



**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 following paragraphs may or may not be in the most logical order. Each paragraph is numbered in brackets, and question 14 will ask you to choose where Paragraph 3 should most logically be placed.

**Bar Codes: A Linear History**

[1]

In 1948, graduate students, Norman Woodland<sup>1</sup> and Bernard Silver,<sup>1</sup> took on a problem that had troubled retailers for years: how to keep track of store inventories.

Inspired by the dots and dashes of Morse code, however,<sup>2</sup> Woodland and Silver created a system of lines that could encode data. Called a *symbolology*, the pattern created by the spacing and widths of the lines encodes information by representing different characters.

1. **A.** NO CHANGE  
**B.** students, Norman Woodland and Bernard Silver  
**C.** students Norman Woodland and Bernard Silver  
**D.** students Norman Woodland and Bernard Silver,
  
2. **F.** NO CHANGE  
**G.** in other words,  
**H.** consequently,  
**J.** DELETE the underlined portion.



[2]

The first bar code was composed of four white lines set at specific distances from each other on a black

background. The first line was always present. [4]

Depending on the presence or absence of the remaining three lines, up to seven different arrangements were

susceptible and, therefore, seven different encodings.

Today, twenty-nine white lines making more than half a billion encodings possible.

[3]

To create a bar code scanner, Woodland and Silver adapted technology from an optical movie sound system. Their prototype scanner used a 500-watt bulb, a photomultiplier tube (a device that detects light), and an oscilloscope (a device that translates electronic signals into readable information). Although successful, the concoction

was both large and costly. For example, progress stalled until the 1970s, when laser technology (both more compact and less expensive) became available.

[4]

In today's scanners, a laser sends light back and forth across a bar code. While the black lines absorb the light, the white lines reflect it back at a fixed mirror inside the scanner. In this way, the scanner reads the symbology and decodes the information.

3. A. NO CHANGE  
B. distances so that each was separated, one from the  
C. locations, each one set apart from the  
D. lengths of distance from each
4. The writer is considering deleting the preceding sentence. Should the sentence be kept or deleted?  
E. Kept, because it begins the description that is completed in the sentence that follows.  
G. Kept, because it gives a clear image of what the first bar code looked like.  
H. Deleted, because it provides an extra detail that is not relevant to the subject of the paragraph.  
J. Deleted, because it contradicts a point made later in the paragraph.
5. A. NO CHANGE  
B. responsible  
C. possible  
D. capable
6. F. NO CHANGE  
G. which make  
H. to make  
J. make
7. A. NO CHANGE  
B. contraption  
C. substance  
D. stuff
8. F. NO CHANGE  
G. As a result,  
H. However,  
J. Even so,
9. A. NO CHANGE  
B. them  
C. ones  
D. one



[5]

10 Today,

being that there are one- and  
<sup>11</sup>  
two-dimensional bar codes using numeric  
and alphanumeric symbologies. Bar codes  
are used not only for a pack of gum or an airline  
ticket, but also for research. In one study, for  
instance, tiny bar codes were placed on bees tracking  
<sup>12</sup>  
their activities. Shaping the way we gather, track, and  
share information, we have almost certainly exceeded  
<sup>13</sup>  
even Woodland and Silver's expectations.  
<sup>13</sup>

10. Which of the following true statements, if added here, would most effectively lead into the new subject of the paragraph?
- F. In the 1940s, Woodland and Silver were graduate students at the Drexel Institute of Technology in Philadelphia.
  - G. Woodland and Silver were granted a patent for their bar code on October 7, 1952.
  - H. Bar code equipment has been available for retail use since 1970.
  - J. Bar codes themselves have advanced as well.
11. A. NO CHANGE  
B. there are  
C. where  
D. DELETE the underlined portion.
12. F. NO CHANGE  
G. had been placed on bees trying to track  
H. placed on bees, which would track  
J. were placed on bees to track
13. A. NO CHANGE  
B. exceeding Woodland and Silver's expectations about bar codes has almost certainly been done.  
C. bar codes have almost certainly exceeded even Woodland and Silver's expectations.  
D. it is almost certain that we have exceeded even Woodland and Silver's expectations.

Questions 14 and 15 ask about the preceding passage as a whole.

14. For the sake of the logic and coherence of the essay, Paragraph 3 should be placed:
- F. where it is now.
  - G. before Paragraph 1.
  - H. after Paragraph 1.
  - J. after Paragraph 5.
15. Suppose the writer's primary purpose had been to describe how a specific technological advancement changed business practices. Would this essay accomplish that purpose?
- A. Yes, because it offers an overview of current bar code technology and indicates the variety of ways in which bar codes are used by specific businesses.
  - B. Yes, because it explains how bar codes and scanners made it easier for stores to keep track of their inventories.
  - C. No, because it focuses primarily on the development of bar codes and only briefly mentions how businesses have implemented the use of bar codes.
  - D. No, because it focuses on why businesses needed new technology but does not explain how bar codes were able to serve that need.



