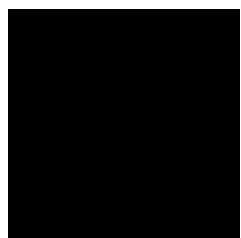# Form H11

(September 2024)

The ACT® 2024 | 2025

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.

ACT owns the test questions and responses, and you may not share them with anyone in any form.

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.**

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

A House Finds a New Home

After over 120 years in one place, a three-story,
    1
forty-five-ton house in Iowa City, Iowa, changed its
    1
address. Built in the 1890s, the ornate, asymmetrically
shaped Queen Anne–style house, known as the Houser-
Metzger house in honor of early owners, and slated for
    2
demolition in 2016 to allow for new construction. But,
earlier that year, a house on a row of historic homes just a
few blocks away had to be torn down due to storm damage.
Preservationists' plans to move the Houser-Metzger house
to the gaping, newly empty lot came together quickly.

Preparation for the move began in March at
the empty lot, starting with builders pouring a new
    3
concrete foundation. Meanwhile, volunteers prepared the

Houser-Metzger house, which weighs forty-five tons. The
    4
furnace and water heater were salvaged from the basement.

1. **A.** NO CHANGE
   B. place, a three-story, forty-five-ton,
   C. place a three-story, forty-five-ton,
   D. place a three-story, forty-five-ton

2. **F.** NO CHANGE
   G. marked as
   H. had been
   J. DELETE the underlined portion.

3. **A.** NO CHANGE
   B. it started with builders pouring
   C. builders started by pouring
   D. to start, builders poured

4. **F.** NO CHANGE
   G. house, which stands three stories tall.
   H. house, in Iowa City, Iowa.
   J. house.

GO ON TO THE NEXT PAGE.

The antique fireplace and mantel were pulled out

with some damage to the surrounding tilework. The
                                                5
original porch columns and decorative railings were

carefully taken down and packed.

As scheduled, the house movers arrived in April,
        6
their first step was to break open the house's foundation,

allowing them to wedge a huge dolly under the building.

Next, the movers inserted steel supporting beams to
7

create a temporary—and moveable platform—which they
            8

attached to their truck. When driven forward, the truck
                                9
slowly pulled the house off its foundation. The truck
                              9

inched its way ahead with the house as its' cargo. Utility
                                          10
workers disconnected power lines to make way for the

freight as the towering, elegant house moved down city

blocks like a stately ship coasting over calm water.
                                              11

While crowds at the Houser-Metzger house's new
                                    12
address on foot tracked the house's two-hour-long journey,
12
a construction crew was waiting. The crew helped the

movers to back the house squarely onto its new foundation,

a task that took twice as long as the move itself.

5. Given that all the choices are accurate, which one provides information that most clearly emphasizes the goal of preserving and relocating the house?
   A. NO CHANGE
   B. like the many fireplaces for sale in the city's architectural salvage warehouse.
   C. and carried to the yard in front of the house.
   D. to be reinstalled at the new location.

6. F. NO CHANGE
   G. Driving in from a nearby town, the
   H. When the
   J. The

7. A. NO CHANGE
   B. The dolly having been wedged under the building,
   C. Then in this process here,
   D. Following the first step,

8. F. NO CHANGE
   G. temporary—and moveable—platform,
   H. temporary, and moveable platform
   J. temporary and moveable, platform

9. Given that all the choices are accurate, which one best links the preceding sentence to the information that follows in this paragraph?
   A. NO CHANGE
   B. The house's old foundation was now crumbling due to the preparation of the platform.
   C. The same truck had been used to move a barn and an all-glass greenhouse.
   D. The moving team consisted of only four workers.

10. F. NO CHANGE
    G. hauled as it's
    H. being its'
    J. as its

11. Which choice best reinforces the image of the house as towering and elegant and makes clear that the move was going smoothly?
    A. NO CHANGE
    B. like a gigantic monstrosity interrupting the typically peaceful scene on the street.
    C. like an ancient castle that looked like it would topple over in the lightest breeze.
    D. as if it were just another car in traffic.

12. The best placement for the underlined portion would be:
    F. where it is now.
    G. after the word *While*.
    H. after the word *journey* (and before the comma).
    J. after the word *waiting* (and before the period).

[13] At the end of the long day, preservationists and passersby alike marveled at the impossible sight: a new-old house stood soundly where there had been

only an empty lot, therefore, the day before.
                              14

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

> During this process, many people who had watched the house's journey became bored and left.

Should the writer make this addition here?

A. Yes, because it presents a drawback of the methods used by the house movers.
B. Yes, because it makes clear that the house move was a difficult task to complete.
C. No, because it detracts from the essay's positive portrayal of the house move.
D. No, because it argues that the house movers were unsuccessful with their task.

14. F. NO CHANGE
G. lot, subsequently,
H. lot, likewise,
J. lot

Question 15 asks about the preceding passage as a whole.

15. Suppose the writer's primary purpose had been to describe a project in which several groups of people had to work together to achieve success. Would this essay accomplish that purpose?

A. Yes, because it outlines how preservationists convinced several groups to join a particular cause.
B. Yes, because it explains a house move primarily through describing the work of various groups along the way.
C. No, because it instead argues for the value of preserving old buildings through a description of one house's significance to a community.
D. No, because it instead focuses on the technical aspects of preparing an empty lot for a new house.

PASSAGE II

Glow-in-the-Dark Mushrooms

[1]

Deep in the coconut forests of Brazil, *Neonothopanus gardneri*—known to locals as "flor-de-coco"—glows more brightly than any other known species of bioluminescent mushroom. On a moonless
                                                        16

night, the green light the mushrooms elicit is the only
                                        17
observable light in the forest aside from firefly light.

16. F. NO CHANGE
G. Coincidentally, on
H. Nevertheless, on
J. However, on

17. A. NO CHANGE
B. evoke
C. emit
D. eject

Scientists have known about *N. gardneri* for years; it was first classified in 1840. Only recently, though, have they uncovered the evolutionary reason that the fungus's glow.
18

[2]

[1] Wanting to learn more about the mushroom's glow, he and a team of scientists studied *N. gardneri* in its natural habitat. [2] The team discovered that instead of producing light constantly, the mushroom produces light mainly at night. [3] Its circadian rhythm controls the timing of its glow. [4] Jay Dunlap, whose a geneticist
19
and molecular biologist at Dartmouth College, was

particularly interested in *N. gardneri* because the
20

intensity of its light. 21

[3]

An organism's circadian rhythm is synchronized with cycles in the external environment, such as light-dark cycles or temperature cycles. Discovering that *N. gardneri*'s glow is regulated rather than constant led Dunlap and his team to suspect that the glow serves
22

an adaptive function. In some way, they reasoned,
23
the species benefits from glowing at night.

18. **F.** NO CHANGE
G. why
H. for
J. DELETE the underlined portion.

19. **A.** NO CHANGE
B. whom is
C. him
D. DELETE the underlined portion.

20. **F.** NO CHANGE
G. as the result from
H. resulting from
J. because of

21. For the sake of logic and cohesion, Sentence 4 should be placed:
A. where it is now.
B. before Sentence 1.
C. after Sentence 1.
D. after Sentence 2.

22. Which choice makes most clear that at this point in the study of *N. gardneri*, the team had not yet proved that the mushroom's glow serves an adaptive function?
F. NO CHANGE
G. demonstrate
H. ascertain
J. verify

23. **A.** NO CHANGE
B. way they reasoned—
C. way—they reasoned
D. way they reasoned,

[4]

[A] To investigate this theory, the scientists created artificial mushrooms out of acrylic resin. They put green LEDs inside some of the phony mock-ups
24

to simulate *N. gardneri*'s glow, they left the rest unlit.
25
[B] Then each of the synthetic mushrooms was covered with potent glue and positioned in the forest.

[5]

Over the course of five nights, the LED mushrooms "caught" a larger number of flies, beetles, and ants then did there unlit counterparts. [C] Dunlap and
26

his team concluded that *N. gardneri*'s bright nocturnal
27

glow helps ensure the proliferation of the species.
28

Alerted by the light, insects land on *N. gardneri*, taking
29
the mushroom's spores with them when they leave and spreading those spores throughout the forest. [D]

24. **F.** NO CHANGE
    G. duped fakes
    H. simulations
    J. replicas

25. **A.** NO CHANGE
    B. glow and they left
    C. glow and left
    D. glow leaving

26. **F.** NO CHANGE
    G. than did there
    H. than did their
    J. then did their

27. **A.** NO CHANGE
    B. that, as it pertains to bioluminescence,
    C. that once night has fallen,
    D. that when it's dark out,

28. **F.** NO CHANGE
    G. by helping ensure
    H. helping to ensure
    J. helps ensuring

29. Which choice most clearly indicates that *N. gardneri*'s glow entices insects?
    A. NO CHANGE
    B. Lured
    C. Vexed
    D. Petitioned

Question 30 asks about the preceding passage as a whole.

---

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

    > A total of forty-two insects were captured on the lighted mushrooms; twelve were captured on the control mushrooms.

    If the writer were to add this sentence, it would most logically be placed at:
    F. Point A in Paragraph 4.
    G. Point B in Paragraph 4.
    H. Point C in Paragraph 5.
    J. Point D in Paragraph 5.

PASSAGE III

Weaving Weeds

Four major rivers run in and around

the southwestern Nigerian city of Ibadan,

the capital of Oyo State. The city faces a
<u>   </u>
        31

challenge however; common to river-
<u>   </u>
          32
lying communities: water hyacinth. This

invasive weed <u>flourishes</u> in estuaries and
               33

inlets, <u>sprouting sweeping beds of ivy-like leaves</u>
                              34
on the surface of the water. Beneath the surface

are knotted networks of <u>roots that inhibits</u> access
                         35
to the region's vital fishing waters.

While <u>business</u> analyst Achenyo Idachaba has
       36
made a career of addressing challenges like this. She's

counseled many US businesses in crisis, helping to

implement sustainable, community-driven solutions. In

2009, she immigrated to her parents' birthplace—Ibadan.

<u>There, in Ibadan,</u> Idachaba would launch an eco-friendly
        37
start-up. After seeing fishing boats immobilized by the

rivers' matted surface, she zeroed in on finding a viable

solution to the water hyacinth problem.

31. Given that all the choices are accurate, which provides information about Ibadan that is most relevant to the essay's discussion of the problems associated with water hyacinth?
  A. NO CHANGE
  B. the largest city in Nigeria by geographical area.
  C. a region with a lengthy wet season.
  D. a key fishing industry hub.

32. F. NO CHANGE
  G. challenge, however, common
  H. challenge; however common,
  J. challenge, however. Common

33. The writer wants to emphasize water hyacinth's negative impact, as it is described in the rest of the paragraph. Which choice best accomplishes that goal?
  A. NO CHANGE
  B. clogs
  C. survives
  D. remains in

34. Which of the following alternatives to the underlined portion would NOT be acceptable?
  F. inlets, with sweeping beds of ivy-like leaves sprouting
  G. inlets, where it sprouts sweeping beds of ivy-like leaves
  H. inlets; there sprouting sweeping beds of ivy-like leaves
  J. inlets; its sweeping beds of ivy-like leaves sprout

35. A. NO CHANGE
  B. are knotted networks of roots that inhibit
  C. is knotted networks of roots that inhibits
  D. is knotted networks of roots that inhibit

36. F. NO CHANGE
  G. Although business
  H. Since business
  J. Business

37. A. NO CHANGE
  B. After permanently moving there in 2009,
  C. There, business analyst
  D. There,

Idachaba learned that the stems of water hyacinth, when dried, were similar in strength and durability to rattan used in handcrafted wicker baskets. Rather, the weed could likewise be woven into marketable home accessories. This weed,
<u>38</u>

seen as an unchecked burden on the community,
<u>39</u>

could actually be fashioned into opportunity.
<u>40</u>

Though Idachaba used her experience to design what she called a broad view of
<u>41</u>
"river handicraft product development," she

was unfamiliar with weed removal practices.
<u>42</u>
Within the community, she recruited ecologists who knew how to best remove the weed, rattan artisans who could weave the dried, rope-like

stems into products, and merchants in the area.
<u>43</u>

These individuals together collectively formed
<u>44</u>
the base of a cooperative and were responsible for training others.

38. F. NO CHANGE
G. In general,
H. Otherwise,
J. Thus,

39. If the writer were to delete the underlined portion (adjusting the punctuation as needed), the essay would primarily lose:
A. an explanation of why artisans were resistant to using the weed in woven products.
B. a reminder of the seriousness of the weed's relentless growth.
C. an indication that water hyacinth's abundance would have made using it in handcrafted products more cost-effective than using rattan.
D. a suggestion that Idachaba understood the full extent of the water hyacinth problems only after she began working in the community.

40. F. NO CHANGE
G. fashionably in
H. fashioned by
J. fashioned

41. Which placement of the underlined portion makes it most clear that Idachaba coined the term "river handicraft product development"?
A. Where it is now
B. After the word *used*
C. After the phrase *experience to*
D. After the phrase *view of*

42. Which choice best completes the sentence and leads into the description of Idachaba's approach that follows in the paragraph?
F. NO CHANGE
G. consulted other business analysts with whom she had formerly worked for advice.
H. relied on the expertise of area residents to carry out the details.
J. continued to develop ideas for other potential eco-friendly start-ups.

43. Which choice provides the most specific information and maintains the stylistic pattern established in the sentence?
A. NO CHANGE
B. who were familiar with distribution practices.
C. buying and selling various products.
D. who knew about the process.

44. F. NO CHANGE
G. came together as a group of people to form
H. formed all together
J. formed

GO ON TO THE NEXT PAGE.

The venture caught on quickly. Its profits created new sources of revenue and continuous funding for the extraction of water hyacinth. Idachaba's vision now, reaching other communities, not only helped revive the fishing industry in Ibadan, but also engaged people in a sustainable solution.

45. A. NO CHANGE
    B. vision, now,
    C. vision, now
    D. vision now

PASSAGE IV

Red Crab Migration

[1] Each year, between October and January, millions of Christmas Island red crabs annually migrate nearly five miles from their burrowed homes, in the island's rain forest to the shores of the Indian Ocean. [2] As the eggs hatch, the adult females follow their male counterparts, making the long trek back to their inland homes. [3] On the beach, the crabs breed, and before the turn of the tide, the females release their eggs into the sea. 48

46. F. NO CHANGE
    G. make their annual migration of nearly five miles
    H. migrate nearly five miles every year
    J. migrate nearly five miles

47. A. NO CHANGE
    B. homes in the island's rain forest to the shores
    C. homes, in the island's rain forest to the shores,
    D. homes in the island's rain forest, to the shores,

48. Which sequence of sentences makes this paragraph most logical?
    F. NO CHANGE
    G. 1, 3, 2
    H. 2, 1, 3
    J. 3, 1, 2

The breeding migration is lengthy—typically taking eighteen days—and is a tourist attraction as well.

