Form F12

(June 2023)

The ACT®

2022 | 2023

In response to your request for Test Information Release materials, this booklet contains the test questions, scoring keys, and conversion tables used in determining your ACT scores. Enclosed with this booklet is a report that lists each of your answers, shows whether your answer was correct, and, if your answer was not correct, gives the correct answer.

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Directions

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

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

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

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

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

You may work on each test **only** when 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.

DO NOT OPEN THIS BOOKLET
UNTIL TOLD TO DO SO.

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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

Story Seeker

[1]

On my ninth birthday, my grandmother gave me the typewriter she had used, throughout her career (1) as a news writer. I thanked her but regarded (2) it as I would have the bones of a prehistoric animal. Being used to the (3) computer keyboard, the tapping of the keys, the letters appearing on-screen as if by magic. Even so, (4) typing on a typewriter required endurance. Each of the keys was raised on a metal stilt, which, if jabbed forcefully enough, would snap up and imprint the paper with the print of the corresponding letter. (5) It took me forever (6) to type a single sentence. [A]

1. **A.** NO CHANGE
B. used, throughout her career,
C. used throughout her career,
D. used throughout her career

2. **F.** NO CHANGE
G. but regarding
H. yet regarding
J. so regarded

3. **A.** NO CHANGE
B. I was used to the
C. Used to the
D. The

4. **F.** NO CHANGE
G. For example,
H. In contrast,
J. Still,

5. **A.** NO CHANGE
B. print of the letter, depending on the key that was pressed.
C. corresponding letter that matched.
D. corresponding letter.

6. Which choice most effectively maintains the narrator's tone by using exaggeration for emphasis?
F. NO CHANGE
G. kind of a long time
H. a while
J. time

[2]

Nevertheless, I eked out my first news story, which was about a boy who received a typewriter from his grandmother on his birthday. [B] The story didn't even fill half a page, but I handed it to my grandmother with pride. After she read it, she squinted at me from behind her glasses. [C] "But news writing is about telling your readers something they *need* to know. Enlighten them."

[3]

The next morning I scoured the neighborhood empty notebook in hand, (7) dejected. [D] I was surrounded by adults who already seemed to know everything. Who was I to judge what people needed to know?

[4]

Then, as I approached the park at the end of my block, I heard a small squeal coming from the direction of the swings. I ran over to find a girl standing there, brushing dirt from her jeans. The seat of the nearest swing dangled from one chain while the other chain swayed back and forth, (8) unattached. No one else had witnessed what I had; I realized I'd found my story.

[5]

Later that day, while I hand-delivered (9) copies of my broken swing story to every house on the block. Someone repaired the swing the very next day. Regardless, (10) my grandmother attributed (11) its quick repair to my story.

7. **A.** NO CHANGE
B. neighborhood, empty notebook in hand,
C. neighborhood, empty notebook in hand
D. neighborhood empty notebook in hand

8. **F.** NO CHANGE
G. forth for it was
H. forth, it was
J. forth being

9. **A.** NO CHANGE
B. while hand-delivering
C. I hand-delivered
D. hand-delivering

10. **F.** NO CHANGE
G. Of course,
H. However,
J. Instead,

11. **A.** NO CHANGE
B. designated
C. assigned
D. referred

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[6]

Now, fifteen years later, I've moved past writing about broken playground equipment. But whatever I write, whenever I write, my grandmother's voice still guides me. "Anthony," she says, "tell them something they need to know."

12 13 13

12. **F.** NO CHANGE
G. passed writing about
H. passed writing for
J. past writing for

13. The essay writer is considering deleting the underlined portion. Should the underlined portion be kept or deleted?

A. Kept, because it introduces the grandmother's voice to the narrative.
B. Kept, because it reiterates the main theme of the narrative.
C. Deleted, because it fails to explain how the grandmother is qualified to give the narrator advice.
D. Deleted, because it takes the focus away from the narrator's writing technique.

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

14. The essay writer is considering adding the following sentence to the essay:

"This is a good start, Anthony," she said.

The sentence would most logically be placed at:

F. Point A in Paragraph 1.
G. Point B in Paragraph 2.
H. Point C in Paragraph 2.
J. Point D in Paragraph 3.

15. Suppose the essay writer's primary purpose had been to provide a brief overview of the narrator's fifteen-year career as a news writer. Would this essay accomplish that purpose?

A. Yes, because it describes the narrator's most significant news stories and how they shaped him as a writer.
B. Yes, because it focuses on the news stories the narrator wrote when he was nine years old.
C. No, because it instead focuses on the narrator's grandmother's experiences as a news writer and how those experiences shaped her career.
D. No, because it instead describes a single story that marked the beginning of the narrator's interest in news writing.

PASSAGE II

Animals Over, Under, and Above All

[1]

In northwest Montana, more than thirty species of animals, ranging from otters to elk, travel across a busy fifty-six-mile stretch of US Highway 93 via overpasses, bridges, and tunnels. These structures comprise the most expensive and innovative wildlife-centered highway design project in the United States. [A]

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[2]

In the late 1980s, as plans were under way to expand a crowded tract of US Highway 93 into a four-lane road. [16]

[B] This section of highway bisects the Flathead Indian Reservation, home to members of the Confederated Salish and Kootenai tribes. It also intersects the migration paths and breeding grounds of many animals, furthermore. These animals were forced to cross the busy road, dying in large numbers while doing so. [C] Insisting on a plan that would help wildlife thrive, tribal members worked with highway engineers and scientists from Montana State University to create a highway infrastructure that allows animals to move freely and safely. [17] [18] [19] [20]

[3]

This length of road now features forty-one wildlife crossings deliberately placed along the animals' most important migratory routes. [D] Ten-foot-wide culverts and small concrete tunnels allow animals of various sizes to pass under the highway [21]. The project's most visible crossing is a twenty-six-foot-high, and two-hundred-foot-long overpass covered with natural vegetation. [22]

16. **F.** NO CHANGE
G. 1980s, when
H. 1980s,
J. 1980s;

17. **A.** NO CHANGE
B. highway, which bisects
C. highway that bisects
D. highway, bisecting

18. Which choice most precisely conveys that the highway crosses through the migration paths and breeding grounds?

F. NO CHANGE
G. is a part of
H. runs along
J. follows

19. **A.** NO CHANGE
B. animals, whose migration routes and breeding areas are here.
C. animals, quite a few of them.
D. animals.

20. **F.** NO CHANGE
G. include a means for allowing
H. were to allow
J. allow

21. If the writer were to add the phrase "even in groups" at this point (adjusting the punctuation as needed), the paragraph would primarily gain:

A. an indication that many animals living near US Highway 93 have grown accustomed to traveling alone, even during migration periods.
B. a detail that emphasizes that the culverts and tunnels were specially designed to accommodate animals' needs.
C. a suggestion that more groups of large animals than groups of small animals have been using the crossings to travel together.
D. a concession that traveling alone is dangerous for most animals, even when they are using the crossings.

22. **F.** NO CHANGE
G. is: a twenty-six-foot-high,
H. is, a twenty-six-foot-high
J. is a twenty-six-foot-high

It guides bears and moose from the highway for (23) the other half of their natural habitat range.

[4]

This highway project helps protect (24) both humans and animals. (24) Surveillance cameras have (25) captured animals seeming (26) to teach their young how to use the structures. A mother black bear nudges her cub as it climbs onto the overpass; then the two walk (27) ahead quickly so her cub will follow her. White-tailed does lie down (in a culvert) (28) as their fawns run back and forth in it, and then they all walk through the culvert together. With thousands of deer having bounded over one new bridge, animals seem to be learning that they have found safe passage.

23. **A.** NO CHANGE
B. with the highway toward
C. over the highway to
D. on the highway at

24. Which statement most effectively introduces this paragraph?
F. NO CHANGE
G. The very highways that allow people to move freely often block the movement of animals.
H. So far, these wildlife crossings appear to be doing what they were designed to do.
J. Safe, carefully placed fencing seems to help animals use the crossings.

25. **A.** NO CHANGE
B. that record nearby activities have
C. recording animals have
D. have recorded and

26. **F.** NO CHANGE
G. are seeming
H. while seem
J. seem

27. **A.** NO CHANGE
B. she walks
C. they walk
D. it walks

28. **F.** NO CHANGE
G. down, in a culvert,
H. down, in a culvert
J. down in a culvert

Questions 29 and 30 ask about the preceding passage as a whole.

29. The writer is considering adding the following sentence to the essay:

> If the road were widened conventionally, crossing it would become even more dangerous, and animals would eventually be trapped in haphazard fragments of their natural habitat.

If the writer were to add this sentence, it would most logically be placed at:
A. Point A in Paragraph 1.
B. Point B in Paragraph 2.
C. Point C in Paragraph 2.
D. Point D in Paragraph 3.

30. Suppose the writer's primary purpose had been to describe the process by which a few groups worked together to achieve a common goal. Would this essay accomplish that purpose?
F. Yes, because the essay makes clear that groups worked together in the 1980s to prevent the redesign of several historic two-lane roads in Montana.
G. Yes, because the essay describes the organized group protests by tribes, engineers, and scientists that led to the animal crossings being built.
H. No, because although the essay states that groups worked together to create animal crossings, the essay focuses on describing the benefits of the structures.
J. No, because the essay instead focuses on providing data to show the number of animal deaths that a road redesign project has prevented.

PASSAGE III

Eva Zeisel's Playful Search for Beauty

[1]

Speaking at an event held to honor her nearly eighty years as a ceramics designer, artist Eva Zeisel said her focus had always been the same; a playful (31) search for beauty. [A] The Hungarian-born artist's search began following a 1925 trip to the World's Fair in Paris, France. [B] There she had visited row after row of exhibitions not only by the world's preeminent new architects but also by creators of fashion mannequins. (32) Zeisel felt that many of the featured designs, stressing stark, geometric shapes and angular lines, fundamentally (33) too cold. [34] For Zeisel, the only emotion they conveyed (35) was "leave me alone."

[2]

Zeisel herself personally thought and believed (36) that items to be used in the home, where people gather most often and most closely, should be warm and inviting. Working in simple white ceramic, for creating her (37) dinnerware sets of plates, bowls, cups, and saucers and exhibiting them at local fairs.

31. **A.** NO CHANGE
B. same: a playful
C. same a playful:
D. same a playful

32. Given that all the choices are accurate, which one best provides a foundation for the essay's discussion of Zeisel's artistic focus?
F. NO CHANGE
G. graphic artists, many of whom were from Poland.
H. leading designers of objects for the home.
J. prominent French perfume makers.

33. **A.** NO CHANGE
B. were
C. also
D. DELETE the underlined portion.

34. Which of the following true statements, if added here, would best connect the preceding sentence to the last sentence in the paragraph?
F. They didn't remind her of anything she had created as an apprentice potter.
G. She did, however, appreciate that the designs were not at all flowery or frilly.
H. She still appreciated all that she had taken in at the World's Fair.
J. They didn't express a sense of joy or humanity.

35. **A.** NO CHANGE
B. emotion, they conveyed,
C. emotion they conveyed:
D. emotion they conveyed,

36. **F.** NO CHANGE
G. Zeisel, who was a ceramics designer for nearly eighty years,
H. Zeisel, who attended the 1925 World's Fair in Paris,
J. Zeisel

37. **A.** NO CHANGE
B. she began creating
C. the creation of her
D. while creating

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Her pieces were spare and unadorned, following key elements of the design trends she had observed in Paris, yet they highlighted soft S curves, asymmetrical bends, and whimsical, informal shapes regardless, without adornments. Hers was a joyful, casual twist, however, on what was new and exciting in modern design. Hungarian ceramic manufacturers quickly promoted and mass-produced several of her collections. [C] Though unsure of the offbeat new look at first, European and American families soon embraced Zeisel's carefree approach to the table, and Zeisel became even more playful to her designs.

38. **F.** NO CHANGE
G. shapes. Still, her pieces were spare.
H. shapes, having no embellishments.
J. shapes.

39. **A.** NO CHANGE
B. twist, previously,
C. twist, similarly,
D. twist

40. **F.** NO CHANGE
G. along
H. in
J. at

[3]

Wanting her pieces to symbolize human relationships and bonds, Zeisel designed salt and pepper shakers that nestled, able to be set as one piece or apart as two. Gravy boats had sides that reached upward to barely meet them, as if in a light, grazing touch. Plates, rather than all looking identical when stacked, revealed complementary, wavelike bends.

41. Given that all the choices are accurate, which one best introduces the series of examples of Zeisel's designs that follows?
A. NO CHANGE
B. Long after her first ceramics exhibition in the United States, which had been held in 1926,
C. While the originals of her early work have become sought-after collectibles,
D. Sometimes establishing and teaching ceramics design courses,

42. **F.** NO CHANGE
G. each other,
H. that,
J. it,

43. **A.** NO CHANGE
B. they didn't all look
C. were not
D. and not

In her long and lighthearted search, Zeisel showed both designers and diners that art, and everyday life, should include a swerve of joy and eccentricity. [D]

44. **F.** NO CHANGE
G. long, and lighthearted search, Zeisel showed
H. long and lighthearted search Zeisel showed,
J. long and lighthearted search Zeisel showed

Question 45 asks about the preceding passage as a whole.

45. The writer is considering adding the following sentence to the essay:

> Many of Zeisel's first designs to be mass-manufactured had been critically acclaimed by art enthusiasts and museums, but she wanted her dinnerware pieces to be enjoyed by people in the home.

If the writer were to add this sentence, it would most logically be placed at:

A. Point A in Paragraph 1.
B. Point B in Paragraph 1.
C. Point C in Paragraph 2.
D. Point D in Paragraph 3.

PASSAGE IV

Berry Sweet

Dark red and containing one seed, the berry of [46]

Synsepalum dulcificum, called miracle fruit, may not [47] seem particularly impressive at first. Its mildly sweet tang is often compared to that of a cranberry. But within this small fruit lays [48] miraculin, a natural protein with the power to trick the tongue by making even the sourest flavors taste remarkably sweet.

Eating a miracle fruit allows miraculin molecules that bind [49] to the sweetness receptors on the tongue's taste buds. Then, when a food containing acid (which generally causes a sour taste) is consumed, this molecular bond intensifies. This reaction, in turn, transmits a signal indicating sweetness to the brain. Thus, acidic foods with sour or bitter flavors register as sweet. Raw lemon slices taste like candy.