## 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. The numbers 1 through 15 were each written on individual pieces of paper, 1 number per piece. Then the 15 pieces of paper were put in a jar. One piece of paper will be drawn from the jar at random. What is the probability of drawing a piece of paper with a number less than 9 written on it?

- A.  $\frac{1}{9}$
- B.  $\frac{1}{15}$
- C.  $\frac{6}{15}$
- D.  $\frac{7}{15}$
- E.  $\frac{8}{15}$

2. Which of the following expressions is equivalent to  $-4x^3 - 12x^3 + 9x^2$ ?

- F.  $x^8$
- G.  $-7x^8$
- H.  $-8x^3 + 9x^2$
- J.  $-16x^3 + 9x^2$
- K.  $-16x^6 + 9x^2$

3. When  $x = 2$ ,  $10 + 3(12 \div (3x)) = ?$

- A. 12
- B. 16
- C. 26
- D. 34
- E. 104

4.  $|6 - 4| - |3 - 8| = ?$

- F. -7
- G. -3
- H. 3
- J. 7
- K. 21

5. The expression  $(4c - 3d)(3c + d)$  is equivalent to:

- A.  $12c^2 - 13cd - 3d^2$
- B.  $12c^2 - 13cd + 3d^2$
- C.  $12c^2 - 5cd - 3d^2$
- D.  $12c^2 - 5cd + 3d^2$
- E.  $12c^2 - 3d^2$

6. Of the 180 students in a college course,  $\frac{1}{4}$  of the students earned an A for the course,  $\frac{1}{3}$  of the students earned a B for the course, and the rest of the students earned a C for the course. How many of the students earned a C for the course?

- F. 75
- G. 90
- H. 105
- J. 120
- K. 135

7. The number of fish,  $f$ , in Skipper's Pond at the beginning of each year can be modeled by the equation  $f(x) = 3(2^x)$ , where  $x$  represents the number of years after the beginning of the year 2000. For example,  $x = 0$  represents the beginning of the year 2000,  $x = 1$  represents the beginning of the year 2001, and so forth. According to the model, how many fish were in Skipper's Pond at the beginning of the year 2006?

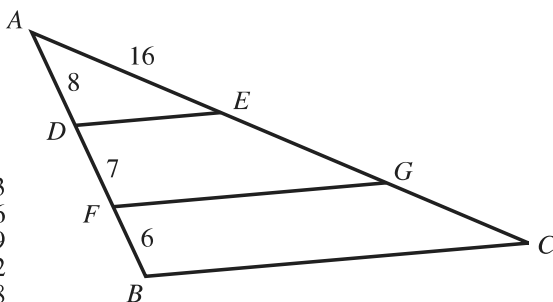
- A. 96
- B. 192
- C. 384
- D. 1,458
- E. 46,656



8. Manish drove from Chicago to Baton Rouge. At 8:00 a.m., he was 510 km from Baton Rouge. At 1:00 p.m., he was 105 km from Baton Rouge. Which of the following values is closest to Manish's average speed, in kilometers per hour, from 8:00 a.m. to 1:00 p.m. ?

F. 58  
G. 68  
H. 81  
J. 94  
K. 102

9. In the figure shown below,  $E$  and  $G$  lie on  $\overline{AC}$ ,  $D$  and  $F$  lie on  $\overline{AB}$ ,  $\overline{DE}$  and  $\overline{FG}$  are parallel to  $\overline{BC}$ , and the given lengths are in feet. What is the length of  $\overline{AC}$ , in feet?



A. 13  
B. 26  
C. 29  
D. 42  
E. 48

10. Katerina runs 15 miles in  $2\frac{1}{2}$  hours. What is the average number of *minutes* it takes her to run 1 mile?

F. 6  
G. 10  
H.  $12\frac{1}{2}$   
J.  $16\frac{2}{3}$   
K.  $17\frac{1}{2}$

11. A bag contains 8 red marbles, 9 yellow marbles, and 7 green marbles. How many additional red marbles must be added to the 24 marbles already in the bag so that the probability of randomly drawing a red marble is  $\frac{3}{5}$  ?

A. 11  
B. 16  
C. 20  
D. 24  
E. 32

12. In the standard  $(x,y)$  coordinate plane, the point  $(2,1)$  is the midpoint of  $\overline{CD}$ . Point  $C$  has coordinates  $(6,8)$ . What are the coordinates of point  $D$  ?