49. Which of the following choices provides the best transition to the rest of the paragraph?
    A. NO CHANGE
    B. is physically demanding for the crabs.
    C. is dangerous for the crabs.
    D. traverses hills and valleys.

Their migration route crosses many of its

50. F. NO CHANGE
    G. Christmas Island's
    H. their
    J. these

main thoroughfares, which, for decades, left the crustaceans vulnerable to traffic.

51. A. NO CHANGE
    B. where,
    C. while,
    D. when,

But in 1998, <u>rangers at Christmas Island National Park</u>
₅₂
began taking steps to ensure the crabs' safe crossing.

    The park rangers created a "crab lane"

<u>of vinyl barricade</u> by placing over twelve miles
₅₃
parallel to the roads along the crabs' migration path.

The barricade is roughly eighteen inches tall, ensuring

the crabs cannot scale it and crawl into oncoming traffic.

<u>In</u> places where the crabs' migratory path requires that
₅₄
they cross the roads, thirty-one "underpasses" have been

built. The rangers created the underpasses by removing

thick asphalt swaths and replacing <u>it</u> with thin steel grids.
₅₅
As vehicles cross over the grids, the underpasses provide

crabs with safe passage from below.

    Perhaps the most impressive structure is the

Christmas Island Crab Bridge. Spanning a busy highway,

the bridge <u>raises</u> nearly forty feet in the air. Built out of
₅₆
sheets of gridded steel, the bridge allows the crabs to use

their four-inch claws to gain traction as they ascend and

descend the bridge.

    Chief <u>Ranger Rob Muller</u> says that the barricades,
₅₇

underpasses, and bridge <u>has saved</u> the lives of countless
₅₈
red crabs each year. Muller hopes the island's residents

will continue to support the efforts made to protect the

crabs. After all, not only is the red crabs' migration

integral to the island's ecosystem, <u>it is also</u> a singular
₅₉
event in nature.

---

52. F. NO CHANGE
    G. rangers, at Christmas Island National Park,
    H. rangers at Christmas Island National Park,
    J. rangers, at Christmas Island National Park

53. The best placement for the underlined portion would be:
    A. where it is now.
    B. after the word *miles*.
    C. after the word *roads*.
    D. after the word *path* (and before the period).

54. F. NO CHANGE
    G. In other words, in
    H. For instance, in
    J. Therefore, in

55. A. NO CHANGE
    B. this
    C. them
    D. that

56. F. NO CHANGE
    G. has raised
    H. arises
    J. rises

57. A. NO CHANGE
    B. Ranger, Rob Muller,
    C. Ranger Rob Muller,
    D. Ranger, Rob Muller

58. F. NO CHANGE
    G. is saving
    H. saves
    J. save

59. A. NO CHANGE
    B. and it is
    C. but is
    D. DELETE the underlined portion.

Question 60 asks about the preceding passage as a whole.

60. Suppose the writer's primary purpose had been to explain how a natural phenomenon has benefited humans. Would this essay accomplish that purpose?

   F. Yes, because the essay describes how the Christmas Island red crabs' breeding migration has increased tourism on Christmas Island.
   G. Yes, because the essay provides an overview of how the Christmas Island red crabs' breeding migration affects other wildlife on the island.
   H. No, because instead the essay provides an overview of the Christmas Island red crabs' breeding migration and the projects park rangers have undertaken to safeguard it.
   J. No, because instead the essay describes the ecological impact of the Christmas Island red crabs' breeding migration and how this impact has increased the responsibilities of park rangers on the island.

PASSAGE V

You Don't Look a Day Over 2,000

White-trunked aspen in a grove in Utah,

brain coral off the coast of Tobago that is gray,
   61

green moss on rocky outcrops in Antarctica—Rachel

Sussman has photographed a diverse array of living

things all over the world. These organisms may seem
                                    62

unrelated, share one important trait: longevity. They

have all been alive for 2,000 years or longer.

61. Which choice most closely maintains the word pattern established by the other two examples in the sentence?

   A. NO CHANGE
   B. off the coast of Tobago, brain coral colored gray,
   C. gray brain coral located off Tobago's coast,
   D. gray brain coral off the coast of Tobago,

62. F. NO CHANGE
   G. organisms, seemingly
   H. organisms that seem
   J. organisms seeming

Sussman's project, which <u>totaled</u> in the photo
<u>   </u>
63

collection <u>*The Oldest Living Things in the World*</u>
<u>   </u>
64

began in 2004. ⬚65 The ancient tree

<u>peeked her curiosity about</u> which organisms have lived
<u>   </u>
66

the longest. <u>Although</u> no comprehensive list of the oldest
<u>   </u>
67
living things existed, Sussman had to locate the organisms

herself. She did everything from conducting internet

searches at home <u>and</u> meeting with researchers abroad.
<u>   </u>
68
In all, the project took almost ten years to complete.

    Sussman ventured to all seven continents on her

quest. She photographed Baobab trees in South Africa

(2,000 years old), <u>took a picture of a Meelup Mallee</u>
<u>   </u>
69
eucalyptus tree in Australia (6,000 years old), and

Posidonia sea grass off the coast of Spain (100,000 years

old). In Russia, she encountered the oldest-known living

things in the <u>world—Siberian actinobacteria,</u> which are
<u>   </u>
70
up to 600,000 years old.

63. A. NO CHANGE
    B. rounded off
    C. culminated
    D. terminated

64. F. NO CHANGE
    G. collection, *The Oldest Living Things in the World*,
    H. collection *The Oldest Living Things in the World*,
    J. collection, *The Oldest Living Things in the World*

65. Given that all the choices are accurate, which one, if added here, would best serve as a transition from the first sentence to the rest of the paragraph?
    A. By the time she finished, she had photographed individuals from thirty separate species.
    B. While in Japan, Sussman visited Jōmon Sugi, a Japanese cedar at least 2,180 years old.
    C. At the outset, Sussman didn't know how long her project would take.
    D. At the time, Sussman lived and worked in New York City.

66. F. NO CHANGE
    G. piqued her curiosity about
    H. peaked her curiosity in
    J. peeked her curiosity in

67. A. NO CHANGE
    B. Whether
    C. Because
    D. Unless

68. F. NO CHANGE
    G. as well as
    H. or
    J. to

69. A. NO CHANGE
    B. another photo was of
    C. she photographed
    D. DELETE the underlined portion.

70. F. NO CHANGE
    G. world, Siberian actinobacteria;
    H. world—Siberian actinobacteria;
    J. world; Siberian actinobacteria

Sussman wanted her photos to look like portraits of individuals. She made large-format prints to bring out the species' colors and textures. In a photo of a 12,000-year-old creosote bush in California, for instance, facets of the bush, such as the leaves, fill the frame. Sussman intended that this up-close look would

allow viewers to connect with the plant, they would better understand the plant.

More than a photo collection, a reflection on time is in *The Oldest Living Things*. Each taken in a fraction of a second, the photographs record one moment in the lifespan of organisms that has survived for thousands of years. By considering the organisms, viewers get a sense of the brevity of human lives and the vastness of time.

71. Given that all the choices are accurate, which one provides the most detailed description of the creosote bush?
- **A.** NO CHANGE
- **B.** the bush's twisting branches and tiny leaves
- **C.** Sussman causes the bush's branches to
- **D.** features of the bush

72. **F.** NO CHANGE
- **G.** the plant, additionally, they could
- **H.** it and viewers would
- **J.** and

73. **A.** NO CHANGE
- **B.** Sussman reflects on time in *The Oldest Living Things*.
- **C.** *The Oldest Living Things* is a reflection on time.
- **D.** time is reflected on in *The Oldest Living Things*.

74. **F.** NO CHANGE
- **G.** was able to survive
- **H.** have survived
- **J.** has lived

Question 75 asks about the preceding passage as a whole.

---

75. Suppose the writer's primary purpose had been to describe the process an artist used to create a work of art. Would this essay accomplish that purpose?
- **A.** Yes, because it focuses on the challenges Sussman overcame while working on her *Oldest Living Things* project.
- **B.** Yes, because it focuses on how Sussman located and photographed her subjects for *The Oldest Living Things* project.
- **C.** No, because it instead discusses Sussman's approach to photography in general, not a specific project.
- **D.** No, because it instead describes the oldest organisms in the world, which Sussman located.

END OF TEST 1

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

MATHEMATICS TEST

60 Minutes—60 Questions

DIRECTIONS: Solve each problem, choose the correct answer, and then fill in the corresponding oval on your answer document.

Do not linger over problems that take too much time. Solve as many as you can; then return to the others in the time you have left for this test.

You are permitted to use a calculator on this test. You may use your calculator for any problems you choose,

but some of the problems may best be done without using a calculator.

Note: Unless otherwise stated, all of the following should be assumed.

1. Illustrative figures are NOT necessarily drawn to scale.
2. Geometric figures lie in a plane.
3. The word *line* indicates a straight line.
4. The word *average* indicates arithmetic mean.

---

1. Given that $f(x) = 3x^3 - 7$, what is $f(-2)$?

   A. -31

   B. -29

   C. $\sqrt[3]{\dfrac{5}{3}}$

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

   E. $\dfrac{31}{2}$

2. During a certain game, the probability of randomly drawing Card A is $\dfrac{1}{8}$. What is the probability of randomly drawing a card that is NOT Card A ?

   F. 0

   G. $\dfrac{1}{8}$

   H. $\dfrac{1}{7}$

   J. $\dfrac{1}{4}$

   K. $\dfrac{7}{8}$

3. Dawn randomly selected 6 books from the teen library, read them, and then rated them as follows: 40, 60, 10, 80, 30, and 40. Based on the sample data, what is the best estimate of Dawn's average rating of all the books in the library?

   A. 10
   B. 40
   C. 43
   D. 45
   E. 80

DO YOUR FIGURING HERE.

4. On a digital music player there are 153 rap songs, 72 country songs, 14 jazz songs, and 121 rock songs. Given that the player is set to randomly shuffle the song selection, what is the probability, rounded to the nearest thousandth, the 1st song played will be a country song?

F. 0.003
G. 0.014
H. 0.200
J. 0.250
K. 0.720

DO YOUR FIGURING HERE.

5. A city bus picks up and drops off passengers according to the table below. The bus has 0 passengers before Stop 1. After Stop 5, there are 13 passengers remaining on the bus. How many passengers did the bus pick up at Stop 1 ?

Stop	Passenger pickup/drop-off
1	?
2	Picks up 3 passengers
3	Drops off $\frac{1}{2}$ of all passengers
4	Picks up 11 passengers
5	Drops off $\frac{1}{2}$ of all passengers

A. 1
B. 10
C. 27
D. 33
E. 71

6. What is the length, in inches, of the hypotenuse of a right triangle with a leg that is 8 inches long and a leg that is 3 inches long?

F. $\sqrt{22}$
G. $\sqrt{55}$
H. $\sqrt{73}$
J. 5.5
K. 11

7. Given $x = 100$ and $y = -20$, $x + y$ is equal to the product of -5 and what number?

A. -24
B. -16
C. 16
D. 24
E. 400

8. The operation ⊗ is defined by $a \otimes b = a^2 b$. If $a = 5$ and $a \otimes b = 100$, what is the value of b ?

F.　　2
G.　　4
H.　　20
J.　　500
K.　2,500

9. For $\overleftrightarrow{RT}$ shown below, point S is on $\overline{RT}$, the length of $\overline{RS}$ is 6 cm, and the length of $\overline{ST}$ is 16 cm. What is the distance, in centimeters, between T and the midpoint of $\overline{RS}$?

A.　11
B.　14
C.　16
D.　19
E.　22

R　6　S　　　16　　　T

10. Matrices A and B are given below.

$$A = \begin{bmatrix} -2 & 6 \\ 3 & -8 \end{bmatrix} \quad B = \begin{bmatrix} 8 & 5 \\ 1 & -4 \end{bmatrix}$$

Which of the following matrices is $A - B$?

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

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

H.　$\begin{bmatrix} 6 & 11 \\ 4 & -12 \end{bmatrix}$

J.　$\begin{bmatrix} 6 & 4 \\ 11 & -12 \end{bmatrix}$

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

11. One of the lines graphed in the standard (x,y) coordinate plane below has a negative slope and a negative y-intercept. Which one?
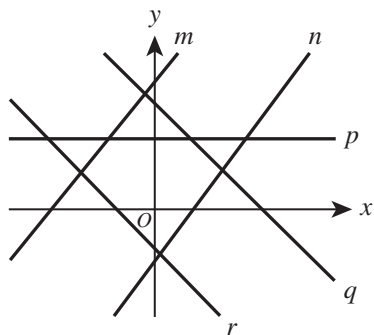
A.　m
B.　n
C.　p
D.　q
E.　r

12. In a certain isosceles triangle, the measure of the vertex angle is 34°. What is the measure of *each* of the 2 base angles?

F.　　17°
G.　　34°
H.　　68°
J.　　73°
K.　112°

13. This month, Reed sold 40 figurines in 2 sizes. The large figurines sold for $12 each, and the small figurines sold for $4 each. The amount of money he received from the sales of the large figurines was equal to the amount of money he received from the sales of the small figurines. How many large figurines did Reed sell this month?

    A. 10
    B. 16
    C. 20
    D. 24
    E. 30

14. The 7th term and the 8th term of an arithmetic sequence are 4 and 12, respectively. What is the 2nd term of this sequence?

    F. −44
    G. −36
    H.   8
    J. 20
    K. 28

15. The Cross High School girls' softball team currently has a record of 14 wins, 11 losses, and 0 ties. What is the *least* number of its remaining 12 games the team must win to finish the season winning *more than* 50% of all the team's games?

    A. 3
    B. 5
    C. 6
    D. 7
    E. 12

16. An object is launched vertically at 49 meters per second from a 980-meter high platform. The equation for the object's height, h, at time t seconds after launch is $h(t) = -4.9t^2 + 49t + 980$, where h is in meters. What will be the height, in meters, of the object 6 seconds after launch?

    F.   980.0
    G. 1,097.6
    H. 1,274.0
    J. 1,332.8
    K. 1,450.4

17. The 1st term of Pattern A is 2. The rule to find each subsequent term is to multiply the previous term by 2 and then subtract 1. The 1st term of Pattern B is 2. The rule to find each subsequent term is to subtract 1 from the previous term and then multiply by 2. What is the sum of the 4th terms of Pattern A and Pattern B ?

    A.   0
    B.   4
    C. 11
    D. 18
    E. 19

DO YOUR FIGURING HERE.

18. Which of the following binomials is a factor of $x^2 - x - 156$?

   F. $x - 13$
   G. $x - 12$
   H. $x + 2$
   J. $x + 13$
   K. $x + 78$

19. One of the following graphs is that of the solution set of the inequality $4x - 2 \leq 10$. Which one?

   A.

   B.

   C.

   D.

