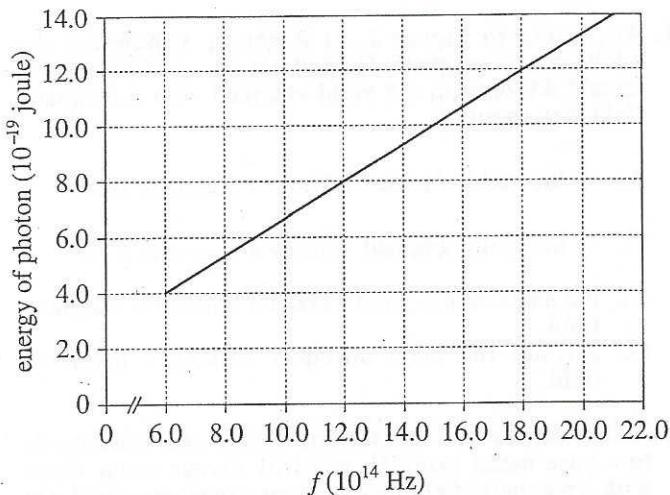


Figure 2

24. For a photon to free an electron from Ca, the photon's frequency must be at least:
- $1.15 \times 10^{14}$  Hz.
  - $2.45 \times 10^{14}$  Hz.
  - $6.55 \times 10^{14}$  Hz.
  - $9.45 \times 10^{14}$  Hz.
25. Based on Figure 1, which of the following correctly ranks Ca, Mg, and Pt in order of increasing  $K_{\max}$  at  $f = 16.0 \times 10^{14}$  Hz?
- Pt, Mg, Ca
  - Pt, Ca, Mg
  - Mg, Pt, Ca
  - Mg, Ca, Pt

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26. Based on Table 1 and Figure 2, the *threshold energy*,  $E_T$ , for Hg is closest to which of the following?

- F.  $3 \times 10^{-19}$  joule
- G.  $5 \times 10^{-19}$  joule
- H.  $7 \times 10^{-19}$  joule
- J.  $9 \times 10^{-19}$  joule

27. Based on Figure 1, for electrons ejected from Pt by photons having  $f = 28.0 \times 10^{14}$  Hz,  $K_{\max}$  would be:

- A. less than  $1.0 \times 10^{-19}$  joule.
- B. between  $1.0 \times 10^{-19}$  joule and  $4.0 \times 10^{-19}$  joule.
- C. between  $4.0 \times 10^{-19}$  joule and  $7.0 \times 10^{-19}$  joule.
- D. greater than  $7.0 \times 10^{-19}$  joule.

28. Photons having  $f = 11.8 \times 10^{14}$  Hz and photons having  $f = 13.3 \times 10^{14}$  Hz are shone separately upon a new metal, Metal X, resulting in ejected electrons with the following  $K_{\max}$ :

$f$ ( $10^{14}$ Hz)	$K_{\max}$ ( $10^{-19}$ joule)
11.8	2.5
13.3	3.5

Based on Figure 1 and Table 1, the  $f_T$  of Metal X is most likely closest to which of the following?

- F.  $6.0 \times 10^{14}$  Hz
- G.  $8.0 \times 10^{14}$  Hz
- H.  $10.0 \times 10^{14}$  Hz
- J.  $12.0 \times 10^{14}$  Hz

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### Passage VI

At constant temperature and pressure, the ratio in which the volumes of gases react and form products is indicated by the balanced chemical equation for the reaction. For example, consider the balanced chemical equation for hypothetical Gases A, B, and C:



At constant temperature and pressure, 1 L of Gas A will react with 2 L of Gas B to form 1 L of Gas C.

Students did experiments at constant room temperature and pressure to determine the ratio in which nitric oxide (NO) and O<sub>2</sub> (either pure, or from air) react to form nitrogen dioxide (NO<sub>2</sub>).

The same procedure was used with various initial volumes of NO and O<sub>2</sub> (see Table 1).