F.  $(-2, -\frac{7}{2})$   
G.  $(-2, -6)$   
H.  $(4, \frac{9}{2})$   
J.  $(10, 10)$   
K.  $(10, 15)$

13. At his job, the first 40 hours of each week that Thomas works is *regular time*, and any additional time that he works is *overtime*. Thomas gets paid \$15 per hour during regular time. During overtime Thomas gets paid 1.5 times as much as he gets paid during regular time. Thomas works 46 hours in 1 week and gets \$117 in deductions taken out of his pay for this week. After the deductions are taken out, how much of Thomas's pay for this week remains?

A. \$492  
B. \$573  
C. \$609  
D. \$618  
E. \$735

14. At Sweet Stuff Fresh Produce the price of a bag of grapes depends on the total number of bags purchased at 1 time, as shown in the table below. In 2 trips to Sweet Stuff this week, Janelle purchased 3 bags of grapes on Monday and 4 bags of grapes on Wednesday. How much money would Janelle have saved if she had instead purchased 7 bags of grapes in 1 trip on Monday?

Number of bags	Price per bag
1–3	\$3.00
4–6	\$2.80
7–9	\$2.60
10 or more	\$2.50

F. \$0.20  
G. \$1.00  
H. \$1.40  
J. \$2.00  
K. \$2.50

15. What is 3% of  $4.14 \times 10^4$  ?

A. 1,242  
B. 1,380  
C. 12,420  
D. 13,800  
E. 124,200

## READING TEST

35 Minutes—40 Questions

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

## Passage I

**LITERARY NARRATIVE:** Passage A is adapted from the memoir *The Piano Shop on the Left Bank* by Thad Carhart (©2001 by T.E. Carhart). Passage B is adapted from the article “Me and My Violin” by Arnold Steinhardt (©2014 by Listen: Life with Classical Music).

## Passage A by Thad Carhart

- Even when Luc was busy and could not talk he always made me welcome and allowed me to wander around the inner sanctum of the back room on my own. When things were quieter, he seemed glad of the company and would tell me about the pianos that had just arrived. Our talks made real for me one of his fundamental beliefs, that each and every piano had completely individual characteristics, even if of the same manufacturer and age.
- 10 Sometimes he knew all the details, had even met the owners and talked about their instrument with them and knew intimately how they had treated it. Other times he knew nothing beyond what he could see, feel, or hear. Most often pianos came to him from auctions and charity sales, their history anonymous. But even then, like an expert in artifacts, he could deduce a great deal: whether a piano had been played much or little, whether it had been in an environment with the proper level of humidity (one of his cardinal rules), whether there had been children in the household, even whether it had recently been transported by ship. (“The worst thing you can possibly do to a piano,” he told me more than once.) At these moments he was part detective, part archaeologist, part social critic.
- 25 His attitude about how people treated their pianos seemed to mirror his philosophy of life. While regretting the depredations worked by children on keyboards and strings, he regarded them as tolerable because the piano was at least used and, as he put it, “*au sein de la famille*” (“at the heart of the family”). It was more than just any piece of furniture, but it was that, too, and if drinks were spilled and stains bit into shiny finishes, it was the price one paid for initiating the young to a joy that should stem from familiarity rather than reverence.
- 35 Those who preserved their piano as an altar upon which the art of music was to be worshipped irritated

Luc, but he was deeply respectful of serious musicians who used and depended upon their instrument for their livelihood.

## Passage B by Arnold Steinhardt

- 40 Marc Lifschey, one of the greatest oboists of his era, told me that after retiring as a performer and teacher, he sold his oboe. On the face of it, giving up an instrument you no longer use seems perfectly reasonable, but nevertheless I was taken aback. Marc was not merely an excellent oboist; he was a great artist. Still, Marc didn’t do it alone. He and his oboe did it together. Even in retirement, wouldn’t Marc have some sort of lasting relationship with his oboe that transcended performing on it? Wouldn’t he want to keep it if for no other reason than as a reminder of the magnificent music the two of them had made together?
- 50 Joseph Roisman, the distinguished first violinist of the Budapest String Quartet, seemed to be content to give up his beloved Lorenzo Storioni when he agreed to sell it to me after the Quartet retired. But when I finally met with him, he had second thoughts. “Steinhardt,” he said to me plaintively, “I’ll sell the violin to you some day, but for now I’m enjoying playing chamber music with my friends every Friday night.” And that is exactly what he did until his death a year or two later.
- 65 Lifschey and Roisman dealt with retirement in different ways, but their stories made me wonder about not only what I’ll do with my violin if and when I retire, but also about the very nature of a musician’s day-to-day, year-to-year relationship with his instrument.
- I began playing violin when I was six years old, and now I’m seventy-six. It has been an integral part of my life for the last seven decades. Does that make the violin my very close friend? Well, yes. Sometimes. The violin obviously can’t speak with words, but when I ask something of it, the instrument can respond with an astonishing range of substance and emotion. This is friendship on a most exalted level.
- 75 There are other moments, however, when the violin stubbornly refuses to do my bidding—when it only reluctantly plays in tune, or makes the sound I want, or delivers the music’s essence for which I strive. Then I have to cajole, bargain or adjust to its every

whim. Some friend; more like an adversary, you might  
80 say.

