Practice Test 2

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Form 16MC2

2015 | 2016

Directions

This booklet contains tests in English, mathematics, reading, and science. These tests measure skills and abilities highly related to high school course work and success in college. Calculators may be used on the mathematics test only.

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

For each question, first decide which answer is best. Next, locate on the answer document the row of ovals numbered the same as the question. Then, locate the oval in that row lettered the same as your answer. Finally, fill in the oval completely. Use a soft lead pencil and make your marks heavy and black. Do not use ink or a mechanical pencil.

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

Only responses marked on your answer document will be scored. Your score on each test will be based only on the number of questions you answer correctly during the time allowed for that test. You will not be penalized for guessing. It is to your advantage to answer every question even if you must guess.

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

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

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

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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 Kam Wah Chung & Co. Museum

To the casual observer, the Kam Wah Chung & Co. building, located in the eastern Oregon community of John Day, that is, simply a small, unassuming structure made of rock and wood. To those with an interest in history, however, it's a unique building that preserves a part of the legacy of the Chinese community in the nineteenth-century American West.

Built in the 1860s, the Kam Wah Chung building first served as a trading post for travelers who attract to the land east of the Cascade Mountains by news of gold strikes there.

1. A. NO CHANGE
   B. is
   C. it's
   D. DELETE the underlined portion.

2. Given that all the choices are true, which one most effectively introduces the historical and cultural significance of the Kam Wah Chung & Co. building?
   F. NO CHANGE
   G. has seven rooms: a front room, an herb shop, two bedrooms, a stockroom, a general store, and a kitchen and bunk room.
   H. is cooperatively preserved and operated by the Oregon Parks and Recreation Department and the City of John Day.
   J. has a kitchen that holds antique tables, a large woodstove, and a variety of Chinese teas and cooking utensils.

3. A. NO CHANGE
   B. will be attracted
   C. were attracted
   D. are attracted

GO ON TO THE NEXT PAGE.
In 1887, the original owner sold the building. The men combined their skills, organized a group of investors, and remains in business together for more than fifty years.

Educated in the Chinese classics and fluent in English, Lung On was a skilled merchant who built a successful textile and import business. He also sold food and supplies to local miners. His partner, Doc Hay, established an herbal medicine clinic. Hay became famous throughout central and eastern Oregon when he would make perceptive diagnoses and curing patients whose previous treatments had failed. Over time, the partners’ building evolved into a social, medical, and supply center, as well as a post office, library, and herb shop.

4. At this point, the writer is considering adding the following accurate information:
   to two enterprising young Chinese immigrants, Ing “Doc” Hay and Lung On
   Should the writer make this addition here?
   F. Yes, because it builds upon a claim made about Hay and On in the preceding sentence.
   G. Yes, because it provides a logical link to the information that follows in the essay.
   H. No, because it unnecessarily states information that’s implied later in the essay.
   J. No, because it provides little information about Hay and On’s partnership.

5. A. NO CHANGE
   B. has remained
   C. have remain
   D. remained

6. F. NO CHANGE
   G. for making
   H. as he made
   J. and made

7. A. NO CHANGE
   B. who experienced that their previous treatments
   C. being previous treatments which
   D. of whom previous treatments

8. The writer is considering deleting the preceding sentence. Should the sentence be kept or deleted?
   F. Kept, because it provides information that suggests why Hay’s work was particularly noteworthy.
   G. Kept, because it presents examples of Hay’s most challenging and successful diagnoses.
   H. Deleted, because it doesn’t make clear whether On was involved with Hay’s herbal medicine clinic.
   J. Deleted, because it doesn’t fit logically in this paragraph about On’s accomplishments.

9. If the writer were to delete the preceding sentence, the paragraph would primarily lose a statement that:
   A. demonstrates the scope of services eventually provided in the Kam Wah Chung & Co. building.
   B. makes clear that the social aspect of Kam Wah Chung & Co. was most important to visitors.
   C. provides a summary of one regular visitor’s experiences at Kam Wah Chung & Co.
   D. indicates for how long Hay and On’s businesses prospered.

GO ON TO THE NEXT PAGE.
1. Hay and On's businesses prospered through the turn of the century, during the Great Depression, and beginning the 1940s. [2] Because the climate in eastern Oregon is semi-arid, the artifacts left inside—including gold-mining tools, rare antique furniture, financial documents, and a thousand different herbs—were preserved. [3] Although On died in 1940, Hay continued to run Kam Wah Chung & Co. until 1948. [4] After Hay's death, his nephew inherited the building and donated it to the city of John Day. [5] For almost twenty years, it remained locked. [6] The building was restored by the state of Oregon in the 1970s and has become the Kam Wah Chung & Co. Museum. [7] Designated as being called a National Historic Landmark in 2005, besides, it encapsulates an era.

10. F. NO CHANGE
G. as it entered
H. becoming
J. into

11. A. NO CHANGE
B. have become
C. became
D. become

12. F. NO CHANGE
G. with the appropriation of
H. in being identified as a
J. a

13. A. NO CHANGE
B. in conclusion,
C. in time,
D. DELETE the underlined portion.

14. For the sake of the logic and coherence of this paragraph, Sentence 2 should be placed:
F. where it is now.
G. before Sentence 1.
H. after Sentence 3.
J. after Sentence 5.

Question 15 asks about the preceding passage as a whole.

15. Suppose the writer's goal had been to write a brief essay that outlined the steps the state of Oregon took to restore the Kam Wah Chung & Co. building. Would this essay accomplish that goal?
A. Yes, because it makes clear that the Kam Wah Chung & Co. building was renovated in the 1970s.
B. Yes, because it explains why the artifacts that were inside the Kam Wah Chung & Co. building were preserved.
C. No, because it instead focuses on describing the history of the Kam Wah Chung & Co. building and the building's uses.
D. No, because it instead focuses on critiquing both On's business philosophies and Hay's medical diagnoses and treatments.

GO ON TO THE NEXT PAGE.
PASSAGE II

One Fair Season

At first glance a Renaissance fair, looks a lot like a theme park. Crowds of people mill about, moseying they’re way past costumed characters and colorful booths. Being that roller coasters and Ferris wheels, the fair’s attractions are the sights, sounds, and tastes inspired by sixteenth-century England. Musicians, magicians, and archers demonstrate their talents to curious fairgoers. Horses carrying knights to a jousting match walk along the streets.

Vendors, ranging from king-sized turkey legs to suits of armor, peddle wares.

I’ve always enjoyed attending Renaissance fairs, and I found out just how interesting they are. Those of us working at the fair spent weeks perfecting our characters’ accents and mannerisms. We also incorporated sixteenth-century English vocabulary into our speech. Substituting good morrow for “good morning” and gramercy for “thank you.” In my role

16. F. NO CHANGE
   G. glance, a Renaissance fair,
   H. glance, a Renaissance fair
   J. glance a Renaissance fair;

17. A. NO CHANGE
   B. they’re way passed
   C. their way passed
   D. their way past

18. F. NO CHANGE
   G. Yet instead of
   H. Because of
   J. Given that

19. A. NO CHANGE
   B. Horses, carrying knights,
   C. Horses carrying knights
   D. Horses, carrying knights

20. Which choice best conveys the horses’ movement in a way that adds a sensory detail to the description of the fair?
   F. NO CHANGE
   G. clip-clop
   H. move
   J. travel

21. A. NO CHANGE
   B. Peddling wares, ranging from king-sized turkey legs to suits of armor are vendors.
   C. Ranging from king-sized turkey legs to suits of armor, vendors peddle wares.
   D. Vendors peddle wares ranging from king-sized turkey legs to suits of armor.

22. Which choice best introduces the subject of the paragraph and the rest of the essay?
   F. NO CHANGE
   G. but it wasn’t until I spent a summer working at one that I understood how much effort went into re-creating the past.
   H. and I knew that getting a job at one would be the easiest way to experience one and have fun at the same time.
   J. so one summer’s day, some friends and I decided to attend a nearby fair.

23. A. NO CHANGE
   B. speech, we substituted
   C. speech, substituting
   D. speech; substituting

GO ON TO THE NEXT PAGE.
as a lady-in-waiting, I often used the sixteenth-century expressions while I served the queen's meals or introduced her to guests.

It was exhausting to spend every day in the hot summer temperatures while pretending to be a person whom had lived in a different country and century. The physical demands were especially strenuous for the queen and us ladies-in-waiting because our costumes, they consisted of confining corsets, several scratchy petticoats, and heavy velvet gowns.

We strove to make the fairgoers' experience as authentic as possible. Things that had come into existence more recently after the sixteenth century had to be explained in Renaissance terms. However, when a guest wished to take a photograph, we would marvel at the camera and ask how such lifelike paintings were created inside the tiny box.

After three tiring months of rehearsals and performances, the fair closed for the season, and I bade fare thee well to my Renaissance character when the summer months were over. Although it had been a wonderful trip back in time, it was a relief to return to the comforts of my own century.

24. F. NO CHANGE
   G. to introduce
   H. introducing
   J. introduce

25. A. NO CHANGE
   B. who were to live
   C. whom lived
   D. who lived

26. F. NO CHANGE
   G. of our costumes, they
   H. of our costumes
   J. our costumes

27. At this point, the writer is considering adding the following sentence:
   Many theme park characters have to wear uncomfortable costumes. Should the writer make this addition here?
   A. Yes, because it develops the essay's earlier comparison between Renaissance fairs and theme parks.
   B. Yes, because it elaborates on the preceding sentence's point about costumes.
   C. No, because it adds a comment that's only loosely related at this point in the essay.
   D. No, because it repeats information stated elsewhere in the essay.

28. F. NO CHANGE
   G. Any kind of object or type of item created and introduced for use
   H. Anything invented
   J. Stuff from

29. A. NO CHANGE
   B. For example,
   C. One time,
   D. Instead,

30. F. NO CHANGE
   G. when the fair closed down.
   H. at the end of the summer.
   J. DELETE the underlined portion and end the sentence with a period.

GO ON TO THE NEXT PAGE.
Uncovered at Johnson’s Shut-Ins

In Reynolds County, Missouri, a one-billion-gallon blast of water caused by a breach of the Taum Sauk reservoir roared down Proffit Mountain into the east fork of the Black River on December 14, 2005. They ripped a channel through Johnson’s Shut-Ins, one of Missouri’s most popular state parks. Though flood damage marred the parks beauty for a time, the scar the raging water left in its wake specifically revealed over a billion years’ worth of Earth’s geologic history.

The area known today as Johnson’s Shut-Ins State Park had begun to develop 1.5 billion years ago. When the volcanoes that created the St. Francois Mountains exploded. Slow-moving magma cooled down its temperature and crystallized to form silica-rich rhyolite rock. Over time sedimentary rock such as limestone and shale, formed from material deposited by shallow inland seas, buried the rhyolite. After the seas had receded, gravel-rich rivers and streams eventually chipped away the soft sedimentary rock in some areas.

31. A. NO CHANGE  
B. water caused by,  
C. water caused, by  
D. water, caused by

32. F. NO CHANGE  
G. That they  
H. Which  
J. It

33. A. NO CHANGE  
B. park’s beauty for a time,  
C. parks’ beauty for a time,  
D. park’s beauty for a time

34. F. NO CHANGE  
G. ultimately  
H. instead  
J. thus

35. A. NO CHANGE  
B. begun developing  
C. began to develop  
D. begun to develop

36. F. NO CHANGE  
G. ago; when  
H. ago when  
J. ago

37. A. NO CHANGE  
B. cooled down to a lower temperature  
C. lowered its temperature to cool  
D. cooled

38. F. NO CHANGE  
G. form silica-rich, rhyolite,  
H. form silica-rich rhyolite,  
J. form, silica-rich rhyolite
exposing the erosion-resistant rhyolite rock and creating pockets and pits. In low places, the
Black River was confined (or “shut in”) by the rhyolite and creating the natural waterslides and
canyon-like gorges that have become a summer playground for thousands of visitors.