46. Given that all the choices are accurate, which one provides the most specific description of the berry's appearance?

F. NO CHANGE
G. about the size and shape of an almond,
H. cultivated primarily in warm climates,
J. grown on a shrub with dense foliage,

47. **A.** NO CHANGE
B. *dulcificum* called, miracle fruit,
C. *dulcificum* called miracle fruit,
D. *dulcificum*, called miracle fruit

48. **F.** NO CHANGE
G. lies
H. laid
J. lie

49. **A.** NO CHANGE
B. molecules, which then bind
C. molecules, binding them
D. molecules to bind

With tart vinegar, you taste apple juice. Sour cream
50
tastes like pudding. The effect takes anywhere from

fifteen minutes to an hour to compress.
51

In its native West Africa, given that miracle
52

fruit has been used as a sweetener for centuries. Yet,
53
due in part to its fragility and short shelf life, the fruit is not widely known in the Western world. Growers such as Curtis Mozie, who began growing miracle fruit in Florida as a hobby over two decades ago, is attempting to
54
increase awareness and consumption of the fruit. To avoid difficulties in shipping the delicate berries, his company sells them in frozen and dried forms and it also sells them
55

in powder, gum, and lollipops. [56]

50. Which choice best maintains the stylistic pattern established in the preceding sentence and continued in the sentence that follows?

F. NO CHANGE
G. An apple juice taste replaces one of tart vinegar.
H. Vinegar that is tart tastes like apple juice instead.
J. Tart vinegar tastes like apple juice.

51. **A.** NO CHANGE
B. downgrade.
C. diminish.
D. constrict.

52. **F.** NO CHANGE
G. a region in which
H. where
J. DELETE the underlined portion.

53. **A.** NO CHANGE
B. Consequently,
C. Moreover,
D. That is,

54. **F.** NO CHANGE
G. are attempting
H. has attempted
J. attempts

55. **A.** NO CHANGE
B. forms, additionally, it sells them
C. forms, the berries are also sold
D. forms, as well as

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

> Mozie has said that his favorite foods to eat with miracle fruit include green mangoes and oysters with lemon juice.

Should the writer make this addition here?

F. Yes, because it offers an informed opinion on a subject with which many people may be unfamiliar.
G. Yes, because it provides examples of acidic foods that pair well with miracle fruit.
H. No, because it is only loosely related to the paragraph's focus on efforts to expand awareness of and access to miracle fruit.
J. No, because it gives the false impression that miracle fruit is widely available.

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Dr. Linda Bartoshuk, whose studied the miracle fruit and it's properties over several decades, says miraculin's effect is unique among known proteins. (57)

57. **A.** NO CHANGE
B. who's studied the miracle fruit and it's
C. who's studied the miracle fruit and its
D. whose studied the miracle fruit and its

Though other plants can influence taste perceptions—one herb, for example, which entirely blocks sweet receptors—none but the miracle fruit triggers such powerfully sweet tastes in response to an acidic environment. (58)

58. **F.** NO CHANGE
G. entirely blocking sweet receptors
H. blocks sweet receptors entirely
J. to block sweet receptors entirely

Bartoshuk (and other scientists) continue, to research potential health benefits of the berry; meanwhile, (59)

59. **A.** NO CHANGE
B. Bartoshuk, and other scientists, continue
C. Bartoshuk and other scientists continue,
D. Bartoshuk and other scientists continue

researchers in Japan have created a type of lettuce capable of producing miraculin. (60)

60. Which choice would best conclude the sentence and the essay by highlighting the berry's main capability?

F. NO CHANGE
G. they've learned that heating or cooking the fruit destroys miraculin's taste-transforming properties.
H. the fruit's consumers enjoy turning sour foods into "miraculously" sweet treats.
J. many chefs have created tasting menus incorporating miracle berries.

PASSAGE V

Hilo Hula

[1]

Clad in a flowing, floor-length red dress, her neck and hair adorned with red and yellow flowers. A woman slowly makes her way to the stage. (61)

61. **A.** NO CHANGE
B. flowers, a woman slowly makes
C. flowers while slowly making
D. flowers, slowly making

Wearing a flowing dress of red as the guitar's soft melody floats through the air, she offers a sad smile. Raising her arms gracefully, she begins to tell a legendary and sorrowful Hawaiian tale. (62)

62. **F.** NO CHANGE
G. Flowers ornamenting her hair as
H. Approaching the stage as
J. As

63. If the writer were to delete the underlined portion, the paragraph would primarily lose information that:

A. indicates the reason that the woman's smile is sad.
B. specifies why the story the woman is sharing is considered sad.
C. suggests that ancient legends are difficult stories to convey clearly.
D. explains why Hawaiian legends are traditionally told through dance.

She speaks no words, however, instead relaying the ancient story through the expressive art of dance native to Hawai‘i: hula. [A] Her performance marks the start of the world’s most prestigious hula competition, held each spring at the Merrie Monarch Festival in Hilo, Hawai‘i. [B]

64. **F.** NO CHANGE
G. dance—native to Hawai‘i,
H. dance, native to Hawai‘i,
J. dance native to Hawai‘i;

[2]

Founded in 1964 as an endeavor to accomplish a boost in Hilo’s economy, the festival, named for a nineteenth-century Hawaiian king known for patronizing the arts, initially struggled to gain interest. [C] It wasn’t until festival organizer Dottie Thompson and respected hula master, “Uncle” George Na‘ope introduced hula competitions in 1971 that attendance was invigorated. It’s renewed focus on celebrating hula and other aspects of authentic Hawaiian culture attracted both locals and visitors alike.

65. **A.** NO CHANGE
B. a way of trying to help out with
C. an attempt to bolster
D. an effort to amp up

66. **F.** NO CHANGE
G. organizer, Dottie Thompson, and respected hula master
H. organizer, Dottie Thompson and respected hula master,
J. organizer Dottie Thompson and respected hula master

67. **A.** NO CHANGE
B. so that
C. when
D. DELETE the underlined portion.

68. **F.** NO CHANGE
G. The festival’s
H. They’re
J. One’s

[3]

Thompson and Na‘ope believed all elements of hula tradition, both ancient (referring to hula predating 1893) and modern, need to be preserved and shared. [D] *Kahiko*, or ancient hula, involves chanting and little instrumental accompaniment. *‘Auana* (modern hula), on the other hand, having been influenced by Western music, is generally accompanied by guitar or ukulele. Due in part to Na‘ope’s efforts to revive male hula, when a men’s division was added in 1976.

69. **A.** NO CHANGE
B. has a need
C. does need
D. needs

70. **F.** NO CHANGE
G. he had
H. so
J. DELETE the underlined portion.

The festival's competitive hula events, which had grown [71] so popular by then that they were relocated from a small auditorium to a larger venue, [72] where they have taken place ever since.

[4]

Today, many credit the festival, an annual event in Hilo, [73] with the widespread revitalization of hula. The organizers' ongoing commitment to promote and preserve Hawaiian culture helps the art of hula continue to thrive as a "living tradition."

71. **A.** NO CHANGE
B. events had grown
C. events growing
D. events,

72. The writer is considering revising the underlined portion to the following:

5,000-seat stadium,

Given that the information is accurate, should the writer make this revision?

F. Yes, because it provides a more specific idea of the number of dancers competing in the festival.
G. Yes, because it offers a specific detail that better illustrates how popular the events became.
H. No, because it is only loosely related to the sentence's discussion of the events' popularity.
J. No, because it repeats information about festival attendance stated earlier in the essay.

73. **A.** NO CHANGE
B. festival, which hosts the world's most prestigious hula competition,
C. festival, established in 1964,
D. festival

Questions 74 and 75 ask about the preceding passage as a whole.

74. The writer wants to add the following sentence to the essay:

To that end, they established two stylistic categories in the competition.

This sentence would most logically be placed at:

F. Point A in Paragraph 1.
G. Point B in Paragraph 1.
H. Point C in Paragraph 2.
J. Point D in Paragraph 3.

75. Suppose the writer's primary purpose had been to discuss the revival of a traditional cultural art form. Would this essay accomplish that purpose?

A. Yes, because it describes how the Merrie Monarch Festival helped rekindle widespread interest in hula.
B. Yes, because it notes significant events in the history of many traditional Hawaiian art forms.
C. No, because it focuses instead on describing the various activities that take place at the Merrie Monarch Festival.
D. No, because it focuses instead on explaining the origins of hula and its initial impact on Hawaiian culture.

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.

DO YOUR FIGURING HERE.

1. A bag contains exactly 7 marbles, each with 1 number on it: 4 red marbles numbered 1, 2, 3, and 4; and 3 black marbles numbered 1, 2, and 3. One marble will be selected at random from the bag. What is the probability that the marble selected will be an odd-numbered red marble?

A. $\frac{1}{2}$

B. $\frac{2}{7}$

C. $\frac{7}{12}$

D. $\frac{8}{49}$

E. $\frac{16}{49}$

2. Given $p = 40$ and $q = -12$, $p + q$ is equal to the product of -4 and what number?

F. -13
G. -7
H. 7
J. 13
K. 120

3. In $\triangle ABC$, $\angle A$ and $\angle C$ are congruent, and the measure of $\angle B$ is $93.5°$. What is the measure of $\angle A$?

A. $43.25°$
B. $46.75°$
C. $60°$
D. $86.5°$
E. $93.5°$

DO YOUR FIGURING HERE.

4. Ken is paid a regular hourly wage of \$15 per hour, before taxes and benefits are deducted, for working up to and including 40 hours in 1 week. For each additional hour he works in a week, Ken is paid 2 times his regular hourly wage. Ken worked 44 hours this week. What was his pay for this week before taxes and benefits were deducted?

F. \$ 630
G. \$ 660
H. \$ 720
J. \$ 930
K. \$1,320

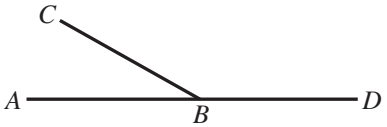
5. What is the length, in inches, of the hypotenuse of a right triangle with a leg that is 7 inches long and a leg that is 4 inches long?

A. $\sqrt{22}$
B. $\sqrt{33}$
C. $\sqrt{65}$
D. 5.5
E. 11

6. Given $3x - 7 = 8x - 16$ is true, $x = ?$

F. $-\frac{23}{5}$
G. $-\frac{23}{11}$
H. $-\frac{9}{5}$
J. $\frac{9}{5}$
K. $\frac{23}{11}$

7. As shown in the figure below, points A, B, and D lie on a line. The measure of angle ABC ($m\angle ABC$) is $x°$, and $m\angle CBD$ is $(5x + 4)°$.



Which of the following equations is true?

A. $(5x + 4) = x$
B. $x - (5x + 4) = 90$
C. $x + (5x + 4) = 90$
D. $x + (5x + 4) = 180$
E. $x + (5x + 4) = 360$

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DO YOUR FIGURING HERE.

8. A restaurant currently has an outdoor rectangular dining section measuring 30 feet by 40 feet. The shorter sides will be increased by 10 feet each, resulting in a larger rectangular dining section. What is the positive difference, in square feet, between the areas of the resulting and current dining sections?

F. 100
G. 300
H. 400
J. 500
K. 600

9. What is the value of $|-4| - |6 - 29|$?

A. −31
B. −27
C. −19
D. 19
E. 27

10. Christopher works in a clothing store. He earns \$7.50 per hour, plus 6% of his sales. Which of the following expressions gives Christopher's earnings, in dollars, when he works x hours and has y dollars in sales?

F. $75x + 6y$
G. $75x + 0.06y$
H. $7.5x + 6y$
J. $7.5x + 0.6y$
K. $7.5x + 0.06y$

11. For $\overleftrightarrow{RT}$ shown below, point S is on $\overline{RT}$, the length of $\overline{RS}$ is 8 cm, and the length of $\overline{ST}$ is 20 cm. What is the distance, in centimeters, between T and the midpoint of $\overline{RS}$?

A. 14
B. 18
C. 20
D. 24
E. 28

12. A conference presenter earned \$48.50 for attending a conference and \$15.35 per hour for the hours she spent preparing for her presentation. Let y be the amount of money, in dollars, earned by the presenter when she spent x hours preparing for her presentation. Which of the following equations gives the relationship between x and y ?

F. $y = 15.35x$
G. $y = 33.15x$
H. $y = 63.85x$
J. $y = 15.35x + 48.50$
K. $y = 48.50x + 15.35$

DO YOUR FIGURING HERE.

13. Ben and Shawnee are painting a room in the library. They started with 7 gallons of paint. On the first day, Ben used $\frac{3}{4}$ gallon of paint and Shawnee used $3\frac{1}{2}$ gallons of paint. How many gallons of paint were left when they completed their first day of painting?

A. $2\frac{3}{4}$

B. $3\frac{1}{2}$

C. $3\frac{3}{4}$

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

E. $6\frac{1}{4}$

14. If $x = -4$, then $\frac{-5 + 9x}{x^2 - 9x} = ?$

F. $-\frac{41}{20}$

G. $-\frac{41}{52}$

H. $-\frac{5}{16}$

J. $\frac{31}{52}$

K. $\frac{41}{20}$

15. In the standard (x,y) coordinate plane, what is the slope of the line represented by the equation $y = 4x + 2$?

A. $\frac{1}{2}$

B. 2

C. 4

D. $4x$

E. $\frac{1}{2}y$

16. The trinomial $x^2 + 11x + 24$ can be factored into 2 binomials with positive integer coefficients. Which of the following binomials is 1 of the factors?

F. $x + 1$
G. $x + 2$
H. $x + 3$
J. $x + 4$
K. $x + 5$

DO YOUR FIGURING HERE.