Or is the violin my partner? A woman once went  
backstage to congratulate the great violinist Jascha  
Heifetz after a concert. “What a wonderful sound your  
violin has, Mr. Heifetz!” she exclaimed. Heifetz leaned  
85 over his violin that lay in its open case, listened intently  
for a moment, and said, “Funny, I don’t hear a thing.”  
My violin also lies mute in its case without me—but, on  
the other hand, I stand mute on the concert stage with-  
out it.

1. In Passage A, the parenthetical information in line 19 and lines 21–23 mainly serves to:
  - A. specify how Luc identified certain aspects of a piano’s history.
  - B. portray Luc as overly judgmental about piano transportation.
  - C. describe the types of rules that visitors to Luc’s shop were required to follow.
  - D. indicate some of Luc’s firm beliefs about piano care.
2. Based on the assertion in Passage A that Luc’s “attitude about how people treated their pianos seemed to mirror his philosophy of life” (lines 25–26), which of the following statements would most nearly describe Luc’s philosophy of life?
  - F. It’s better to live a full and imperfect life than not participate because something might go wrong.
  - G. Life is a fragile gift that must be cherished and kept safe at all times.
  - H. Living well is like playing the piano well; it requires dedication and practice.
  - J. It’s important not to take life’s opportunities for granted because they may not come a second time.
3. As it is used in line 32, the phrase *bit into* most nearly means:
  - A. pinched.
  - B. ingested.
  - C. marred.
  - D. severed.
4. In the third paragraph of Passage B (lines 61–65), the author most clearly shifts from:
  - F. making an argument against musicians selling their instruments to using evidence from his life to support that argument.
  - G. introducing musicians he admires to explaining why he hopes people admire him as a musician.
  - H. examining his own emotions about his violin to explaining why musicians must develop a partnership with their instruments.
  - J. discussing the connection between other musicians and their instruments to pondering his own connection with his violin.
5. In Passage B, the statement that Lifschey “was not merely an excellent oboist; he was a great artist” (lines 44–45) can best be described as:
  - A. a fact supported by details about Lifschey’s career.
  - B. a fact confirmed by experts quoted in the passage.
  - C. an opinion that the author attributes to Lifschey’s colleagues and students.
  - D. an opinion that the author asserts but does not explain.
6. In Passage B, it can most reasonably be inferred that Heifetz’s response to the woman who congratulates him is intended to point out that:
  - F. the woman hears Heifetz’s violin differently than Heifetz does.
  - G. the woman isn’t qualified to judge the quality of Heifetz’s violin.
  - H. Heifetz enjoyed the woman’s humorous comment.
  - J. Heifetz’s violin doesn’t make sounds by itself.
7. In Passage B, the author most directly indicates that the violin is sometimes an adversary by stating that it:
  - A. lies mute in its case.
  - B. makes him adjust to its whims.
  - C. responds with a range of emotion.
  - D. can’t speak with words.
8. Compared to Passage A, Passage B is more directly focused on the:
  - F. damage a musician can do to an instrument.
  - G. characteristics of an instrument that give clues to its history.
  - H. interdependence between musician and instrument.
  - J. benefits of making instruments available to young children.
9. In contrast to the way the pianos are described in Passage A, the passage author’s violin in Passage B is described as:
  - A. exhibiting unique characteristics.
  - B. having an active personality of its own.
  - C. sustaining damage from careless children.
  - D. being important to daily life.
10. Which of the following assertions about instruments is most strongly supported by details provided in both Passage A and Passage B?
  - F. Familiarity with your instrument is an important part of the joy of playing music.
  - G. Instruments should be revered and never treated like furniture.
  - H. Selling your instrument shows disrespect for the music you have made together.
  - J. Maintaining proper humidity levels is essential to preserving an instrument.

**SCIENCE TEST***35 Minutes—40 Questions*

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

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

**Passage I**

In a particular *playa* (relatively flat, dry desert basin) evidence shows that some large rocks have moved along the surface, leaving shallow trails in the clay sediment, some up to several hundred meters long. Three scientists provided explanations for how these rocks moved.