Although the flood left the shut-ins unscathed, the surge of water that tore through the park in 2005 stripped away all trees, soil, and sedimentary rock in its path. Left behind is a channel that is composed of granite—and previously unexposed rhyolite rock—and contain rocks from at least three other geological eras. The menacing floodwaters also revealed a half-billion-year-old beach made of both sand and gravel.

Five years of work has restored most of the park surrounding the shut-ins. Some have returned back. Geologists from around the world visit to get a close look at the ancient volcanic rock along what has been named the “Scour Channel.” The “Scour Channel” now rivals the park’s other geologic curiosities for most frequently visited site.

39. The writer is considering deleting the underlined portion. Should the underlined portion be kept or deleted?
A. Kept, because it describes how people feel when they visit the park.
B. Kept, because it suggests the inspiration for the park’s name.
C. Deleted, because it makes an informal observation that is not consistent with the essay’s tone.
D. Deleted, because it interrupts the sentence’s description of the Black River.

40. F. NO CHANGE
G. rhyolite; creating
H. rhyolite, creating
J. rhyolite, created

41. A. NO CHANGE
B. on their
C. in their
D. on its

42. F. NO CHANGE
G. have contained
H. are containing
J. contains

43. A. NO CHANGE
B. Those who are nuts about the outdoors
C. Swimmers, hikers, and campers
D. All types of outdoorsy people

44. F. NO CHANGE
G. by coming back to the park.
H. to revisit the park.
J. DELETE the underlined portion and end the sentence with a period.
A Birthplace of Stars

The winter night I attempted to see the famed Orion Nebula, I didn’t expect to succeed. I was an inexperienced astronomer peering through light-polluted skies. But I was eager to test my new telescope’s capabilities, and the nebula being one of the greatest sights in the night sky. So I bundled up, set out my scope to cool down (its mirrors must adjust to the cold air for optimal viewing), and scanned for the constellation Orion.

I had prepared for this night by studying constellations in my astronomy books. Orion appears as a hunter who, in some mythologies, is fighting Taurus the Bull, another constellation. [A] Even in bright skies, the telltale three stars marking Orion’s belt has been easy to spot. [B] I knew to follow the belt to Orion’s sword, a dim line of stars extending south. [C] The middle of these is actually not a star but a nebula, the Great Orion Nebula, a birthplace of stars. [D] When gravity causes the gas and dust to collapse, forming stars.

The nebula, is home to thousands of young stars, is often called a galactic “nursery.”

GO ON TO THE NEXT PAGE.
I centered my scope where the nebula should be, inserted my lowest-powered eyepiece, and leaned in to look. I just made out a dull smudge. I couldn’t get much improvement even when I adjusted the focuser.

Coincidentally, I switched to a higher-powered eyepiece and tried a trick I’d read about for viewing faint objects: using averted vision.

The principle of averted vision states that the eye can often see distant objects better by looking to their one side rather than directly at them. I focused my eye on an area beside the smudge, and, sure enough,

my peripheral vision yielded far more of a better view of the nebula’s swirling clouds. I even saw the Trapezium star cluster, illuminated by four bright young stars nestled in the nebula like birds’ eggs.
PASSAGE V

Chords of Color

Some viewers see the paintings of abstract artist James Little as impersonal, discordant rainbows. Others see them as minimalistic distillations of emotion, in other words, they are metaphors for Little’s feelings about social issues and historical events. He paints large-scale patterns of shapes—mostly triangles and narrow rectangles in vibrant contrasting hues.

59. Given that all the following statements are true, which one, if added here, would best conclude the paragraph and the essay by referring back to the opening paragraph?

A. Observing these features made my winter trek outdoors worthwhile, teaching me that a change in focus is sometimes helpful to see more clearly.
B. In addition to averted vision, it is also important to eliminate stray light and use the correct magnification when observing the night sky.
C. Although my initial goal was to observe Orion’s belt and sword, the constellation is also very useful as an aid to locating other constellations such as Taurus and Gemini.
D. The Trapezium star cluster was originally discovered in 1617 by Galileo, whom I’d read about extensively in my astronomy books.

Question 60 asks about the preceding passage as a whole.

60. Suppose the writer’s goal had been to write an essay about a personal experience with astronomy. Would this essay accomplish that goal?

F. Yes, because the narrator recounts several past adventures and challenges of using the telescope to view the night sky.
G. Yes, because the narrator describes a stargazing session from start to finish, from setting up the telescope to observing an actual constellation.
H. No, because it primarily focuses on the Orion Nebula and its process of star formation.
J. No, because it describes a universally used technique for viewing distant objects in the night sky.

61. A. NO CHANGE
B. emotion, they see the paintings as
C. emotion the works offer
D. emotion,

62. Which choice is correctly punctuated and makes clear that all the shapes that Little paints are painted in vibrant and contrasting hues?

F. NO CHANGE
G. shapes—mostly triangles and narrow rectangles—in vibrant,
H. shapes—mostly triangles—and narrow rectangles in vibrant,
J. shapes, mostly triangles and narrow rectangles in vibrant

GO ON TO THE NEXT PAGE.
His paintings explore the ambiguity of space, the energy of movement, and the coming together of unlikely elements. But his subject he says is color.

In 2011, working out of his studio in Brooklyn, New York, Little is painting on canvas using his own blends of beeswax and oil paint. He applies at least fifteen layers of these paints that he blended himself to achieve a thick, smooth, color-soaked, luminescent surface. Most of his paintings are voluminous, about six feet by eight feet. To create sharp visual breaks and clean edges of color in these expansive works, he paints slashing diagonal lines and rays.

In his 2005 painting Bittersweet Victory, by all means, the canvas is bisected by a vertical, beige line. On the left half, three orange triangles in a row, each one which stretched from the bottom to the top of the canvas’s left half, angle slightly to the right on a purple

63. A. NO CHANGE
B. But his subject, he says,
C. But, his subject, he says
D. But his subject, he says

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

Little also says that Syracuse University, where he earned his MFA in 1976, was a “beacon for abstract painting.”

Should the writer make this addition here?
A. Yes, because it provides a smooth transition to the biographical focus of the paragraph that follows.
B. Yes, because it indicates where Little first became focused on working with color.
C. No, because it adds information that is tangentially related to the essay but blurs the focus of the first paragraph.
D. No, because it causes unnecessary confusion concerning the essay’s assertion that Little works with geometric figures.

65. A. NO CHANGE
B. paint, which is of his own making, and does so
C. his own blends that he made
D. these blends

66. F. NO CHANGE
G. immeasurable,
H. mountainous,
J. large.

67. A. NO CHANGE
B. for example,
C. in contrast,
D. thereafter,

68. Which of the following alternatives to the underlined portion would NOT be acceptable?
A. vertically bisected by a beige
B. bisected by a vertically beige
C. bisected vertically by a beige
D. bisected by a beige, vertical

69. A. NO CHANGE
B. which by stretching
C. stretching
D. stretches

70. F. NO CHANGE
G. canvas, on the left half,
H. left half of the canvas,
J. canvas,
background. On the right half, three vertical bands of dark green, one edge of each band slanting to create a point that touches the top of the canvas, cuts through a lime-green background. Little explains that the internal spaces in his paintings (created by lines and blocks of color) need to play off of each other in a way that lends rhythm and unity to the whole work. The effect is much like something that would remind you of a perfect jazz collaboration.

One of Little’s favorite assessments of his work came from a woman who told him that his paintings are optimistic. Little believes the bold, positive energy infusing his work comes from what he observes around him. His paintings reflect what he considers the essence of our experiences as human beings. The malleable nature of space, the surprising shifts, but, in the end, a balance.

71. A. NO CHANGE
   B. cuts crossed
   C. cut through
   D. cut crossed

72. E. NO CHANGE
   G. on the entirety of the
   H. into the whole
   J. with the entire

73. A. NO CHANGE
   B. reminiscent of something that echoes
   C. much like that of
   D. being like

74. If the writer were to delete the preceding sentence, the paragraph would primarily lose a description of Little’s work that:
   F. builds on the subtle musical reference in the paragraph to create a comparison between Little’s paintings and jazz.
   G. indicates the popularity of Little’s paintings by drawing a comparison between his work and jazz collaborations.
   H. provides a transition to the following paragraph’s focus on several assessments of Little’s work by art critics.
   J. emphasizes the idea that Little’s methods allowed him to reach the goals he uniquely set for his piece Bittersweet Victory.

Question 75 asks about the preceding passage as a whole.

75. Suppose the writer’s primary purpose had been to describe how an artist uses simple elements to convey large ideas. Would this essay accomplish that purpose?
   A. Yes, because it focuses primarily on one viewer’s conclusion that the lines of color in Little’s Bittersweet Victory communicate the idea of optimism.
   B. Yes, because it conveys that Little uses shapes and color to capture what he sees as the movement and rhythm of the human experience.
   C. No, because it focuses too heavily on describing the metaphor that Little hoped to create with Bittersweet Victory but does not explain what that painting looked like.
   D. No, because it indicates that Little focuses on color in his work but does not suggest the effect that his work achieves.

END OF TEST 1
STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.
MATHEMATICS TEST
60 Minutes—60 Questions

DIRECTIONS: Solve each problem, choose the correct answer, and then fill in the corresponding oval on your answer document. Do not linger over problems that take too much time. Solve as many as you can; then return to the others in the time you have left for this test. You are permitted to use a calculator on this test. You may use your calculator for any problems you choose, but some of the problems may best be done without using a calculator.

Note: Unless otherwise stated, all of the following should be assumed.
1. Illustrative figures are NOT necessarily drawn to scale.
2. Geometric figures lie in a plane.
3. The word line indicates a straight line.
4. The word average indicates arithmetic mean.

1. A restaurant occupying the top floor of a skyscraper rotates as diners enjoy the view. Ling and Sarah notice that they began their meal at 7:00 p.m. looking due north. At 7:45 p.m. they had rotated 180° to a view that was due south. At this rate, how many degrees will the restaurant rotate in 1 hour?
   A. 90°
   B. 180°
   C. 240°
   D. 270°
   E. 400°

DO YOUR FIGURING HERE.

2. The cost of a gym membership is a onetime fee of $140, plus a monthly fee of $40. Brendan wrote a $500 check to pay his gym membership for a certain number of months, including the onetime fee. How many months of membership did he pay for?
   F. 3
   G. 4
   H. 9
   J. 12
   K. 13

3. A museum offers a 2-hour guided group tour. For groups with fewer than 25 people the cost is $9.25 per person; for groups with 25 people or more the cost is $8.50 per person. The 27 people in the 9:00 a.m. tour group each paid $9.25 in advance. What is the total refund that the museum owes the 9:00 a.m. group?
   A. $12.50
   B. $13.00
   C. $18.75
   D. $20.25
   E. $25.00

GO ON TO THE NEXT PAGE.
4. The 13-member math club needs to choose a student government representative. They decide that the representative, who will be chosen at random, CANNOT be any of the 3 officers of the club. What is the probability that Samara, who is a member of the club but NOT an officer, will be chosen?

F. 0
G. \( \frac{1}{13} \)
H. \( \frac{1}{10} \)
J. \( \frac{3}{13} \)
K. \( \frac{1}{3} \)

5. Mele earned scores of 75, 70, 92, 95, and 97 points (a total of 429 points) on the first 5 tests in Economics II. Solving which of the following equations for \( s \) gives the score he needs to earn on the 6th test to average exactly 85 points for all 6 tests?

A. \( \frac{429}{5} + s = 85 \)
B. \( \frac{429}{6} + s = 85 \)
C. \( \frac{s + 429}{5} = 85 \)
D. \( \frac{s + 429}{6} = 85 \)
E. \( \frac{s + 429}{6} = \frac{85}{100} \)

6. The figure below shows quadrilateral \( ABCD \). What is the measure of \( \angle C \)?

F. 120°
G. 115°
H. 105°
J. 100°
K. 80°

7. In the figure below, \( \triangle ABC \) and \( \triangle DEF \) are similar triangles with the given side lengths in meters. What is the perimeter, in meters, of \( \triangle DEF \)?