17. Which of the following matrices is equal to $4\begin{bmatrix} -2 & 6 \\ 0 & -3 \end{bmatrix}$?

A. $\begin{bmatrix} -8 & 12 \end{bmatrix}$

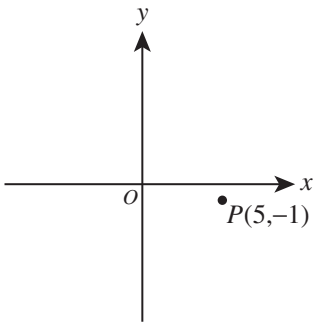
B. $\begin{bmatrix} 16 \\ -12 \end{bmatrix}$

C. $\begin{bmatrix} 2 & 10 \\ 4 & 1 \end{bmatrix}$

D. $\begin{bmatrix} -\frac{1}{2} & \frac{3}{2} \\ 0 & -\frac{3}{4} \end{bmatrix}$

E. $\begin{bmatrix} -8 & 24 \\ 0 & -12 \end{bmatrix}$

18. Point $P(5,-1)$, which is graphed in the standard (x,y) coordinate plane below, will be reflected across the x-axis. What will be the coordinates of the image of P ?



F. (–5,–1)
G. (–5, 1)
H. (–1, 5)
J. (5,–1)
K. (5, 1)

19. Given that $x \leq 2$ and $x + y \geq 6$, what is the LEAST value that y can have?

A. –8
B. –4
C. 0
D. 4
E. 8

20. A square vegetable garden is built in a rectangular 50-meter-by-40-meter lawn. The lengths of the sides of the garden are 5 meters. What area of the lawn, in square meters, is outside of the vegetable garden?

F. 1,575
G. 1,750
H. 1,800
J. 1,975
K. 2,475

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DO YOUR FIGURING HERE.

21. The distance of the longest jump of each of the participants in a long jump competition is given in the stem-and-leaf plot below.

Stem	Leaf
6	8 9
7	1 4 7 8 9
8	0 1 2

Key: 7 | 3 = 73 inches

What is the probability that a long jump participant chosen at random from the competition will have jumped *at least* 75 inches?

A. $\frac{3}{13}$

B. $\frac{7}{13}$

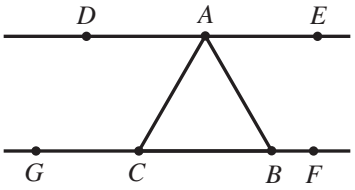
C. $\frac{3}{10}$

D. $\frac{4}{10}$

E. $\frac{6}{10}$

22. In the figure below, $\overleftrightarrow{DE} \parallel \overleftrightarrow{GF}$, point A lies on $\overline{DE}$, points C and B lie on $\overline{GF}$, $m\angle GCA = 120°$, and $m\angle GBA = 50°$. What is $m\angle CAB$?

(Note: The figure is NOT drawn to scale. The degree measure of $\angle STU$ is denoted $m\angle STU$.)



F. 10°
G. 20°
H. 50°
J. 60°
K. 70°

23. Gabe will use 1 fluid ounce of fertilizer for every 30 square feet of soil. At this rate, how much fertilizer, to the nearest 0.01 gallon, will Gabe use for 0.8 acres of soil?

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

A. 0.07
B. 0.11
C. 9.08
D. 14.18
E. 24.00

DO YOUR FIGURING HERE.

24. On each of 10 tests, Andreas scored 2 points higher than Mischa. When their average test scores on these 10 tests are compared, how many points higher is Andreas's average than Mischa's average?

F. 2
G. 5
H. 6
J. 8
K. 20

25. For a certain basketball player, the probability of success on any given free throw attempt is 0.7. What is the least number of free throw attempts for which the result is expected to be at least 18 successes?

A. 21
B. 25
C. 26
D. 43
E. 44

26. Some consecutive terms of a geometric sequence are below.

$$\cdots, 64, 48, 36, 27, \cdots$$

What is the common ratio of this sequence?

F. -16

G. -12

H. -9

J. $\frac{3}{4}$

K. $\frac{4}{3}$

27. Sets A, B, and C are defined below.

$$A = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$$
$$B = \{3, 6, 9\}$$
$$C = \{2, 4, 6, 8\}$$

A number will be randomly selected from set A. What is the probability that the selected number will be an element of set B *and* an element of set C ?

A. 0

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

C. $\frac{2}{9}$

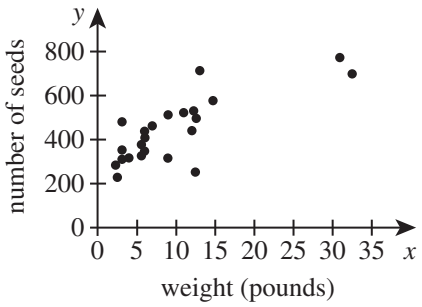
D. $\frac{6}{9}$

E. $\frac{7}{9}$

DO YOUR FIGURING HERE.

Use the following information to answer questions 28–30.

In a science class, students measured the weights, in pounds, of 23 pumpkins and counted the seeds in each pumpkin. A scatterplot of the data is shown below. To the nearest pound, the average weight of these pumpkins was 10 pounds, and the average number of seeds per pumpkin was 444 seeds. An equation of the regression line of best fit is $y = 15x + 294$, where x is the weight, in pounds, and y is the number of seeds.



28. According to the regression line of best fit, what is the predicted number of seeds for a pumpkin weighing 27 pounds?

F. 309
G. 336
H. 405
J. 699
K. 714

29. When one of the pumpkins is removed from the group of 23 pumpkins, the average number of seeds per pumpkin for the remaining 22 pumpkins is 10 fewer than it was for all 23 pumpkins. How many seeds are in the removed pumpkin?

A. 224
B. 434
C. 454
D. 516
E. 664

30. An object that weighs 1 pound on Earth has a mass of 0.45 kilograms. What is the mass, to the nearest 0.1 kilogram, of a pumpkin that weighs the same as the average weight of the 23 pumpkins?

F. 4.5
G. 10.4
H. 14.9
J. 22.2
K. 51.1

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DO YOUR FIGURING HERE.

31. Let n be any even number greater than or equal to 4. Which of the 3 expressions below *must* be equal to an even number?

$$\frac{n}{2},\ 2n,\ \sqrt{n}$$

A. $\frac{n}{2}$ only

B. $2n$ only

C. $\sqrt{n}$ only

D. $2n$ and $\sqrt{n}$ only

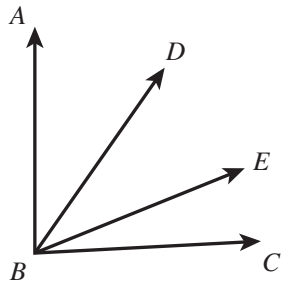
E. $\frac{n}{2}$, $2n$, and $\sqrt{n}$

32. A vertical radio tower stands on level ground. From a point 200 feet along level ground from the base of the tower, the angle of elevation to the top of the tower is 50°. Which of the following values is closest to the height, in feet, of the radio tower?

(Note: $\sin 50° \approx 0.77$, $\cos 50° \approx 0.64$, $\tan 50° \approx 1.20$)

F. 150
G. 170
H. 240
J. 260
K. 310

33. In the figure below, the measure of $\angle ABC$ is 87°, the measure of $\angle ABE$ is 68°, and the measure of $\angle DBC$ is 52°. What is the measure of $\angle DBE$?



A. 19°
B. 29°
C. 33°
D. 35°
E. 54°

34. Consider the number 630.6×10^a, where a is an integer. What is scientific notation for this number?

F. $6.306 \times 10^{a-2}$

G. $6.306 \times 10^{a-1}$

H. 6.306×10^{a}

J. $6.306 \times 10^{a+1}$

K. $6.306 \times 10^{a+2}$

DO YOUR FIGURING HERE.

Use the following information to answer questions 35–37.

RunOnline sells shoes and accessories to members and nonmembers of their club. Members are charged a onetime fee of $40 in order to pay the member price. The nonmember and member prices of certain items are given below.

Item	Nonmember price	Member price
Pair of shoes	$100	$90
Hat	$ 12	$10
Water bottle	$ 15	$14
Workout bag	$ 27	$20

All given prices include tax and shipping. Last year, RunOnline had a total of 1,000 customers. Of those customers, 25% were members.

35. Ed and Sarah both bought p pairs of shoes from RunOnline. Ed is a member and Sarah is a nonmember. Ed's total cost, including the onetime fee, was equal to Sarah's total cost. What is p ?

A. 2
B. 4
C. 5
D. 8
E. 10

36. From RunOnline, a nonmember purchased a total of 5 items: 2 hats, 2 water bottles, and 1 workout bag. Which of the following dollar amounts is closest to the mean cost per item purchased by this nonmember?

F. $12
G. $15
H. $16
J. $18
K. $27

37. RunOnline is currently selling 100 water bottles to members each year. It was predicted that for every $0.50 decrease in the member price, RunOnline will sell 10 more water bottles to members each year. RunOnline decides to lower the member price to $10 per water bottle. Based on the prediction and excluding the onetime fee, what will be the total revenue from water bottles sold to members the year following the price reduction?

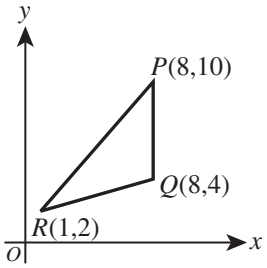
A. $1,000
B. $1,100
C. $1,400
D. $1,800
E. $2,520

DO YOUR FIGURING HERE.

38. Which of the following expressions is equivalent to $(2x)^6(10y^2)$?

F. $20x^6y^2$
G. $200x^6y^2$
H. $240x^6y^2$
J. $640x^6y^2$
K. $6{,}400x^6y^2$

39. The vertices of $\triangle PQR$ are given in the standard (x,y) coordinate plane below. What is the area, in square coordinate units, of $\triangle PQR$?



A. 18
B. 21
C. 36
D. 40
E. 42

40. Which of the following expressions is undefined?

F. $\tan(0)$

G. $\tan(\pi)$

H. $\dfrac{1}{\sin\left(-\frac{\pi}{2}\right)}$

J. $\dfrac{1}{\cos(0)}$

K. $\dfrac{1}{\sin(0)}$

41. Given that i is the imaginary unit, which of the following numbers is equal to $(4 + 3i)^2$?

A. 7
B. 25
C. $7 + 24i$
D. $8 + 6i$
E. $25 + 24i$

42. Given that $f(x) = x^2 - 5x + 6$ and $g(x) = x^2 - 7x - 10$, what is $g(f(-1))$?

F. −55
G. −24
H. 20
J. 21
K. 50

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DO YOUR FIGURING HERE.

43. For all nonzero values of x and y, which of the following expressions is equal to $\frac{9x^3y^2}{3y} \cdot \frac{xy^2}{2x^4}$?

A. $\frac{3y^3}{2}$

B. $\frac{3y^3}{2x}$

C. $\frac{9y^3}{5}$

D. $\frac{6x^6}{y}$

E. $6x^{11}$

44. In a 73-member choir of only altos and sopranos, there are 19 more altos than sopranos. What is the ratio of altos to sopranos?

F. 27:46
G. 27:73
H. 46:27
J. 46:73
K. 54:19

45. A drum contains 40 liters of a 6% potassium bromide solution. This solution is mixed with 80 liters of pure water to produce a new potassium bromide solution. What percent of the new solution is potassium bromide?

A. 2%
B. 3%
C. 6%
D. 8%
E. 12%

46. Given that $\sin \theta = \frac{2}{3}$, which of the following values is a possible value of $\cos \theta$?

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

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

H. $\frac{5}{9}$

J. $\frac{\sqrt{5}}{9}$

K. $\frac{\sqrt{5}}{3}$

47. A certain rectangle in the standard (x,y) coordinate plane has a length of 7 coordinate units and a width of 5 coordinate units. The point (0,0) is in the interior of this rectangle. Two vertices of this rectangle are at (3,2) and (3,–3). What is the x-coordinate of the other 2 vertices?

A. –4
B. –3
C. –2
D. 8
E. 10

DO YOUR FIGURING HERE.

48. Two nonvertical parallel lines in the standard (x,y) coordinate plane have the equations $y = m_1x + b_1$ and $y = m_2x + b_2$. The 2 lines are not coincident. Which of the following assertions *must* be true?

I. $b_1 = b_2$
II. $b_1 \neq b_2$
III. $m_1 = m_2$
IV. $m_1 \neq m_2$

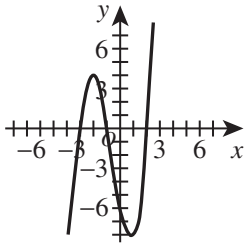
F. I only
G. III only
H. I and III only
J. I and IV only
K. II and III only

49. The function $f(x)$ when graphed in the standard (x,y) coordinate plane has the features below:

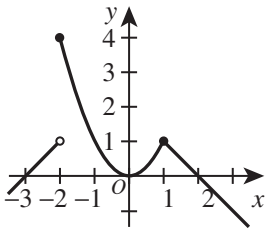
I. One of its intercepts is located at $(-3,0)$.
II. $f(x)$ increases for all $x > 3$.
III. $f(x)$ is not defined for $x = -2$.

One of the following is the graph of $f(x)$. Which one?

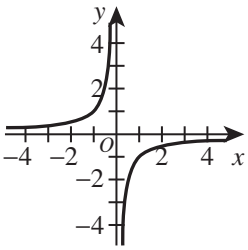
A.



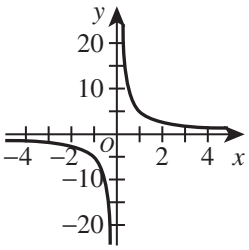
D.



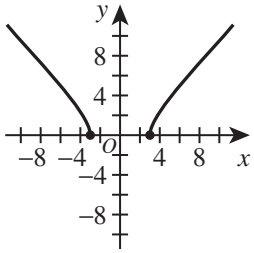
B.



E.



C.



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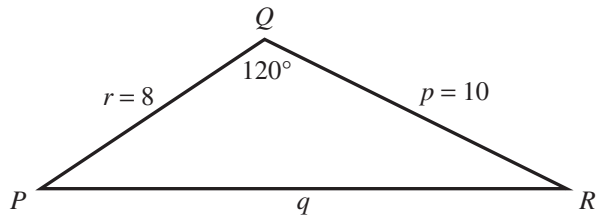
DO YOUR FIGURING HERE.

50. In $\triangle PQR$ shown below, $r = 8$ meters, $p = 10$ meters, and the measure of $\angle Q$ is 120°. The solution of which of the following equations gives the length q in meters?



(Note: For a triangle with sides of length a, b, and c that are opposite angles $\angle A$, $\angle B$, and $\angle C$, respectively, $\frac{\sin \angle A}{a} = \frac{\sin \angle B}{b} = \frac{\sin \angle C}{c}$ and $c^2 = a^2 + b^2 - 2ab \cos \angle C$.)