*Scientist 1*

In the spring, snowmelt from surrounding mountains runs downhill and collects in the *playa*. At night, cold temperatures cause this water to freeze around the rocks. When temperatures rise again, the ice begins to melt, leaving a layer of mud on the surface and ice “rafts” around the rocks. The buoyancy of the ice rafts floats the rocks on top of the mud such that even light winds can then push the rocks along the surface. Evidence of this lifting is seen in that the trails left by rocks are both shallow and only about  $\frac{2}{3}$  as wide as the rocks themselves. Due to the combination of ice, mud, and light winds, the rocks are able to move several hundred meters in a few days.

*Scientist 2*

Snowmelt from surrounding mountains does collect in the *playa* during the spring. However, the temperature in the *playa* does not get cold enough for ice to form. When the *playa*’s surface gets wet, the top layer of clay transforms into a slick, muddy film. In addition, dormant algae present in the dry clay begin to grow rapidly when the clay becomes wet. The presence of mud and algae reduces friction between the rocks and the clay. Even so, relatively strong winds are required to push the rocks along the wet surface, forming trails. Due to the combination of mud, algae, and strong winds, the rocks are able to move several hundred meters in a few hours.

*Scientist 3*

Water does collect in the *playa*, producing mud and ice. However, neither mud nor ice is responsible for the rocks’ movements. The *playa* is located along a fault line between tectonic plates. Minor vertical shifts in the plates cause the rocks to move downhill, leaving trails. Due to the combination of tectonic plate movement and strong winds, the rocks are able to move only a few meters over several years.

- According to Scientist 2, friction between the rocks and the clay is reduced by which of the following?
  - Ice only
  - Algae only
  - Ice and mud only
  - Mud and algae only
- Suppose a researcher observed that wind speeds greater than 80 miles per hour are needed to move the rocks in the *playa*. This observation is consistent with which of the scientists’ explanations?
  - Scientists 1 and 2 only
  - Scientists 1 and 3 only
  - Scientists 2 and 3 only
  - Scientists 1, 2, and 3
- Suppose that no seismic activity was recorded in the *playa* where the trails left by the rocks are found. This finding would *weaken* which of the scientists’ explanations?
  - Scientist 1 only
  - Scientist 3 only
  - Scientist 1 and Scientist 2 only
  - Scientist 2 and Scientist 3 only
- Suppose it were discovered that a particular rock formed a 200 m long trail in 72 hr. Would this discovery support Scientist 1’s explanation?
  - Yes; Scientist 1 indicated the rocks can move several hundred meters in a few hours.
  - Yes; Scientist 1 indicated the rocks can move several hundred meters in a few days.
  - No; Scientist 1 indicated the rocks can move several hundred meters in a few hours.
  - No; Scientist 1 indicated the rocks can move several hundred meters in a few days.



**4****4**

5. Suppose that during one year there was no measurable movement of any rocks in the playa during the spring. Scientists 1 and 2 would most likely both agree that this was due to the absence of which of the following factors?
- A. Algae
  - B. Snowmelt
  - C. Strong winds
  - D. Subzero temperatures
6. Suppose that air temperature in the playa varies between  $4^{\circ}\text{C}$  and  $47^{\circ}\text{C}$ . Would this information support the explanation of Scientist 2 ?
- F. Yes, because ice cannot form in that temperature range.
  - G. Yes, because ice can form in that temperature range.
  - H. No, because ice cannot form in that temperature range.
  - J. No, because ice can form in that temperature range.
7. Based on Scientist 1's explanation, a rock trail that is 33 cm wide was most likely made by a rock with approximately what width?
- A. 10 cm
  - B. 25 cm
  - C. 50 cm
  - D. 65 cm

**Passage II**

When certain substances are added to diet cola,  $\text{CO}_2$  gas is produced, generating a foam. Two experiments were done to study this process.

In each trial, an apparatus like that shown in Figure 1 was used as follows: A jar was nearly filled with  $\text{H}_2\text{O}$  and fitted with a 2-holed lid. One end of a tube (Tube B) was inserted through one of the holes and submerged. The other end of Tube B was placed in an empty graduated cylinder. Another tube (Tube A) was inserted through the other hole in the lid. A certain solid substance was inserted into the other end of Tube A, and the substance was secured by a clamp. Tube A was then attached to a freshly opened bottle containing 355 mL of diet cola. The clamp was removed, releasing the substance into the diet cola. The foam that was produced traveled into the jar, and liquid was transferred into the cylinder. The mass of  $\text{CO}_2$  produced was calculated based on the volume of liquid that was measured in the cylinder after foaming had ceased.