A. 3
B. 8
C. 11
D. 12
E. 13

GO ON TO THE NEXT PAGE.
8. \(|3(-2) + 4| = ?\)
   F. \(-2\)
   G. \(2\)
   H. \(5\)
   J. \(9\)
   K. \(10\)

9. What are the values for \(x\) that satisfy the equation 
   \((x + a)(x + b) = 0\)?
   A. \(-a\) and \(-b\)
   B. \(-a\) and \(b\)
   C. \(-ab\)
   D. \(a\) and \(-b\)
   E. \(a\) and \(b\)

10. In the figure below, \(G\) is the center of the circle, \(LK\) is a diameter, \(H\) lies on the circle, \(J\) lies outside the circle on \(LK\), and \(JM\) is tangent to the circle at \(M\). Which of the following angles or minor arcs has the greatest degree measure?

   \[\text{F. } \overrightarrow{LM}\]
   \[\text{G. } \overrightarrow{MK}\]
   \[\text{H. } \angle JMG\]
   \[\text{J. } \angle LHK\]
   \[\text{K. } \angle MJL\]

11. Points \(B\) and \(C\) lie on \(AD\) as shown below. The length of \(AD\) is 30 units; \(AC\) is 16 units long; and \(BD\) is 20 units long. How many units long, if it can be determined, is \(BC\)?

   \[\text{A. } 4\]
   \[\text{B. } 6\]
   \[\text{C. } 10\]
   \[\text{D. } 14\]
   \[\text{E. } \text{Cannot be determined from the given information}\]

12. If \(12x = -8(10 - x)\), then \(x = ?\)

   \[\text{F. } 20\]
   \[\text{G. } 8\]
   \[\text{H. } \frac{5}{11}\]
   \[\text{J. } \frac{12}{13}\]
   \[\text{K. } -20\]

GO ON TO THE NEXT PAGE.
Use the following information to answer questions 13–15.

Ken baked, frosted, and decorated a rectangular cake for the last Math Club meeting. The cake was 3 inches high, 12 inches wide, and 16 inches long. He centered the cake on a piece of cardboard whose rectangular top surface had been covered with aluminum foil, as shown in the figure below.

13. Ken used a piece of cardboard large enough to allow the cardboard to extend 2 inches beyond the cake on all sides. What is the area, in square inches, of the aluminum foil that is exposed on the top surface of the cardboard?
   A. 60
   B. 64
   C. 88
   D. 96
   E. 128

14. At the Math Club meeting, Principal Gonzales cut the entire cake into pieces. Each piece is 2 inches wide, 2 inches long, and 3 inches high. What is the number of pieces Principal Gonzales cut the cake into?
   F. 16
   G. 20
   H. 28
   J. 48
   K. 96

15. The Math Club will pay Ken $5.00 for preparing the cake and will also pay him for the cost of the cake mix at $1.73, the frosting mix at $2.67, and the sales tax of 5% on these 2 items. What is the total amount the Math Club will pay Ken?
   A. $4.67
   B. $9.40
   C. $9.45
   D. $9.62
   E. $9.87

GO ON TO THE NEXT PAGE.
16. What is the y-intercept of the line in the standard (x,y) coordinate plane that goes through the points (−3,6) and (3,2)?
   F. 0
   G. 2
   H. 4
   J. 6
   K. 8

17. A machine part is diagrammed in the figure below with the dimensions given in inches. If the centers of the circles lie on the same line parallel to the bottom of the part, what is the distance, in inches, between the centers of the 2 holes in the machine part?

   A. 5 3/16
   B. 5 1/16
   C. 5
   D. 4 13/16
   E. 4 3/16

18. The depth of a pond is 180 cm and is being reduced by 1 cm per week. The depth of a second pond is 160 cm and is being reduced by 1 1/2 cm per week. If the depths of both ponds continue to be reduced at these constant rates, in about how many weeks will the ponds have the same depth?

   F. 10
   G. 20
   H. 40
   J. 80
   K. 140
19. When graphed in the standard (x,y) coordinate plane, which of the following equations does NOT represent a line?

A. $x = 4$
B. $3y = 6$
C. $x - y = 1$
D. $y = \frac{3}{4}x - 2$
E. $x^2 + y = 5$

DO YOUR FIGURING HERE.

20. In the right triangle shown below, which of the following statements is true about $\angle A$?

F. $\cos A = \frac{12}{13}$
G. $\sin A = \frac{12}{13}$
H. $\tan A = \frac{12}{13}$
J. $\cos A = \frac{13}{12}$
K. $\sin A = \frac{13}{12}$

![Right Triangle Diagram]

21. A park has the shape and dimensions in blocks given below. A water fountain is located halfway between point $B$ and point $D$. Which of the following is the location of the water fountain from point $A$?

(Note: The park's borders run east-west or north-south.)

A. $3\frac{1}{2}$ blocks east and 6 blocks north
B. 5 blocks east and $4\frac{1}{2}$ blocks north
C. 5 blocks east and 6 blocks north
D. $8\frac{1}{2}$ blocks east and $4\frac{1}{2}$ blocks north
E. 9 blocks east and $7\frac{1}{2}$ blocks north

GO ON TO THE NEXT PAGE.
22. The braking distance, \( y \) feet, for Damon's car to come to a complete stop is modeled by \( y = \frac{3(x^2 + 10x)}{40} \), where \( x \) is the speed of the car in miles per hour. According to this model, which of the following is the maximum speed, in miles per hour, Damon can be driving so that the braking distance is less than or equal to 150 feet?

F. 10
G. 30
H. 40
I. 50
K. 60

23. If \( f(x) = x^2 + x + 5 \) and \( g(x) = \sqrt{x} \), then what is the value of \( \frac{g(4)}{f(1)} \)?

A. \( \frac{2}{7} \)
B. \( \frac{25}{7} \)
C. \( \frac{2}{25} \)
D. 2
E. 4

24. At a school picnic, 1 junior and 1 senior will be selected to lead the activities. If there are 125 juniors and 100 seniors at the picnic, how many different 2-person combinations of 1 junior and 1 senior are possible?

F. 25
G. 100
H. 125
J. 225
K. 12,500

GO ON TO THE NEXT PAGE.
25. The scatterplot in the standard (x, y) coordinate plane below contains data points showing a strong linear correlation between the variables x and y. Mia drew the line shown to model the data. One of the following equations represents Mia’s line. Which one?

[Graph showing a line on a coordinate plane with data points around it.]

A. \( y = -3x + 8 \)
B. \( y = -3x + 10 \)
C. \( y = -2x + 10 \)
D. \( y = 2x + 10 \)
E. \( y = 2x + 8 \)

26. The temperature, \( r \), in degrees Fahrenheit, in a certain town on a certain spring day satisfies the inequality \( |r - 24| \leq 30 \). Which of the following temperatures, in degrees Fahrenheit, is NOT in this range?

F. \(-10\)
G. \(-6\)
H. \(-5\)
J. \(0\)
K. \(54\)

27. If 5 times a number \( n \) is subtracted from 15, the result is negative. Which of the following gives the possible value(s) for \( n \)?

A. \( 0 \) only
B. \( 3 \) only
C. \( 10 \) only
D. All \( n > 3 \)
E. All \( n < 3 \)

28. For all \( x > 21 \), \( \frac{(x^2 + 8x + 7)(x - 3)}{(x^2 + 4x - 21)(x + 1)} = ? \)

F. \( 1 \)
G. \( \frac{9}{7} \)
H. \( \frac{x - 3}{x + 3} \)
J. \( \frac{2(x - 3)}{x + 1} \)
K. \( \frac{-4(x - 3)}{x + 1} \)
29. The median of a set of data containing 9 items was found. Four data items were added to the set. Two of these items were greater than the original median, and the other 2 items were less than the original median. Which of the following statements must be true about the median of the new data set?

A. It is the average of the 2 new lower values.
B. It is the same as the original median.
C. It is the average of the 2 new higher values.
D. It is greater than the original median.
E. It is less than the original median.

30. The figure below shows 2 tangent circles such that the 10-centimeter diameter of the smaller circle is equal to the radius of the larger circle. What is the area, in square centimeters, of the shaded region?

F. 10
G. 75
H. 5π
I. 10π
K. 75π

31. The sign of a is positive. The sign of b is negative. If it can be determined, what is the sign of the mean of a and b?

A. Positive
B. Negative
C. Both positive and negative
D. Neither positive nor negative
E. Cannot be determined from the given information

Use the following information to answer questions 32–34.

The curve \( y = 0.005x^2 - 2x + 200 \) for \( 0 \leq x \leq 200 \) and the line segment from \( F(0,200) \) to \( G(200,0) \) are shown in the standard \((x,y)\) coordinate plane below.

GO ON TO THE NEXT PAGE.
32. What is the y-coordinate for the point on the curve with x-coordinate 20?
   F. 160
   G. 162
   H. 164
   J. 166
   K. 168

33. The length of this curve is longer than \( FG \). About how many coordinate units long is \( FG \)?
   A. 20
   B. 141
   C. 200
   D. 283
   E. 400

34. Tran wants to approximate the area underneath the curve \( y = 0.005x^2 - 2x + 200 \) for \( 0 \leq x \leq 200 \), shown shaded in the graph below.

He finds an initial estimate, A, for the shaded area by using \( FG \) and computing
\[
A = \frac{1}{2} (200 \text{ units})(200 \text{ units}) = 20,000 \text{ square units.}
\]
The area of the shaded region is:
   F. less than 20,000 square units, because the curve lies under \( FG \).
   G. less than 20,000 square units, because the curve lies over \( FG \).
   H. equal to 20,000 square units.
   J. greater than 20,000 square units, because the curve lies under \( FG \).
   K. greater than 20,000 square units, because the curve lies over \( FG \).

GO ON TO THE NEXT PAGE.
35. A cargo ship is 4.2 miles from a lighthouse, and a fishing boat is 5.0 miles from the lighthouse, as shown below. The angle between the straight lines from the lighthouse to the 2 vessels is 5°. The approximate distance, in miles, from the cargo ship to the fishing boat is given by which of the following expressions?

(Note: The law of cosines states that for any triangle with vertices \( A, B, \) and \( C \) and the sides opposite those vertices with lengths \( a, b, \) and \( c, \) respectively, \( c^2 = a^2 + b^2 - 2ab \cos C. \))

A. \( \sqrt{(5.0)^2 - (4.2)^2} \)
B. \( \sqrt{(4.2)^2 + (5.0)^2 - 2 \cdot 4.2 \cdot 5.0 \cos 5^\circ} \)
C. \( \sqrt{(4.2)^2 + (5.0)^2 + 2 \cdot 4.2 \cdot 5.0 \cos 5^\circ} \)
D. \( \sqrt{(4.2)^2 + (5.0)^2 - 2 \cdot 4.2 \cdot 5.0 \cos 85^\circ} \)
E. \( \sqrt{(4.2)^2 + (5.0)^2 + 2 \cdot 4.2 \cdot 5.0 \cos 85^\circ} \)

36. Which of the following equations expresses \( c \) in terms of \( a \) for all real numbers \( a, b, \) and \( c \) such that \( a^3 = b \) and \( b^2 = c \)?

F. \( c = a^6 \)
G. \( c = a^5 \)
H. \( c = 2a^3 \)
J. \( c = \frac{1}{2}a \)
K. \( c = a \)

37. After visiting Florida State University during spring break, Francisco rents a car for 2 days to travel around Florida. He has $255 to spend on car rental for the 2 days. Sea Horse Car Rental charges $50 per day and $0.25 per mile. Ocean Blue Car Rental charges $60 per day and $0.20 per mile. Which company, if either, allows him to travel more miles for the 2 days, and how many miles more?

(Note: Taxes are already included in the rental charges.)