F. $\frac{\sin q}{120} = \frac{8}{10}$

G. $\frac{\sin 120°}{q} = \frac{8}{10}$

H. $\frac{\sin 10°}{q} = \frac{\sin 8°}{120}$

J. $120^2 = 8^2 + 10^2 - 2(8)(10) \cos q$

K. $q^2 = 8^2 + 10^2 - 2(8)(10) \cos 120°$

51. Consider the 4 expressions below, where m and n are distinct integers greater than 2.

$$\frac{m}{n-1}, \frac{m}{n}, \frac{m}{n+1}, \frac{m-1}{n}$$

If it can be determined, which of the 4 expressions *must* have the greatest value?

A. $\frac{m}{n-1}$

B. $\frac{m}{n}$

C. $\frac{m}{n+1}$

D. $\frac{m-1}{n}$

E. Cannot be determined from the given information

52. The original price of an item was decreased by 20%. The 1st reduced price was decreased by 20% and then that 2nd reduced price was decreased by 50%. The price that resulted from these 3 decreases was what percent less than the original price?

F. 10%
G. 32%
H. 68%
J. 90%
K. 98%

DO YOUR FIGURING HERE.

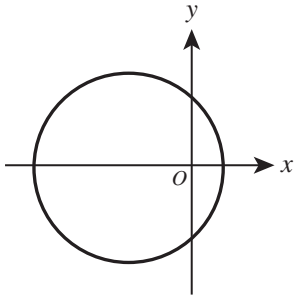
53. A particular company produces 500 computers a day. For 20 days the number of defective computers produced each day was recorded, and the results were placed in the table below.

Number of defective computers	Number of days
0	14
1	4
2	1
3	1

Based on this data, on average over a long period of time, what is the expected number of defective computers produced on any given day?

A. 0.45
B. 0.75
C. 1
D. 1.5
E. 2.25

54. One of the following equations is an equation of the circle graphed in the standard (x,y) coordinate plane below. Which one is it?



F. $x^2 + y^2 = 1$
G. $x^2 + y^2 - 2x = 1$
H. $x^2 + y^2 - 2y = 1$
J. $x^2 + y^2 + 2x = 1$
K. $x^2 + y^2 + 2y = 1$

55. Aman left his bicycle at his friend's house last night. Today, he decided to walk from home to his friend's house, visit, and then ride the bicycle back home along the same route he walked. Aman walked at 3 mph, visited for 1.5 hours, and then rode the bicycle at 8 mph. Aman arrived home 3 hours after he started walking. Which of the following values is closest to the number of miles Aman walked?

A. 2.3
B. 3.3
C. 4.1
D. 4.5
E. 8.3

56. Points $A(8,5)$ and $C(-4,11)$ lie in the standard (x,y) coordinate plane. Point B lies on $\overline{AC}$ such that $AB:BC = 1:2$. What are the coordinates of B ?

F. $(-8,13)$
G. $(0, 9)$
H. $(2, 8)$
J. $(3, 6)$
K. $(4, 7)$

DO YOUR FIGURING HERE.

57. The ratio of a to b is 3 to 1, and the ratio of b to c is 6 to 1. What is the value of $\frac{2a+3b}{4b+3c}$?

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

B. $\frac{9}{22}$

C. $\frac{8}{9}$

D. 2

E. $\frac{24}{7}$

58. In the 3 equations below, A, B, and C are positive real numbers. Each equation will be graphed in the standard (x,y) coordinate plane. Which of the following equations will result in lines that have a negative slope?

I. $Ax + By = C$
II. $Ax - By = C$
III. $-Ax - By = C$

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

59. The function $f(x) = 5^{\frac{x}{2}}$ has an inverse function, $f^{-1}(x)$, defined for all $x > 0$ by which of the following expressions?

A. $\frac{2}{\log_5 x}$

B. $\frac{1}{(\log_5 x)^2}$

C. $(\log_5 x)^2$

D. $\frac{1}{2}\log_5 x$

E. $2\log_5 x$

60. Rectangle P has an *area* of 24 square inches. Rectangle Q has a *perimeter* of 24 inches. The ratio of the area of Rectangle P to the area of Rectangle Q is 2:3. Which of the quantities below can be determined from just the given information?

I. The perimeter of Rectangle P
II. The area of Rectangle Q
III. The ratio of the perimeter of Rectangle P to the perimeter of Rectangle Q

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

END OF TEST 2

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

DO NOT RETURN TO THE PREVIOUS TEST.

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READING TEST

35 Minutes—40 Questions

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

Passage I

LITERARY NARRATIVE: This passage is adapted from the short story "Janus" by Ann Beattie (©1985 by The New Yorker Magazine, Inc.).

The bowl was perfect. Perhaps it was not what you'd select if you faced a shelf of bowls, and not the sort of thing that would inevitably attract a lot of attention at a crafts fair, yet it had real presence. It was as predictably admired as a mutt who has no reason to suspect he might be funny. Just such a dog, in fact, was often brought out (and in) along with the bowl.

Andrea was a real-estate agent, and when she thought that some prospective buyers might be dog-lovers, she would drop off her dog at the same time she placed the bowl in the house that was up for sale. She would put a dish of water in the kitchen for Mondo, take his squeaking plastic frog out of her purse and drop it on the floor. He would pounce delightedly, just as he did every day at home, batting around his favorite toy. The bowl usually sat on a coffee table, though recently she had displayed it on top of a pine blanket chest and on a lacquered table. It was once placed on a cherry table beneath a glorious still-life painting, where it held its own.

Everyone who has purchased a house or who has wanted to sell a house must be familiar with some of the tricks used to convince a buyer that the house is quite special: a fire in the fireplace in early evening; jonquils in a pitcher on the kitchen counter, where no one ordinarily has space to put flowers; perhaps the slight aroma of spring, made by a single drop of scent vaporizing from a lamp bulb.

The wonderful thing about the bowl, Andrea thought, was that it was both subtle and noticeable—a paradox of a bowl. Its glaze was the color of cream and seemed to glow no matter what light it was placed in. There were a few bits of color in it—tiny geometric flashes—and some of these were tinged with flecks of silver. They were as mysterious as cells seen under a microscope; it was difficult not to study them, because they shimmered, flashing for a split second, and then resumed their shape. Something about the colors and their random placement suggested motion. People who liked country furniture always commented on the bowl, but then it turned out that people who felt comfortable with opulence loved it just as much. But the bowl was not at all ostentatious, or even so noticeable that anyone would suspect that it had been put in place deliberately. They might notice the height of the ceiling on first entering a room, and only when their eye moved down from that, or away from the refraction of sunlight on a pale wall, would they see the bowl. Then they would go immediately to it and comment. Yet they always faltered when they tried to say something. Perhaps it was because they were in the house for a serious reason, not to notice some object.

Once, Andrea got a call from a woman who had not put in an offer on a house she had shown her. That bowl, she said—would it be possible to find out where the owners had bought that beautiful bowl? Andrea pretended that she did not know what the woman was referring to. A bowl, somewhere in the house? Oh, on a table under the window. Yes, she would ask, of course. She let a couple of days pass, then called back to say that the bowl had been a present and the people did not know where it had been purchased.

She was sure that the bowl brought her luck. Bids were often put in on houses where she had displayed the bowl. Sometimes the owners, who were always asked to be away or to step outside when the house was being shown, didn't even know that the bowl had been in their house. Once—she could not imagine how—she left it behind, and then she was so afraid that something might have happened to it that she rushed back to the house and sighed with relief when the owner opened the door. The bowl, Andrea explained—she had purchased a bowl and set it on the chest for safekeeping while she toured the house with the prospective buyers, and she . . . She felt like rushing past the frowning woman and seizing her bowl. The owner stepped aside. In the few seconds before Andrea picked up the bowl, she realized that the owner must have just seen that it had been perfectly placed, that the sunlight struck the bluer part of it. Her pitcher had been moved to the far side of the chest, and the bowl predominated. All the way home, Andrea wondered how she could have left the bowl behind. It was like leaving a friend at an outing—just walking off. Sometimes there were stories in the paper about families forgetting a child somewhere and driving to the next city. Andrea had only gone a mile down the road before she remembered.

1. The point of view from which the passage is told is best described as that of a:
   - **A.** first person narrator, present in the action, who relates events as they happen.
   - **B.** first person narrator, not present in the action, who relates events that happened in the past.
   - **C.** third person narrator, present in the action, who relates the thoughts and feelings of many characters.
   - **D.** third person narrator, not present in the action, who relates the thoughts and feelings of primarily one character.

2. The passage as a whole can best be described as an exploration of the:
   - **F.** career of a real estate agent and the agent's typically mundane transactions with clients.
   - **G.** special glaze on a bowl and why the glaze makes the bowl both subtle and noticeable.
   - **H.** perceived perfection of an object and that object's effect on people.
   - **J.** problems that can result from a person's unyielding focus on obtaining material goods.

3. The passage most strongly suggests that a useful characteristic of the bowl, in terms of Andrea's purpose for the object, is the bowl's:
   - **A.** universal appeal.
   - **B.** famous designer.
   - **C.** ostentatious look.
   - **D.** commercial availability.

4. In lines 53–75, Andrea responds to an inquiry about her bowl and explains why her bowl was placed in a client's home with statements that can both best be described as:
   - **F.** vague generalizations.
   - **G.** absolute truths.
   - **H.** half-truths.
   - **J.** lies.

5. In the passage, Andrea is characterized as believing that compared to most tricks used by real estate agents to impress potential buyers, her trick of placing the bowl in a home is:
   - **A.** more humorous to potential buyers.
   - **B.** more obvious to potential buyers.
   - **C.** less familiar to potential buyers.
   - **D.** less enticing to potential buyers.

6. According to the passage, the random placement of colors in the bowl's glaze creates a surface that:
   - **F.** acts as a mirror.
   - **G.** seems to move.
   - **H.** appears cracked in the sunlight.
   - **J.** scatters prisms on the walls of a room.

7. One main point of the fifth paragraph (lines 53–62) is that:
   - **A.** Andrea's bowl sometimes attracts more interest than does the home for sale itself.
   - **B.** Andrea's bowl does not actually belong to her, but she hopes to find its owner.
   - **C.** Andrea is often asked about the bowl when a client puts in an offer on a house.
   - **D.** Andrea sometimes forgets in which room in a house she has placed the bowl.

8. In the passage, the admiration the bowl receives is directly compared to the admiration received by:
   - **F.** a mutt.
   - **G.** a plastic frog.
   - **H.** a cherry table.
   - **J.** the aroma of spring.

9. The passage suggests that one reason prospective home buyers have difficulty sharing their thoughts about the bowl is they realize that:
   - **A.** they are not visiting the home for the purpose of noticing decorative objects.
   - **B.** they do not want to reveal that they have the financial means to buy the bowl.
   - **C.** Andrea might start talking about the bowl instead of discussing the home that is for sale.
   - **D.** Andrea might find the bowl even more intriguing than they do.

10. Which of the following statements provides the best summary of the events portrayed in the sentences in lines 77–81?
    - **F.** The homeowner, first noticing the bowl, explains to Andrea that she thinks the bowl is enchanting.
    - **G.** Andrea imagines the homeowner's sudden realization of Andrea's deliberate and perfect placement of the bowl.
    - **H.** The homeowner tells Andrea that she thinks the bowl had been perfectly placed, even though Andrea had moved a pitcher.
    - **J.** Andrea determines the reason that the homeowner had not noticed the bowl on the chest.

Passage II

SOCIAL SCIENCE: This passage is from the book *The Botany of Desire: A Plant's-Eye View of the World* by Michael Pollan.

Originally cultivated in the Ottoman Empire, tulips were introduced to Europe at the end of the sixteenth century and became wildly popular in the seventeenth century.

One crucial element of the beauty of the tulip that intoxicated the Dutch, the Turks, the French, and the English has been lost to us. To them the tulip was a magic flower because it was prone to spontaneous and brilliant eruptions of color. In a planting of a hundred tulips, one of them might be so possessed, opening to reveal the white or yellow ground of its petals painted, as if by the finest brush and steadiest hand, with intricate feathers or flames of a vividly contrasting hue. When this happened, the tulip was said to have "broken," and if a tulip broke in a particularly striking manner—if the flames of the applied color reached clear to the petal's lip, say, and its pigment was brilliant and pure and its pattern symmetrical—the owner of that bulb had won the lottery. For the offsets of that bulb would inherit its pattern and hues and command a fantastic price. The fact that broken tulips for some unknown reason produced fewer and smaller offsets than ordinary tulips drove their prices still higher. Semper Augustus was the most famous such break.

The closest we have to a broken tulip today is the group known as the Rembrandts—so named because Rembrandt painted some of the most admired breaks of his time. But these latter-day tulips, with their heavy patterning of one or more contrasting colors, look clumsy by comparison, as if painted in haste with a thick brush. To judge from the paintings we have of the originals, the petals of broken tulips could be as fine and intricate as marbleized papers, the extravagant swirls of color somehow managing to seem both bold and delicate at once. In the most striking examples—such as the fiery carmine that Semper Augustus splashed on its pure white ground—the outbreak of color juxtaposed with the orderly, linear form of the tulip could be breathtaking, with the leaping, wayward patterns just barely contained by the petal's edge.

Anna Pavord recounts the extraordinary lengths to which Dutch growers would go to make their tulips break, sometimes borrowing their techniques from alchemists, who faced what must have seemed a comparable challenge. Over the earth above a bed planted with white tulips, gardeners would liberally sprinkle paint powders of the desired hue, on the theory that rainwater would wash the color down to the roots, where it would be taken up by the bulb. Charlatans sold recipes believed to produce the magic color breaks; pigeon droppings were thought to be an effective agent, as was plaster dust taken from the walls of old houses. Unlike the alchemists, whose attempts to change base metals into gold reliably failed, now and then the would-be tulip changers would be rewarded with a good break, inspiring everybody to redouble their efforts.