   E.
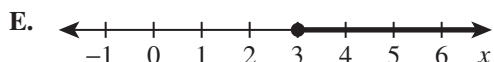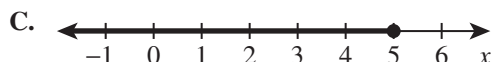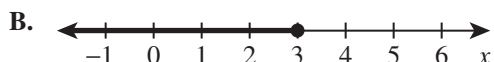
20. Let y be an irrational number. Which of the following statements about the value of $15y$ must be true?

   F. It is rational.
   G. It is irrational.
   H. It is imaginary.
   J. It is undefined.
   K. It is neither irrational nor rational.

21. One of the following equations represents the line of best fit shown in the scatterplot below. Which one?
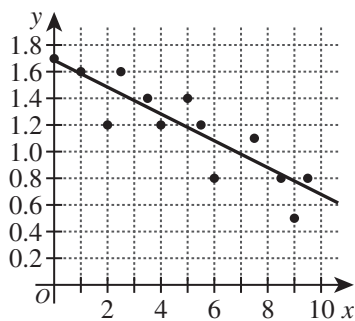
   A. $y = -1.7x - 0.1$
   B. $y = -0.1x + 1.7$
   C. $y = -0.1x - 1.7$
   D. $y = 0.1x + 1.7$
   E. $y = 1.7x - 0.1$

22. Points $G(2,6)$ and $H(10,14)$ lie in the standard (x,y) coordinate plane. What is the midpoint of $\overline{GH}$?

   F. $(4,10)$
   G. $(6, 8)$
   H. $(6,10)$
   J. $(8, 8)$
   K. $(8,10)$

DO YOUR FIGURING HERE.

GO ON TO THE NEXT PAGE.

DO YOUR FIGURING HERE.

23. A machine blade in the shape of a right triangle is rotated about a mechanical shaft at high speed. The mechanical shaft is along the longer leg of the triangle that represents the blade. In the diagram below, the figure on the left shows the blade at rest, and the figure on the right shows a bottom view of the blade in motion. One of the following solids is generated as the blade rotates about the shaft. Which one?

machine blade
at rest
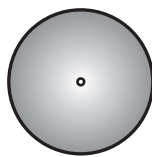
bottom view of
machine blade
in motion

  A. Cone
  B. Cylinder
  C. Sphere
  D. Triangular prism
  E. Triangular pyramid

24. The sum of 2 numbers is 22. The sum of the squares of the 2 numbers is 260. What is the product of the 2 numbers?

  F.   105
  G.   112
  H.   121
  J.   224
  K. 5,720

25. Trapezoid A and Trapezoid B are congruent and graphed in the standard (x,y) coordinate plane below. One of the following transformations or sequences of transformations would map Trapezoid A onto Trapezoid B. Which one?
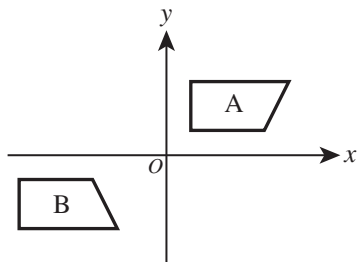
  A. Reflection over the line $y = x$
  B. Reflection over the line $y = -x$
  C. Rotation of 180° around the origin
  D. Reflection over the y-axis and then a reflection over the x-axis
  E. Reflection over the x-axis and then a translation to the left

GO ON TO THE NEXT PAGE.

DO YOUR FIGURING HERE.

26. A circle with its center at (5,4) and a radius of 3 coordinate units is graphed in the standard (x,y) coordinate plane. One point on the circle has a y-coordinate greater than that of any other point on the circle. What is the y-coordinate of that point?

    F. 3
    G. 7
    H. 8
    J. 9
    K. 13

27. For real constants a, b, and c, the graph in the standard (x,y) coordinate plane below is represented by an equation in one of the following forms. Which one?

    A. $y = \dfrac{a}{x}$

    B. $y = a^x$

    C. $y = ax + b$

    D. $y = ax^2 + bx + c$

    E. $y = |ax + b| + c$
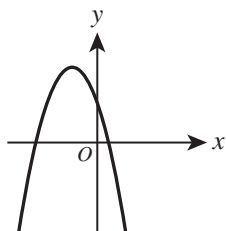
28. Jared is driving home. He is currently 231 miles away from home. His car's fuel tank holds 16 gallons and is $\dfrac{3}{4}$ full of fuel. Given that his car travels 22 miles per gallon of fuel and he doesn't stop for fuel, how many gallons of fuel will be in his tank when he gets home?

    F. 1.5
    G. 4
    H. 5.5
    J. 10
    K. 10.5

29. In the figure below, 5 right triangles share a common vertex, O. The legs of each of these triangles are shown dashed, and their lengths are labeled in feet. The point on each triangle that is farthest from O is labeled A, B, C, D, or E. A circle centered at O with a radius of 10 feet will be drawn. Which of the following points is outside of this circle?
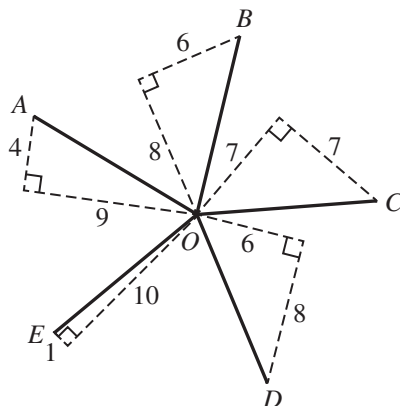
    A. A
    B. B
    C. C
    D. D
    E. E

30. Albert won a contest for which he will be paid $1.00 on the 1st day, $2.00 on the 2nd day, $3.00 on the 3rd day, and so on for 1 year (365 days). What is the total amount of money Albert will be paid in contest winnings?

(Note: For arithmetic series, $S_n = \dfrac{n(t_1 + t_n)}{2}$, S_n is the sum of the first n terms of a sequence such that t_1 is the 1st term and t_n is the nth term.)
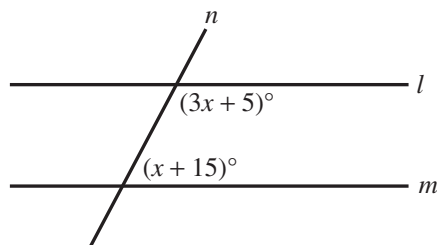
F. $ 730.00
G. $ 33,397.50
H. $ 66,612.50
J. $ 66,795.00
K. $133,225.00

31. Tables of values for the 2 functions f and g are shown below. What is the value of $g(f(5))$?

x	$f(x)$
−6	7
−4	−6
3	5
5	4

x	$g(x)$
−4	5
3	−3
4	−5
5	−6

A. −24
B.   −6
C.   −5
D.   4
E.   7

32. In the figure below, line l is parallel to line m, and line n intersects the parallel lines. What is the value of x ?

F.   5
G. 10
H. 17.5
J. 40
K. 50

33. Which of the following expressions is equal to $(2\sqrt{7} + 1)(\sqrt{7} - 1) - (\sqrt{7} - 1)$?

A. 12
B. 96
C. $-2 - 4\sqrt{7}$
D. $1 + 2\sqrt{7}$
E. $14 - 2\sqrt{7}$

34. Given $i^2 = -1$, $-2i(3 + 4i) - 3(2 + 5i) = ?$

   F. $-14 - 21i$
   G. $1 - 3i$
   H. $2 - 21i$
   J. $2 + 9i$
   K. $14 + 9i$

DO YOUR FIGURING HERE.

35. At an ice-cream shop, patrons can purchase a single scoop of 1 ice-cream flavor and 1 topping for $2.99. The owner recorded the number of different ice-cream flavors and 1-topping combinations that were purchased, as shown in the table below. To the nearest 0.01, what is the probability that a randomly selected patron purchased a scoop of vanilla ice cream topped with sprinkles?

	Sprinkles	Syrup	Fruit	Total
Vanilla	77	38	60	175
Chocolate	107	55	21	183
Swirl	118	110	59	287
Total	302	203	140	645

   A. 0.12
   B. 0.25
   C. 0.27
   D. 0.44
   E. 0.47

36. The equation $y = f(x)$ is graphed in the standard (x,y) coordinate plane below.
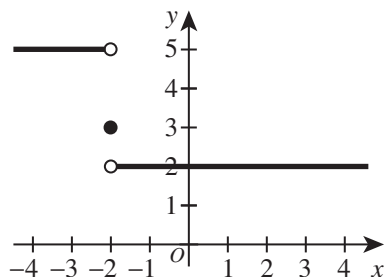
One of the following defines f. $f(x) = ?$

   F. $\begin{cases} 5 \text{ for } x < -2 \\ 3 \text{ for } x = -2 \\ 2 \text{ for } x > -2 \end{cases}$

   G. $\begin{cases} 5 \text{ for } x \leq -2 \\ 3 \text{ for } x = -2 \\ 2 \text{ for } x > -2 \end{cases}$

   H. $\begin{cases} 5 \text{ for } x < -2 \\ 3 \text{ for } x = -2 \\ 2 \text{ for } x \geq -2 \end{cases}$

   J. $\begin{cases} 5 \text{ for } x \leq -2 \\ 3 \text{ for } x = -2 \\ 2 \text{ for } x \geq -2 \end{cases}$

   K. $\begin{cases} 5 \text{ for } x = -2 \\ 3 \text{ for } x = -2 \\ 2 \text{ for } x = -2 \end{cases}$

GO ON TO THE NEXT PAGE.

37. A restaurant conducted a survey to determine whether its customers like or dislike corn bread and whether they like or dislike banana bread. The table below shows the results of the survey.

	Like corn bread	Dislike corn bread	Total
Like banana bread	78	57	135
Dislike banana bread	82	32	114
Total	160	89	249

Given that a customer selected at random from those surveyed likes corn bread, what is the probability that the customer dislikes banana bread?

A. $\dfrac{82}{249}$

B. $\dfrac{82}{160}$

C. $\dfrac{114}{249}$

D. $\dfrac{160}{249}$

E. $\dfrac{192}{249}$

38. For all positive values of a and b, $8^{\frac{a}{b}}$ is equivalent to:

F. $\sqrt[8]{b^a}$

G. $\sqrt[b]{a^8}$

H. $\sqrt[a]{b^8}$

J. $\sqrt[a]{8^b}$

K. $\sqrt[b]{8^a}$

39. The positive integer 134,678 contains exactly 6 digits. Including this integer, how many 6-digit positive integers contain the digits 1, 3, 4, 6, 7, and 8 ?

A.   6
B.   29
C.   720
D.   4,032
E.   40,320

40. What is the least common denominator for

$$\frac{x+2}{x^2-1} + \frac{x^2-9}{7x-7} ?$$

F. $(x-1)$
G. $(x-1)(x+1)$
H. $7(x-1)(x-1)$
J. $7(x-1)(x+1)$
K. $(x-3)(x+2)(x+3)$

DO YOUR FIGURING HERE.

GO ON TO THE NEXT PAGE.

41. Thomas wanted to test whether his coin was unfair. To do this, he flipped the coin 6 times and counted the number of heads and tails. Four of the flips resulted in heads, and two resulted in tails. One of the following statements is a correct conclusion based on Thomas's test. Which one?

  A. The coin is unfair, because there were more than the expected number of heads.
  B. The coin is unfair, because there were fewer than the expected number of tails.
  C. The coin is fair, because some flips resulted in heads and some resulted in tails.
  D. The coin is fair, because the flips resulted in approximately the same number of heads and tails.
  E. Not enough flips were performed to accurately predict whether the coin is unfair.

DO YOUR FIGURING HERE.

42. In $\triangle ABC$ below, $\overline{BD}$ is the altitude from B to $\overline{AC}$, the measure of $\angle A$ is $60°$, $AD = 10$ m, and $DC = 2$ m. What is the area, in square meters, of $\triangle ABC$?
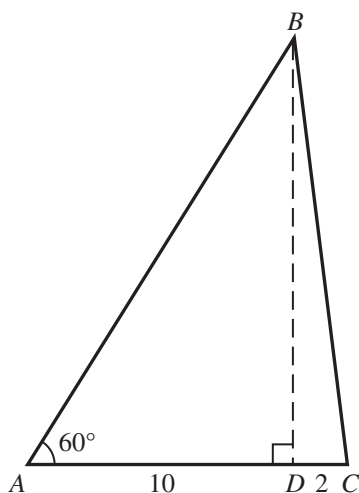
  F. 60
  G. $60\sqrt{2}$
  H. $60\sqrt{3}$
  J. 120
  K. $120\sqrt{3}$

43. The area of any triangle is given by $\frac{1}{2}ab(\sin C)$, where a and b are the lengths of any 2 sides, and C is the interior angle formed by those 2 sides. Which of the following is closest to the area, in square feet, of a triangle with side lengths of 6.2 ft, 10.0 ft, and 14.0 ft, and with angle measures of 23°, 39°, and 118° ?

(Note: $\sin 23° \approx 0.39$; $\sin 39° \approx 0.63$; $\sin 118° \approx 0.88$)

  A. 20
  B. 27
  C. 31
  D. 38
  E. 43

44. What are the slope and y-intercept of the line that goes through $(0,8)$ and $\left(\frac{4}{3},0\right)$ in the standard (x,y) coordinate plane?

	slope	y-intercept
F.	-6	$(0,8)$
G.	-6	$\left(\frac{4}{3},0\right)$
H.	$\frac{1}{6}$	$\left(\frac{4}{3},0\right)$
J.	6	$(0,8)$
K.	6	$\left(\frac{4}{3},0\right)$

45. What are the solutions of $(x + 1)^2 + 1 = 0$?

  A. -1 ± 1

  B. $\frac{-1 \pm \sqrt{3}}{2}$

  C. $0 \pm i$

  D. $-1 \pm i$

  E. $\frac{-1 \pm i\sqrt{3}}{2}$

DO YOUR FIGURING HERE.

Use the following information to answer questions 46–48.

A small company has 12 employees and 5 job titles. The job title, number of employees with that title, and monthly salary of each employee with that title are given in the table below.

Job title	Number of employees	Monthly salary of each employee
Supervisor	1	$7,500
Software Engineer	5	$6,000
Hardware Engineer	3	$5,500
Accountant	2	$4,500
Assistant	1	$3,000

46. What percent of employees in this company have a monthly salary greater than $5,000 ?

F. 25%
G. 40%
H. 60%
J. 75%
K. 90%

47. Rodrigo and Kim are both employees with the company. Rodrigo has a job title of Hardware Engineer and Kim has a different job title. The absolute value of the difference between Rodrigo's monthly salary and Kim's monthly salary is greater than $800. Let x represent Kim's monthly salary, in dollars. Which of the following statements shows all and only the possible values of x ?

A. $x < 4,700$
B. $x > 4,700$
C. $x > 6,300$
D. $4,700 < x < 6,300$
E. $x < 4,700$ or $x > 6,300$

48. Next year, the monthly salary of each employee with the title of Software Engineer will be increased to $6,500. No other monthly salaries will be increased or decreased, and the number of employees with each job title will remain the same. Which of the following dollar amounts is closest to the change in the mean of the 12 monthly salaries from before the increase to after the increase?