A. Sea Horse, 20
B. Ocean Blue, 55
C. Ocean Blue, 100
D. Sea Horse, 135
E. Francisco would get the same maximum number of miles from each company.

GO ON TO THE NEXT PAGE.
38. In the standard \((x,y)\) coordinate plane below, the points \((0,0), (10,0), (13,6),\) and \((3,6)\) are the vertices of a parallelogram. What is the area, in square coordinate units, of the parallelogram?

\[
\begin{array}{c}
\text{F. } 30 \\
\text{G. } 60 \\
\text{H. } 30\sqrt{3} \\
\text{J. } 30\sqrt{5} \\
\text{K. } 60\sqrt{5}
\end{array}
\]

39. For every pair of natural numbers \(n\) and \(m\), to which of the following sets must \(n + m\) belong?

I. The natural numbers
II. The integers
III. The rational numbers
IV. The real numbers
V. The complex numbers

A. I, II, and III only
B. II, III, and IV only
C. III, IV, and V only
D. II, III, IV, and V only
E. I, II, III, IV, and V

40. A certain perfect square has exactly 4 digits (that is, it is an integer between 1,000 and 9,999). The positive square root of the perfect square must have how many digits?

F. 1
G. 2
H. 3
J. 4
K. Cannot be determined from the given information

41. A certain hotel has 80 rooms. Based on many previous years’ occupancy rates, the owners of the hotel constructed the table below showing the daily occupancy rates and their probabilities of occurring for the coming summer season. Based on the probability distribution in the table, to the nearest whole number, what is the expected number of rooms that will be occupied on any day during the coming summer season?

<table>
<thead>
<tr>
<th>Occupancy rate</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.60</td>
<td>0.20</td>
</tr>
<tr>
<td>0.70</td>
<td>0.40</td>
</tr>
<tr>
<td>0.80</td>
<td>0.30</td>
</tr>
<tr>
<td>0.90</td>
<td>0.10</td>
</tr>
</tbody>
</table>

A. 20
B. 25
C. 58
D. 60
E. 75

GO ON TO THE NEXT PAGE.
42. What is the matrix product \[
\begin{bmatrix}
\frac{a}{2a} & [1 \ 0 \ -1]
\end{bmatrix}?
\]
F. \[
\begin{bmatrix}
a & 0 & -a \\
2a & 0 & -2a \\
3a & 0 & -3a
\end{bmatrix}
\]
G. \[
\begin{bmatrix}
a & 2a & 3a \\
0 & 0 & 0 \\
\frac{a}{2a} & -2a & -3a
\end{bmatrix}
\]
H. \[
\begin{bmatrix}
2a & 0 & -2a
\end{bmatrix}
\]
J. \[
\begin{bmatrix}
6a & 0 & 6a
\end{bmatrix}
\]
K. \[
\begin{bmatrix}
0
\end{bmatrix}
\]

43. What is the degree measure of the smaller of the 2 angles formed by the line and the ray shown in the figure below?

![](image)

A. 14°
B. 28°
C. 29°
D. 58°
E. Cannot be determined from the given information

44. Let \(a\) equal \(2b + 3c - 5\). What happens to the value of \(a\) if the value of \(b\) decreases by 1 and the value of \(c\) increases by 2?

F. It increases by 4.
G. It increases by 2.
H. It increases by 1.
J. It is unchanged.
K. It decreases by 2.

45. Shima will mix 1 fluid ounce of fertilizer in water for every 40 square feet of soil. At this rate, which of the following expressions gives the number of gallons of fertilizer that Shima will mix in water for 0.5 acres of soil?

(Note: 1 acre = 43,560 square feet; 1 gallon = 128 fluid ounces)

A. \[
\frac{0.5(40)(128)}{43,560}
\]
B. \[
\frac{40(128)}{0.5(43,560)}
\]
C. \[
\frac{0.5(43,560)}{40(128)}
\]
D. \[
\frac{43,560}{0.5(40)(128)}
\]
E. \[
\frac{0.5(43,560)(40)}{128}
\]
46. A restaurant has 10 booths that will seat up to 4 people each. If 20 people are seated in booths, and NO booths are empty, what is the greatest possible number of booths that could be filled with 4 people?
   
   F. 0
   G. 1
   H. 2
   J. 3
   K. 5

47. Let A and B be independent events. Denote $P(A)$ as the probability that Event A will occur, and denote $P(A \cap B)$ as the probability that Events A and B will both occur. Which of the following equations must be true?
   
   A. $P(A) = P(B)$
   B. $P(A) = 1 - P(B)$
   C. $P(A \cap B) = P(A) + P(B)$
   D. $P(A \cap B) = P(A) \cdot P(B)$
   E. $P(A \cap B) = P(A) + P(B) - (P(A) \cdot P(B))$

48. In the standard $(x,y)$ coordinate plane below, an angle is shown whose vertex is the origin. One side of this angle with measure $\theta$ passes through $(4,-3)$, and the other side includes the positive $x$-axis. What is the cosine of $\theta$?

   F. $-\frac{4}{3}$
   G. $-\frac{3}{4}$
   H. $-\frac{3}{5}$
   J. $\frac{4}{5}$
   K. $\frac{5}{4}$

49. Which of the following expressions, if any, are equal for all real numbers $x$?

   I. $\sqrt{(-x)^2}$
   II. $|\sqrt{x}|$
   III. $|x|

   A. I and II only
   B. I and III only
   C. II and III only
   D. I, II, and III
   E. None of the expressions are equivalent.

GO ON TO THE NEXT PAGE.
50. In the figure below, $A$, $C$, $F$, and $D$ are collinear; $B$, $C$, and $E$ are collinear; and the angles at $A$, $E$, and $F$ are right angles, as marked. Which of the following statements is NOT justifiable from the given information?

- F. $\overrightarrow{AB}$ is parallel to $\overrightarrow{EF}$.
- G. $\overline{DE}$ is perpendicular to $\overline{BE}$.
- H. $\angle ACB$ is congruent to $\angle FCE$.
- J. $\triangle ABC$ is similar to $\triangle EFC$.
- K. $\overline{CE}$ is congruent to $\overline{ED}$.

51. In the figure below, all line segments are either horizontal or vertical and the dimensions given are in inches. What is the perimeter, in inches, of the figure?

- A. 10
- B. 12
- C. 13
- D. 14
- E. 16

52. Triangle $\triangle ABC$ has vertices $A(8,2)$, $B(0,6)$, and $C(-3,2)$. Point $C$ can be moved along a certain line, with points $A$ and $B$ remaining stationary, and the area of $\triangle ABC$ will not change. What is the slope of that line?

- F. $-\frac{1}{2}$
- G. $-\frac{3}{4}$
- H. 0
- J. $\frac{4}{3}$
- K. 2
53. On his first day as a telemarketer, Marshall made 24 calls. His goal was to make 5 more calls on each successive day than he had made the day before. If Marshall met, but did not exceed, his goal, how many calls had he made in all after spending exactly 20 days making calls as a telemarketer?

A. 670  
B. 690  
C. 974  
D. 1,430  
E. 1,530

54. Which of the following is the graph of the function \( f(x) \) defined below?

\[
f(x) = \begin{cases} 
  x^2 - 2 & \text{for } x \leq 1 \\
  x - 7 & \text{for } 1 < x < 5 \\
  4 - x & \text{for } x \geq 5 
\end{cases}
\]

F.  
G.  
H.  
J.  
K.

55. Which of the following expressions gives the number of permutations of 15 objects taken 5 at a time?

A. \( 15(5) \)  
B. \( (15 - 5)! \)  
C. \( \frac{15!}{5!} \)  
D. \( \frac{15!}{(15 - 5)!} \)  
E. \( \frac{15!}{(5!)(15 - 5)!} \)
56. For all $x > 0$, which of the following expressions is equivalent to $\frac{i}{\sqrt{x} - i}$, where $i = \sqrt{-1}$?

F. $i$

G. $\frac{\sqrt{x}}{x}$

H. $\frac{\sqrt{x} - 1}{x + 1}$

J. $\frac{i\sqrt{x} + 1}{x - 1}$

K. $\frac{i\sqrt{x} - 1}{x + 1}$

57. Vectors $\overrightarrow{AB}$ and $\overrightarrow{CD}$ are shown in the standard $(x,y)$ coordinate plane below. One of the following is the unit vector notation of the vector $\overrightarrow{AB} + \overrightarrow{CD}$. Which one?

A. $-6i + 3j$
B. $3i - 1j$
C. $3i + 9j$
D. $9i + 1j$
E. $9j + 11j$

58. A simple pendulum consists of a small mass suspended from a string that is fixed at its upper end and has negligible mass. The length of time, $t$ seconds, for a complete swing of a simple pendulum can be modeled by the equation $t = 2\pi \sqrt{\frac{L}{32}}$, where $L$ is the length, in feet, of the string. If the time required for a complete swing of Pendulum 1 is triple the time required for a complete swing of Pendulum 2, the length of Pendulum 1’s string is how many times the length of Pendulum 2’s string?

F. $\frac{1}{3}$
G. 3
H. 6
J. 9
K. 27
59. If \( \log_a x = s \) and \( \log_a y = t \), then \( \log_a (xy)^2 \) = ?
   A. \( 2(s + t) \)
   B. \( s + t \)
   C. \( 4st \)
   D. \( 2st \)
   E. \( st \)

   F. 32%
   G. 30%
   H. 20%
   J. 15%
   K. 2%

END OF TEST 2
STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.
DO NOT RETURN TO THE PREVIOUS TEST.
LITERARY NARRATIVE: This passage is adapted from the novel *Homeland* by John Jakes (©1993 by John Jakes).

Joseph Emanuel Crown, owner of the Crown Brewery of Chicago, was a worried man. Worried on several counts, the most immediate being a civic responsibility he was scheduled to discuss at an emergency meeting this Friday, the fourteenth of October; a meeting he had requested.

Joe Crown seldom revealed inner anxieties, and that was the case as he worked in his office this morning. He was a picture of steadiness, rectitude, prosperity. He wore a fine suit of medium gray enlivened by a dark red four-in-hand tied under a high collar. Since the day was not yet too warm, he kept his coat on.

Joe’s hair was more silver than white. He washed it daily, kept it shining. His eyes behind spectacles with silver wire frames were dark brown, rather large, and alert. His mustache and imperial showed careful attention; he had an appointment at twelve for the weekly trim. His hands were small but strong. He wasn’t handsome, but he was commanding.

Three principles ruled Joe Crown’s business and personal life, of which the most important was order. In German, *Ordnung*. Without order, organization, some rational plan, you had chaos.

The second principle was accuracy. Accuracy was mandatory in brewing, where timing and temperatures were critical. But accuracy was also the keystone of any business that made money instead of losing it. The primary tool for achieving accuracy was mathematics. Joe Crown had a towering belief in the potency of correct information, and the absolute authority of numbers which provided it.

In Germany, he’d learned his numbers before he learned to read. Though a mediocre student in most school subjects, at ciphering he was a prodigy. He could add a column of figures, or do calculations in his head, with astonishing speed. In Cincinnati, his first stop in America, he’d begged the owner of a Chinese laundry to teach him to use an abacus. One of these ancient counting devices could be found in his office, sitting on a low cabinet, within reach. Money measured success; counting measured money.

Questions he asked of his employees often involved numbers. “What is the exact temperature?” “How large is the population in that market?” “How many barrels did we ship last week?” “What’s the cost, per square foot, of this expansion?”

As for his third principle, modernity, he believed that, too, was crucial in business. Men who said the old ways were the best ways were fools, doomed to fall behind and fail. Joe was always searching for the newest methods to improve the brewery’s product, output, efficiency, cleanliness. He hadn’t hesitated to install expensive pasteurization equipment when he opened his first small brewery in Chicago. He’d been among the first to invest heavily in refrigerated freight cars. He insisted that modern machines be used in the office. From his desk he could hear the pleasant rattle noise of a mechanical adding machine. This blended with the clicking keys and pinging bell on the black iron typewriter used for correspondence by his chief clerk, Stefan Zwick.