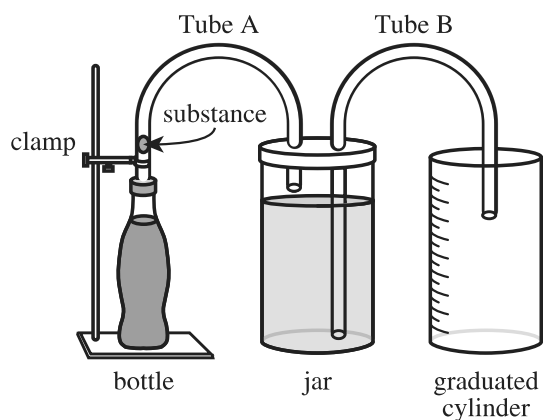


Figure 1

*Experiment 1*

In each of Trials 1–4, a different 1 of 4 substances of equal mass—a piece of chalk, a sugar cube, a fruit-flavored piece of candy, or a mint-flavored piece of candy—was added to a bottle of diet cola at  $3^\circ\text{C}$ . See Table 1.

Trial	Substance	Volume of liquid in cylinder (mL)	Mass of $\text{CO}_2$ produced (g)
1	chalk	699	1.36
2	sugar cube	570	1.11
3	fruit candy	525	1.02
4	mint candy	631	1.23

*Experiment 2*

In each of Trials 5–8, Trial 4 from Experiment 1 was repeated, except that the temperature of the diet cola was different in each trial. See Table 2.

Trial	Temperature ( $^\circ\text{C}$ )	Volume of liquid in cylinder (mL)	Mass of $\text{CO}_2$ produced (g)
5	10	598	1.13
6	25	539	0.969
7	45	501	0.844
8	60	476	0.766

Tables 1 and 2 adapted from Christopher J. Huber and Aaron M. Massari, "Quantifying the Soda Geyser." ©2014 by Division of Chemical Education, Inc., American Chemical Society.



8. If another trial had been performed in Experiment 2 and 450 mL of liquid had been measured in the cylinder, the temperature of the diet cola in this trial would most likely have been:
- F. less than 25°C.
  - G. between 25°C and 45°C.
  - H. between 45°C and 60°C.
  - J. greater than 60°C.
9. Suppose Trial 6 had been repeated, but the bottle of diet cola had been opened and then left undisturbed at 25°C for 12 hours *before* it was attached to the apparatus. Would the mass of CO<sub>2</sub> produced in this trial likely be greater than 0.969 g or less than 0.969 g?
- A. Greater, because over the 12 hours, the concentration of CO<sub>2</sub> in the diet cola would have decreased.
  - B. Greater, because over the 12 hours, the concentration of CO<sub>2</sub> in the diet cola would have increased.
  - C. Less, because over the 12 hours, the concentration of CO<sub>2</sub> in the diet cola would have decreased.
  - D. Less, because over the 12 hours, the concentration of CO<sub>2</sub> in the diet cola would have increased.
10. One *millimole* (mmol) of CO<sub>2</sub> has a mass of 0.044 g. How many trials resulted in the production of at least 1 mmol of CO<sub>2</sub>?
- F. 1
  - G. 4
  - H. 5
  - J. 8
11. According to Figure 1, which of Tube A and Tube B, if either, had at least one end submerged in a liquid before the clamp was removed?
- A. Tube A only
  - B. Tube B only
  - C. Both Tube A and Tube B
  - D. Neither Tube A nor Tube B
12. Is the relationship between the volume of liquid in the cylinder at the end of the experiment and the mass of CO<sub>2</sub> produced a direct relationship or an inverse relationship?
- F. Direct; as the volume of liquid that was measured in the cylinder increased, the mass of CO<sub>2</sub> produced increased.
  - G. Direct; as the volume of liquid that was measured in the cylinder increased, the mass of CO<sub>2</sub> produced decreased.
  - H. Inverse; as the volume of liquid that was measured in the cylinder increased, the mass of CO<sub>2</sub> produced increased.
  - J. Inverse; as the volume of liquid that was measured in the cylinder increased, the mass of CO<sub>2</sub> produced decreased.
13. Consider these steps that were performed in each trial.
1. Removing clamp
  2. Measuring liquid in cylinder
  3. Inserting a solid substance into Tube A
  4. Attaching Tube A to a bottle of diet cola
- According to the procedure, these steps were performed in what sequence?
- A. 3, 1, 2, 4
  - B. 3, 4, 1, 2
  - C. 4, 2, 3, 1
  - D. 4, 3, 1, 2
14. Assume that *room temperature* is 25°C. In how many trials was the diet cola tested at a temperature *lower* than room temperature?
- F. 1
  - G. 2
  - H. 5
  - J. 8