F. $ 42
G. $ 83
H. $100
J. $208
K. $500

GO ON TO THE NEXT PAGE.

49. In the standard (x,y) coordinate plane, the graph of $y = 5x^2$ is reflected over the x-axis and then translated to the right 3 coordinate units. The graph of which of the following equations is the result of these 2 transformations?

   A. $y = -5(x - 3)^2$

   B. $y = -5(x + 3)^2$

   C. $y = -5x^2 + 3$

   D. $y = \frac{1}{5}x^2 + 3$

   E. $y = 5x^2 - 3$

**50.** What are the real solutions for the equation $x^4 - 9 = 0$?

   F. $\pm\sqrt{3}$
   G. $\pm\sqrt{3i}$
   H. $\pm\sqrt{3}, \pm\sqrt{3i}$
   J. ± 3
   K. ± 9

51. To the nearest 0.1 second, how many seconds will it take a car to travel a distance of 100 feet given that it is traveling at 45 miles per hour?

(Note: 1 mile = 5,280 feet)

   A.   1.2
   B.   1.5
   C.   3.3
   D. 27.0
   E. 52.8

52. The interior diameter and interior height of a cylindrical container are given in inches in the figure below. Water will be poured into the empty container at a rate of 40π cubic inches per minute. At this rate, in exactly how many minutes will the container be completely filled?
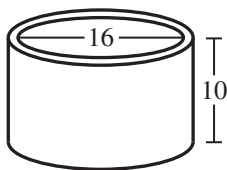
(Note: The volume of a cylinder with radius r and height h is $\pi r^2 h$.)

   F. 16
   G. 20
   H. 24
   J. 40
   K. 64

53. For what real value of x is $\dfrac{3^x 3^4}{\left(3^4\right)^7} = \dfrac{1}{9}$ true?

A. 5
B. 7
C. 17
D. 22
E. 24

DO YOUR FIGURING HERE.

54. Craig writes a check for $18. When he records the check in his check register, he accidentally *adds* $18 to his balance instead of subtracting $18, which causes a discrepancy between what Craig's check register shows and what it should show. Because of his mistake, Craig's check register shows:

F. $36 less than it should.
G. $18 less than it should.
H. $ 9 more than it should.
J. $18 more than it should.
K. $36 more than it should.

55. In the figure shown below, $\overline{CE}$ is shared by $\triangle CDE$ and rectangle $ABCE$. The height of $\triangle CDE$ from D to $\overline{CE}$ is 4 cm, and $BC = AE = 15$ cm. The area of pentagon $ABCDE$ is 200 square centimeters. Which of the following values is closest to the length, in centimeters, of $\overline{CE}$?
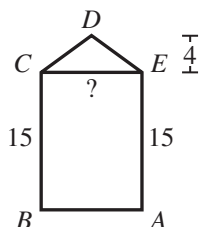
A. 10.5
B. 11.3
C. 11.8
D. 12.8
E. 13.1

56. In the standard (x,y) coordinate plane below, a circle with radius 2 coordinate units is centered at the origin. Point A is on the circle and on the terminal side of a 150° angle in standard position. What are the coordinates of A ?
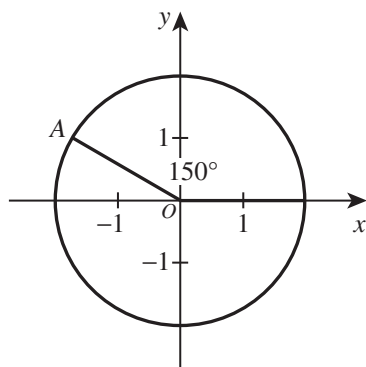
F. $\left(-\dfrac{\sqrt{3}}{2}, \dfrac{1}{2}\right)$

G. $\left(\dfrac{\sqrt{3}}{2}, -\dfrac{1}{2}\right)$

H. $(2,1)$

J. $(1, -\sqrt{3})$

K. $(-\sqrt{3}, 1)$

57. The line plot below shows the number of miles Bob framed each day for a new sidewalk. After he finished framing, he poured concrete for $\frac{1}{2}$ mile of sidewalk each day. Which of the following is closest to the total number of days it took Bob to pour concrete for the entire sidewalk?

```
                  X
                  X
                  X           X     X
            X     X           X     X
            X     X     X     X     X     X
   ←────┼─────┼─────┼─────┼─────┼─────┼─────┼─────┼────→
        0    1/8   1/4   3/8   1/2   5/8   3/4   7/8    1
                        length (mi)
```
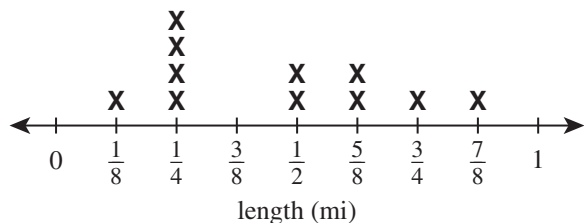
- **A.** 3
- **B.** 5
- **C.** 7
- **D.** 9
- **E.** 10

58. A store that sells office furniture tracks the number of bookcases sold each day for a year and then prepares the data table below. Which of the following is closest to the number of bookcases the store can expect to sell in 100 randomly selected days?

Bookcases sold	Probability
0	0.06
1	0.12
2	0.18
3	0.34
4	0.22
5	0.08

- **F.** 138
- **G.** 190
- **H.** 250
- **J.** 278
- **K.** 300

59. On the interval $0° \le x \le 180°$, what are all the real solutions to $(2 \cos x + 1)(\cos x - 1) = 0$?

- **A.** 0° and 120°
- **B.** 0° and 150°
- **C.** 30° and 180°
- **D.** 60° and 120°
- **E.** 60° and 150°

60. The circumference of a circle is 16π feet. What is the perimeter, in feet, of a square inscribed in the circle?

- **F.** 8
- **G.** $8\sqrt{2}$
- **H.** 16
- **J.** $16\sqrt{2}$
- **K.** $32\sqrt{2}$

DO YOUR FIGURING HERE.

END OF TEST 2

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

DO NOT RETURN TO THE PREVIOUS TEST.

READING TEST

35 Minutes—40 Questions

DIRECTIONS: There are 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

My interest in jazz probably started as an act of adolescent rebellion, since my father played and listened only to classical music. I bought my first jazz record album, *Count 'Em 88*, on the strength of the odd
5 title and the cover art—a photograph of a white grand piano. I didn't just listen to the music. When there was no one at home, I would set up a record on my father's hi-fi and drum along.

Jazz was a private pastime, since none of my
10 friends listened to the music. Making my own way was part of the pleasure. St. John's did not have a jazz club, but the tobacconist's shop did carry *Down Beat*. The magazine was like a jazz correspondence course. It was also—and this was part of the attraction—an escape
15 from a sometimes dreary and always provincial town.

Jazz was the music of big cities, especially New York. In *Down Beat* I read about a famed New York jazz club, Birdland—named after Charlie "Yardbird" Parker, the legendary alto saxophonist who had played
20 at its opening a decade earlier. According to the magazine, Birdland had a special section reserved for underage patrons like me—I was sixteen. So, when my family went on a holiday to New York City, after we visited Radio City Music Hall, the Empire State Build-
25 ing, and a Horn & Hardart Automat, I knew exactly where I wanted to go. We were staying at a seedy hotel near Times Square, and I set off up Broadway to Fifty-second Street. It was a day or two before New Year's Eve, and the city was in a festive mood. Many
30 of the bars were open to the street, and people and music spilled out on the sidewalk. The noise, the neon lights, and the crowd were exhilarating and not the least threatening. It was December 1959.

When I reached Birdland, I felt slightly let down.
35 The basement club, with no marquee and no grand entrance, didn't look like a jazz Mecca. I tried to appear nonchalant as I went in. Just as *Down Beat* had described, I was shown to a raised section in the rear of the dark room and served a soft drink. It was early in
40 the evening, and no one was playing. Eventually, musi-

cians filed up onto the stage, spotlights were turned on, and with the arrival of the man himself—Count Basie— the sound of a big band at full tilt filled the room.

For once, the hackneyed phrase is apt: I was blown
45 away. I had listened to records on my father's hi-fi, but the only live jazz I had ever heard was a performance by Benny Goodman in the Montreal Forum: swing music in a cavernous space. I was unprepared for the visceral impact of a hard-driving band in a small room.
50 Nor had I ever heard anyone sing like Joe Williams— my parents' taste in popular crooners ran to Perry Como. I stayed for two sets. I don't recall the walk back to the hotel. After Basie, Broadway seemed pretty tame.

55 My father didn't accompany me to Birdland, but several times in Montreal we did go to jazz concerts together, not only Goodman but also the Modern Jazz Quartet and Duke Ellington. These occasions were memorable because it was rare that the two of us went
60 out. It's not that we didn't spend time together, but it was usually with the rest of the family, on vacations, camping trips, outings. He was a private man and, with me at least, somewhat remote. This remoteness was probably unintentional—he suffered the disadvantage
65 of many immigrant fathers: his boyhood had been so different from his son's. The things that he had done as an adolescent—kayaking, spending summers at country houses, going to formal social functions, giving piano recitals—were not things I did. The books he read as a
70 boy were not my own (I could not read Polish). Playing the piano was his sole pastime, so he did not have hobbies to share—he was not a fisherman, or a golfer, or a do-it-yourselfer—nor did we go to baseball or hockey games together. I don't mean to sound rueful. Despite
75 my schoolboy athleticism, I was not attracted by the spectacle of sports, so I didn't feel I was missing anything.

My father and I did share something in addition to the occasional jazz concert. For some reason he did not
80 introduce me to classical music—except indirectly through his evening playing—but we did sometimes play at home together. Like many classically trained musicians, he was somewhat baffled by the improvisational nature of jazz, but he did know how to improvise
85 fugues. I enjoyed accompanying him, although I'm not sure if he enjoyed my doing so, or if he played with me

GO ON TO THE NEXT PAGE.

merely out of a sense of parental obligation. It was, in any case, our most effective way of communicating.

1. Which of the following events referred to in the passage took place first chronologically?

   A. New Year's Day, 1960
   B. The narrator's first trip to Birdland
   C. The narrator's first time seeing Benny Goodman perform
   D. The narrator and his family's visit to Radio City Music Hall in New York City

2. The point of view from which the passage is told is best described as that of:

   F. a teenager recounting how he became interested in classical music.
   G. a teenager recounting a family trip to New York.
   H. an adult recounting how his interest in jazz played an important role in his adolescence.
   J. an adult recounting how he became interested in his Polish roots.

3. Based on the passage, it can reasonably be inferred that one reason the narrator liked jazz was that it:

   A. was something his friends and family enjoyed.
   B. was performed in clubs in the town where he grew up.
   C. afforded him an opportunity to take a correspondence course from New York.
   D. gave him a way of distinguishing himself from his friends and family.

4. The primary purpose of lines 63–74 is to:

   F. provide reasons why the narrator was envious of his father's childhood.
   G. explain why the narrator's father might have had difficulty bonding with the narrator.
   H. justify why the narrator's father was resentful of the life the narrator's family had at St. John's.
   J. embellish stories that the narrator used to justify his father's remoteness.

5. Based on the passage, which of the following statements best expresses how the narrator felt about accompanying his father when his father played the improvised fugues?

   A. He liked accompanying his father, but was embarrassed by his father's lack of musical talent.
   B. He liked accompanying his father, but was uncertain about his father's motivation for letting him do so.
   C. He disliked accompanying his father, but was grateful for his father's attempt at playing improvisational music.
   D. He disliked accompanying his father, but admired his father's ability to improvise fugues.

6. The narrator indicates that he selected the first jazz album he ever purchased primarily based on the:

   F. advice of a record store clerk.
   G. title and appearance of the album cover.
   H. review of it he had read in *Down Beat* magazine.
   J. fact that his father played the piano.

7. According to the passage, when the narrator first arrives at Birdland, he feels slightly:

   A. disappointed.
   B. intimidated.
   C. thrilled.
   D. reassured.

8. As it is used in line 51, the phrase *ran to* most nearly means:

   F. took refuge with.
   G. gravitated toward.
   H. imitated.
   J. performed with.

9. According to the passage, for the narrator the jazz concerts he attended with his father are memorable because:

   A. his father played the piano with the musicians onstage.
   B. his father rarely left the house where they lived.
   C. the narrator got to spend time alone with his father.
   D. the narrator learned about the activities his father enjoyed as a child.

10. It can reasonably be inferred from the passage that the narrator's father thought the improvisational nature of jazz was:

    F. perplexing.
    G. annoying.
    H. calming.
    J. delightful.

Passage II

The art of the late Renaissance is heavily popu-
lated by mirrors lurking inside paintings, most famously
in Diego Velázquez's inverted masterpiece, *Las Meni-
nas*, which shows the artist (and the extended royal
5 family) in the middle of painting King Philip IV and
Queen Mariana of Spain. The entire image is captured
from the point of view of two royal subjects sitting for
their portrait; it is, in a very literal sense, a painting
about the act of painting. The king and queen are visi-
10 ble only in one small fragment of the canvas, just to the
right of Velázquez himself: two small, blurry images
reflected back in a mirror.

As a tool, the mirror became an invaluable asset to
painters who could now capture the world around them
15 in a far more realistic fashion, including the detailed
features of their own faces. Leonardo da Vinci observed
the following in his notebooks (using mirrors, natu-
rally, to write in his legendary backward script):

When you wish to see whether the general
20 effect of your picture corresponds with that of
the object represented after nature, take a
mirror and set it so that it reflects the actual
thing, and then compare the reflection with
your picture, and consider carefully whether
25 the subject of the two images is in conformity
with both, studying especially the mirror. The
mirror ought to be taken as a guide.

The historian Alan MacFarlane writes of the role
of glass in shaping artistic vision, "It is as if all humans
30 had some kind of systematic myopia, but one which
made it impossible to see, and particularly to represent,
the natural world with precision and clarity. Humans
normally saw nature symbolically, as a set of signs. . . .
What glass ironically did was to take away or compen-
35 sate for the dark glass of human sight and the distor-
tions of the mind, and hence to let in more light."

At the exact moment that the glass lens was allow-
ing us to extend our vision to the stars or microscopic
cells, glass mirrors were allowing us to see ourselves
40 for the first time. It set in motion a reorientation of
society that was more subtle, but no less transforma-
tive, than the reorientation of our place in the universe
that the telescope engendered. "The most powerful
prince in the world created a vast hall of mirrors, and
45 the mirror spread from one room to another in the bour-
geois household," Lewis Mumford writes in his
Technics and Civilization. "Self-consciousness, intro-
spection, mirror-conversation developed with the new
object itself." Social conventions as well as property
50 rights and other legal customs began to revolve around
the individual rather than the older, more collective
units: the family, the tribe, the city, the kingdom.
People began writing about their interior lives with far
more scrutiny. Hamlet ruminated onstage; the novel

55 emerged as a dominant form of storytelling, probing the
inner mental lives of its characters with an unrivaled
depth. Entering a novel, particularly a first-person nar-
rative, was a kind of conceptual parlor trick: it let you
swim through the consciousness, the thoughts and emo-
60 tions, of other people more effectively than any aes-
thetic form yet invented. The psychological novel, in a
sense, is the kind of story you start wanting to hear
once you begin spending meaningful hours of your life
staring at yourself in the mirror.