Table 1

Trial	Volume of NO (mL)	Volume of O <sub>2</sub> (mL)	Final volume (mL)	Syringe I contents (mL)		
				NO	O <sub>2</sub>	NO <sub>2</sub>
1	20	20	30	0	10	20
2	40	20	40	0	0	40
3	20	40	50	0	30	20
4	30	10	30	10	0	20

### Experiment 1

Two glass syringes (Syringes I and II) were lubricated so their plungers would move freely. Then, 20 mL of NO was introduced into empty Syringe I through its tip and the tip was closed. Next, 20 mL of O<sub>2</sub> was introduced into empty Syringe II through its tip and the tip was closed. The syringes were then attached to each other and the tips were opened. The plunger of Syringe II was pushed to the bottom (emptying its content into Syringe I) and its tip was closed. After the reaction was complete, the final volume of gas in Syringe I was recorded and its contents were analyzed (see Figure 1).

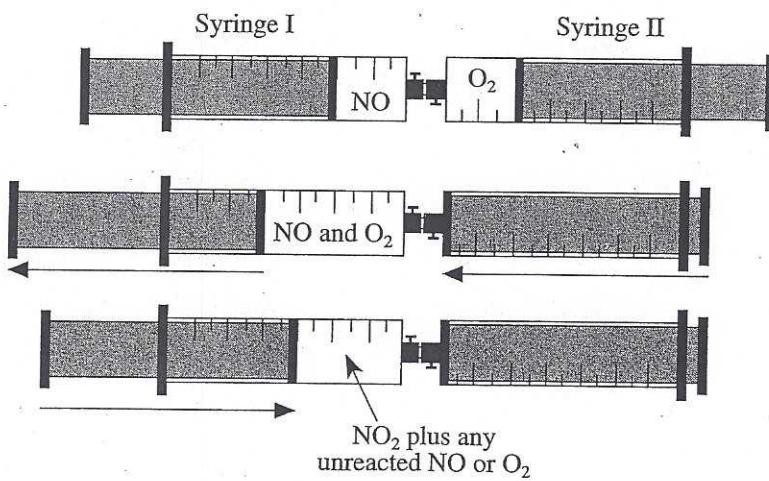


Figure 1

Figure 1 adapted from Donald D. DuPré, "A Simple Demonstration of the Law of Combining Volumes." ©1993 by Division of Chemical Education, Inc., American Chemical Society.

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## Experiment 2

The procedure from Experiment 1 was used to test 20 mL of air (instead of O<sub>2</sub>) mixed with various amounts of NO (see Table 2).

Table 2

Trial	Volume of NO (mL)	Volume of air (mL)	Final volume (mL)	Syringe I contents (mL)			
				NO	O <sub>2</sub>	NO <sub>2</sub>	Other gases
5	4	20	22	0	2	4	16
6	8	20	24	0	0	8	16
7	16	20	32	8	0	8	16
8	32	20	48	24	0	8	16

29. In Experiment 2, from trial to trial, as the volume of NO was increased, the volume of NO<sub>2</sub> produced:
- increased only.
  - decreased only.
  - increased, then remained constant.
  - decreased, then remained constant.
30. In which of the trials of Experiments 1 and 2 were all of the gases in the syringes completely converted to NO<sub>2</sub>?
- Trial 1
  - Trial 2
  - Trial 5
  - Trial 6
31. The reactant that is used up first in a reaction is called the *limiting reagent*. What was the limiting reagent in Trial 1?
- NO
  - O<sub>2</sub>
  - NO<sub>2</sub>
  - Air
32. Based on Experiment 1, the balanced chemical equation for the reaction of NO and O<sub>2</sub> to form NO<sub>2</sub> is:
- NO + 2O<sub>2</sub> → NO<sub>2</sub>
  - 2NO + O<sub>2</sub> → NO<sub>2</sub>
  - NO + 2O<sub>2</sub> → 2NO<sub>2</sub>
  - 2NO + O<sub>2</sub> → 2NO<sub>2</sub>
33. NO<sub>2</sub> readily dissolves in H<sub>2</sub>O to form a strong acid, while NO and O<sub>2</sub> do not. Suppose the final contents of Syringe I from each of Trials 1–4 had been injected into one of four 5 mL samples of pure H<sub>2</sub>O. The pH would have been *lowest* in the sample injected with the Syringe I contents from:
- Trial 1.
  - Trial 2.
  - Trial 3.
  - Trial 4.
34. Which of the following best describes what occurred to the plunger of Syringe I during Trial 2? When O<sub>2</sub> was injected from Syringe II into Syringe I, the distance between the end of the plunger and the syringe tip:
- increased; then, as the reaction occurred, the distance decreased.
  - increased; then, as the reaction occurred, the distance increased more.
  - decreased; then, as the reaction occurred, the distance decreased more.
  - decreased; then, as the reaction occurred, the distance increased.