Originally Stefan had resisted Joe’s suggestion that he learn to operate a typewriter. “Sir, I respectfully decline, a quill pen suits me perfectly.”

“But Stefan,” Joe said to him in a friendly but firm way, “I’m afraid it doesn’t suit me, because it makes Crown’s look old-fashioned. However, I’ll respect your feelings. Please place a help wanted advertisement. We’ll hire one of those young women who specialize in using the machines. I believe they too are called typewriters.”

Zwick blanched. “A woman? In my office?”

“I’m sorry, Stefan, but you leave me no choice if you won’t learn to typewrite.”

Stefan Zwick learned to typewrite.

Every solid house or building was supported by a strong foundation; and so there was a foundation on which Joe Crown’s three principles rested. It was not unusual, or peculiar to him. It was the cheerful acceptance, not to say worship, of hard work. Among other
artifacts, advertising sheets, flags and fading brown photographs of annual brewery picnics decorating his office there was a small framed motto which his wife had done colorfully in cross-stitch and put into a frame of gilded wood. Ohne Fleiss, kein Preis, it said. In rough translation, this reminded you that without industry there was no reward. From his desk Joe Crown couldn’t see the gold-framed motto; it hung on the wall behind him, slightly to his right. But he didn’t need to see it. Its truth was in him deeper than the marrow of his bones. He was a German.

5. At the time described in the passage’s opening, what is Crown’s most immediate preoccupation?
   A. Whether he will be on time for his weekly trim
   B. Whether to install expensive pasteurization equipment at his brewery
   C. Zwick’s impertinent behavior
   D. A civic responsibility

6. The passage states that Crown was what kind of student?
   F. Exceptionally gifted, especially in ciphering
   G. Mediocre, except in ciphering
   H. Successful when he applied himself, otherwise poor
   J. Increasingly successful as he gained the use of counting aids

7. Based on the passage, which of the following questions would be most characteristic of the kind Crown typically asked his employees?
   A. “Was your weekend a most pleasant one?”
   B. “Have you had a chance to repair that old typewriter?”
   C. “By what figure will our sales increase if we advertise in that publication?”
   D. “Who among you has a better idea for how we can work well as a team?”

8. At the time in which the passage is set, which of the following devices are still apparently being used in offices in the United States even as those same devices are, in Crown’s view, becoming increasingly obsolete?
   F. Typewriters
   G. Mechanical adding machines
   H. Quill pens
   J. Abacuses

9. The metaphor the author uses to help describe Crown’s three principles primarily draws upon imagery from what discipline?
   A. Architecture
   B. Business
   C. Astronomy
   D. Education

10. Which of the following is a detail from the passage that indicates the length of time Crown has been in the brewery business?
    F. Some outdated refrigerators from when he first opened his business
    G. A newly hung cross-stitched phrase framed and placed on his office wall
    H. Photographs of annual company picnics decorating his office
    J. A bell, the ringing of which has marked the start of his workday for the last twenty years
Passage II

SOCIAL STUDIES: This passage is adapted from the book *The Age of Wonder* by Richard Holmes (©2008 by Richard Holmes).

In the summer of 1785 astronomer William Herschel embarked on his revolutionary new project to observe and resolve the heavens with a telescope more powerful than ever previously attempted.

What he intended to build was a telescope 'of the Newtonian form, with an octagon tube 40 foot long and five feet in diameter; the specula [mirrors] of which it would be necessary to have at least two, or perhaps three'. The telescope would have to be mounted in an enormous wooden gantry, capable of being turned safely on its axis by just two workmen, but also susceptible to the finest fingertip adjustments by the observing astronomer.

The forty-foot would be higher than a house. The astronomer (William) would be required to climb a series of ladders to a special viewing platform perched at the mouth of the telescope. The assistant (William's sister, Caroline) would have to be shut in a special booth below to avoid light pollution, where she would have her desk and lamp, celestial clocks, and observation journals. Astronomer and assistant would be invisible to each other for hours on end, shouting commands and replies, although eventually connected by a metal speaking-tube.

William had decided that his grand project required a new house with larger grounds for constructing and erecting the telescope. On 3 April 1786 they moved to 'The Grove', a quite small and rather dilapidated country house on the edge of the tiny village of Slough, England.

The house itself was not large, but it had sheds and stables which were gradually converted into workshops and laboratories. Above the stables were a series of haylofts which could be converted into a separate apartment. Caroline claimed these for her own. A small outside staircase led up to a flat roof from which she hoped to carry out her comet 'sweeps' in security and independently. She would check over the calculations of William's nebulae by day, and make her own sweeps up on the roof by night.

William had built Caroline a special two-foot Newtonian reflector. Because of its large aperture, its tube appeared much fatter, heavier and stubbier than normal reflectors of this type. Suspended from a pivot at the top of the box-frame, the telescope could be precisely raised or lowered by a system of pulleys operated by a winding handle. These adjustments were easy to make, and extremely fine.

This beautiful instrument was designed specifically for its huge light-gathering power and its wide angle of vision. The magnification was comparatively low at twenty-four times. As with modern binoculars, this combination of low power with a large viewing field allowed the observer to see faint stellar objects very brightly, while placing them within a comparatively wide context of surrounding stars. The telescope was perfectly designed to spot any strange or unknown object moving through the familiar field of 'fixed stars'. In other words, to catch new planets or new comets.

On 1 August 1786, only two nights after starting her new sweeps, Caroline thought she had spotted an unknown stellar object moving through Ursa Major (the Great Bear constellation). It appeared to be descending, but barely perceptibly, towards a triangulation of stars in the beautifully named constellation Coma Berenices. To find something so quickly, and in such a familiar place (the Great Bear or Big Dipper being the first stop of every amateur stargazer wanting to locate the Pole Star), seemed wildly unlikely. Caroline's Observation Book conveys meticulous caution, but also remarkable certainty.

Unable to calculate the mathematical coordinates of the object, she accompanied her observations with a series of three neat drawings or 'figures', over an eighty-minute time lapse. These showed the circular viewing field of her telescope, with an asterisk shape very slightly changing position relative to three known fixed stars. The account written into her 'Book of Work Done' catches something of her growing excitement.

August 1st. I have calculated 100 nebulae today, and this evening I saw an object which I believe will prove tomorrow night to be a Comet. August 2nd. 1 o'clock. the object of last night IS A COMET. August 3rd. I did not go to rest till I had written to Dr Blagden [at the Royal Society] and Mr Aubert to announce the Comet.

The verification of Caroline's comet was achieved much more rapidly than William's discovery of the planet Uranus had been. Its movement through Coma Berenices was relatively easy to ascertain, and its fine hazy tail or coma was unmistakable.

11. Which of the following statements best describes how the passage characterizes William's response to Caroline's discovery of a comet?

A. The passage makes it clear that although William applauded Caroline's discovery, he was disappointed that Caroline wasn't looking for nebulae.

B. The passage claims that William supported Caroline's discovery by verifying the comet himself.

C. The passage suggests that William resented the fact that Caroline's comet was recognized so quickly.

D. The passage does not give a clear indication of how William felt about Caroline's discovery.
Taking Additional Practice Tests

12. In the passage, the author emphasizes the large size of William's powerful telescope's octagon tube by comparing the tube's height to that of a:
   F. series of ladders.
   G. wooden gantry.
   H. hayloft.
   J. house.

13. The primary function of the fifth paragraph (lines 31–40) is to:
   A. explain the methods Caroline used to perform her comet sweeps.
   B. shift the passage's focus from William's project to Caroline's own astronomical work.
   C. describe the renovations Caroline made to the stables in order to accommodate William's telescope.
   D. introduce the passage's discussion of how Caroline's observation techniques compared to William's.

14. In the context of the passage, the excerpt from Caroline's "Book of Work Done" primarily serves to:
   F. outline the process by which Caroline determined her finding was a comet.
   G. provide an example of the types of observation notes Caroline made for William.
   H. illustrate Caroline's growing sense of excitement about her discovery.
   J. explain Dr. Blagden's and Mr. Aubert's role in verifying Caroline's discovery.

15. As it is used in line 12, the word finest most nearly means:
   A. slightest.
   B. fairest.
   C. thinnest.
   D. greatest.

16. The passage most strongly suggests that while William operated his telescope, Caroline would have to work below in a special booth because:
   F. she would be relaying William's instructions to the workmen who turned the telescope.
   G. she preferred seclusion when working on calculations.
   H. the telescope's viewing platform would not be large enough to hold both William and Caroline.
   J. the light from her lamp would interfere with William's view of the night sky.

17. Which of the following questions is most directly answered by the passage?
   A. What inspired William to embark on his project to observe and resolve the heavens?
   B. Why did Caroline and William move to "The Grove"?
   C. Why couldn't Caroline calculate the coordinates of the comet she discovered?
   D. How long did it take the Royal Society to confirm Caroline's discovery was a new comet?

18. It can most reasonably be inferred from the passage that compared to normal telescopes of its type, the two-foot Newtonian reflector William built had:
   F. a larger aperture.
   G. a smaller box-frame.
   H. more magnifying power.
   J. less light-gathering power.

19. According to the passage, when Caroline first saw her comet, it appeared to be moving through:
   A. Coma Berenices and descending toward the Pole Star.
   B. Coma Berenices and descending toward stars in the Big Dipper.
   C. Ursa Major and descending toward stars in Coma Berenices.
   D. a triangulation of stars, which included the Pole Star, and descending toward Coma Berenices.

20. The passage indicates that Caroline's discovery of a new comet was unlikely because Caroline:
   F. found the comet quickly in a part of the sky that was familiar to astronomers and stargazers.
   G. knew more about nebulae than she knew about comets.
   H. had already discovered a planet while performing observations with William.
   J. had little experience calculating the mathematical coordinates of stellar objects.

GO ON TO THE NEXT PAGE.
Passage A by Vivian Gornick

Once, in Texas, I gave a reading from my memoir *Fierce Attachments*. No sooner had I finished speaking than a woman in the audience asked a question: “If I come to New York, can I take a walk with your mamma?”

I told her that, actually, she wouldn’t want to take a walk with my mother, it was the woman in the book she wanted to walk with. They were not exactly the same.

Shortly afterwards, I attended a party in New York where, an hour into the evening, one of the guests blurted out in a voice filled with disappointment, “Why, you’re nothing like the woman who wrote *Fierce Attachments*!” At the end of the evening she cocked her head at me and said, “Well, you’re something like her.”

I understood perfectly. She had come expecting to have dinner with the narrator of the book, not with me; again, not exactly the same.

On both occasions, what was desired was the presence of two people who existed only between the pages of a book. In our actual persons, neither Mama nor I could give satisfaction. We ourselves were just a rough draft of the written characters. Moreover, these characters could not live independent of the story which had called them into life, as they existed for the sole purpose of serving that story. In the flesh, neither Mama nor I were serving anything but the unesthetic spill of everyday thought and feeling that routinely floods us all, only a select part of which, in this case, invoked the principals in a tale of psychological embroilment that had as its protagonist neither me nor my mother but rather our “fierce attachment.”

At the heart of my memoir lay a revelation: I could not leave my mother because I had become my mother. This complicated insight was my bit of wisdom, the history I wanted badly to trace out. The context in which the book is set—our life in the Bronx in the 1950s, alternating with walks taken in Manhattan in the 1980s—was the situation; the story was the insight. What mattered most to me was not the literalness of the situation, but the emotional truth of the story. What actually happened is only raw material; what matters is what the memoirist makes of what happened.

Memoirs belong to the category of literature, not of journalism. It is a misunderstanding to read a memoir as though the writer owes the reader the same record of literal accuracy that is owed in newspaper reporting or historical narrative. What is owed the reader is the ability to persuade that the narrator is trying, as honestly as possible, to get to the bottom of the tale at hand.