65 How much does this transformation owe to glass?
Two things are undeniable: the mirror played a direct
role in allowing artists to paint themselves and invent
perspective as a formal device; and shortly thereafter a
fundamental shift occurred in the consciousness of
70 Europeans that oriented them around the self in a new
way, a shift that would ripple across the world (and that
is still rippling). No doubt many forces converged to
make this shift possible: the self-centered world played
well with the early forms of modern capitalism that
75 were thriving in places like Venice and Holland (home
to those masters of painterly introspection, Dürer and
Rembrandt). Likely, these various forces complemented
each other: glass mirrors were among the first high-tech
furnishings for the home, and once we began gazing
80 into those mirrors, we began to see ourselves differ-
ently, in ways that encouraged the market systems that
would then happily sell us more mirrors. It's not that
the mirror made the Renaissance, exactly, but that it got
caught up in a positive feedback loop with other social
85 forces, and its unusual capacity to reflect light strength-
ened those forces.

11. The primary purpose of the passage is to:

   A. contrast several experts' views about whether mir-
   rors were invaluable to European society.
   B. argue that the invention of the mirror led to the
   invention of modern capitalism in Europe.
   C. examine the various effects the mirror had on
   European art and society.
   D. analyze ways in which the mirror caused European
   artists to be more innovative.

12. Based on details in the passage, who would most likely
assert that mirrors are a valuable tool for artists?

   F. Velázquez only
   G. MacFarlane only
   H. Both Leonardo and Mumford
   J. Both Leonardo and MacFarlane

13. The passage author most strongly suggests that the novel's emerging popularity was a result of the:

A. bourgeois household's ability to afford books.
B. spread of theatrical works such as *Hamlet*.
C. introspection created by access to mirrors.
D. mirror's transformation of social conventions and property rights.

14. It can most reasonably be inferred that the passage author describes Velázquez's *Las Meninas* as "inverted" (line 3) because it portrays:

F. the scene from Velázquez's point of view.
G. both King Philip IV and Queen Mariana of Spain.
H. what King Philip IV and Queen Mariana of Spain would have seen while sitting for their portrait.
J. the extended royal family painting portraits of King Philip IV and Queen Mariana of Spain.

15. The main idea of the quotation from MacFarlane (lines 29–36) is that:

A. glass lenses and mirrors allowed artists to represent nature symbolically, as a set of signs.
B. humans are afflicted with a systematic myopia that makes it impossible to see the world clearly.
C. before windows, artists lacked access to light both indoors and beyond daylight hours.
D. glass lenses and mirrors helped humans depict the natural world much more accurately.

16. According to the passage, compared to the reorientation of society caused by the telescope, the reorientation caused by the mirror was:

F. less obvious but just as transformative.
G. less obvious and less transformative.
H. more obvious and similarly transformative.
J. more obvious but less transformative.

17. Regarding the impact of the novel, the passage most strongly supports the claim that:

A. first person narratives tended to confuse those who didn't have access to a mirror.
B. once novels became popular, other forms of story-telling became obsolete.
C. first person narratives allowed unprecedented exposure to people's inner mental lives.
D. psychological novels prompted people to spend more time examining themselves in mirrors.

18. The passage most strongly portrays the relationship between the mirror and capitalism as:

F. reciprocal; each promoted the spread of the other.
G. conflicting; capitalism hindered innovations in art.
H. causational; capitalism made money for buying mirrors more readily available.
J. insubstantial; each developed independently of the other.

19. The passage most strongly suggests that, in the paintings of the late Renaissance, mirrors were:

A. depicted frequently.
B. large and conspicuous.
C. disguised as other objects.
D. not painted very accurately.

20. As it is used in line 49, the word *conventions* most nearly means:

F. conferences.
G. practices.
H. gatherings.
J. resolutions.

Passage III

HUMANITIES: Passage A is from the article "This Modern Master Spent His Life Bringing Black Faces to Classic Art" by Sam Worley. Passage B is from the article "In the Tower: Kerry James Marshall" by Karen Wilkin.

Passage A by Sam Worley

Kerry James Marshall knew he wanted to be an artist, but he didn't know what kind. After graduating from Otis College of Art and Design in Los Angeles, he tried some social realist stuff. He tried collage. He tried
5 abstraction. But none of it fit. "I hadn't quite figured out what my interest in making art was supposed to be," he says. "Except I really wanted to do it."

So, at 25, he decided to return to the basics and paint a self-portrait—a classic portrait, almost. Its title
10 alluded to a great literary work: *Portrait of the Artist as a Shadow of His Former Self*. Marshall used egg tempera, a 13th-century favorite. He adopted compositional techniques associated with artists such as Michelangelo, Leonardo da Vinci, Raphael. But, of
15 course, his subject was black. So black that the shade of his skin is deeper than the portrait's black background, which he fades into, as if invisible. Compared with conventional European portraiture, it's like a photo negative. "This is where I first started to figure out you can
20 use all that information, all that knowledge, you can use that technique, you can use this medium, but it doesn't have to look like any of the things that you say it's intellectually based on."

And so Marshall settled on creating a body of
25 work inspired by and in dialogue with the classics—his early barbershop portrait *De Style*, for example, its name a sly play on the Dutch abstract art movement de Stijl—while remaining resolutely its own thing. He found success with a simple insistence on placing black
30 people, and black history, at the center of his raucous, colorful paintings, and that has opened a space for younger artists.

One Marshall disciple, Kehinde Wiley, the star 39-year-old New York artist whose huge canvases show
35 black people in the heroic postures favored by the old masters, has said that when, as a child, he walked into the Los Angeles County Museum of Art and saw a Kerry James Marshall painting, its black subjects highlighted nothing so much as their absence elsewhere in
40 the museum.

In a certain sense, young Kehinde Wileys have always been Marshall's target audience. "If I have anything to do with it, you'll always be able to encounter a picture that has a black person in it that's also made by
45 a black person," says Marshall.

Passage B by Karen Wilkin

Painter Kerry James Marshall, born in Birmingham, Alabama, and raised in Watts, Los Angeles, lives and works in Chicago. He is the recipient of a MacArthur Fellowship, among other prestigious
50 awards, and has exhibited in major institutions in the U.S. and Europe. His work figures in important museum and private collections, including a permanent installation, completed in 2008, in the lobby of the San Francisco Museum of Modern Art—vast frescoes of
55 George Washington at Mount Vernon and Thomas Jefferson at Monticello. Yet the Tower installation at the National Gallery of Art in 2013 was his first one-person exhibition in Washington.

The selection in the Tower presents Marshall to us
60 as a modern day History Painter—a creator of large-scale, often complex narrative images that are packed with references and populated by eloquent figures. The leading lights of the eighteenth- and nineteenth-century art establishment deemed History Painting to be the
65 most high-minded and important of approaches—a conception of what painting could be that was attainable only by the most ambitious, gifted artists. It is instantly clear that Marshall lacks neither ambition nor talent nor, in fact, high-mindedness of a certain kind. But
70 unlike his distinguished (and often dogmatic) predecessors—who concentrated on scenes from ancient history, mythology, and the Bible, presented with a mix of archaeological accuracy and polite generalization—he does not restrict himself to imaginary visions of a
75 remote, idealized past.

Quite the contrary: His unruly, discomfiting images fuse a commonplace, imperfect American present with palpable echoes of an even more imperfect American past, all of it highlighting specifically
80 African-American experience and all of it served up in a rich, materially expressive language of intensely hued paint, extravagant mark-making, collage, and, occasionally, glitter. Fleeting allusions to the highest of high art of both the distant and recent past share the
85 canvas with present-day, vernacular, sometimes slightly ham-fisted imagery, as well as African symbols and emblems of African deities. Rather than cancelling each other out, these unlikely bedfellows somehow reinforce each other.

21. Which of the following events mentioned in Passage A occurred first chronologically?

  A. Marshall inspired Wiley.
  B. Marshall painted *De Style*.
  C. Marshall experimented with social realism, collage, and abstraction.
  D. Marshall painted *Portrait of the Artist as a Shadow of His Former Self*.

22. From Wiley's perspective, as presented in Passage A, seeing Marshall's painting in the Los Angeles County Museum of Art was:

  F. momentous; the painting made Wiley want to work in an art museum as an adult.
  G. disappointing; the painting should have featured more direct commentary on black history.
  H. shocking; the painting was similar to one that Wiley had done but never exhibited.
  J. influential; the painting drew attention to the lack of black representation in the museum.

23. Based on Passage A, in *Portrait of the Artist as a Shadow of His Former Self*, Marshall demonstrates his knowledge of conventional European portraiture by:

  A. depicting his subjects in the heroic postures favored by the old masters.
  B. adopting compositional techniques associated with Michelangelo, Leonardo, and Raphael.
  C. painting with oil paint instead of the egg tempera favored in the thirteenth century.
  D. creating a photonegative effect between his subject and the background of the painting.

24. The main purpose of the first paragraph of Passage B (lines 46–58) is to:

  F. establish where Marshall was born and raised.
  G. establish that Marshall is a well-regarded artist.
  H. provide a critique of some of Marshall's art installations.
  J. provide a comprehensive list of paintings Marshall has completed during his artistic career.

25. In the last paragraph of Passage B, the author describes Marshall's artistic philosophy. Which of the following statements best summarizes this description?

  A. Marshall's dissimilar images combine to create something new and portray a flawed America.
  B. Marshall's images are distinctive because they emphasize the present in unusual ways.
  C. Marshall's portrayal of present-day America is familiar yet unusual.
  D. Marshall's use of unexpected images in his portrayal of America is needlessly extravagant.

26. Based on Passage B, the "leading lights of the eighteenth- and nineteenth-century art establishment" (lines 63–64) believed History Painting to be an art form that was:

  F. admired by historians.
  G. trivialized by the general public.
  H. mastered only by gifted artists.
  J. snubbed only by high-minded artists.

27. Which of the following aspects of Marshall's work is addressed in Passage B but not in Passage A?

  A. Honors that Marshall has received for his work
  B. The work's reception by the general public
  C. The work's occasional resemblance to photography
  D. Characteristic elements of the work Marshall creates

28. Which of the following claims from Passage A or Passage B is directly supported by both passage authors?

  F. "Kerry James Marshall knew he wanted to be an artist, but he didn't know what kind" (lines 1–2).
  G. "Marshall settled on creating a body of work inspired by and in dialogue with the classics" (lines 24–25).
  H. "The Tower installation at the National Gallery of Art in 2013 was his first one-person exhibition in Washington" (lines 56–58).
  J. "The selection in the Tower presents Marshall to us as a modern day History Painter" (lines 59–60).

29. Both passages make note of Marshall's use of:

  A. vibrant color.
  B. emblems of African deities.
  C. unique brushstroke techniques.
  D. glitter.

30. Based on the passage authors' remarks about Marshall's paintings, it can reasonably be inferred that both authors perceive Marshall's work as:

  F. heavy-handed in its execution.
  G. intentionally encouraging young black artists.
  H. successful in its ability to convey meaning.
  J. conservative in its approach to the African-American experience.

Passage IV

NATURAL SCIENCE: This passage is from the book *Numericon: A Journey through the Hidden Lives of Numbers* by Marianne Freiberger and Rachel Thomas.

Hexagonal tiles are available from your nearest hardware store, and even nature loves to use them. Bees build a honeycomb of hexagonal wax cells to store pollen and honey and to house the bee larvae.

5 As well as being delicious, honeycomb illustrates a fascinating mathematical idea: a honeycomb is the most efficient way to divide a plane into equal-sized areas, in that it uses the least amount of wax. We have known about this since at least AD 300 when the Greek
10 mathematician Pappus of Alexandria introduced the fifth book in his series *The Mathematical Collection* with a charming diversion called *On the Sagacity of Bees*. People have believed for millennia that this *Honeycomb Conjecture* is true, but it wasn't until 1999 that
15 mathematician Thomas Hales confirmed it with a mathematical proof.

Hales' proof of the Honeycomb Conjecture came shortly after his groundbreaking proof in 1998 of the 400-year-old *Kepler Conjecture*, which essentially said
20 that the most efficient way to stack oranges, in the sense that it leaves the smallest gaps possible, was in the familiar pyramid you see at the greengrocers. The question had been posed in the 16th century by Sir Walter Raleigh (who also brought Europe the potato) to
25 his assistant Thomas Harriot, although Raleigh was thinking of cannon balls rather than oranges. Harriot eventually forwarded the question to Johannes Kepler, and it now bears his name.

Hales' proof of Kepler's Conjecture was ground-
30 breaking because a significant proportion of the proof was done using a computer. Although this was still unusual in 1998 it wasn't entirely new: ever since the computer-assisted proof in 1976 of the *four-colour theorem* (which states that you need no more than four
35 colours to colour any flat map so that no two adjacent countries or regions are shaded in the same colour), the mathematical community has had to come to terms with this drastic change in the nature of mathematical proof. Mathematicians had always prided themselves in need-
40 ing nothing but a pen, paper and their brain to prove a theorem, but now a machine was doing some of the work for them. How could they be sure there wasn't a bug in the code? At the time of Hales' result, the *Annals of Mathematics*, one of the most prestigious journals in
45 mathematics, had been handling computer-assisted proofs for nearly a decade. But Hales' proof was another ballgame altogether: it consisted of 250 pages of traditional mathematical proof and over 3 gigabytes of computer code and data. The *Annals* assembled a
50 team of twelve experts to verify the proof and after four years the best they could say was that they were 99% certain the proof was correct—everywhere they looked it was correct but they had to admit they would never be able to check the whole thing.

55 The *Annals* and other mathematical journals have had to introduce specific policies to deal with computer-assisted proofs: the human part of the proofs is refereed to the same standard as always but the computer parts are treated more like an experiment—the
60 methods are verified and other mathematicians are encouraged to replicate the results, preferably using different methods.

In 1999, just one year after Hales' mammoth proof of Kepler's Conjecture, Hales turned his attention to
65 the problem of honeycombs. Hales said that after his experience with Kepler's Conjecture he had 'come to expect every theorem to be a monumental effort'. To his surprise, his proof of the Honeycomb Conjecture took only six months to complete (compared with
70 'years of forced labor' for the proof of Kepler's), was 'just' twenty pages long and required no significant use of computers: 'I felt as if I'd won the lottery.'