4



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## Passage VII

A *physical pendulum* is an object that is suspended vertically from a rigid support (see example in Figure 1).

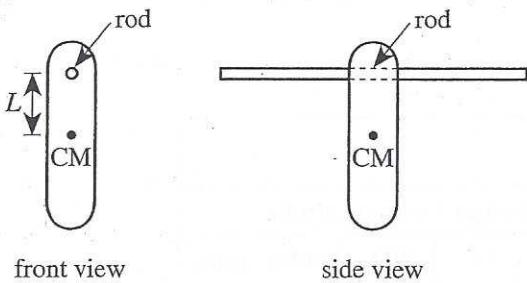


Figure 1

$L$  is the distance between the rod (the rigid support) and the pendulum's center of mass (CM). When the pendulum is displaced from its equilibrium position and then released, it *oscillates* (swings back and forth) about the rod, which acts as the axis of rotation.

Students tested several types of physical pendulums. In each trial, first, they computed the *moment of inertia*,  $I$ , in kilogram meters<sup>2</sup> ( $\text{kg m}^2$ ), of a pendulum. ( $I$  is a measure of the mass of a pendulum and how the mass is distributed.) Next, they displaced the pendulum slightly from its equilibrium position, released it, and measured the time, in seconds, it took the pendulum to oscillate through 20 cycles (1 cycle is 1 round-trip back and forth). Finally, they computed the pendulum's average *period*,  $P$  (the average time it took to complete 1 cycle).

## Study 1

In Trials 1–5, each pendulum was a 1.0 kg solid sphere with a diameter,  $D$ , of 0.20 m (see Figure 2).

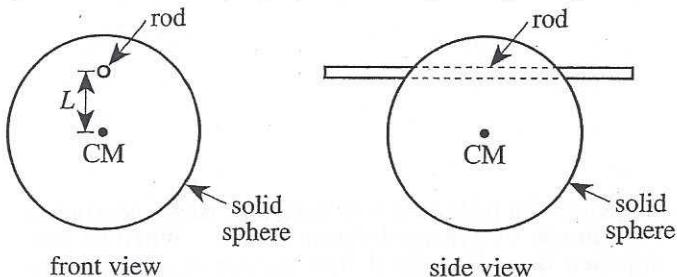


Figure 2

Each pendulum, however, had a different  $L$ . The results are shown in Table 1.

Table 1

Trial	$L$ (m)	$I$ ( $10^{-3}$ kg m <sup>2</sup> )	$P$ (sec)
1	0.020	4.40	0.94
2	0.040	5.60	0.75
3	0.060	7.60	0.71
4	0.080	10.4	0.72
5	0.090	12.1	0.74

## Study 2

In Trials 6–10, each pendulum was a 1.0 kg thin, flat circular plate with  $D = 0.20$  m (see Figure 3).

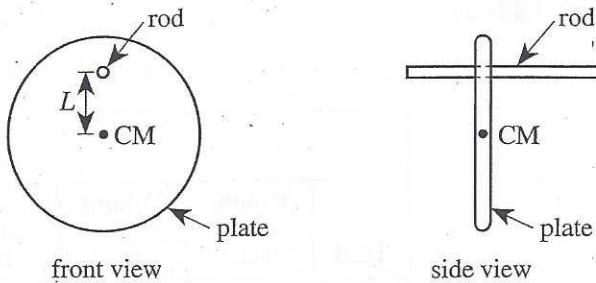


Figure 3

Each pendulum had a different  $L$  (see Table 2).