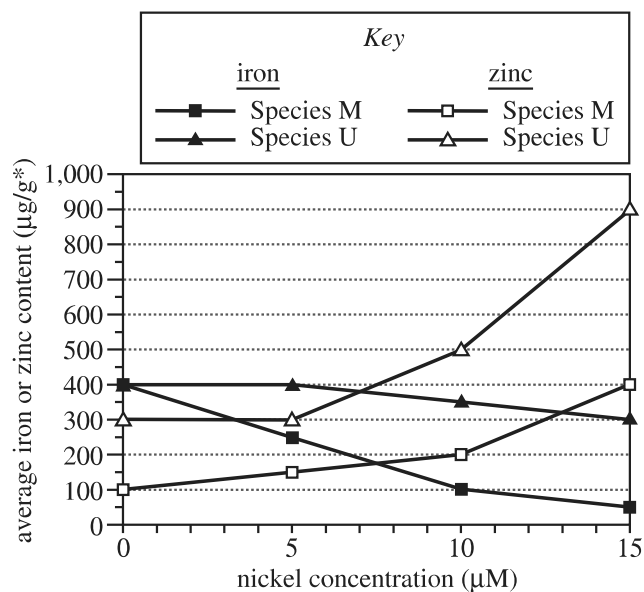


### Passage III

Scientists studied the effects of pH and of nickel concentration on plant growth and on the uptake of iron and zinc by plants. Recently germinated seedlings of Species M and Species U were fed 1 of 12 nutrient solutions (Solutions 1–12) for 8 days and then were harvested. Solutions 1–12 differed only in pH and/or nickel concentration. Table 1 shows, for each species, the average dry mass of the plants that were fed each nutrient solution. Figure 1 shows, for each species, the average iron content and the average zinc content of the plants that were fed Solutions 1–4.

Solution	pH	Nickel concentration ( $\mu\text{M}^*$ )	Average dry mass (g) of plants of Species:	
			M	U
1	7	0	33.9	10.7
2	7	5	28.8	10.7
3	7	10	23.8	9.6
4	7	15	18.7	8.5
5	6	0	33.9	9.2
6	6	5	28.8	9.2
7	6	10	23.8	8.1
8	6	15	18.7	7.0
9	5	0	27.8	7.7
10	5	5	22.7	7.7
11	5	10	17.6	6.6
12	5	15	12.4	5.4

\* $\mu\text{M}$  = micromoles per liter



\* $\mu\text{g/g}$  = micrograms of iron or zinc per gram of plant dry mass

Figure 1

15. According to Figure 1, as the nickel concentration in the nutrient solutions increased, the average iron content of Species M plants:
- increased only.
  - decreased only.
  - increased, then decreased.
  - decreased, then increased.



16. According to Table 1, the Species U plants that were fed the solution that had a pH of 6 and a nickel concentration of  $10\ \mu\text{M}$  had an average dry mass of:
- F. 7.0 g.  
 G. 8.1 g.  
 H. 9.2 g.  
 J. 23.8 g.
17. According to Table 1, Species M plants that were fed a nutrient solution with which of the following combinations of pH and nickel concentration had the greatest average dry mass?
- |    | <u>pH</u> | <u>nickel concentration</u> |
|----|-----------|-----------------------------|
| A. | 6         | $0\ \mu\text{M}$            |
| B. | 6         | $5\ \mu\text{M}$            |
| C. | 5         | $0\ \mu\text{M}$            |
| D. | 5         | $5\ \mu\text{M}$            |
18. According to Table 1 and Figure 1, the Species M plants that were fed Solution 3 had an average zinc content of:
- F.  $100\ \mu\text{g/g}$ .  
 G.  $150\ \mu\text{g/g}$ .  
 H.  $200\ \mu\text{g/g}$ .  
 J.  $400\ \mu\text{g/g}$ .
19. According to Table 1 and Figure 1, for the Species M plants that were fed Solutions 1–4, what was the order of the nutrient solutions, from the solution that resulted in the lowest average iron content to the solution that resulted in the highest average iron content?
- A. 1, 2, 3, 4  
 B. 1, 4, 3, 2  
 C. 4, 2, 1, 3  
 D. 4, 3, 2, 1
20. According to Table 1, compared to the average dry mass of Species U plants that were fed Solution 3, the average dry mass of Species M plants that were fed Solution 6 was approximately:
- F.  $\frac{1}{3}$  as great.  
 G.  $\frac{1}{2}$  as great.  
 H. 2 times as great.  
 J. 3 times as great.

## Extracurricular Activities and Codes of Conduct

For many students, extracurricular activities are a meaningful part of the high school experience. These activities allow students to develop their skills in areas such as sports, music, and drama while building relationships with peers and gaining experience performing or competing. But at many schools, students who participate in extracurricular activities are subject to special codes of conduct. These codes often establish high standards for academic performance and behavior, and students must meet the standards to stay eligible for their activities. Should students who participate in extracurricular activities be subject to special codes of conduct?