As well as being a win for mathematicians, the Honeycomb Conjecture does have an important conse-
75 quence for bees. The conjecture proves they made a wise decision using the honeycomb structure for their hives: it uses the least amount of wax. And making wax is very expensive for bees: they collectively need to consume about 6 pounds of honey to make one pound
80 of wax, and they'd need to fly the equivalent of 9 times around the world to collect enough pollen to produce that much honey. However, it's unlikely that the reason why bees use a honeycomb structure is because they beat Hales to a proof by millions of years. It's thought
85 they actually build roughly circular cells, which when pressed against each other deform into hexagons, the way soap bubbles form flat sides when they join together.

31. Which of the following events referred to in the passage occurred first chronologically?

   A. Hales completed his proof of the Kepler Conjecture.
   B. Hales completed his proof of the Honeycomb Conjecture.
   C. *Annals of Mathematics* began handling computer-assisted proofs.
   D. The four-color theorem was proven.

32. In the passage, the authors mention the fifth book of Pappus of Alexandria's *The Mathematical Collection* in part to:

    F. indicate the errors made in an early attempt to prove the Honeycomb Conjecture.
    G. describe how the complexities of the Honeycomb Conjecture have baffled mathematicians.
    H. emphasize how much time has passed since the Honeycomb Conjecture was first articulated.
    J. provide an account of the first rebuttal of the Honeycomb Conjecture.

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

    A. desperate.
    B. extreme.
    C. preposterous.
    D. exaggerated.

34. As it is used in line 59, the word *treated* most nearly means:

    F. served.
    G. advised.
    H. consulted.
    J. handled.

35. The main point of the fifth paragraph (lines 55–62) is that:

    A. mathematical journals have implemented new policies that mathematicians follow when verifying the results of computer-assisted proofs.
    B. mathematical journals rarely publish computer-assisted proofs because the methods to verify the proofs are too costly.
    C. mathematicians had to change their methods of verifying the results of proofs completed by hand after the introduction of computer-assisted proofs.
    D. mathematicians prefer verifying the results of proofs completed by hand to verifying the results of computer-assisted proofs.

36. According to the passage, Hales was surprised by his proof of the Honeycomb Conjecture in part because the proof:

    F. required significant use of computers.
    G. required just one mathematician to verify its results.
    H. was a monumental effort.
    J. was just twenty pages long.

37. According to the passage, who made the initial inquiry that led to the Kepler Conjecture?

    A. Harriot
    B. Pappus of Alexandria
    C. Kepler
    D. Raleigh

38. It can reasonably be inferred from the passage that, in 1998, the mathematics community considered the *Annals of Mathematics* to be:

    F. a distinguished journal.
    G. a controversial journal.
    H. an old-fashioned journal.
    J. an amateur journal.

39. According to the passage, how much honey must bees collectively consume to produce 1 pound of wax?

    A. 1 pound
    B. 3 pounds
    C. 6 pounds
    D. 9 pounds

40. Based on the passage, the authors would most likely agree that bees' process for making wax is:

    F. mysterious.
    G. laborious.
    H. imprecise.
    J. evolving.

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

The properties of diesel fuel depend on the source material from which the fuel is made. Petroleum diesel is made from petroleum, and biodiesel is made from plants or algae. Table 1 shows the source material for each of 4 diesel fuel types (Types W, X, Y, and Z).

Table 1	
Type	Source material
W	petroleum
X	dried algae
Y	dried soybeans
Z	soybean oil
Note: Types X, Y, and Z are types of biodiesel.	

Table 2 shows, for Types W, X, Y, and Z, the temperature increase of 100.0 mL of water in an aluminum can when 50 drops of the fuel were burned on a cotton ball below the can.

Table 2	
Type	Temperature increase (°C)
W	16
X	12
Y	14
Z	13

Table 3 shows, for Types W, X, Y, and Z, how long 10.0 mL of the fuel burned in an oil lamp and how long it took for 2.0 mL of the fuel to drain from a pipet at 20°C.

Table 3		
Type	Time lamp burned (min)	Time to drain from pipet (s)
W	20	11
X	19	3
Y	21	4
Z	22	26

Tables 1–3 adapted from Jillian L. Blatti and Michael D. Burkart, "Releasing Stored Solar Energy within Pond Scum: Biodiesel from Algal Lipids." ©2011 by American Chemical Society and Division of Chemical Education, Inc.

1. Which 2 types of diesel fuel were made from the same type of plant?

   A. Types W and X
   B. Types X and Y
   C. Types X and Z
   D. Types Y and Z

2. Based on Tables 1 and 3, was the diesel fuel type that burned for the shortest time in an oil lamp a type of biodiesel?

   F. Yes; Type W was made from petroleum.
   G. Yes; Type X was made from dried algae.
   H. No; Type W was made from petroleum.
   J. No; Type X was made from dried algae.

---

3. Based on Table 3, the time that it took for Type W to drain from a pipet was approximately how many times as great as the time that it took for Type X to drain from a pipet?

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

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

C. 2

D. 4

4. Consider the procedure used to obtain the data shown in Table 2. If the water in the can had an initial temperature of 22°C before the fuel sample was burned, what was the temperature of the water immediately after the Type Z fuel sample was burned?

F. 9°C
G. 13°C
H. 35°C
J. 38°C

5. Suppose that the procedures used to obtain the data shown in Table 2 were repeated except that 200.0 mL of water was in the aluminum can. Would the water temperature increases obtained more likely be greater than or less than the values listed in Table 2?

A. Greater; a larger volume of water would increase in temperature by a greater amount when burning each fuel.
B. Greater; a smaller volume of water would increase in temperature by a greater amount when burning each fuel.
C. Less; a larger volume of water would increase in temperature by a smaller amount when burning each fuel.
D. Less; a smaller volume of water would increase in temperature by a smaller amount when burning each fuel.

6. Consider only the biodiesel fuel types listed in Table 1. Based on Table 2, which of the biodiesel fuel types caused the temperature of the water in the can to increase the most?

F. Type W
G. Type X
H. Type Y
J. Type Z

Passage II

The roots of soybean plants can produce structures called root nodules. Root nodules have been found to contain a certain species of bacteria. Four students each predicted the function of root nodules and the effect of the bacteria on the soybean plants. Then the students conducted an experiment to test their predictions.

Student 1

The function of root nodules is to house the bacteria. Root nodules form only when the bacteria are present. The bacteria convert nitrogen (N_2) in the atmosphere to ammonia (NH_3), which can be more readily used as a nutrient by plants. Thus, the plants will grow larger when the bacteria are present.

Student 2

The function of root nodules is to house the bacteria. Root nodules form regardless of whether the bacteria are present. The bacteria convert N_2 in the atmosphere to NH_3, which can be more readily used as a nutrient by plants. Thus, the plants will grow larger when the bacteria are present.

Student 3

The function of root nodules is to protect the plants from the bacteria. Root nodules form only when the bacteria are present. If the bacteria infect a plant's roots, root nodules grow around the bacteria to keep the bacteria from spreading. The bacteria are harmful to the plants, so the plants will grow larger when the bacteria are absent.

Student 4

The function of root nodules is to protect the plants from the bacteria. Root nodules form regardless of whether the bacteria are present. If the bacteria infect a plant's roots, the plant transports the bacteria to the root nodules to keep the bacteria from spreading. The bacteria are harmful to the plants, so the plants will grow larger when the bacteria are absent.

Experiment

In each of 200 identical pots filled with a sterile soil, a single soybean seed was planted. The bacteria were added to half of the pots, and then all the pots were placed in a greenhouse where they experienced identical growing conditions for 45 days. Then, the average number of root nodules and the average plant dry mass, in the presence of and in the absence of the bacteria, were determined (see Figures 1 and 2, respectively).
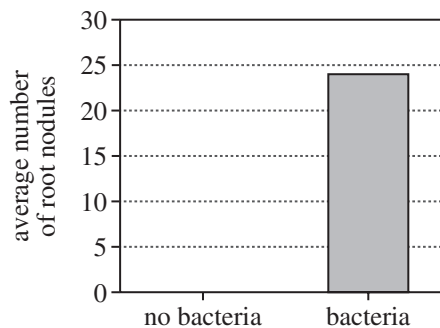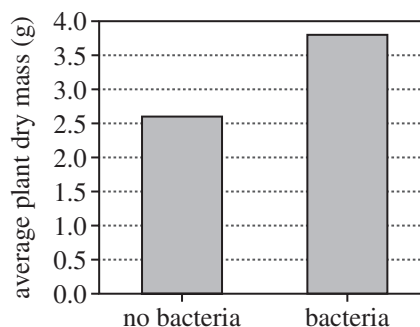

Figure 1

Figure 2

7. Students 2 and 4 both indicated that root nodules:

A. form only when the bacteria are present.
B. form whether the bacteria are present or not.
C. provide a place for helpful bacteria to live.
D. keep bacteria from spreading to other parts of the plant.

8. Suppose that an additional study showed that if the bacteria were present, soybean plants required less fertilizer to reach their maximum size. This result would support the prediction(s) of which of the students?

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

9. How did the students ensure that the bacteria were present in only half of the pots? They filled the pots with a:

A. sterile soil and added the bacteria to 100 of the pots.
B. sterile soil and added the bacteria to 200 of the pots.
C. nonsterile soil and added the bacteria to 100 of the pots.
D. nonsterile soil and added the bacteria to 200 of the pots.

10. Are the results for average plant dry mass more consistent with the prediction of Student 2 or with the prediction of Student 3?

F. Student 2; Student 2 predicted that the plants would grow larger when the bacteria were present.
G. Student 2; Student 2 predicted that the plants would grow larger when the bacteria were absent.
H. Student 3; Student 3 predicted that the plants would grow larger when the bacteria were present.
J. Student 3; Student 3 predicted that the plants would grow larger when the bacteria were absent.

11. Consider the 2 organisms discussed in the passage. Which of the students, if any, indicated that the prokaryote harms the eukaryote?

A. Students 1 and 3 only
B. Students 1 and 2 only
C. Students 3 and 4 only
D. None of the students

12. Before the experiment, which of Students 1 and 4, if either, would have been likely to predict that the average plant dry mass would be the same for the plants grown in the presence of bacteria and for the plants grown in the absence of bacteria?

F. Student 1 only
G. Student 4 only
H. Both Student 1 and Student 4
J. Neither Student 1 nor Student 4

13. How many of the students, if any, stated that the bacteria must produce nitrogen to infect a plant's roots?

A. 0
B. 2
C. 3
D. 4

Passage III

A *Newton's cradle* consists of a row of metal spheres hung by strings from a frame (see the diagram). When a sphere at one end of the row (the *colliding sphere*) is pulled back and released, it collides with the rest of the spheres in the row, and a sphere at the other end of the row (the *ejected sphere*) swings out.

diagram
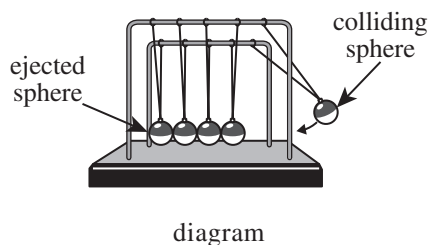
A Newton's cradle was built such that different numbers and sizes of spheres could be hung from the frame. Two sizes of spheres were tested. The small spheres had a diameter of 2.5 cm and a mass of 67 g, and the large sphere had a diameter of 3.8 cm and a mass of 226 g.

Scientists performed 2 studies with the Newton's cradle to examine the time between collision and ejection.

Study 1

A series of 9 trials were conducted: 3 trials at each of 3 *release heights* (the height to which the colliding sphere was pulled back). For each release height, a row of 3 small spheres, a row of 4 small spheres, and a row of 5 small spheres were tested.

For each trial, the colliding sphere was pulled back and dropped from the specified release height. The *interaction time* (the time between when the colliding sphere struck the rest of the row and when the ejected sphere swung out), in microseconds (μs), was measured.

The results are shown in Figure 1. Each data point represents 1 trial.
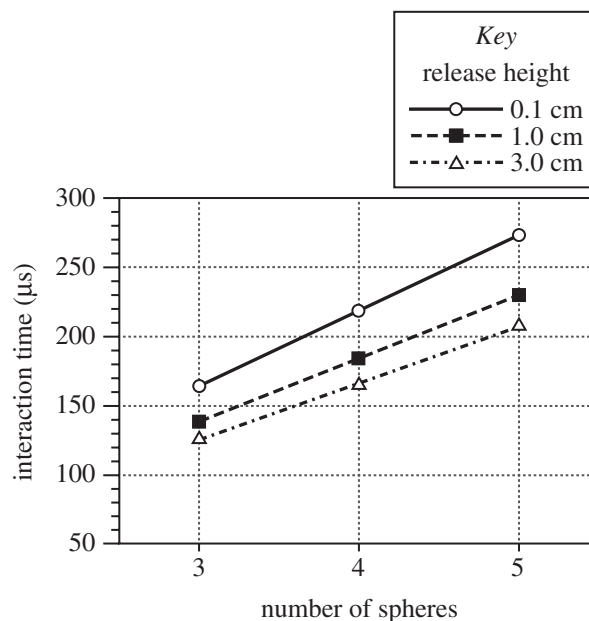
Figure 1

Study 2

The procedures of Study 1 were repeated, except that in each trial, the ejected sphere was a large sphere and the others were small spheres. The results are shown in Figure 2.
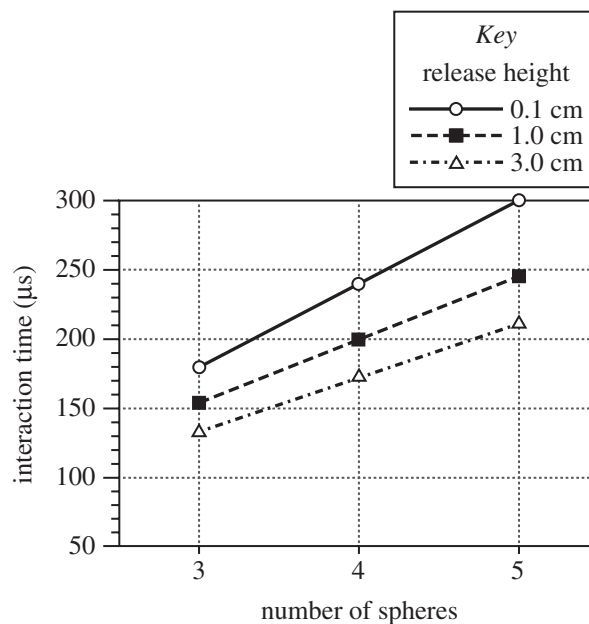

Figure 2

14. In which of the following ways did Study 1 differ from Study 2 ? In Study 1:

   F. rows containing only small spheres were tested, whereas in Study 2, rows containing both large and small spheres were tested.

   G. rows containing both large and small spheres were tested, whereas in Study 2, rows containing only small spheres were tested.