What the Dutch could not have known was that a virus was responsible for the magic of the broken tulip, a fact that, as soon as it was discovered, doomed the beauty it had made possible. The color of a tulip actually consists of two pigments working in concert—a base color that is always yellow or white and a second, laid-on color called an anthocyanin; the mix of these two hues determines the unitary color we see. The virus works by partially and irregularly suppressing the anthocyanin, thereby allowing a portion of the underlying color to show through. It wasn't until the 1920s, after the invention of the electron microscope, that scientists discovered the virus was being spread from tulip to tulip by *Myzus persicae*, the peach potato aphid. Peach trees were a common feature of seventeenth-century gardens.

By the 1920s the Dutch regarded their tulips as commodities to trade rather than jewels to display, and since the virus weakened the bulbs it infected (the reason the offsets of broken tulips were so small and few in number), Dutch growers set about ridding their fields of the infection. Color breaks, when they did occur, were promptly destroyed, and a certain peculiar manifestation of natural beauty abruptly lost its claim on human affection.

I can't help thinking that the virus was supplying something the tulip needed, just the touch of abandon the flower's chilly formality called for. Maybe that's why the broken tulip became such a treasure in seventeenth-century Holland: the wayward color loosed on a tulip by a good break perfected the flower, even as the virus responsible set about destroying it.

On its face the story of the virus and the tulip would seem to throw a wrench into any evolutionary understanding of beauty.

Excerpt from THE BOTANY OF DESIRE: A PLANT'S-EYE VIEW OF THE WORLD by Michael Pollan, copyright © 2001 by Michael Pollan. Used by permission of Random House, an imprint and division of Penguin Random House LLC. All rights reserved.

11. The main purpose of the passage is to:

- **A.** highlight changes in the flower industry from the seventeenth century through today.
- **B.** examine the way certain plants have been represented in art over the centuries.
- **C.** provide an overview of plant viruses and the way they affect the flower market.
- **D.** explain a particular flower variation and how it has been perceived historically.

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12. The main point of the second paragraph (lines 21–36) is that:

F. modern Rembrandt tulips have been painted by many of today's most famous artists.
G. compared to seventeenth-century broken tulips, today's multicolored tulips are less visually appealing.
H. the tulip break known as Semper Augustus was a striking example of the seventeenth-century broken tulip.
J. Rembrandt was responsible for painting the most famous tulip breaks of his time.

13. It can reasonably be inferred from the passage that some seventeenth-century tulip growers believed tulip breaks were mainly caused by:

A. suppliers' storage conditions.
B. diseased tulip bulbs.
C. certain growing techniques.
D. certain weather patterns.

14. The information in lines 56–63 primarily functions to:

F. describe the range of potential tulip colors.
G. explain how the color variation in a broken tulip occurs.
H. argue that yellow and white are the only natural tulip colors.
J. indicate why broken tulips contain no anthocyanin.

15. The sixth paragraph (lines 78–84) differs from the rest of the passage in that it:

A. questions whether the virus that caused broken tulips was harmful to bulbs.
B. argues that growers should have dealt with broken tulips differently.
C. challenges the idea that broken tulips were beautiful.
D. presents a personal meditation on broken tulips.

16. According to the passage, in the seventeenth century, the fact that broken tulip bulbs tended to produce fewer and smaller offsets compared to typical tulip bulbs resulted in:

F. a decrease in the demand for broken tulips.
G. a fear among growers that broken tulips were diseased.
H. an increase in prices for broken tulips.
J. a desire among growers to plant a wider variety of crops.

17. It can reasonably be inferred from the passage that one group of modern multicolored tulips was named after Rembrandt to:

A. highlight Rembrandt's status in the Dutch tulip trade.
B. reassure consumers about the health of the modern tulips.
C. favorably compare the modern tulips to the broken tulips in Rembrandt's paintings.
D. indicate that the modern tulips are identical to the tulips Rembrandt grew.

18. In the passage, the author compares broken tulips as they are represented in Rembrandt's paintings to:

F. peach-tree blossoms.
G. paint powders sprinkled on the ground.
H. a painting hastily done with a thick brush.
J. intricately marbleized papers.

19. The passage author most likely mentions that peach trees were a staple of seventeenth-century gardens to:

A. highlight a crop favored by growers who did not cultivate tulips.
B. emphasize that peach trees are not as popular in gardens today.
C. explain how peach potato aphids spread the tulip virus.
D. compare tulips to another popular seventeenth-century crop.

20. As it is used in line 79, the word *abandon* most nearly means:

F. uninhibitedness.
G. relinquishment.
H. retreat.
J. denial.

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Passage III

HUMANITIES: Passage A is from the book *Foundation: B-Boys, B-Girls, and Hip-Hop Culture in New York* by Joseph G. Schloss. Passage B is from the book *The Tanning of America: How Hip-Hop Created a Culture That Rewrote the Rules of the New Economy* by Steve Stoute.

Passage A by Joseph G. Schloss

The term *b-boying* refers to break dancing.

In the first sense of the term, hip-hop refers collectively to a group of related art forms in different media (visual, sound, movement) that were practiced in Afro-Caribbean, African American, and Latino neighborhoods in New York City in the 1970s. The term, when used in this sense, also refers to the events at which these forms were practiced, the people who practiced them, their shared aesthetic sensibility, and contemporary activities that maintain those traditions.

Perhaps the most important aspect of this variety of hip-hop is that it is unmediated, in the sense that most of the practices associated with it are both taught and performed in the context of face-to-face interactions between human beings. To some degree, this constitutes an intentional rejection of the mass media by its practitioners, but to a great extent it is just the natural result of the practices themselves. Activities like b-boying and graffiti writing are simply not well suited to the mass media. Although in both cases, brief attempts were made to bring these forms of expression into mainstream contexts (b-boying in a series of low-budget "breaksploition" movies in the early 1980s and graffiti as part of a short-lived gallery trend around the same time), neither developed substantially in those environments. This, it has been suggested, was not so much because the forms lacked appeal, but because—on an economic level—b-boying was an advertisement with no product. This reality is reflected in the phrase that is often used to refer to this branch of hip-hop: "hip-hop culture," which suggests something that is lived rather than bought and sold.

The second sense of the term *hip-hop* refers to a form of popular music that developed, or was developed, out of hip-hop culture. This hip-hop, also known as "rap music," resulted from the interaction between hip-hop culture and the preexisting music industry. As we would expect, this hip-hop features elements of both sensibilities. My students are often surprised when I point out that, even when hip-hop lyrics seem to reject every aspect of mainstream culture and morality, the one thing they almost never reject is a strict 16-bar verse structure derived from Tin Pan Alley pop music. But this should not be surprising. This hip-hop, in contrast to hip-hop culture, is deeply intertwined with the mass media and its needs, largely because it *does* have a product: records, CDs, MP3s, and ringtones.

Passage B by Steve Stoute

It wasn't until I was nine years old, late in 1979, that I even heard the words "hip" and "hop" strung together or was able to grasp the notion of what being a rapper actually meant. That was when, fatefully, I heard a record that changed my life (and pop culture) forever.

Like it's yesterday, I can still remember that moment over at my aunt's home in Brooklyn—where it seemed there was always a party under way with relatives and neighbors hanging out, a great spread of food, and new, hot music on the record player. Most stereo systems in those days could be adapted for the single two-sided records that were smaller and had the big hole in the middle (45 RPM) as well as the bigger records with the small holes (33⅓ RPM)—which were the full albums that had several songs on each side.

But as the intro plays to what I recognize as "Good Times" by the group Chic and I'm drawn into the living room because it's a familiar hit song from the previous summer, I encounter a record on the turntable that defies categorization. Instead of the sweet female lead vocals of that disco smash, I hear something totally different and spot a baby-blue label on the black vinyl record I've never seen before. Even though it's a twelve-inch disc, the size of an album, as I listen to the rhyming words being spoken—"*Singin' on 'n' 'n' on 'n' on / The beat don't stop until the break of dawn / Singin' on 'n' 'n' on 'n' on on 'n' on / Like a hot buttered a pop da pop da pop dibbie dibbie pop da pop pop / Ya don't dare stop*"—it hits me that this entire side is one long song.

Almost fifteen minutes long as it turns out. Or, to be exact, fourteen minutes and thirty-six seconds of pure fun laid over the thumping bass beat from the break of "Good Times" with sing-along words easy to remember and repeat. The record, I discover, is by an unknown group, the Sugarhill Gang, and is called "Rapper's Delight."

From then on, nobody ever has to tell me what rap is. It's whatever words are spoken, chanted, or talk-sung, or whatever philosophies, stories, or ideas are espoused, by the house party Master of Ceremonies.

Passage A: FOUNDATION: B-BOYS, B-GIRLS, AND HIP-HOP CULTURE IN NEW YORK by Schloss (2009) 397w from pp.4-5. By permission of Oxford University Press, USA.

Passage B: "Chapter 1: Walk This Way", copyright © 2011 by Steve Stoute, from THE TANNING OF AMERICA by Steve Stoute, with Mim Eichler Rivas. Used by permission of Gotham Books, an imprint of Penguin Publishing Group, a division of Penguin Random House LLC.

Questions 21–24 ask about Passage A.

21. According to Passage A, one reason elements of hip-hop culture such as b-boying are rarely represented in mass media is that these art forms:

A. have never been brought to the public's attention.
B. are not bought and sold as products.
C. do not appeal to young people.
D. declined in popularity after the 1970s.

22. Based on information in Passage A, it can reasonably be inferred that the term "hip-hop":

F. strictly refers to a form of musical expression.
G. strictly refers to a current form of cultural expression.
H. can refer to more than one form of artistic expression.
J. refers to a commercially unsuccessful cultural phenomenon.

23. As it is used in line 38, the word *sensibilities* most nearly means:

A. emotions.
B. sensitivities.
C. perspectives.
D. feelings of gratitude.

24. Based on Passage A, which statement best captures the relationship between Tin Pan Alley pop music and rap music?

F. Rap artists have rejected every aspect of Tin Pan Alley pop.
G. Rap artists have been aware of Tin Pan Alley pop but not influenced by it.
H. Tin Pan Alley pop developed at the same time as rap.
J. Tin Pan Alley pop has influenced many rap artists.

Questions 25–27 ask about Passage B.

25. Which of the following details does the author of Passage B highlight as one that caused "Rapper's Delight" to stand out as different compared to other songs he knew?

A. The song's intro
B. The length of the song
C. The female vocals
D. The fact that the song was on a vinyl record

26. In the context of Passage B, the main point of the third paragraph (lines 62–76) is that the author was:

F. struck by the combination of new and established musical elements in the music he was hearing.
G. uncomfortable with what he viewed as an unwelcome change to a favorite song.
H. more interested in an unfamiliar album label than in the new music that was playing.
J. convinced that the new form of music he was hearing would become more popular than disco.

27. Based on Passage B, it can reasonably be inferred that the author views his first exposure to rap music as:

A. memorable but ultimately not very important.
B. significant for his childhood but less so for his adulthood.
C. a transformative experience.
D. a disappointing experience.

Questions 28–30 ask about both passages.

28. Compared to Passage A, Passage B focuses more on:

F. early hip-hop's interaction with the marketplace.
G. attempts to move hip-hop art into galleries.
H. the mass media.
J. the author's personal experience.

29. Which of the following elements of Passage B is not included in Passage A?

A. A story involving a particular rap song
B. A discussion of the early days of hip-hop
C. A mention of the New York City area in the context of hip-hop
D. An acknowledgment of rap's interaction with other musical forms

30. The authors of both passages would most likely agree with the idea that early rap music:

F. represented artists' rejection of the music industry and its practices.
G. represented a significant development in American popular culture.
H. was more popular than today's rap music.
J. was slow to find an audience.

Passage IV

NATURAL SCIENCE: This passage is from the article "The Rise and Fall of the Living Fossil" by Ferris Jabr.

The term "living fossil" refers to creatures that had emerged long ago and seemed to have stopped evolving.

Like all living fossils, crocodiles were thought to have emerged in the distant past and then stayed largely unchanged. The standard theory held that the crocodilian species we know today originated in Africa during the Cretaceous (145 to 66 million years ago), when the seven continents were much closer together. As the continents drifted apart, the crocodilians went with them, explaining how they ended up in a band of tropics encircling the globe. If that were true, then modern crocodilian species should be very different from one another at the level of genes and molecules, because there would have been more than enough time for substantial mutations to accumulate. By the 1990s, however, molecular analysis revealed that immune system molecules conserved across living crocodilian species were remarkably similar in structure and behavior.

Intrigued by this puzzle, a post-doctoral research fellow at the University of Washington named Jamie Oaks began collecting DNA samples from all 23 living crocodilian species, comparing sections of the genome where mutations were most likely to have appeared. Although the fossil record had confirmed that ancient crocodilians were more diverse than previously realized, it also demonstrated that, on the whole, crocodilians were not particularly swift evolvers compared to mammals and other vertebrates. Even accounting for this slower-than-average evolution, Oaks did not find nearly as many differences between the modern crocodilian genomes as one would expect had those species diverged all the way back in the Cretaceous. He concluded that modern crocodilian species split from their last common ancestor between 8 and 13 million years ago, not long before ancient hominins split from their last common ancestor with chimpanzees. The living fossil theory of crocodiles had overestimated their evolutionary age by about a factor of 10.

Oaks also noticed something odd about the DNA samples he had acquired from the iconic Nile crocodiles (*Crocodylus niloticus*): they did not match up with each other. In fact, the variation between them was great enough to suggest that he was looking at two distinct species. If so, then not only were modern crocodiles much too young to be living fossils, but they had also continued to speciate after diverging from their basal ancestor—something living fossils are not supposed to do. On its own, Oaks' study was intriguing, but not enough to convince the larger scientific community to cleave the Nile crocodile into two species.

Unbeknownst to him, however, a separate team of scientists was preparing to corroborate his results. In the early 2000s, on an excursion to Chad, the wildlife conservationist Michael Klemens encountered some odd little crocodiles in a desert oasis. They were so docile that he and his companions could swim beside them without concern. He took a tissue sample from one that had recently perished and sent it to the American Museum of Natural History in New York City, where Evon Hekkala, an assistant professor at Fordham University studying crocodilian diversity, sequenced its genome. When she compared the docile croc's DNA to other Nile crocodiles, she noticed some rather striking differences. She found similar reports of tame crocodiles in Mauritania, and she remembered once reading a description by the Greek historian Herodotus of ancient Egyptians using mellow crocodiles in temple rituals. Could these tame crocs be an entirely distinct species?