Questions 21–24 ask about Passage A.

21. The main purpose of the first two paragraphs of Passage A (lines 1–16) is to:
   A. establish the popularity of Gornick’s book by indicating that people wanted to meet her after reading the book.
   B. introduce the idea that the characters in Gornick’s memoir are not exactly like their real-life counterparts.
   C. illustrate Gornick’s frustration with some of her readers.
   D. suggest that Gornick’s memoir should be classified as fiction, not as nonfiction.

GO ON TO THE NEXT PAGE.
22. Which of the following quotations from Passage A most directly relates to the party guest’s disappointment upon meeting the author of *Fierce Attachments*?
   F. “We ourselves were just a rough draft of the written characters” (lines 20–21).
   G. “I had become my mother” (line 32).
   H. “This complicated insight was my bit of wisdom” (line 33).
   J. “The story was the insight” (line 37).

23. According to Passage A, Gornick believes the heart of her memoir to be:
   A. the walks she took with her mother in Manhattan.
   B. the revelation that she had become her mother.
   C. her childhood experiences in the Bronx.
   D. her shared history with her mother.

24. According to Passage A, Gornick believes that memoirs belong to the category of:
   F. journalism.
   G. personal diaries.
   H. historical narratives.
   J. literature.

25. According to Passage B, the protagonists in Hemingway’s fiction are often:
   A. composites of Hemingway’s friends.
   B. based on Hemingway’s family members.
   C. projections of Hemingway himself.
   D. completely made-up characters.

26. Based on Passage B, the question of accuracy in *A Moveable Feast* is particularly difficult because:
   F. Hemingway used the book to create a particular portrait of himself and his contemporaries.
   G. Hemingway’s contemporaries were writing conflicting memoirs during the same time period.
   H. Hemingway could not produce any documents to support his stories.
   J. Hemingway said his memory was excellent, but others doubt this.

27. Which of the following statements best expresses the opinion the author of Passage B seems to have about *A Moveable Feast*?
   A. It stands alongside Hemingway’s fiction as one of his best works.
   B. It is a complex example of a book that combines fact and fiction.
   C. It provides an accurate look at a specific time in Hemingway’s life.
   D. It should be read with other books from the same time period.

28. Based on the passages, Gornick’s and Hemingway’s approaches to writing their memoirs are similar in that both writers:
   F. put real characters into wholly fictional situations.
   G. wanted to portray themselves in a flattering way.
   H. were motivated to settle old scores and present their own versions of personal relationships.
   J. used only material from their lives that served the story they each wanted to tell.

29. Based on the passages, it can most reasonably be inferred that Gornick and Hemingway would agree that when it comes to a writer’s responsibility to be truthful in a memoir:
   A. the degree of truthfulness should be the same as that for fiction.
   B. if a writer can’t remember the exact details of a certain event, that event should be left out of the memoir.
   C. it is more important to create an artistic whole than to relate only facts.
   D. the writer should only include incidents that have documented evidence to support them.

30. Another author wrote the following about the role of truth in memoir:
   A memoir is a story, not a history, and real life doesn’t play out as a story.

Which passage most closely echoes the view presented in this quotation?
   F. Passage A, because it offers a story about what happens when you meet someone who doesn’t live up to your expectations.
   G. Passage A, because it stresses that what happens in life is only raw material for a memoirist.
   H. Passage B, because it states that Hemingway viewed *A Moveable Feast* as his literary testament.
   J. Passage B, because it states that Hemingway seldom lied about pure facts.

GO ON TO THE NEXT PAGE.
Passage IV

NATURAL SCIENCE: This passage is adapted from the article "The Next Wave: What Makes an Invasive Species Stick?" by Robert R. Dunn (©2010 by Natural History Magazine, Inc.).

Like many biologists, Andrew V. Suarez struggled for years with the question of which colonizing organisms fail and which succeed. He studied it the hard way—with fieldwork and lab experiments—until 1999, when he found some brown jars. He had gone to the Smithsonian Institution National Museum of Natural History's National Insect Collection to look for early samples of Argentine ants collected in the United States or at its borders. He hoped to find out how vintage specimens of Argentine ants were related to the existing populations.

At the museum, among many thousands of jars of insects labeled with taxonomic notes, locations, and dates, Suarez ultimately found relatively few samples of Argentine ants. But what he found besides them was, to his mind, far more interesting: some of the ethanol-filled jars were jammed with vials of ants collected at ports of entry in the eastern U.S. from 1927 to 1985. They were ants that border agents had picked from plants being shipped into the U.S. Could those ants be identified as members of species that had failed or succeeded as colonists, and if so, could the specimens be used to compare the two groups?

In the jars and vials were 394 separate samples of ants. Suarez solicited the help of two friends, ant ecologist David A. Holway of the University of California, San Diego, and Philip S. Ward, guru of ant gurus, at the University of California, Davis. Altogether they identified 232 distinct species.

Suarez considered the traits possessed by each of the ant species in an attempt to see what might have predisposed some of them to survival. He measured whether they were big or small. He examined whether each lived in the canopy or on the ground, and whether they were from one subfamily or another. He also looked at a simpler possibility: that "survivor species" tended to be those introduced more than once. The evidence in the jars showed, for example, that Argentine ants had arrived at least twice. Were successes just a consequence of the number of tries?

When a pioneering group sets up camp and starts living in a new place, possible futures diverge. One species might be wiped out within a generation or two. A second might survive, but never become common.

Yet another species might thrive, eventually spreading across states, continents, and even the world! Even if surviving in a new environment is sometimes a matter of being introduced again and again, thriving is a different story. Relatively few invasive species truly prevail.

One curious thing about Argentine ants is that they are, despite their apparent meekness, ecologically dominant. They are squishy, small, stingless wimps, as ants go, yet somehow they have managed to overpower the big, tough native ants.

There's another strange thing about Argentine ants. If you take an Argentine ant from what looks like one colony and put it together with one from a distant colony, they accept each other. In fact, you can perform that trick over much of California and very few of the ants will fight. It is as though all of the Argentine ants in California are part of a few huge colonies—"supercolonies," they've come to be called.

Biologist Ted Case joined forces with Holway and Suarez for an experiment to test whether the lack of aggression among those ant colonies somehow helped them to compete with other species. Might it simply be that by not fighting with their neighbors, the Argentine ants wasted less energy on war and could spend more time on the good stuff? It turned out that, yes, aggressive ants wasted energy fighting (and dying), and so gathered less food and fared poorly, in general. Peace pays (at least peace with one's kin), and so Argentine ants have made bank everywhere they have moved.

In fact, it isn't just for the Argentine ant that peace seems to pay. Supercolonies and the unicolonial populations they create look to be common among invasive ants.

Ants flash chemical badges identifying their home nest. Without such markers, no one knows who is friend or foe. When the clarity of "us versus them" breaks down, peace breaks out among colonies of an ant species. Different nests swap workers and queens, and the term "colony" becomes fuzzy. Experiments seemed to show that one conglomeration of Argentine ants stretched the length of California, another from Italy to Portugal . . . until, in 2009, workers from those two "colonies" (along with a third from Japan) were put together, and they didn't fight. Thus, across the entire globe, a few peaceful supercolonies could exist and expand.

31. The main purpose of this passage is to:
   A. describe events that led to the discovery of Argentine ants in the United States.
   B. examine the physical differences between Argentine ants and other insects.
   C. highlight the technology that scientists used to determine the size of supercolonies.
   D. discuss factors that contribute to a colonizing organism’s success as an invasive species.

32. The author makes repeated use of which of the following in order to help establish the passage’s somewhat casual tone?
   F. Personal anecdotes
   G. Idiomatic expressions
   H. Humorous quotations
   J. Self-critical asides
33. Which of the following events mentioned in the passage occurred first chronologically?
A. Case joined Holway and Suarez to assist them with an experiment.
B. Workers from three Argentine ant supercolonies in different parts of the world were brought together.
C. Suarez found samples of Argentine ants in the Smithsonian insect collection.
D. Holway and Ward were recruited by Suarez to assist with his research.

34. The main purpose of the fifth paragraph (lines 41–49) is to:
F. explain how Argentine ants are able to survive in new areas and discuss their spread throughout the world.
G. describe possible outcomes for a pioneering species and stress the improbability that the species will thrive.
H. define the concept of invasive species as it relates to ants.
J. compare the behaviors of Argentine ants to those of other, more successful pioneering species.

35. The author’s claim that the Argentine ant behavior described in lines 56–58 is unusual is based upon which of the following assumptions?
A. Supercolonies are common among several species of ants.
B. Argentine ants in California are less aggressive than Argentine ants elsewhere.
C. California’s ecosystem is especially suited for Argentine ants.
D. Ants from different colonies typically fight one another.

36. According to the passage, the question of which colonizing organisms fail and which succeed is one that has been studied by:
F. many biologists for a number of years.
G. many biologists beginning in 1999.
H. the Smithsonian exclusively.
J. Suarez exclusively.

37. The passage makes clear which of the following about the ant samples Suarez found in the Smithsonian insect collection?
A. Most of the samples were of Argentine ants.
B. Ward and Holway had collected the samples as part of a larger study of US insect populations.
C. Suarez discovered that most of the samples were of previously undiscovered species of ants.
D. Suarez was most interested in the samples that had been collected at eastern US ports of entry.

38. According to the passage, which of the following is true of Argentine ants?
F. They are stingless.
G. They are physically dominant.
H. They were first discovered in the United States by Suarez.
J. They have failed to thrive in Japan.

39. The passage indicates that compared to peaceful ants, aggressive ants:
A. live in larger colonies.
B. spend less time gathering food.
C. are less likely to live in a colony.
D. are more likely to be a “survivor species.”

40. The passage most clearly establishes which of the following facts about ants?
F. In order for ant colonies to combine to form supercolonies, the colonies must have identical chemical badges.
G. Ants identify their home nests by flashing chemical badges.
H. Ant colonies from different species commonly swap workers and queens.
J. The largest supercolony of ants in the world stretches from Italy to Portugal.

END OF TEST 3
STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.
DO NOT RETURN TO A PREVIOUS TEST.
PASSAGE I

The figure below is a pedigree that shows the inheritance of a trait, Trait G, in a family. The presence of Trait G in an individual is determined entirely by Gene G. Gene G has 2 alleles: G, which is dominant, and g, which is recessive.

Each individual represented in the pedigree was assigned a number (shown below the symbol for the individual) for reference. Scientists determined that the Gene G genotype of Individual 20 is gg and that the Gene G genotype of Individual 21 is Gg. Based on this information, the scientists concluded that Trait G is a recessive trait.

1. How many generations are shown in the figure?
A. 3
B. 4
C. 22
D. 24

2. Based on the figure, the 2 individuals in which of the following pairs most likely have the greatest genetic similarity across their genomes?
F. Individual 3 and Individual 4
G. Individual 12 and Individual 13
H. Individual 16 and Individual 24
J. Individual 18 and Individual 21

3. Suppose that Individual 23 and Individual 24 have 4 biological children. Based on the figure, how many of the children, if any, have Trait G?
A. 0
B. 1
C. 3
D. 4

4. According to the figure, how many of the grandchildren of Individual 1 and Individual 2, if any, have Trait G?
F. 0
G. 1
H. 2
J. 7

GO ON TO THE NEXT PAGE.
5. Based on the figure, is it likely that Trait G is a sex-linked trait?
   A. Yes, because mothers with Trait G always passed Trait G to their sons.
   B. Yes, because mothers with Trait G did not always pass Trait G to their sons.
   C. No, because mothers with Trait G always passed Trait G to their sons.
   D. No, because mothers with Trait G did not always pass Trait G to their sons.