*Read and carefully consider these perspectives. Each suggests a particular way of thinking about the question above.*

### Perspective One

All school rules and standards must apply equally to every student. It is unfair to hold students who play sports or music to higher standards than students who do not.

### Perspective Two

Participation in school activities is a privilege, not a right. It is fair to ask students to earn this privilege by studying hard and behaving themselves.

### Perspective Three

School programs should be open to all students. Not all students can meet high standards, which means not all students can participate in extracurricular activities.

### Essay Task

Write a unified, coherent essay in which you address the question of whether students who participate in extracurricular activities should be subject to special codes of conduct. In your essay, be sure to:

- clearly state your own perspective and analyze the relationship between your perspective and at least one other perspective
- develop and support your ideas with reasoning and examples
- organize your ideas clearly and logically
- communicate your ideas effectively in standard written English

Your perspective may be in full agreement with any of those given, in partial agreement, or completely different.

## Planning Your Essay

*Your work on these prewriting pages will not be scored.*

Use the space below and on the back cover to generate ideas and plan your essay. You may wish to consider the following as you think critically about the task:

Strengths and weaknesses of different perspectives on the issue

- What insights do they offer, and what do they fail to consider?
- Why might they be persuasive to others, or why might they fail to persuade?

Your own knowledge, experience, and values

- What is your perspective on this issue, and what are its strengths and weaknesses?
- How will you support your perspective in your essay?

### **Note**

- For your practice essay, you will need scratch paper to plan your essay and four lined sheets of paper for your response.
- On test day, if you are taking the paper test, you will receive a test booklet with space to plan your essay and an answer document with four lined pages on which to write your response.
- Read pages 60–61 for information and instructions on scoring your practice writing test.

<p><b>Marking Directions:</b> Mark only <b>one</b> oval for each question. Fill in response completely. Erase errors cleanly without smudging.</p> <p><b>Correct mark:</b> ○ ● ○ ○</p> <p>-----</p> <p><b>Do NOT use these incorrect or bad marks.</b></p> <p>Incorrect marks: </p> <p>Overlapping mark: </p> <p>Cross-out mark: </p> <p>Smudged erasure: </p> <p>Mark is too light: </p>	<p><b>BOOKLET NUMBER</b></p> <table border="1" style="width: 100%; text-align: center;"> <tr><td> </td><td> </td><td> </td><td> </td><td> </td></tr> </table>						<p><b>FORM</b></p> <table border="1" style="width: 100%; text-align: center;"> <tr><td> </td><td> </td><td> </td></tr> </table> <p>Print your 3-character <b>Test Form</b> in the boxes above and fill in the corresponding oval at the right.</p>				<p><b>BE SURE TO FILL IN THE CORRECT FORM OVAL.</b></p> <p><input type="radio"/> PRE</p>

**TEST 1**

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

**TEST 2**

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

**TEST 3**

1 (A B C D)	8 (F G H J)	15 (A B C D)	22 (F G H J)	29 (A B C D)	36 (F G H J)
2 (F G H J)	9 (A B C D)	16 (F G H J)	23 (A B C D)	30 (F G H J)	37 (A B C D)
3 (A B C D)	10 (F G H J)	17 (A B C D)	24 (F G H J)	31 (A B C D)	38 (F G H J)
4 (F G H J)	11 (A B C D)	18 (F G H J)	25 (A B C D)	32 (F G H J)	39 (A B C D)
5 (A B C D)	12 (F G H J)	19 (A B C D)	26 (F G H J)	33 (A B C D)	40 (F G H J)
6 (F G H J)	13 (A B C D)	20 (F G H J)	27 (A B C D)	34 (F G H J)	
7 (A B C D)	14 (F G H J)	21 (A B C D)	28 (F G H J)	35 (A B C D)	

**TEST 4**

1 (A B C D)	8 (F G H J)	15 (A B C D)	22 (F G H J)	29 (A B C D)	36 (F G H J)
2 (F G H J)	9 (A B C D)	16 (F G H J)	23 (A B C D)	30 (F G H J)	37 (A B C D)
3 (A B C D)	10 (F G H J)	17 (A B C D)	24 (F G H J)	31 (A B C D)	38 (F G H J)
4 (F G H J)	11 (A B C D)	18 (F G H J)	25 (A B C D)	32 (F G H J)	39 (A B C D)
5 (A B C D)	12 (F G H J)	19 (A B C D)	26 (F G H J)	33 (A B C D)	40 (F G H J)
6 (F G H J)	13 (A B C D)	20 (F G H J)	27 (A B C D)	34 (F G H J)	
7 (A B C D)	14 (F G H J)	21 (A B C D)	28 (F G H J)	35 (A B C D)	