DNA analysis of 123 African crocodiles—as well as 57 separate samples from museum specimens, including crocodiles mummified in ancient Egypt—confirmed her suspicion. In a few sections of their respective genomes, all the mild-mannered crocs would have one DNA sequence, and all the typical Nile crocs another. They even had different numbers of chromosomes. "That made us very confident that there were actually two different populations and they were not mixing their DNA," Hekkala says. The two different species had diverged between 3 and 6 million years ago: *Crocodylus niloticus* in the East and the smaller, less aggressive *Crocodylus suchus* in the West. The vast majority of mummified crocodiles were *C. suchus*, suggesting that ancient Egyptians had recognized the difference.

Together, Hekkala, Oaks, and other scientists helped redraw the map of how crocodilians evolved in space and time, and conclusively removed them from the category of living fossils.

Ferris Jabr, science writer. Originally published in Nautilus.

31. In the context of the passage, how does the analysis of crocodilian immune system molecules relate to the living fossil theory of crocodilian evolution?

A. The analysis confirms the living fossil theory.
B. The analysis suggests the living fossil theory is accurate.
C. The analysis supports the living fossil theory in some ways and does not support the theory in other ways.
D. The analysis does not support the living fossil theory.

32. Which of the following statements best summarizes Oaks's analysis of Nile crocodiles' DNA as it is presented in the third paragraph (lines 37–48)?

F. It suggested that Nile crocodiles are older than what was previously believed, which does not support the living fossil theory of crocodiles.
G. It suggested that different species of crocodiles do not share a basal ancestor, which the scientific community has confirmed.
H. It suggested that the analysis was hastily done, which prompted the scientific community to ignore it.
J. It suggested that the DNA came from two species, which did not support the living fossil theory of crocodiles.

33. The main purpose of the fifth paragraph (lines 67–82) is to:

A. describe the DNA analysis that confirmed *Crocodylus niloticus* and *Crocodylus suchus* were two distinct species.
B. provide information on the mummification of crocodiles that was pertinent to Hekkala's analysis.
C. explain how Hekkala revolutionized DNA analysis by comparing the DNA of 123 different African crocodiles.
D. introduce the behavioral differences between *Crocodylus niloticus* and *Crocodylus suchus*.

34. As it is used in line 3, the word *standard* most nearly means:

F. accepted.
G. moderate.
H. normal.
J. regulated.

35. According to the passage, molecular analysis revealed that immune system molecules from living crocodilian species were similar in:

A. structure and behavior.
B. color and size.
C. density and age.
D. shape and weight.

36. In the context of the passage, the statement in lines 53–55 mainly serves to:

F. indicate that Klemens and his companions believed that the crocodiles were diseased.
G. establish the tameness of the crocodiles in the desert oasis.
H. suggest that Klemens and his companions suspected they were swimming with *Crocodylus niloticus*.
J. indicate that the crocodiles in the desert oasis had not yet fully matured.

37. According to the passage, after Klemens sent a tissue sample of a perished crocodile to Hekkala, Hekkala then:

A. estimated the crocodile's age.
B. studied the crocodile's immune system.
C. sequenced the crocodile's genome.
D. identified mutations in the crocodile's molecular structure.

38. In the context of the passage, the detail that *Crocodylus niloticus* and *Crocodylus suchus* have different numbers of chromosomes provides support for the claim that the two species:

F. diverged during the Cretaceous.
G. had similar diets.
H. did not evolve from the same ancestor.
J. were not mixing their DNA.

39. According to the passage, *Crocodylus niloticus* and *Crocodylus suchus* diverged between:

A. 1 and 2 million years ago.
B. 3 and 6 million years ago.
C. 8 and 13 million years ago.
D. 66 and 145 million years ago.

40. Based on the passage, the phrase "redraw the map" (line 84) is most likely meant to be read:

F. literally; scientists no longer believed crocodiles originated in Africa.
G. literally; scientists no longer believed crocodiles once lived in a band of tropics.
H. figuratively; scientists amended the narrative of the natural history of crocodiles.
J. figuratively; scientists believe their findings will have broader implications on archaeology.

END OF TEST 3

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

DO NOT RETURN TO A PREVIOUS TEST.

SCIENCE TEST

35 Minutes—40 Questions

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

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

Passage I

A *zero-age main sequence* (ZAMS) star is a star in which the hydrogen nuclei in its core have just begun the process of *fusion* (the combining of light nuclei to form heavier nuclei). The table below shows the mass, *luminosity* (total power output), radius, surface temperature, core temperature, and core density of each of 8 ZAMS stars.

Mass (M_{sun}*)	Luminosity (L_{sun}*)	Radius (R_{sun}*)	Surface temperature ($\times 10^3$ K†)	Core temperature ($\times 10^6$ K†)	Core density (g/cm^3‡)
30	140,000	6.6	44	36	3.0
15	21,000	4.7	32	34	6.2
9	4,500	3.5	26	31	7.9
5	630	2.2	20	27	26
3	93	1.7	14	24	42
1.5	5.4	1.2	8.1	19	95
1.0	0.74	0.87	5.8	14	89
0.5	0.038	0.44	3.9	9.1	78

*Solar units:
1 M_{sun} is the present-day mass of the Sun.
1 L_{sun} is the present-day luminosity of the Sun.
1 R_{sun} is the present-day radius of the Sun.

†kelvins

‡grams per cubic centimeter

Table adapted from H. Kartunnen et al., *Fundamental Astronomy*. ©1994 by Springer-Verlag.

1. The rate at which a ZAMS star fuses hydrogen into helium is directly proportional to the core temperature of that star. Based on the table, is the rate of fusion more likely greater for a 3 M_{sun} ZAMS star or for a 9 M_{sun} ZAMS star?

A. A 3 M_{sun} star, because the core temperature of a 3 M_{sun} star is higher than that of a 9 M_{sun} star.
B. A 3 M_{sun} star, because the core temperature of a 3 M_{sun} star is lower than that of a 9 M_{sun} star.
C. A 9 M_{sun} star, because the core temperature of a 9 M_{sun} star is higher than that of a 3 M_{sun} star.
D. A 9 M_{sun} star, because the core temperature of a 9 M_{sun} star is lower than that of a 3 M_{sun} star.

2. According to the table, as mass increases from 3 M_{sun} to 30 M_{sun}, does radius increase or decrease, and does core density increase or decrease?

	radius	core density
F.	increase	increase
G.	increase	decrease
H.	decrease	increase
J.	decrease	decrease

3. An astronomer observes a ZAMS star with a surface temperature of 27,000 K. Based on the table, this star's luminosity is most likely closest to which of the following values?

A. 100 L_{sun}
B. 700 L_{sun}
C. 5,000 L_{sun}
D. 20,000 L_{sun}

4. Based on the table, what is the approximate temperature difference between the surface of the 30 M_{sun} ZAMS star and the surface of the 1.5 M_{sun} ZAMS star?

F. 17,000 K
G. 36,000 K
H. 52,000 K
J. 55,000 K

5. According to the table, what is the mass of the ZAMS star that has a core temperature closest to 25,000,000 K ?

A. 3 M_{sun}
B. 5 M_{sun}
C. 9 M_{sun}
D. 15 M_{sun}

6. Based on the table, what is the mass of 1 cubic meter (1 m^3) of material in the core of the 1.5 M_{sun} ZAMS star?

(Note: 1 $m^3 = 1 \times 10^6$ cm^3)

F. 6.2×10^3 g
G. 9.5×10^4 g
H. 6.2×10^6 g
J. 9.5×10^7 g

Passage II

Sorghum, rapoko, and millet are 3 crops grown in a particular region. Table 1 shows, for each of 14 growth seasons (Seasons 1–14), the yield of each crop, in metric tons (MT).

Table 1

Season	Yield (MT) for: sorghum	rapoko	millet
1	1,836	2,604	731
2	1,025	1,033	102
3	1,904	2,589	698
4	879	5,190	90
5	1,218	1,942	1,030
6	475	2,135	1,743
7	518	3,340	179
8	1,456	3,583	384
9	926	1,995	307
10	2,250	4,694	276
11	1,403	1,558	746
12	2,186	3,108	640
13	3,674	3,937	163
14	842	1,903	360

The region receives an average rainfall of 600 mm per season. Figure 1 shows, for each of Seasons 1–14, the *rainfall deviation* (amount of rainfall received above or below the average).

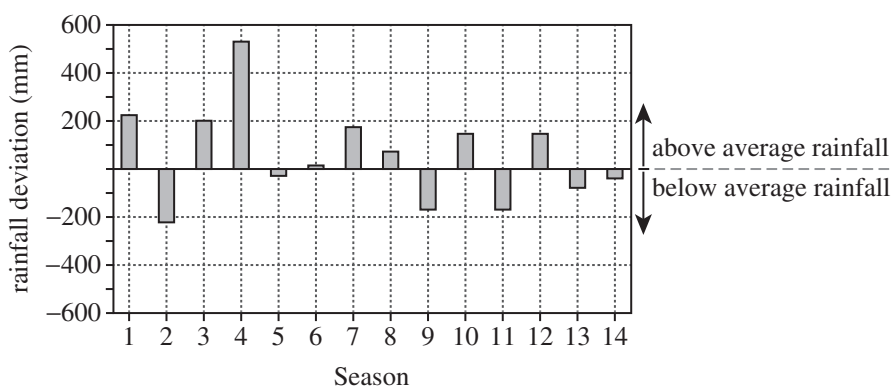


Figure 1

Table and figure adapted from Farai Malvern Simba et al., "Climate Change Scenarios, Perceptions and Crop Production: A Case Study of Semi-Arid Masvingo Province in Zimbabwe." ©2012 by Simba FM, et al.

7. For which growth season was the amount of rainfall received closest to the region's average rainfall per season?

A. Season 5
B. Season 6
C. Season 8
D. Season 14

8. Season 9 and Season 11 had the same amount of rainfall, but Season 9 had more *dry spells* (30 days or more with no rain) than did Season 11. Based on Table 1, did the greater number of dry spells in Season 9 more likely have a positive effect or a negative effect on the yield of sorghum?

F. Positive; for sorghum, the yield for Season 9 was greater than the yield for Season 11.
G. Positive; for sorghum, the yield for Season 11 was greater than the yield for Season 9.
H. Negative; for sorghum, the yield for Season 9 was greater than the yield for Season 11.
J. Negative; for sorghum, the yield for Season 11 was greater than the yield for Season 9.

9. Based on Figure 1 and Table 1, for the growth season with the least amount of rainfall, which of rapoko or millet had the larger yield, and what was the yield for that crop?

A. Rapoko; 1,033 MT
B. Rapoko; 1,903 MT
C. Millet; 102 MT
D. Millet; 640 MT

10. The rainfall deviation in *centimeters* for Season 1 was closest to which of the following values?

F. 0.225 cm
G. 2.25 cm
H. 22.5 cm
J. 2,250 cm

11. Does Figure 1 show the variation in an abiotic factor or a biotic factor in the region?

A. Abiotic; the crops grown in a region are a living factor in an ecosystem.
B. Abiotic; the amount of rainfall is a nonliving factor in an ecosystem.
C. Biotic; the crops grown in a region are a living factor in an ecosystem.
D. Biotic; the amount of rainfall is a nonliving factor in an ecosystem.

12. Suppose a *wet season* is any growth season in which there is at least 900 mm of rainfall. Given the region's average rainfall and the data in Figure 1, how many of the growth seasons, if any, would have been wet seasons?

F. 0
G. 1
H. 6
J. 8

Passage III

Two studies examined how the concentration of Drug M in water affects the accumulation of Drug M in the bodies of a species of *planarian* (a freshwater flatworm) and the swimming speed of those planarians.

Study 1

Each of 24 dishes was prepared as follows: First, 20 mL of a 0.05 mg/L aqueous solution of Drug M was added to the dish. Next, a single 0.04 g planarian was placed in the dish. Finally, the dish was covered with a lid. The dishes were then divided equally into 4 groups.

Each group was incubated at 20°C for a different period of time. At the end of a group's incubation period, a 1-microgram (μg) tissue sample was collected from each planarian in the group. The average *biologic Drug M level* (BML, micrograms of Drug M per gram of tissue) was determined for each group.

These procedures were repeated for a 0.20 mg/L and for a 0.50 mg/L aqueous solution of Drug M (see Figure 1).

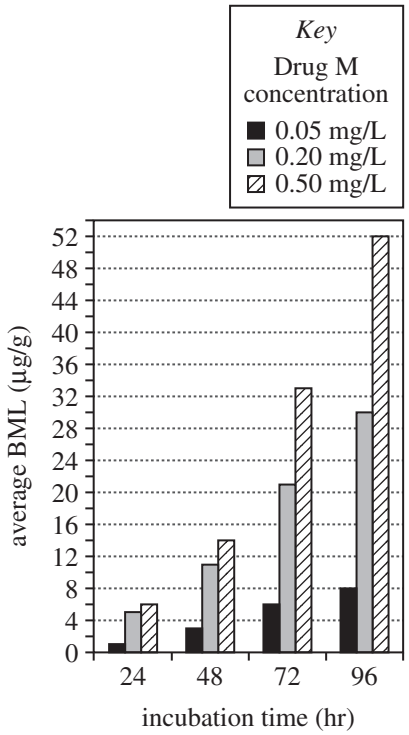


Figure 1

Study 2

Twelve dishes were prepared using the 0.05 mg/L aqueous solution of Drug M, as in Study 1, and were divided equally into 4 groups.

Each group was incubated at 25°C for a different period of time. At the end of a group's incubation period, each dish in the group was placed on top of a piece of graph paper. The total number of gridlines crossed by each planarian during a 4 min observation period was recorded. The average *swimming speed* (the number of gridlines crossed per minute) was then determined for each group.

These procedures were repeated for a 0.20 mg/L and for a 1.80 mg/L aqueous solution of Drug M (see Figure 2).