6. Based on the information provided, will an individual with the Gene G genotype Gg have Trait G?
   F. Yes, because Trait G is a dominant trait.
   G. Yes, because Trait G is a recessive trait.
   H. No, because Trait G is a dominant trait.
   J. No, because Trait G is a recessive trait.
Passage II

*Heliconia metallic* is a plant found in the understory of tropical rain forests. (The understory is the area below the forest canopy.) *H. metallic* flowers are normally pollinated by hummingbirds. The flowers can be self-pollinated (egg and pollen are from the same *H. metallic* plant) or cross-pollinated (egg and pollen are from different *H. metallic* plants). The following study was conducted to investigate the effects of different pollination treatments on fruit production and seed mass in a population of *H. metallic*.

Study

Before pollination could occur, the *anthers* (pollen-producing structures) were removed from each of 400 *H. metallic* flowers. Then, the flowers were covered with nylon bags to prevent the normal pollinators from pollinating the flowers. The covered flowers were divided equally into 4 groups (Groups 1–4), and each group received a different pollination treatment (see Table 1). Four weeks after the pollination treatments, the percent of flowers that produced fruit and the average mass per seed were determined for each group (see Figures 1 and 2, respectively).

<table>
<thead>
<tr>
<th>Group</th>
<th>Pollination treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>self-pollination*</td>
</tr>
<tr>
<td>2</td>
<td>cross-pollination with pollen collected from a single donor <em>H. metallic</em> plant</td>
</tr>
<tr>
<td>3</td>
<td>cross-pollination with a mixture of pollen collected from 6 donor <em>H. metallic</em> plants</td>
</tr>
<tr>
<td>4</td>
<td>no pollination</td>
</tr>
</tbody>
</table>

*Each flower was pollinated with pollen from its removed anthers.

Table and figures adapted from Matthias Schleuning et al., "Effects of Inbreeding, Outbreeding, and Supplemental Pollen on the Reproduction of a Hummingbird-pollinated Clonal Amazonian Herb." ©2010 by The Author(s).
7. The data that were averaged to produce the results shown in Figure 2 were most likely collected using which of the following pieces of equipment?
   A. Balance
   B. pH meter
   C. Telescope
   D. Thermometer

8. One of the questions about *H. metallica* plants that the study was designed to answer was which of the following?
   F. Does the location of the plants in the understory of tropical rain forests determine whether the flowers are self-pollinated or cross-pollinated?
   G. Are the percent of flowers that produce fruit and the average mass per seed different when flowers are self-pollinated than when flowers are cross-pollinated?
   H. How long after the plants are pollinated does the fruit ripen?
   J. Are the flowers normally pollinated by hummingbirds?

9. The pollination treatments received by Groups 1 and 2 differed in which of the following ways? The pollen received by each Group 1 flower was:
   A. from the same plant as the flower, whereas the pollen received by each Group 2 flower was from a different plant than the flower.
   B. from a different plant than the flower, whereas the pollen received by each Group 2 flower was from the same plant as the flower.
   C. collected from 6 plants, whereas the pollen received by each Group 2 flower was collected from 6 plants.
   D. collected from 6 plants, whereas the pollen received by each Group 2 flower was collected from 1 plant.

10. For any group, the value shown in Figure 1 was most likely calculated using which of the following expressions?
   F. \[ \text{number of seeds} \times 100 \]
   G. \[ \frac{\text{total seed mass}}{\text{number of seeds}} \times 100 \]
   H. \[ \frac{\text{number of flowers producing fruit}}{\text{total number of flowers}} \times 100 \]
   J. \[ \frac{\text{total number of flowers}}{\text{number of flowers producing fruit}} \times 100 \]

11. The anthers were most likely removed from the flowers for the purpose of ensuring that the flowers:
   A. would spontaneously self-pollinate.
   B. would not spontaneously self-pollinate.
   C. would be pollinated by hummingbirds.
   D. would not be pollinated by hummingbirds.

12. Do the results of the study indicate that the nylon bags successfully prevented the normal pollinators from pollinating the *H. metallica* flowers?
   F. Yes; only 20% of the flowers receiving the self-pollination treatment produced fruit.
   G. Yes; none of the flowers receiving the no pollination treatment produced fruit.
   H. No; only 20% of the flowers receiving the self-pollination treatment produced fruit.
   J. No; none of the flowers receiving the no pollination treatment produced fruit.

13. What was the total mass of the seeds produced by the Group 3 flowers?
   A. 0 mg
   B. 45 mg
   C. 85 mg
   D. Cannot be determined from the given information
4

Passage III

When 2 types of bacteria found in the soil of a wetland (land having a high water table) break down organic matter, gases are generated. Aerobic bacteria, which require O₂, generate CO₂. Anaerobic bacteria, which require little or no O₂, generate CH₄.

Study

At the beginning of a particular summer, 3 soil sections, each 1.5 m long, 1 m wide, and 0.6 m deep, were removed intact from the surface of each of 2 wetlands—a bog and a fen—after all live plants had been removed from the sections. Each section was placed in a separate 100 L tank having sides and a lid made entirely of glass. An instrument to measure gas emissions was mounted on the underside of the lid, above the soil. All the tanks were placed at an outdoor site near the wetlands.

Different amounts of water were added to the 3 tanks containing bog soil sections to produce a water table (WT) 1 cm above the surface (+1 cm) of the first soil section, a WT 10 cm below the surface (−10 cm) of the second soil section, and a WT 20 cm below the surface (−20 cm) of the third soil section. This procedure was repeated for the 3 tanks containing fen soil sections. All the lids were then closed.

Over the next 3 months, gas emissions from each soil section were measured, in moles of carbon per square meter (mol C/m²). Throughout this period, the temperature inside the tanks was kept as the same as the outdoor temperature. Figure 1 shows the total emission of CO₂ and the total emission of CH₄ from each bog soil section due to bacterial activity; Figure 2 does the same for each fen soil section.

Figures adapted from Karen Updegraff et al., “Response of CO₂ and CH₄ Emissions from Peatlands to Warming and Water Table Manipulations.” ©2001 by the Ecological Society of America.
14. The researchers who conducted the study most likely chose to conduct it during the summer rather than during the winter because organic matter in soil is broken down:
   F. in the summer by aerobic bacteria only and in the winter by anaerobic bacteria only.
   G. in the summer by anaerobic bacteria only and in the winter by aerobic bacteria only.
   H. by both aerobic and anaerobic bacteria more rapidly in the summer than in the winter.
   J. by both aerobic and anaerobic bacteria less rapidly in the summer than in the winter.

15. According to the results of the study, as the water table for the bog soil sections and the fen soil sections became progressively lower, did the total CO₂ emission increase or decrease, and did the total CH₄ emission increase or decrease?
   
<table>
<thead>
<tr>
<th>total CO₂ emission</th>
<th>total CH₄ emission</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. increased</td>
<td>decreased</td>
</tr>
<tr>
<td>B. decreased</td>
<td>increased</td>
</tr>
<tr>
<td>C. increased</td>
<td>increased</td>
</tr>
<tr>
<td>D. decreased</td>
<td>decreased</td>
</tr>
</tbody>
</table>

16. One of the reasons that the lid on each tank was kept closed for the 3-month period was to:
   F. minimize the amount of emitted gas that exited the tank.
   G. maximize the amount of atmospheric gas that entered the tank.
   H. prevent bacteria from leaving the tank.
   J. prevent sunlight from entering the tank.

17. The 2 types of wetland investigated in this study—bogs and fens—have different levels of the nutrients that sustain bacterial growth. Do the results of the study suggest that the levels of the nutrients that sustain aerobic bacteria are higher in bogs or in fens, and do the results of the study suggest that the levels of the nutrients that sustain anaerobic bacteria are higher in bogs or in fens?

   higher nutrients for aerobic bacteria  higher nutrients for anaerobic bacteria
   A. bogs                                bogs
   B. bogs                                fens
   C. fens                                bogs
   D. fens                                fens

18. Based on the results of the study for the 2 soil sections that were completely submerged in water, were aerobic bacteria present in those sections?
   F. Yes; CO₂ was emitted from those sections.
   G. Yes; CH₄ was emitted from those sections.
   H. No; only CO₂ was emitted from those sections.
   J. No; only CH₄ was emitted from those sections.

19. Consider the total CO₂ emission from the fen soil section having a WT of -10 cm. Based on that result, over the 3 months, the average CO₂ emission from that soil section per month would have been closest to which of the following?
   A. 10 mol C/m²
   B. 13 mol C/m²
   C. 16 mol C/m²
   D. 19 mol C/m²

20. The study was conducted at an outdoor site near the wetlands to ensure that the tanks would be nearly identical to the wetlands with respect to which of the following conditions?
   F. Amount of precipitation
   G. Types of plants present
   H. Volume of soil
   J. Hours of daylight

GO ON TO THE NEXT PAGE.
Passage IV

Physics students performed 3 studies to determine the forces that several doors exerted on their hinges. The doors had various weights, W, and widths, D. Each door had 2 hinges; the hinges could be moved to vary the distance, S, between them. None of the doors had a doorknob.

The 2 hinges on each door were equidistant from the center of mass of the door (see the diagram).

![Diagram of door]

Each hinge was fitted with 2 force sensors. With the door attached to a door frame, one of the sensors detected the horizontal force exerted by the door on the hinge, $F_h$, and the other sensor detected the vertical force exerted by the door on the hinge, $F_v$. Once $F_h$ and $F_v$ were determined for each hinge, $F_h$ was averaged over the 2 hinges, yielding the average horizontal force per hinge, $F_{h,av}$, and $F_v$ was averaged over the 2 hinges, yielding the average vertical force per hinge, $F_{v,av}$. From $F_{h,av}$ and $F_{v,av}$, the average net force per hinge, $F_{n,av}$, could be calculated.

In the 3 studies, all forces were recorded in pounds (lb) and all lengths were recorded in inches (in).

Study 1
For a door with $W = 61$ lb and $D = 30$ in, the students determined $F_{h,av}$ and $F_{v,av}$ at various $S$. The results are shown in Figure 1.

![Figure 1]

Study 2
For 3 doors, each with $D = 30$ in but a different $W$, the students determined $F_{n,av}$ at various $S$. The results are shown in Figure 2.

![Figure 2]

Study 3
For 3 doors, each with $W = 61$ lb but a different $D$, the students determined $F_{n,av}$ at various $S$. The results are shown in Figure 3.

![Figure 3]

21. In which study, if any, was the door with the greatest mass tested?
A. Study 1
B. Study 2
C. Study 3
D. None of the studies; all the doors tested in the 3 studies had the same mass.
22. Which of the following statements regarding W and D best describes a difference between Study 2 and Study 3? In Study 2:
   F. W was varied while D was held constant, whereas in Study 3, W was held constant while D was varied.
   G. W was held constant while D was varied, whereas in Study 3, W was varied while D was held constant.
   H. Both W and D were varied, whereas in Study 3, both W and D were held constant.
   J. Both W and D were held constant, whereas in Study 3, both W and D were varied.

23. If a door having W = 90 lb, D = 30 in, and S = 50 in had been tested in Study 2, Fh,av, for this door would most likely have been:
   A. less than 20 lb.
   B. between 20 lb and 30 lb.
   C. between 30 lb and 45 lb.
   D. greater than 45 lb.

24. For the door tested in Study 1, when S was less than 30 in, was Fh,av less than Fv,av, or greater than Fv,av, and when S was greater than 30 in, was Fh,av less than Fv,av, or greater than Fv,av?

<table>
<thead>
<tr>
<th>S less than 30 in</th>
<th>S greater than 30 in</th>
</tr>
</thead>
<tbody>
<tr>
<td>F. less</td>
<td>less</td>
</tr>
<tr>
<td>E. less</td>
<td>greater</td>
</tr>
<tr>
<td>H. greater</td>
<td>less</td>
</tr>
<tr>
<td>J. greater</td>
<td>greater</td>
</tr>
</tbody>
</table>

25. In Studies 2 and 3, which combination of W, D, and S resulted in the lowest Fh,av?

<table>
<thead>
<tr>
<th>W (lb)</th>
<th>D (in)</th>
<th>S (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. 51</td>
<td>30</td>
<td>20</td>
</tr>
<tr>
<td>B. 51</td>
<td>30</td>
<td>70</td>
</tr>
<tr>
<td>C. 61</td>
<td>24</td>
<td>20</td>
</tr>
<tr>
<td>D. 61</td>
<td>24</td>
<td>70</td>
</tr>
</tbody>
</table>

26. In Study 1, which average force, Fh,av or Fv,av, was independent of S?
   F. Fh,av, because as S increased, Fh,av decreased.
   G. Fh,av, because as S increased, Fh,av remained constant.
   H. Fv,av, because as S increased, Fv,av decreased.
   J. Fv,av, because as S increased, Fv,av remained constant.