   H. only 3 release heights were tested, whereas in Study 2, 6 release heights were tested.

   J. 6 release heights were tested, whereas in Study 2, only 3 release heights were tested.

15. Based on the results of Study 2, at a release height of 3.0 cm, the interaction time for the row of 4 spheres was closest to which of the following?

   A. 175 μs
   B. 200 μs
   C. 225 μs
   D. 250 μs

16. Upon completion of both studies, a total of how many trials had been conducted?

   F. 3
   G. 6
   H. 9
   J. 18

17. Based on the descriptions of the spheres used in the studies, a row of 4 small spheres would have what length?

   A. 5.5 cm
   B. 7.0 cm
   C. 8.5 cm
   D. 10.0 cm

18. Consider the results of Studies 1 and 2 for a release height of 0.1 cm. Prior to the studies, a scientist predicted that, for rows having the same number of spheres, interaction times for trials involving a large sphere would be longer than the trials involving only small spheres. Is this prediction supported by those results?

   F. Yes; for rows with the same number of spheres, the interaction time in Study 1 was longer than the corresponding interaction time in Study 2.

   G. Yes; for rows with the same number of spheres, the interaction time in Study 2 was longer than the corresponding interaction time in Study 1.

   H. No; for rows with the same number of spheres, the interaction time in Study 1 was longer than the corresponding interaction time in Study 2.

   J. No; for rows with the same number of spheres, the interaction time in Study 2 was longer than the corresponding interaction time in Study 1.

19. Consider the results of the Study 1 trials in which a release height of 1.0 cm was tested. For each small sphere added to the row, the interaction time increased by a value closest to which of the following?

   A. 5 μs
   B. 25 μs
   C. 45 μs
   D. 65 μs

20. Suppose that Study 2 had included a trial in which a row of 5 spheres and a release height of 0.6 cm had been tested. The interaction time measured for that trial would most likely have been:

   F. less than 215 μs.
   G. between 215 μs and 250 μs.
   H. between 250 μs and 300 μs.
   J. greater than 300 μs.

Passage IV

In the area of an ocean shoreline, the element *selenium* (Se) was found attached to particles of *organic matter* (OM) that were present in the sediment of a salt grass marsh and in the sediment of a tidal flat (see Figure 1).
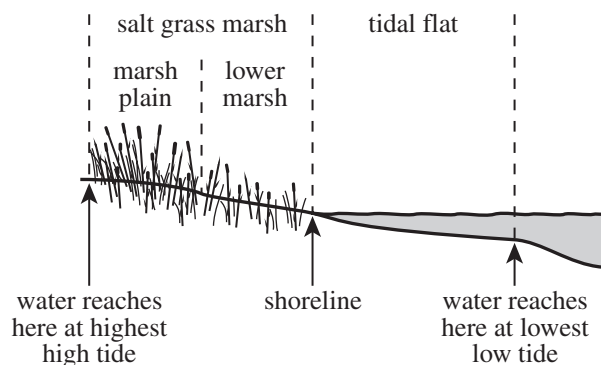
Figure 1

Three cylindrical core samples of the top 20 cm of sediment were collected: one from the marsh plain, one from the lower marsh, and one from the tidal flat. Sediment from each of 9 different depths in each core was analyzed for Se and for OM. Figure 2 shows the average Se contents, in mg/kg, and Figure 3 shows the average OM contents, in percent by mass.
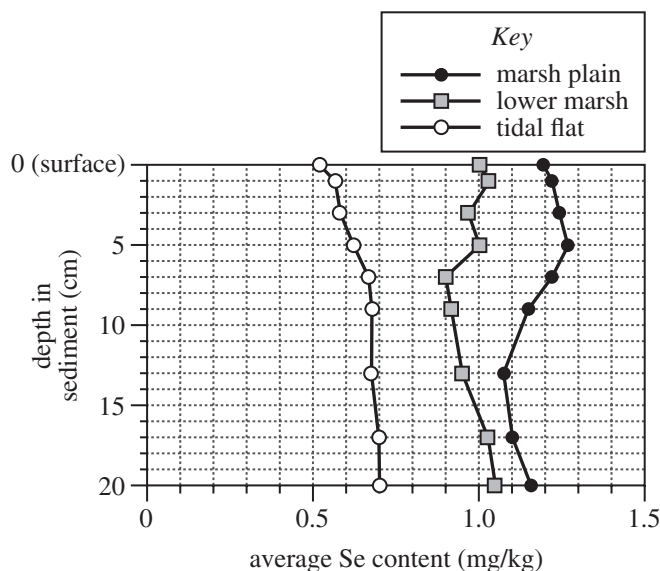
Figure 2
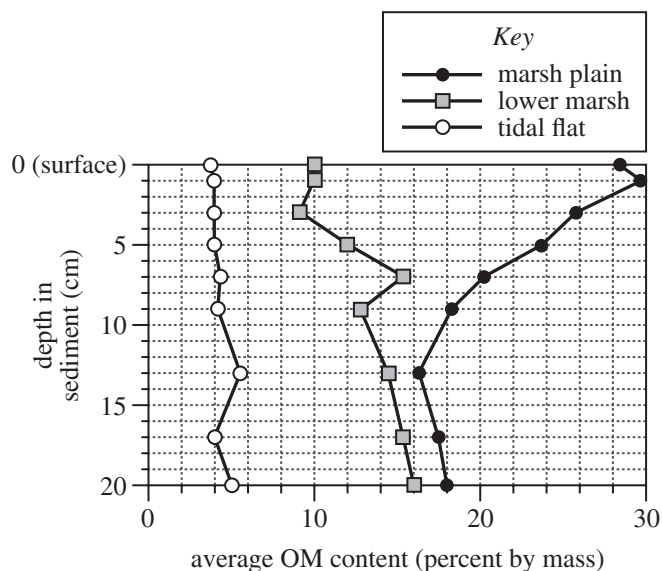
Figure 3

Figures 2 and 3 adapted from P. T. Zawislansky et al., "Selenium Distribution and Fluxes in Intertidal Wetlands, San Francisco Bay, California." ©2001 by the American Society of Agronomy, the Crop Science Society of America, and the Soil Science Society of America.

21. Based on Figure 2, which of the following graphs best shows the average Se contents of the sediments taken from a depth of 7 cm ?

GO ON TO THE NEXT PAGE.
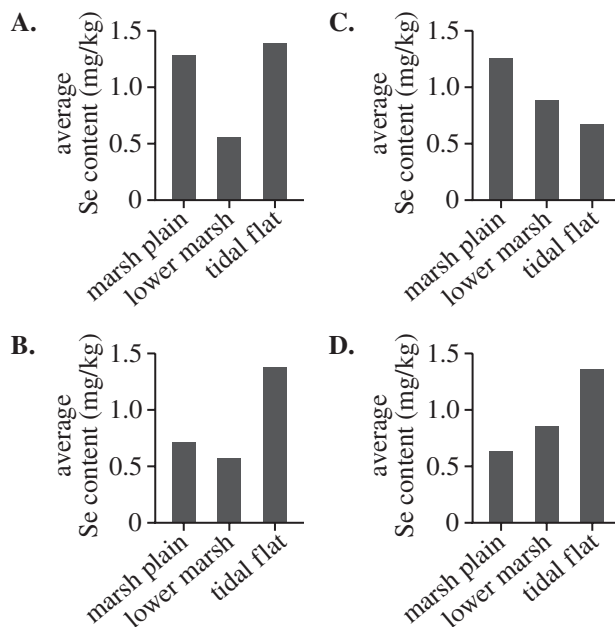
22. According to Figure 3, the average OM contents, in percent by mass, of the marsh plain sediment and the lower marsh sediment taken from a depth of 5 cm were closest to which of the following?

	marsh plain	lower marsh
F.	4	12
G.	12	4
H.	24	12
J.	24	24

23. According to Figures 2 and 3, at any given depth from 0 cm through 20 cm, what is the order of the 3 types of sediment according to Se content and OM content, respectively, from least to greatest?

(Note: The responses below use the abbreviations MP for "marsh plain," LM for "lower marsh," and TF for "tidal flat.")

	Se content	OM content
A.	MP, TF, LM	MP, TF, LM
B.	TF, MP, LM	MP, TF, LM
C.	MP, TF, LM	TF, MP, LM
D.	TF, LM, MP	TF, LM, MP

24. According to Figure 2, at which of the following depths were the average Se contents of the marsh plain sediment and the lower marsh sediment closest in value?

F. 0 cm
G. 5 cm
H. 13 cm
J. 17 cm

25. According to Figure 3, the average OM content of the lower marsh sediment was greatest at which depth?

A. 5 cm
B. 10 cm
C. 15 cm
D. 20 cm

26. Suppose that the core samples had included sediment taken from a depth of 21 cm. Based on Figure 2, the average Se content of the tidal flat sediment taken from that depth would most likely have been:

F. less than 0.55 mg/kg.
G. between 0.55 mg/kg and 0.65 mg/kg.
H. between 0.65 mg/kg and 0.75 mg/kg.
J. greater than 0.75 mg/kg.

Passage V

Spectrophotometry is a method used to determine the amount of light that is absorbed by a substance in a solution. The method involves adding a sample of a solution to a cuvette (a small vial), placing the cuvette into a spectrophotometer, and then sending a beam of light at a particular wavelength through the cuvette (see Figure 1). The absorbance (A) of the solution is a measure of the portion of light that does not reach the detector and depends on light wavelength, solution concentration, and cuvette width.
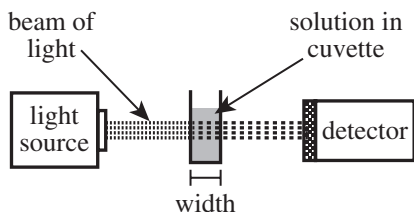
Figure 1

Two experiments were performed to determine the A of samples of aqueous nickel (Ni^{2+}) solutions at various concentrations in grams/liter (g/L). The A for each sample was determined at a wavelength of 710 nanometers (nm; 1 nm = 1×10^{-9} m). During both experiments, just before each trial was run, the spectrophotometer was calibrated with a sample that has zero absorbance by passing light through a cuvette that contained only distilled water.

Experiment 1

For each of Trials 1–6, a sample of an aqueous solution having a different Ni^{2+} concentration was placed into a new cuvette. All the cuvettes were identical in each trial. The A of each solution was measured, and the results are shown in Table 1.

| Trial | Table 1 | |
	Ni^{2+} concentration (g/L)	A
1	2.3	0.048
2	4.7	0.098
3	9.4	0.195
4	14.1	0.274
5	18.8	0.369
6	23.5	0.444

Experiment 2

Samples of a 5.9 g/L aqueous Ni^{2+} solution were placed into 4 separate cuvettes (Trials 7–10). Each cuvette had a different width in millimeters (mm). The A of each solution was measured, and the results are shown in Table 2.

| Trial | Table 2 | |
	Cuvette width (mm)	A
7	10.0	0.112
8	15.0	0.168
9	20.0	0.224
10	30.0	0.336

27. Which of the following variables was held constant in Experiment 1 but intentionally varied in Experiment 2?

   A. Cuvette width
   B. Light wavelength
   C. Sample absorbance
   D. Ni^{2+} concentration

28. The following table shows wavelength ranges for colors of visible light.

Color	Wavelength range (nm)
Violet	400–450
Blue	451–480
Green	481–560
Yellow	561–590
Red	591–720

Based on this table, what was the color of light that came out of the light source?

   F. Blue
   G. Green
   H. Yellow
   J. Red

GO ON TO THE NEXT PAGE.

29. Consider the following steps that were performed in each trial of Experiment 2.

    1. Place the sample in a cuvette.
    2. Place the cuvette in the spectrophotometer.
    3. Measure the *A* of the sample.
    4. Send light through the sample.

These steps were performed in what order?

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

30. Before the experiments, a student claimed that a doubling of the cuvette width between 2 individual trials would result in a doubling of the value of *A*. Are the results shown in Table 2 consistent with this claim?

  F. Yes; cuvette width was doubled from Trial 7 to Trial 8 and from Trial 9 to Trial 10, each resulting in a doubling of the value of *A*.
  G. Yes; cuvette width was doubled from Trial 7 to Trial 9 and from Trial 8 to Trial 10, each resulting in a doubling of the value of *A*.
  H. No; cuvette width was doubled from Trial 7 to Trial 8 and from Trial 9 to Trial 10, but the value of *A* did not double in either case.
  J. No; cuvette width was doubled from Trial 7 to Trial 9 and from Trial 8 to Trial 10, but the value of *A* did not double in either case.

31. Consider the charge of the nickel ion that was in the solutions analyzed in the experiments. To create a nickel ion with that particular charge, 2 subatomic particles were either gained or lost by a neutral nickel atom. What were these 2 particles, and were they gained or lost?

  A. Electrons; gained
  B. Electrons; lost
  C. Protons; gained
  D. Protons; lost

32. What is the meaning of the value for the solution concentration that was tested in Trial 5?

  F. 1 L of solution contains 18.8 g of dissolved Ni^{2+}.
  G. 1 g of solution contains 18.8 L of dissolved Ni^{2+}.
  H. 18.8 L of solution contains 1 g of dissolved Ni^{2+}.
  J. 18.8 g of solution contains 1 L of dissolved Ni^{2+}.

33. Based on the results of Experiments 1 and 2, did a greater amount of light reach the detector in Trial 3 or in Trial 10?

  A. Trial 3; the *A* for Trial 3 was higher than the *A* for Trial 10.
  B. Trial 3; the *A* for Trial 3 was lower than the *A* for Trial 10.
  C. Trial 10; the *A* for Trial 10 was higher than the *A* for Trial 3.
  D. Trial 10; the *A* for Trial 10 was lower than the *A* for Trial 3.

Passage VI

Certain strains of bacteria can communicate by releasing and detecting the molecule VAI. When the released VAI reaches a certain concentration in the environment, the bacteria respond by producing light. Scientists conducted 2 experiments to examine the relationship between the number of bacteria present and the production of light in 3 bacteria strains (Strains P, Q, and R) that differed only in their ability to release or to detect VAI (see Table 1).

Table 1		
Strain	Release VAI?	Detect VAI?
P	yes	yes
Q	no	yes
R	yes	no

Figure 1

Experiment 1

The scientists placed 1 L of a growth medium without VAI into a flask. Then, they added 1×10^6 cells of Strain P to the flask. The flask was placed in a 28°C incubator that rotated at a rate of 500 rotations per minute for 24 hr. These procedures were repeated for each of Strains Q and R.

Every 4 hr during the incubation period, a 1 mL sample was removed from each flask and was used to determine the *optical density* (OD; a measurement directly proportional to the number of bacteria cells in a sample) for each strain (see Table 2).