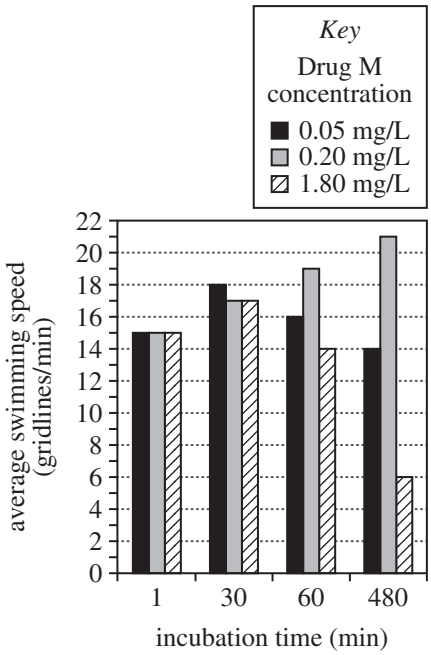


Figure 2

Figures adapted from Michelle Plusquin, et al., "Physiological and Molecular Characterization of Cadmium Stress in *Schmidtea mediterranea*." ©2012 by UBC Press.

13. Based on Figure 1, if an incubation time of 60 hr had been tested in Study 1, the average BML for the planarians incubated in the 0.20 mg/L aqueous solution of Drug M would most likely have been:

A. less than 6 μg/g.
B. between 6 μg/g and 11 μg/g.
C. between 11 μg/g and 21 μg/g.
D. greater than 21 μg/g.

14. A student hypothesized that, as the concentration of Drug M in the solutions increased, the average BML of the planarians would increase only. The results for how many of the incubation times tested in Study 1 are consistent with this hypothesis?

F. 0
G. 1
H. 3
J. 4

15. Suppose that for planarians, swimming speed is directly proportional to the concentration of a particular protein in the body tissues. Based on the results of Study 2, for the 0.20 mg/L aqueous solution of Drug M, which of the incubation times tested would most likely result in the greatest average concentration of this protein in the body tissues of the planarians?

A. 1 min
B. 30 min
C. 60 min
D. 480 min

16. Which of the following statements about the effect of a Drug M concentration of either 0.05 mg/L or 1.80 mg/L on average swimming speed is consistent with the results of Study 2 ? As incubation time increased from 1 min through 480 min, for the planarians in a solution having a Drug M concentration of:

F. 0.05 mg/L, the average swimming speed increased only.
G. 0.05 mg/L, the average swimming speed decreased only.
H. 1.80 mg/L, the average swimming speed increased and then decreased.
J. 1.80 mg/L, the average swimming speed decreased and then increased.

17. Which of the following statements comparing the designs of the 2 studies is accurate?

A. A greater number of incubation times was tested in Study 2 than in Study 1.
B. A Drug M concentration of 1.80 mg/L was tested in both studies.
C. More time was required to complete Study 1 than to complete Study 2.
D. In both studies, there were 6 planarians per group.

18. In which of Studies 1 and 2, if either, was the incubation temperature varied from group to group?

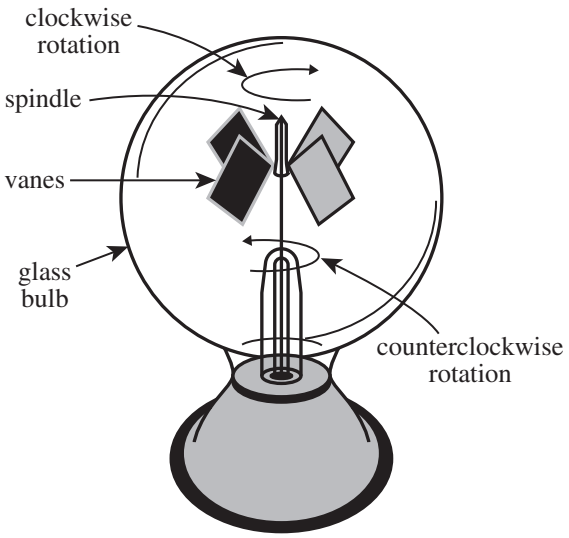
F. Study 1 only
G. Study 2 only
H. Both Study 1 and Study 2
J. Neither Study 1 nor Study 2

19. Consider the samples that were collected from the organisms in Study 1. Do the cells in these samples have nuclei, and do these cells have ribosomes?

	nuclei	ribosomes
A.	yes	yes
B.	yes	no
C.	no	yes
D.	no	no

Passage IV

A *Crooke's radiometer* (CR) is a sealed glass bulb, from which most of the air has been removed, that contains 4 metal vanes mounted on a spindle. The same side of each vane is painted black, and the other is silver. See the diagram.



diagram

When a CR is placed in light, the vanes rotate. For the CR shown in the diagram, four students each provided an explanation for the rotation and predicted the direction—clockwise or counterclockwise—the vanes would rotate.

Student 1

Photons (particles of light) exert a greater force when they are absorbed by a material than when they are reflected by a material. This force is weaker than air resistance, so it can cause rotation only when enough of the air has been removed from the bulb. Photons are absorbed only by the black side of each vane, exerting a stronger force on that side that causes the vanes to rotate clockwise. The brighter the light in which the CR is placed, the more photons are absorbed by the black sides and the faster the vanes rotate.

Student 2

Student 1 is correct except that photons exert a greater force when they are reflected by a material than when they are absorbed by a material. Photons are reflected only by the silver side of each vane, exerting a force that causes the vanes to rotate counterclockwise.

Student 3

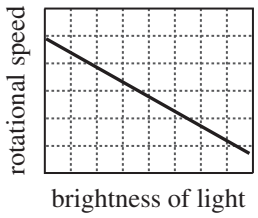
The forces exerted by photons are too weak to cause rotation of the vanes, even when most of the air has been removed. Instead, photons absorbed by the black side of a vane cause that side to heat up, warming the air molecules in contact with it. Air molecules move from the cooler silver side to the warmer black side. This produces a greater air pressure on the black side and, thus, causes the vanes to rotate clockwise. The brighter the light in which the CR is placed, the greater the temperature difference between the 2 sides of a vane and the faster the vanes rotate.

Student 4

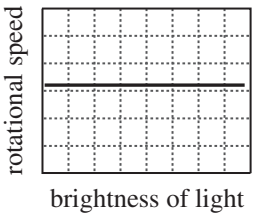
Student 3 is correct except that the air molecules move from the warmer black side to the cooler silver side, producing a greater air pressure on the silver side. This causes the vanes to rotate counterclockwise.

20. Based on the explanation given by Student 1, which of the following plots best shows the predicted relationship between the brightness of light and the rotational speed of the CR vanes?

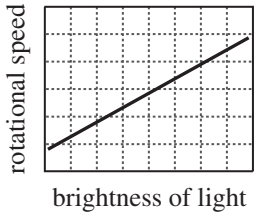
F.



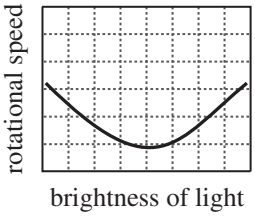
H.



G.



J.



21. Regardless of which student might be correct, for the CR to function as described, which of the following statements about the glass that composes the bulb of the CR must be accurate? The glass must be able to:

A. prevent light from entering.
B. allow light to enter.
C. prevent heat from entering.
D. allow heat to enter.

22. In the process of *thermal transpiration*, gas molecules move from a cooler area to a warmer area. Is thermal transpiration more likely occurring in the process described by Student 3 or in the process described by Student 4 ?

F. Student 3; that student predicted that air molecules would move from the cooler silver side to the warmer black side.
G. Student 3; that student predicted that air molecules would move from the cooler black side to the warmer silver side.
H. Student 4; that student predicted that air molecules would move from the cooler silver side to the warmer black side.
J. Student 4; that student predicted that air molecules would move from the cooler black side to the warmer silver side.

23. Suppose the set of vanes in the CR shown in the diagram has a mass of m. Further suppose the students obtain a CR that is identical to the one shown in the diagram except that the set of vanes has a mass of $10m$. If both CRs are placed in the same light, which set of vanes is more likely to rotate faster? The set with a mass of:

A. m; the set with less mass would be easier to rotate.
B. m; the set with less mass would be more difficult to rotate.
C. $10m$; the set with more mass would be easier to rotate.
D. $10m$; the set with more mass would be more difficult to rotate.

24. Suppose that the silver sides of the vanes in the CR shown in the diagram had been painted white instead. Further suppose that when placed in light the vanes of this CR still rotated. Would this finding be consistent with the explanation given by Student 3 ?

F. Yes; the black side of each vane was likely warmer than the white side, so the vanes should still have rotated.
G. Yes; the black side of each vane was likely cooler than the white side, so the vanes should still have rotated.
H. No; the black side of each vane was likely warmer than the white side, so the vanes should not have rotated.
J. No; the black side of each vane was likely cooler than the white side, so the vanes should not have rotated.

25. Suppose that, when a photon is reflected by a surface, it exerts twice as much force as when it is absorbed by a surface. This information is consistent with the explanation given by which student: Student 1 or Student 2 ?

A. Student 1; that student stated that a greater force is exerted on the black sides of the vanes.
B. Student 1; that student stated that a greater force is exerted on the silver sides of the vanes.
C. Student 2; that student stated that a greater force is exerted on the black sides of the vanes.
D. Student 2; that student stated that a greater force is exerted on the silver sides of the vanes.

26. Consider the statement "The brighter the light in which a CR is placed, the greater the kinetic energy of its vanes." This statement is consistent with the explanations given by which students?

F. Students 1 and 2 only
G. Students 3 and 4 only
H. Students 1, 3, and 4 only
J. Students 1, 2, 3, and 4

Passage V

The amount of heat, in joules (J), needed to raise the temperature of 1 g of a substance by 1°C is the *specific heat* (C_p) of the substance. In an experiment, students determined the C_p of 5 metals: aluminum (Al), copper (Cu), lead (Pb), antimony (Sb), and tin (Sn).

Experiment

The students performed 5 trials for each of the metals. In each trial, the students performed the following steps:

1. A 50.0 mL volume of H_2O was placed in a beaker, and then the beaker was placed in an ice water bath for 5 min.
2. While the H_2O was cooling, a fresh 100.0 g sample of room-temperature pellets of the metal was measured out.
3. The beaker was removed from the ice water bath. A temperature probe that recorded the temperature every 0.5 s was inserted into the beaker. Then the H_2O in the beaker was stirred for 100 s.
4. The metal sample from Step 2 was then added to the beaker while the contents of the beaker were stirred. The H_2O and metal were stirred for 120 s more while the temperature probe continued recording the temperature every 0.5 s.
5. The recorded temperatures were used to calculate, for the moment the metal sample was added to the beaker, the temperature change of the H_2O (ΔT_w) and the corresponding temperature change of the metal sample (ΔT_m).

For each metal, the students calculated the average ΔT_w and the average ΔT_m and then used those values in calculating an average C_p value. The table lists, for each metal, the atomic number, the average experimental C_p value, and the accepted C_p value.

Metal	Atomic number	C_p (J/g•°C)	
		Average experimental	Accepted
Al	13	0.913	0.904
Cu	29	0.388	0.384
Pb	82	0.119	0.127
Sb	51	0.205	0.207
Sn	50	0.217	0.217

Table adapted from Roger Barth and Michael J. Moran, "Improved Method for Determining the Heat Capacity of Metals." ©2014 by American Chemical Society and Division of Chemical Education, Inc.

27. What is the order of Pb, Sb, and Sn from the substance with the smallest accepted C_p to the substance with the greatest accepted C_p ?

A. Sb, Pb, Sn
B. Sb, Sn, Pb
C. Pb, Sb, Sn
D. Pb, Sn, Sb

28. How many protons are in an atom of the metal that had an average experimental C_p of 0.217 J/g•°C ?

F. 13
G. 25
H. 50
J. 100

29. Which of the metals tested in the experiment had the greatest absolute difference between the average experimental C_p and the accepted C_p ?

A. Al
B. Sb
C. Cu
D. Pb

30. Based on the results of the experiment and additional information from the passage, did the greatest average ΔT_w value more likely result from the trials performed with Al or from the trials performed with Pb ?

F. Al; the metal with the greatest C_p value would have released the most heat, thereby causing the temperature of the water to change the most.
G. Al; the metal with the smallest C_p value would have released the most heat, thereby causing the temperature of the water to change the most.
H. Pb; the metal with the greatest C_p value would have released the most heat, thereby causing the temperature of the water to change the most.
J. Pb; the metal with the smallest C_p value would have released the most heat, thereby causing the temperature of the water to change the most.

31. For the 5 metals tested in the experiment, as the atomic number increased, the average experimental C_p:

A. increased only.
B. decreased only.
C. increased and then decreased.
D. decreased and then increased.

32. Based on the results of the experiment, the percent error for the specific heat of Cu is best calculated using which of the following expressions?

F. $\frac{|0.388 - 0.384|}{0.384} \times 100\%$

G. $\frac{|0.388 - 0.384|}{0.388} \times 100\%$

H. $\frac{0.384}{|0.388 - 0.384|} \times 100\%$

J. $\frac{0.388}{|0.388 - 0.384|} \times 100\%$

33. Based on the experimental procedures, in each trial, a total of approximately how many temperature values were recorded?

A. 120
B. 220
C. 240
D. 440

Passage VI

Water that has a pH less than 5.5 after it has flowed through a coal mine is classified as *acid mine drainage* (AMD). AMD is produced when groundwater flowing through the mine interacts with iron disulfide (FeS_2) in the rocks. When FeS_2 dissolves in water, sulfate ions (SO_4^{2-}) are formed. These ions contribute to the low pH of AMD.

Coal combustion products (CCPs), such as the ash left after coal is burned, can be mixed with water to produce *CCP grout* (a substance similar to plaster). After a coal mine is abandoned, the CCP grout can be injected into the mine, where it hardens, coating all the exposed surfaces and preventing the groundwater from coming into contact with the rocks. A 5-year study was done to examine the effects of injecting CCP grout into an abandoned coal mine.

Study

On January 1, 1995, 3 water samples were collected at the location where the groundwater first entered the mine. The samples were analyzed for SO_4^{2-} (in milligrams per liter, mg/L), and the pH of each sample was determined. The averaged results are shown in Table 1.

Table 1	
average SO_4^{2-} (mg/L)	average pH
22.6	6.1

On January 1, 1995, and every 6 months after that, 3 water samples were collected at the location where the groundwater flowed out of the mine. On August 1, 1996, a volume of CCP grout sufficient to cover all exposed rock surfaces was injected into the mine. The average SO_4^{2-} content and pH of the groundwater samples over the 5-year period are shown in Figures 1 and 2, respectively.