27. Suppose that, due to a manufacturing defect, a particular pair of hinges will break when a net force greater than 57 lb is exerted on each hinge. Based on Study 3, the hinges will most likely break if used on a 61 lb door with which of the following combinations of D and S?

<table>
<thead>
<tr>
<th>D (in)</th>
<th>S (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. 30</td>
<td>20</td>
</tr>
<tr>
<td>B. 30</td>
<td>70</td>
</tr>
<tr>
<td>C. 36</td>
<td>20</td>
</tr>
<tr>
<td>D. 36</td>
<td>70</td>
</tr>
</tbody>
</table>
Passage V

In a chemistry class, the teacher placed 0.5 g of porous steel wool, composed mostly of iron (Fe), inside a small heat-resistant quartz tube. She then used silicone hoses to connect the quartz tube to 2 airtight glass syringes (see figure). Each syringe contained 8 mL of air, and the total volume of air in the closed apparatus was 20 mL.

A Bunsen burner was then used to heat the contents of the quartz tube for 2 min. During heating, the plungers were moved up and down to pass the air back and forth through the steel wool. The total volume of gas in the apparatus steadily declined over the 2 min. Once the apparatus and its contents returned to room temperature, the total volume of gas in the apparatus was 16 mL.

The teacher asked each of 4 students to explain what occurred during the demonstration.

Student 1

During heating, the Fe in the steel wool reacted with all the N₂ in the air to form solid iron nitride (FeN), which was deposited on the steel wool. Air contains about 20% N₂ by volume. As a result of the reaction, the total volume of gas in the apparatus decreased by about 20%, so almost all the gas remaining in the apparatus was O₂.

Student 2

During heating, the Fe in the steel wool reacted with some of the O₂ in the air to form solid iron oxide (Fe₂O₃), which was deposited on the steel wool. Air contains about 80% O₂ by volume. As a result of the reaction, the total volume of gas in the apparatus decreased by about 20%. Almost all the gas remaining in the apparatus was a mixture of about 75% O₂ and 25% N₂ by volume.

Student 3

Student 2 is correct, except that (1) the Fe in the steel wool reacted with all the O₂ in the air and (2) air contains about 20% O₂ by volume. After the reaction, almost all the gas remaining in the apparatus was N₂.

Student 4

During heating, the Fe in the steel wool reacted with all the CO₂ in the air to form solid iron carbonate (FeCO₃), which was deposited on the steel wool. Air contains about 20% CO₂ by volume. As a result of the reaction, the total volume of gas in the apparatus decreased by about 20%, so almost all the gas remaining in the apparatus was O₂.
28. Air contains less than 1% argon by volume. This information weakens the explanations given by which of the students, if any?
   F. Students 1 and 2 only
   G. Students 3 and 4 only
   H. All of the students
   J. None of the students

29. Silicone hoses were most likely used to connect the quartz tube to the syringes because silicone has which of the properties listed below?
   I. Strong resistance to heat
   II. Low chemical reactivity
   III. High solubility in water
   A. I and II only
   B. I and III only
   C. II and III only
   D. I, II, and III

30. Based on Student 4’s explanation, during the demonstration, did the percent CO₂ by volume in the apparatus increase or decrease, and did the percent O₂ by volume in the apparatus increase or decrease?

<table>
<thead>
<tr>
<th>percent CO₂ by volume</th>
<th>percent O₂ by volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>F. increase</td>
<td>increase</td>
</tr>
<tr>
<td>G. increase</td>
<td>decrease</td>
</tr>
<tr>
<td>H. decrease</td>
<td>decrease</td>
</tr>
<tr>
<td>J. decrease</td>
<td>increase</td>
</tr>
</tbody>
</table>

31. Which of the students would be likely to agree that, by volume, air contains more O₂ than N₂?
   A. Students 1 and 2 only
   B. Students 1 and 3 only
   C. Students 1, 2, and 4 only
   D. Students 1, 3, and 4 only

32. Based on Student 3’s explanation, the reaction that occurred during the demonstration would be represented by which of the following balanced chemical equations?
   F. 2Fe₂O₃ → 4Fe + 3O₂
   G. 2FeN → 2Fe + N₂
   H. 4Fe + 3O₂ → 2Fe₂O₃
   J. 2Fe + N₂ → 2FeN

33. Which of the students, if any, would be likely to agree that at the end of the demonstration, the gas remaining in the apparatus was at least 20% N₂ by volume?
   A. Student 2 only
   B. Students 2 and 3 only
   C. All of the students
   D. None of the students

34. In a chemical reaction, the limiting reactant is the reactant that is in the shortest supply and thus limits the amount of product that can be produced. Which student would be the most likely to agree that the limiting reactant during the demonstration was the iron in the steel wool?
   F. Student 1
   G. Student 2
   H. Student 3
   J. Student 4
Passage VI

Quarks constitute 1 of the 3 classes of elementary particles that form all matter in the universe. Three quarks bound together form a type of particle called a baryon. A quark’s effective mass (mass when bound to other quarks) is greater than its single-quark mass (mass when unbound). In addition, all quarks possess a property called spin. A quark’s spin can be oriented in 1 of 2 directions, spin-up (↑) or spin-down (↓).

Table 1 lists the symbol, electric charge, and approximate single-quark mass for each of the 6 quarks.

<table>
<thead>
<tr>
<th>Quark</th>
<th>Symbol</th>
<th>Electric charge</th>
<th>Single-quark mass (MeV*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Down</td>
<td>d</td>
<td>−1/3</td>
<td>5</td>
</tr>
<tr>
<td>Up</td>
<td>u</td>
<td>+2/3</td>
<td>3</td>
</tr>
<tr>
<td>Strange</td>
<td>s</td>
<td>−1/3</td>
<td>104</td>
</tr>
<tr>
<td>Charm</td>
<td>c</td>
<td>+2/3</td>
<td>1,270</td>
</tr>
<tr>
<td>Bottom</td>
<td>b</td>
<td>−1/3</td>
<td>4,200</td>
</tr>
<tr>
<td>Top</td>
<td>t</td>
<td>+2/3</td>
<td>171,200</td>
</tr>
</tbody>
</table>

*million electron volts

Table 2 gives the symbol, mass, quark content, and quark spins for several baryons.

<table>
<thead>
<tr>
<th>Baryon</th>
<th>Symbol</th>
<th>Mass (MeV)</th>
<th>Quark content</th>
<th>Quark spins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proton</td>
<td>p</td>
<td>938</td>
<td>uud</td>
<td>↑↑↑</td>
</tr>
<tr>
<td>Neutron</td>
<td>n</td>
<td>939</td>
<td>udd</td>
<td>↑↑↑</td>
</tr>
<tr>
<td>Lambda-zero</td>
<td>Λ⁰</td>
<td>1,115</td>
<td>uds</td>
<td>↑↑↑</td>
</tr>
<tr>
<td>Delta-zero</td>
<td>Δ⁰</td>
<td>1,233</td>
<td>udd</td>
<td>↑↑↑</td>
</tr>
<tr>
<td>Delta-minus</td>
<td>Δ⁻</td>
<td>1,234</td>
<td>ddd</td>
<td>↑↑↑</td>
</tr>
<tr>
<td>Omega-minus</td>
<td>Ω⁻</td>
<td>1,673</td>
<td>sss</td>
<td>↑↑↑</td>
</tr>
</tbody>
</table>

Tables adapted from C. Amsler et al., “Review of Particle Physics.” ©2008 by Elsevier B.V.
35. For all quarks, the amount of spin is always $\frac{1}{2} \hbar$, where $\hbar$ is a constant. A spin-up quark has spin $+\frac{1}{2} \hbar$, and a spin-down quark has spin $-\frac{1}{2} \hbar$. Given that the spin of a baryon equals the sum of its quark spins, what are the spins of the $\Lambda^0$ and $\Lambda^0$ baryons listed in Table 2?

\[
\begin{array}{cc}
\Lambda^0 & \Lambda^0 \\
A. & -\frac{1}{2} \hbar & -\frac{3}{2} \hbar \\
B. & -\frac{1}{2} \hbar & -\frac{1}{2} \hbar \\
C. & +\frac{1}{2} \hbar & +\frac{3}{2} \hbar \\
D. & +\frac{3}{2} \hbar & +\frac{3}{2} \hbar
\end{array}
\]

36. Which of the following diagrams represents the quark content and quark spins for an electrically neutral baryon having only 2 quark spins oriented in the same direction?

F. \[\text{Diagram F}\]

G. \[\text{Diagram G}\]

37. Is the information in Tables 1 and 2 consistent with the known electric charge for the proton?
A. No, because Tables 1 and 2 indicate the proton has an electric charge of 0.
B. No, because Tables 1 and 2 indicate the proton has an electric charge of +1.
C. Yes, because Tables 1 and 2 indicate the proton has an electric charge of 0.
D. Yes, because Tables 1 and 2 indicate the proton has an electric charge of +1.

38. Based on Tables 1 and 2, the $\Omega^-$ baryon has the same electric charge as a baryon containing which of the following quark combinations?
F. $dsb$
G. $ssc$
H. $sst$
J. $usc$

39. Based on Tables 1 and 2, atomic nuclei are made up of which types of quarks?
A. $u$ and $d$ only
B. $d$ and $s$ only
C. $u$ and $s$ only
D. $u$, $d$, and $s$ only

40. The 6 quarks are grouped into 3 generations as shown in the table below.

\[
\begin{array}{cc}
\text{Generation} & \text{Quarks} \\
1 & d, u \\
2 & s, c \\
3 & b, t
\end{array}
\]

For which generation, if any, is the statement "Positively charged quarks are more massive than negatively charged quarks" NOT true?
F. Generation 1
G. Generation 2
H. Generation 3
J. None of the generations; the statement is true for all 3 generations.

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

For many years, the only way to see a large public event—a concert, a movie, a baseball game—was to attend in person. More than just a function of necessity, though, physically attending a large event was seen as an opportunity to build community and fellowship through shared experience. In recent years, however, attendance at public events has declined steadily. Given the long-standing cultural role of public events, it is worth considering what declining attendance might indicate about our shifting cultural values.

Read and carefully consider these perspectives. Each suggests a particular way of thinking about declining event attendance as a reflection of shifting cultural values.

<table>
<thead>
<tr>
<th>Perspective One</th>
<th>Perspective Two</th>
<th>Perspective Three</th>
</tr>
</thead>
<tbody>
<tr>
<td>People these days value convenience over community. It’s easier to watch a game from home than to attend in person, so we do it, even though it keeps us isolated from one another.</td>
<td>For many people, attending an event is a luxury they can’t afford. When time and resources are scarce, we choose what’s most practical first, even if that means sacrificing community participation.</td>
<td>Today, physical presence isn’t necessary for participating in an event and building community. TV, the Internet, and social media offer shared experience to more people than large public events ever could before.</td>
</tr>
</tbody>
</table>

Essay Task

Write a unified, coherent essay in which you evaluate multiple perspectives on declining event attendance as a reflection of shifting cultural values. In your essay, be sure to:

- analyze and evaluate the perspectives given
- state and develop your own perspective on the issue
- explain the relationship between your perspective and those given

Your perspective may be in full agreement with any of the others, in partial agreement, or wholly different. Whatever the case, support your ideas with logical reasoning and detailed, persuasive examples.