Table 2						
	OD at time (hr):					
Strain	4	8	12	16	20	24
P	0.6	1.0	1.4	1.3	1.3	1.3
Q	0.4	1.1	1.2	1.2	1.2	1.2
R	0.3	0.8	1.1	1.1	1.2	1.2

A detector inside the incubator continuously recorded the *relative light units* (RLU) produced by the cells in each flask. Figure 1 shows the RLU values recorded for each strain over the 24 hr incubation.
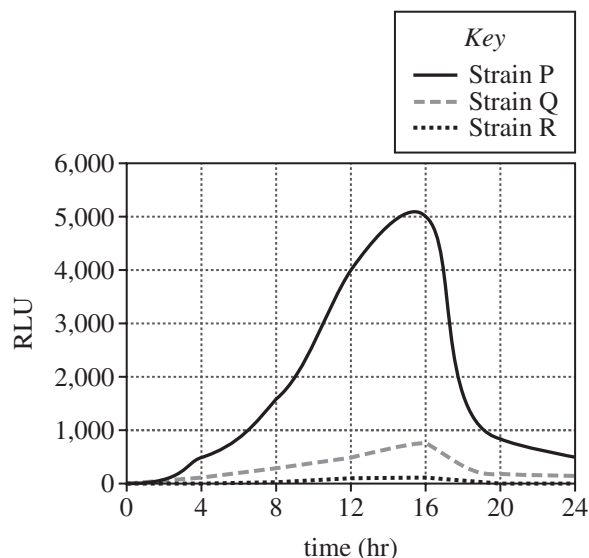
Experiment 2

Experiment 1 was repeated except that the growth medium in each flask contained VAI at a concentration of 5 nanograms per liter. The OD values for each strain were identical to those in Table 2. The RLU values recorded for each strain over the 24 hr incubation are shown in Figure 2.
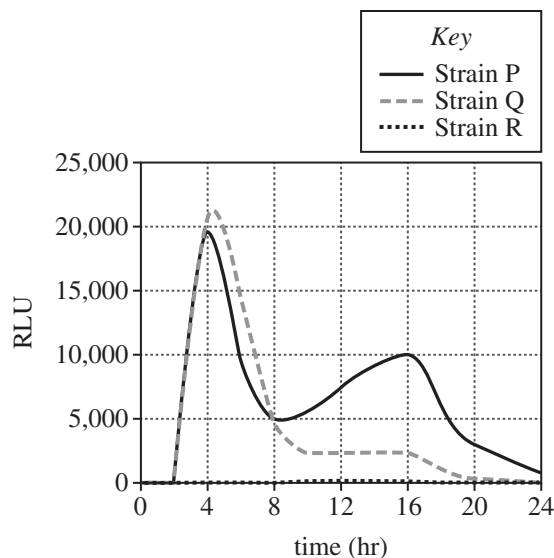

Figure 2

Figures adapted from K. E. Eboigbodin and G. K. Robinson, "Monitoring Bacterial Cell-to-Cell Communication 'Quorum Sensing' Using FLUOstar OPTIMA." ©2009 by BMG LABTECH GmbH.

34. Which of the following conditions was different in Experiment 1 than in Experiment 2?

   F. Number of cells added to each flask
   G. Rotations per minute during incubation
   H. Amount of VAI added to the growth medium
   J. Temperature at which the flasks were incubated

35. Based on the results of Experiment 1, between 4 hr and 8 hr, the RLU values for Strain P:

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

36. Based on the results of Experiment 1, at 8 hr was there a greater number of cells in the flask with Strain Q or in the flask with Strain R?

   F. Strain Q, because it had the higher OD.
   G. Strain Q, because it had the lower OD.
   H. Strain R, because it had the higher OD.
   J. Strain R, because it had the lower OD.

37. Based on the results of Experiment 2 and Table 2, for Strain Q, the greatest RLU was recorded when the OD was closest to which of the following values?

   A. 0.4
   B. 0.8
   C. 1.2
   D. 1.3

38. Suppose the strains in Experiment 1 had each been grown in 2 L of the growth medium. How many cells would the scientists have needed to add to each flask so that the initial number of cells *per liter* would have been the same as described in the passage?

   F. 1×10^3 cells
   G. 1×10^6 cells
   H. 2×10^3 cells
   J. 2×10^6 cells

39. Some species of squid provide shelter for Strains P and R and use the light produced to help capture prey. Is the relationship between squid and the strains better described as parasitic or mutualistic, and based on Figure 1, would Strain P or Strain R more likely produce *less* light for the squid?

   A. Parasitic; Strain P
   B. Parasitic; Strain R
   C. Mutualistic; Strain P
   D. Mutualistic; Strain R

40. In Experiment 1, between each sample removal, approximately how many times did a flask rotate?

   F. 500
   G. 2,000
   H. 30,000
   J. 120,000

END OF TEST 4

STOP! DO NOT RETURN TO ANY OTHER TEST.

Scoring Guide

Raw Scores

The number of questions you answered correctly on each test section is a raw score. Because there are many forms of the ACT, each with different questions, the difficulty level varies between the forms. A raw score of 35 on one form of the mathematics test section, for example, may be about as difficult to earn as a raw score of 37 on another form of that test section.

Computing raw scores: To compute your raw scores, check your answers with the scoring information in the scoring keys and conversion table and do the following:

1. Mark a one (1) in the blank for each question answered correctly.
2. Count the number of correct answers for each of the four multiple-choice test sections.
3. Add up the total number correct for each category and test section and capture it as directed above its scoring key.

These numbers are your raw scores on the individual multiple-choice test sections. The highest raw score for a given test section is the number of questions included on that test section:

- English: 75
- Mathematics: 60
- Reading: 40
- Science: 40

Note: Raw scores are also provided as part of the Summary Report for each test section taken online in TestNav.

English Test 1 Section

English Scoring Key *(for Form H11)*

English Reporting Categories
(Capture raw scores/correct answers.)

Production of Writing (POW) = ___ of 23

Knowledge of Language (KLA) = ___ of 12

Conventions of Standard English (CSE) = ___ of 40

Total English (POW + KLA + CSE) = ___ of 75

English Number	Correct Answer	Correct (Mark 1)	Reporting Categories
1	A		CSE
2	H		CSE
3	A		CSE
4	J		KLA
5	D		POW
6	H		CSE
7	A		KLA
8	G		CSE
9	A		POW
10	J		CSE
11	A		POW
12	J		CSE
13	C		POW
14	J		POW
15	B		POW
16	F		POW
17	C		KLA
18	H		CSE
19	D		CSE
20	J		CSE
21	B		POW
22	F		POW
23	A		CSE
24	J		KLA
25	C		CSE

English Number	Correct Answer	Correct (Mark 1)	Reporting Categories
26	H		CSE
27	A		KLA
28	F		CSE
29	B		POW
30	H		POW
31	D		POW
32	G		CSE
33	B		POW
34	H		CSE
35	B		CSE
36	J		CSE
37	D		KLA
38	J		POW
39	B		POW
40	F		CSE
41	D		CSE
42	H		POW
43	B		KLA
44	J		KLA
45	C		CSE
46	J		KLA
47	B		CSE
48	G		POW
49	C		POW
50	G		CSE

English Number	Correct Answer	Correct (Mark 1)	Reporting Categories
51	A		CSE
52	F		CSE
53	B		CSE
54	F		POW
55	C		CSE
56	J		CSE
57	A		CSE
58	J		CSE
59	A		CSE
60	H		POW
61	D		KLA
62	G		CSE
63	C		KLA
64	H		CSE
65	B		POW
66	G		CSE
67	C		KLA
68	J		CSE
69	D		CSE
70	F		CSE
71	B		POW
72	J		CSE
73	C		CSE
74	H		CSE
75	B		POW

Mathematics Test 2 Section

Mathematics Scoring Key *(for Form H11)*

Mathematics Reporting Categories
(Capture raw scores/correct answers.)

Preparing for Higher Math (PHM) = ___ of 36
  (A + F + G + N + S)
    A = Algebra
    F = Functions
    G = Geometry
    N = Number & Quantity
    S = Statistics & Probability

Integrating Essential Skills (IES) = ___ of 24

Modeling (MDL) = ___ of 19

Total Mathematics (PHM + IES) = ___ of 60

Note: Do not include MDL in Total Mathematics raw score.

Math Number	Correct Answer	Correct (Mark 1)	Reporting Categories
1	A		IES
2	K		PHM-S
3	C		PHM-S, MDL
4	H		IES, MDL
5	C		IES, MDL
6	H		IES
7	B		IES
8	G		IES
9	D		IES
10	G		PHM-N
11	E		PHM-F
12	J		IES
13	A		PHM-A, MDL
14	G		PHM-F
15	B		IES
16	G		IES, MDL
17	C		IES
18	F		PHM-A
19	B		PHM-A
20	G		PHM-N
21	B		IES, MDL

Math Number	Correct Answer	Correct (Mark 1)	Reporting Categories
22	H		PHM-G
23	A		PHM-G, MDL
24	G		PHM-A
25	E		IES
26	G		PHM-G
27	D		PHM-F, MDL
28	F		IES, MDL
29	E		IES
30	J		PHM-A, MDL
31	C		PHM-F
32	J		PHM-G, MDL
33	E		PHM-N
34	H		PHM-N
35	A		IES, MDL
36	F		PHM-F
37	B		PHM-S
38	K		PHM-N
39	C		PHM-S
40	J		PHM-A
41	E		PHM-S, MDL
42	H		PHM-G
43	B		PHM-G
44	F		IES
45	D		PHM-N
46	J		IES, MDL
47	E		IES, MDL
48	J		IES, MDL
49	A		PHM-F
50	F		PHM-A
51	B		IES
52	F		PHM-G, MDL
53	D		PHM-A
54	K		IES
55	C		IES
56	K		PHM-F
57	E		IES, MDL
58	J		PHM-S, MDL
59	A		PHM-F
60	K		PHM-G

Reading Test 3 Section

Reading Scoring Key *(for Form H11)*

Reading Reporting Categories
(Capture raw scores/correct answers.)

Key Ideas & Details (KID) = ___ of 24

Craft & Structure (CS) = ___ of 11

Integration of Knowledge & Ideas (IKI) = ___ of 5

Total Reading (KID + CS + IKI) = ___ of 40

Reading Number	Correct Answer	Correct (Mark 1)	Reporting Categories
1	C		KID
2	H		CS
3	D		KID
4	G		CS
5	B		KID
6	G		KID
7	A		KID
8	G		CS
9	C		KID
10	F		KID
11	C		CS
12	J		CS
13	C		KID
14	H		KID

Reading Number	Correct Answer	Correct (Mark 1)	Reporting Categories
15	D		KID
16	F		KID
17	C		IKI
18	F		KID
19	A		KID
20	G		CS
21	C		KID
22	J		CS
23	B		KID
24	G		CS
25	A		KID
26	H		KID
27	A		IKI
28	G		IKI
29	A		IKI
30	H		IKI
31	D		KID
32	H		CS
33	B		CS
34	J		CS
35	A		KID
36	J		KID
37	D		KID
38	F		KID
39	C		KID
40	G		KID

Science Test 4 Section

Science Scoring Key (for Form H11)

Science Reporting Categories
(Capture raw scores/correct answers.)

Interpretation of Data (IOD) = ___ of 18

Scientific Investigation (SIN)= ___ of 10

Evaluation of Models, Inferences
& Experimental Results (EMI) = ___ of 12

Total Science (IOD + SIN + EMI) = ___ of 40

Science Number	Correct Answer	Correct (Mark 1)	Reporting Categories
1	D		IOD
2	G		IOD
3	D		IOD
4	H		IOD
5	C		SIN
6	H		IOD
7	B		EMI
8	G		EMI
9	A		SIN
10	F		EMI
11	C		EMI
12	J		EMI
13	A		EMI
14	F		SIN

Science Number	Correct Answer	Correct (Mark 1)	Reporting Categories
15	A		IOD
16	J		SIN
17	D		IOD
18	G		EMI
19	C		IOD
20	H		SIN
21	C		IOD
22	H		IOD
23	D		IOD
24	J		IOD
25	D		IOD
26	H		IOD
27	A		SIN
28	J		IOD
29	B		SIN
30	G		EMI
31	B		EMI
32	F		IOD
33	B		EMI
34	H		SIN
35	B		IOD
36	F		EMI
37	A		IOD
38	J		SIN
39	D		EMI
40	J		SIN

Scale Scores

To adjust for the small differences among different forms of the ACT test, raw scores are converted into scale scores. Scale scores appear on reports sent to your school.

When your raw scores are converted into scale scores, it becomes possible to compare your scores with those of examinees who took different test forms. For example, a scale score of 26 on the mathematics test section has the same meaning for any form of the ACT.

Converting Raw Scores to Scale Scores

Each ACT test section generates a single scale score of 1–36. Use the Conversion of Raw Scores to Scale Scores table to convert your raw scores to scale scores. For each test section:

1. Locate your raw score, or the range of raw scores that includes it, in the conversion table.
2. Locate the cell in the Scale Score column of the row that corresponds to that raw score to identify the scale score for that test section.
3. As you determine your scale scores, enter them in the blanks below.

Test section scale scores:

English = ___

Mathematics = ___

Reading = ___

Science = ___

Calculating a Composite Score

An ACT test generates a single Composite score of 1–36. Compute the Composite score by averaging the four scale scores. To do this:

1. Add your four scale scores. Enter this sum of scores in the blank below.
2. Divide the sum by 4. If the resulting number ends in a fraction, round it to the nearest whole number. (Round down any fraction less than one-half, except for averages lower than one; round up any fraction that is one-half or more and/or less than one.)
3. Enter this number in the blank below. This is your Composite score.

Composite of scale scores:

Sum of scores = ___

Composite score (sum ÷ 4) = ___

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

Conversion of Raw Scores to Scale Scores *(for Form H11)*

Scale Score	Raw Score Test 1: English	Raw Score Test 2: Mathematics	Raw Score Test 3: Reading	Raw Score Test 4: Science
36	74–75	59–60	38–40	40
35	71–73	57–58	37	39
34	69–70	56	35–36	38
33	68	55	34	—
32	67	53–54	33	37
31	66	52	32	36
30	65	50–51	31	35
29	64	48–49	30	—
28	62–63	46–47	—	34
27	61	44–45	29	33
26	59–60	41–43	28	32
25	57–58	39–40	—	30–31
24	54–56	37–38	27	28–29
23	52–53	35–36	25–26	25–27
22	50–51	34	24	24
21	46–49	32–33	23	22–23
20	43–45	30–31	21–22	21
19	41–42	29	20	19–20
18	39–40	26–28	19	17–18
17	37–38	23–25	18	15–16
16	35–36	18–22	17	13–14
15	31–34	15–17	16	12
14	28–30	11–14	15	11
13	25–27	9–10	14	10
12	23–24	7–8	12–13	9
11	20–22	6	9–11	8
10	17–19	5	8	7
9	15–16	4	7	6
8	13–14	—	6	5
7	10–12	3	5	4
6	8–9	2	4	3
5	6–7	—	3	—
4	5	1	—	2
3	3–4	—	2	1
2	2	—	1	—
1	0–1	0	0	0