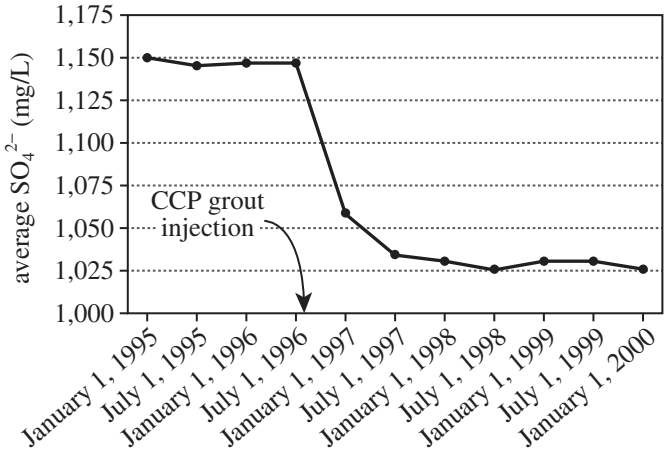


Figure 1

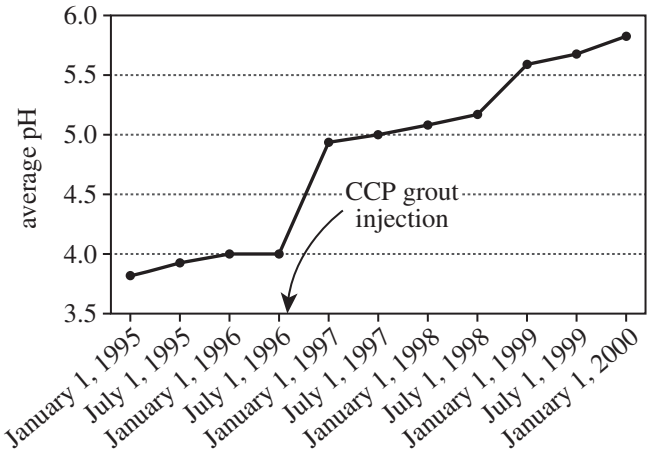


Figure 2

Figures adapted from Robin Lee, Leonard Rafalko, and Joseph Giacinto, "10-Year Update on the Winding Ridge Project." ©2008 by the Maryland Department of Natural Resources.

34. According to the results of the study, did the injection of CCP grout reduce the SO_4^{2-} content of the groundwater flowing out of the mine?

F. Yes; SO_4^{2-} content was much lower on January 1, 1996, than it was on July 1, 1995.
G. Yes; SO_4^{2-} content was much lower on January 1, 1997, than it was on July 1, 1996.
H. No; SO_4^{2-} content was much higher on January 1, 1996, than it was on July 1, 1995.
J. No; SO_4^{2-} content was much higher on January 1, 1997, than it was on July 1, 1996.

35. How many months after the injection of the CCP grout was the next set of water samples collected?

A. 2
B. 3
C. 4
D. 5

36. Consider the description of the chemical interaction that forms ions found in AMD. Which of FeS_2, H_2O, and SO_4^{2-} would be considered a reactant, and which of FeS_2, H_2O, and SO_4^{2-} would be considered a product, in this interaction?

	reactant(s)	product(s)
F.	FeS_2	SO_4^{2-} and H_2O
G.	FeS_2 and H_2O	SO_4^{2-}
H.	SO_4^{2-}	FeS_2 and H_2O
J.	SO_4^{2-} and H_2O	FeS_2

37. Which of the following statements best summarizes the intended role of CCP grout in the coal-mining industry?

A. To decrease the interactions between groundwater and rock exposed by mining
B. To increase the interactions between groundwater and rock exposed by mining
C. To prevent any groundwater from entering a mine
D. To prevent any groundwater from exiting a mine

38. Which of the following was a dependent variable in the study?

F. Time
G. Volume of groundwater
H. SO_4^{2-} content
J. Number of water samples

39. If the CCP grout injection had occurred on August 1, 1997, instead of on August 1, 1996, the pH of the groundwater flowing out of the mine on July 1, 1997, would most likely have been closest to which of the following?

A. 4.0
B. 4.5
C. 5.0
D. 5.5

40. According to the description and results of the study, before August 1, 1996, how many samples were collected at the location where groundwater flowed out of the mine?

F. 4
G. 8
H. 10
J. 12

END OF TEST 4

STOP! DO NOT RETURN TO ANY OTHER TEST.

Scoring Keys for Form F12

Use the scoring key for each test to score your answer document for the multiple-choice tests. Mark a "1" in the blank for each question you answered correctly. Add up the numbers in each reporting category and enter the total number correct for each reporting category in the blanks provided. Also enter the total number correct for each test in the blanks provided. The total number correct for each test is the sum of the number correct in each reporting category.

Test 1: English—Scoring Key

		Reporting Category*		
	Key	POW	KLA	CSE
1.	D			___
2.	F			___
3.	B			___
4.	H	___		
5.	D		___	
6.	F	___		
7.	B			___
8.	F			___
9.	C			___
10.	G	___		
11.	A		___	
12.	F			___
13.	B	___		
14.	H	___		
15.	D	___		
16.	H			___
17.	A			___
18.	F		___	
19.	D		___	
20.	F			___
21.	B	___		
22.	J			___
23.	C			___
24.	H	___		
25.	A		___	
26.	F			___
27.	B			___
28.	J			___
29.	C	___		
30.	H	___		
31.	B			___
32.	H	___		
33.	B			___
34.	J	___		
35.	A			___
36.	J		___	
37.	B			___
38.	J		___	

		Reporting Category*		
	Key	POW	KLA	CSE
39.	D	___		
40.	H			___
41.	A	___		
42.	G			___
43.	A			___
44.	F			___
45.	C	___		
46.	G	___		
47.	A			___
48.	G			___
49.	D			___
50.	J		___	
51.	C		___	
52.	J			___
53.	A	___		
54.	G			___
55.	D			___
56.	H	___		
57.	C			___
58.	H			___
59.	D			___
60.	H	___		
61.	B			___
62.	J		___	
63.	A	___		
64.	F			___
65.	C		___	
66.	J			___
67.	A			___
68.	G			___
69.	A			___
70.	J			___
71.	B			___
72.	G	___		
73.	D		___	
74.	J	___		
75.	A	___		

***Reporting Categories**
POW = Production of Writing
KLA = Knowledge of Language
CSE = Conventions of Standard English

Number Correct (Raw Score) for:

Production of Writing (POW) _____ (23)

Knowledge of Language (KLA) _____ (12)

Conventions of Standard English (CSE) _____ (40)

Total Number Correct for English Test (POW + KLA + CSE) _____ (75)

Test 2: Mathematics—Scoring Key

		Reporting Category*						
		PHM						
	Key	N	A	F	G	S	IES	MDL
1.	B					___		
2.	G						___	
3.	A						___	
4.	H						___	___
5.	C				___			
6.	J		___					
7.	D						___	
8.	H						___	___
9.	C						___	
10.	K						___	___
11.	D						___	
12.	J			___				___
13.	A						___	___
14.	G						___	
15.	C			___				
16.	H		___					
17.	E	___						
18.	K				___			
19.	D		___					
20.	J						___	___
21.	E						___	___
22.	K				___			
23.	C	___						___
24.	F					___		
25.	C					___		___
26.	J			___				
27.	B					___		___
28.	J					___		___
29.	E						___	___
30.	F						___	

		Reporting Category*						
		PHM						
	Key	N	A	F	G	S	IES	MDL
31.	B	___						
32.	H				___			___
33.	C						___	
34.	K		___					
35.	B		___					___
36.	H						___	
37.	D						___	___
38.	J	___						
39.	B						___	
40.	K			___				
41.	C	___						
42.	K			___				
43.	A		___					
44.	H		___					___
45.	A						___	
46.	K				___			
47.	A						___	
48.	K				___			
49.	C			___				
50.	K				___			
51.	A						___	
52.	H						___	___
53.	A					___		___
54.	J			___				
55.	B						___	___
56.	K				___			
57.	D						___	
58.	K		___					
59.	E			___				
60.	G						___	

Combine the totals of these columns and put in the blank for PHM in the box below.

***Reporting Categories**

PHM = Preparing for Higher Math
- N = Number & Quantity
- A = Algebra
- F = Functions
- G = Geometry
- S = Statistics & Probability

IES = Integrating Essential Skills

MDL = Modeling

Number Correct (Raw Score) for:

Preparing for Higher Math (PHM) (N + A + F + G + S)	_____	(35)
Integrating Essential Skills (IES)	_____	(25)
Total Number Correct for Mathematics Test (PHM + IES)	_____	(60)
Modeling (MDL) (Not included in total number correct for mathematics test raw score)	_____	(19)

Test 3: Reading—Scoring Key

	Key	Reporting Category* KID	CS	IKI
1.	D		___	
2.	H	___		
3.	A	___		
4.	J	___		
5.	C	___		
6.	G	___		
7.	A	___		
8.	F	___		
9.	A	___		
10.	G	___		
11.	D		___	
12.	G	___		
13.	C	___		
14.	G		___	
15.	D		___	
16.	H	___		
17.	C	___		
18.	J	___		
19.	C		___	
20.	F		___	

	Key	Reporting Category* KID	CS	IKI
21.	B	___		
22.	H	___		
23.	C		___	
24.	J	___		
25.	B	___		
26.	F	___		
27.	C	___		
28.	J			___
29.	A			___
30.	G			___
31.	D			___
32.	J	___		
33.	A		___	
34.	F		___	
35.	A	___		
36.	G		___	
37.	C	___		
38.	J			___
39.	B	___		
40.	H		___	

***Reporting Categories**
KID = Key Ideas & Details
CS = Craft & Structure
IKI = Integration of Knowledge & Ideas

Number Correct (Raw Score) for:

Key Ideas & Details (KID)	_____	(24)
Craft & Structure (CS)	_____	(11)
Integration of Knowledge & Ideas (IKI)	_____	(5)
Total Number Correct for Reading Test (KID + CS + IKI)	_____	(40)

Test 4: Science—Scoring Key

	Key	Reporting Category* IOD	SIN	EMI
1.	C	___		
2.	G	___		
3.	C	___		
4.	G	___		
5.	A	___		
6.	J	___		
7.	B	___		
8.	J			___
9.	A	___		
10.	H	___		
11.	B	___		
12.	G	___		
13.	C		___	
14.	J			___
15.	D		___	
16.	H			___
17.	C		___	
18.	J		___	
19.	A	___		
20.	G	___		

	Key	Reporting Category* IOD	SIN	EMI
21.	B		___	
22.	F			___
23.	A			___
24.	F			___
25.	D			___
26.	J			___
27.	C	___		
28.	H	___		
29.	A	___		
30.	F			___
31.	B	___		
32.	F	___		
33.	D		___	
34.	G			___
35.	D		___	
36.	G			___
37.	A		___	
38.	H		___	
39.	A			___
40.	J		___	

***Reporting Categories**
IOD = Interpretation of Data
SIN = Scientific Investigation
EMI = Evaluation of Models, Inferences & Experimental Results

Number Correct (Raw Score) for:

Interpretation of Data (IOD)	_____	(18)
Scientific Investigation (SIN)	_____	(10)
Evaluation of Models, Inferences & Experimental Results (EMI)	_____	(12)
Total Number Correct for Science Test (IOD + SIN + EMI)	_____	(40)

Explanation of Procedures Used to Obtain Scale Scores from Raw Scores

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

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

ACT Test F12	Your Scale Score
English	_____
Mathematics	_____
Reading	_____
Science	_____
Sum of scores	_____
Composite score (sum ÷ 4)	_____

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

Scale Score	Raw Scores				Scale Score
	Test 1 English	Test 2 Mathematics	Test 3 Reading	Test 4 Science	
36	75	59-60	38-40	39-40	**36**
35	72-74	56-58	37	38	**35**
34	71	55	—	37	**34**
33	70	54	36	36	**33**
32	69	53	35	—	**32**
31	—	52	34	35	**31**
30	68	50-51	—	34	**30**
29	67	49	33	33	**29**
28	66	47-48	32	—	**28**
27	65	45-46	31	32	**27**
26	63-64	42-44	30	31	**26**
25	61-62	40-41	29	29-30	**25**
24	58-60	38-39	28	27-28	**24**
23	55-57	36-37	26-27	25-26	**23**
22	52-54	34-35	25	23-24	**22**
21	49-51	33	23-24	22	**21**
20	46-48	31-32	22	20-21	**20**
19	43-45	29-30	20-21	18-19	**19**
18	41-42	26-28	19	16-17	**18**
17	39-40	23-25	18	14-15	**17**
16	36-38	18-22	16-17	13	**16**
15	33-35	14-17	15	11-12	**15**
14	30-32	11-13	13-14	10	**14**
13	27-29	8-10	12	9	**13**
12	25-26	7	10-11	8	**12**
11	21-24	5-6	8-9	7	**11**
10	17-20	4	7	6	**10**
9	14-16	—	6	5	**9**
8	12-13	3	5	4	**8**
7	10-11	—	4	—	**7**
6	8-9	2	—	3	**6**
5	6-7	—	3	2	**5**
4	5	1	2	—	**4**
3	3-4	—	—	1	**3**
2	2	—	1	—	**2**
1	0-1	0	0	0	**1**

ACT Resource Links

ACT Online Practice Tests: https://www.crackab.com/act/

※ **ACT English Practice Tests:**

https://www.crackab.com/act/english/

https://www.actexam.net/act/english/

※ **ACT Math Practice Tests:**

https://www.crackab.com/act/math/

https://www.actexam.net/act/math/

※ **ACT Reading Practice Tests:**

https://www.crackab.com/act/reading/

https://www.actexam.net/act/reading/

※ **ACT Science Practice Tests:**

https://www.crackab.com/act/science/

https://www.actexam.net/act/science/

ACT Grammar: **https://www.crackab.com/act/grammar/**

ACT Real Past Papers Download:

https://www.crackab.com/act-downloads/

https://www.actexam.net/act-downloads/

More ACT Practice Tests Online:

https://www.actexam.net

https://www.crackab.com

Digital SAT & New SAT Practice Tests:

https://www.cracksat.net

https://www.satpanda.com

Real SAT Tests Download:

http://www.cracksat.net/sat-downloads/

AP Exams Practice Tests:

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