Table 2

Trial	$L$ (m)	$I$ ( $10^{-3}$ kg m <sup>2</sup> )	$P$ (sec)
6	0.020	5.40	1.04
7	0.040	6.60	0.82
8	0.060	8.60	0.76
9	0.080	11.4	0.76
10	0.090	13.1	0.77

## Study 3

In Trials 11–15, each pendulum was a 1.0 kg thin, spherical shell with  $D = 0.20$  m (see Figure 4).

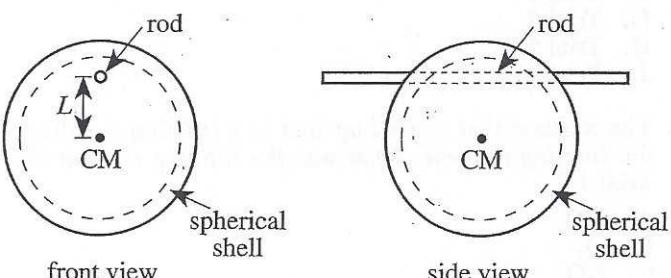


Figure 4

Each pendulum had a different  $L$  (see Table 3).

Table 3

Trial	$L$ (m)	$I$ ( $10^{-3}$ kg m <sup>2</sup> )	$P$ (sec)
11	0.020	7.07	1.19
12	0.040	8.27	0.91
13	0.060	10.3	0.83
14	0.080	13.1	0.81
15	0.090	14.8	0.81

4



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35. If an additional trial had been conducted in Study 1 with  $L = 0.030\text{ m}$ ,  $P$  for this additional trial would most likely have been:
- less than 0.71 sec.
  - between 0.71 sec and 0.75 sec.
  - between 0.75 sec and 0.94 sec.
  - greater than 0.94 sec.
36. In each study, as the distance between the CM and the horizontal rod increased, the moment of inertia:
- increased only.
  - decreased only.
  - varied, but with no general trend.
  - remained the same.
37. Object A and Object B each consists of a pair of spheres connected by a rigid wire of insignificant mass. The 4 spheres are identical to each other. Each object is suspended vertically from a support at a distance  $L$  above the object's CM, as shown in the figure below.
- 
38. In which of the following trials in Study 3 was the frequency of the pendulum's oscillation the greatest?
- Trial 11
  - Trial 12
  - Trial 13
  - Trial 14
39. Prior to the studies, 4 students made predictions about which of the 3 types of physical pendulums, if any, would have the shortest  $P$  for a given  $L$ . Student W predicted that it would be the solid sphere, Student X predicted that it would be the circular plate, and Student Y predicted that it would be the spherical shell. Student Z predicted that the 3 types of physical pendulums would have the same  $P$ . Which student's prediction was correct?
- Student W's
  - Student X's
  - Student Y's
  - Student Z's

$L$  is the same for the 2 objects. Based on Studies 1 and 3, which object has the greater moment of inertia?

- Object A, because the average distance of matter from the support is greater for Object A than for Object B.
- Object A, because the average distance of matter from the support is less for Object A than for Object B.
- Object B, because the average distance of matter from the support is greater for Object B than for Object A.
- Object B, because the average distance of matter from the support is less for Object B than for Object A.

40. In Trial 4, approximately how long did it take the pendulum to complete 20 cycles?
- 0.70 sec
  - 1.4 sec
  - 14 sec
  - 70 sec

END OF TEST 4

STOP! DO NOT RETURN TO ANY OTHER TEST.

**Form 15G**  
**ACT® Writing Test Prompt**  
**(December 2009)**

Teachers debate whether watching television interferes with high school students' education. Some teachers believe watching television does interfere with education because they think it conditions students to have short attention spans, reducing their ability to concentrate and to think critically in class. Other teachers believe television does not hinder student learning because they think that, as long as students finish their homework, watching television during free time does not affect students' education more than any other activity they might choose. In your opinion, does watching television interfere with students' education?

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

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

## Explanation of Procedures Used to Obtain Scale Scores from Raw Scores

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

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

ACT Test 68A	Your Scale Score
English	<hr/>
Mathematics	<hr/>
Reading	<hr/>
Science	<hr/>

**Sum of scores**

**Composite score (sum ÷ 4)**

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

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