# Form D05

(April 2021)

The **ACT**®   2020 | 2021

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.

# 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.

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**PASSAGE I**

### Beat Nation

[1]

A cymbal skitters over a powwow chant. The intonations of the Cree language create a staccato soundscape. Artist Jordan Bennett adorns skateboard decks with traditional beadwork. <u>Dylan Miner is adding painted hides to bikes which are lowriders.</u>[1] *Beat Nation*, an art exhibition and website, showcases

works from Vancouver's Indigenous art scene. [2]

1. Which choice most closely maintains the sentence pattern the writer establishes in the first three sentences of the essay?
   A. NO CHANGE
   B. Adding painted hides to lowrider bikes is done by Dylan Miner.
   C. On lowrider bikes, Dylan Miner has added painted hides.
   D. Dylan Miner adds painted hides to lowrider bikes.

2. At this point, the writer is considering adding the following true statement to the essay:

   > The greater Vancouver area's population is around 2.4 million people.

   Should the writer make this addition here?
   F. Yes, because it adds to the paragraph's description of *Beat Nation*'s impact on viewers.
   G. Yes, because it is relevant to the paragraph's discussion of how various hip-hop art forms originated.
   H. No, because it is irrelevant to the paragraph's introduction of *Beat Nation*.
   J. No, because it adds nothing to the paragraph's description of different Indigenous languages spoken in Vancouver.

**GO ON TO THE NEXT PAGE.**

The works fusing graffiti, b-boying, MCing, and other
hip-hop art forms with traditional Native culture. [A]
The artists strive not only to challenge stereotypes
but also to provide a new lens for young people to
explore their Indigenous roots.

[2]

Tania Willard, *Beat Nation*'s cofounder, traces
the show's origins back to a powwow she attended in
the 1990s. Standing amongst drummers from Canada's
Secwepemc nation, an Indigenous break-dancing crew
six-stepped and moonwalked to the rhythms of traditional
hand drums. For Willard, the powwow represented the
culmination of a generational trend. Throughout the
1990s, many Indigenous young people left Canada's
rural territories for Vancouver's city streets. There,
in Vancouver, they discovered hip-hop and used it as
a means of self-expression. [B] In 2006, Willard began

highlighting their talents by promoting their work.

[3]

The website took off, becoming a hub of
Indigenous culture while also broadcasting political

messages. However, on the site, MC Geronimo Inutiq
raps about pollution that has affected Indigenous

territories. [C] Corey Bulpitt, a graffiti artist, to spraypaint
traditional Haida imagery in his mural *Raven*, located in
downtown Vancouver. On the Beat Nation website,
Bulpitt explains, that the mural expresses how Haida
natives have reclaimed space within the cityscape.

3. A. NO CHANGE
   B. works fuse
   C. works to fuse
   D. works, which fuse

4. F. NO CHANGE
   G. powwow, she attended,
   H. powwow, she attended
   J. powwow she attended,

5. A. NO CHANGE
   B. no longer in Canada's rural territories,
   C. now in the city of Vancouver,
   D. DELETE the underlined portion.

6. Which choice provides the clearest transition to the next paragraph?
   F. NO CHANGE
   G. around Vancouver.
   H. online.
   J. herself.

7. A. NO CHANGE
   B. in it becoming
   C. for becoming
   D. to become

8. F. NO CHANGE
   G. For example,
   H. Either way,
   J. Even so,

9. A. NO CHANGE
   B. spraypainter of
   C. spraypainting
   D. spraypaints

10. F. NO CHANGE
    G. Bulpitt explains
    H. explains Bulpitt,
    J. Bulpitt's explanation

**GO ON TO THE NEXT PAGE.**

[4]

Selected artworks from the Beat Nation site

<u>has been</u> shown in Vancouver's Grunt Gallery,
<sub>11</sub>

<u>in Musée d'Art Contemporain in Montreal,</u> and Toronto's
<sub>12</sub>
Power Plant. [D] The artists in *Beat Nation* continue to

spread their message by collaborating with Idle No More,

<u>a political group promoting Indigenous rights.</u> "We're not
<sub>13</sub>

idle anymore," Inutiq <u>muses.</u> "We're agents of change."
<sub>14</sub>

**11.** **A.** NO CHANGE
 **B.** have been
 **C.** was
 **D.** is

**12.** **F.** NO CHANGE
 **G.** showing at the Montreal museum Musée d'Art Contemporain,
 **H.** seen at Musée d'Art Contemporain located in Montreal,
 **J.** Montreal's Musée d'Art Contemporain,

**13.** Given that all the choices are accurate, which one provides the most relevant information at this point in the essay?
 **A.** NO CHANGE
 **B.** an organization located in Canada.
 **C.** a group that utilizes social media.
 **D.** which was founded in 2012.

**14.** Which choice most clearly indicates that Inutiq is speaking decisively?
 **F.** NO CHANGE
 **G.** suggests.
 **H.** asserts.
 **J.** implies.

Question 15 asks about the preceding passage as a whole.

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

> Videographer Jackson 2Bears criticizes popular culture's stereotypical representations of Native populations.

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

 **A.** Point A in Paragraph 1.
 **B.** Point B in Paragraph 2.
 **C.** Point C in Paragraph 3.
 **D.** Point D in Paragraph 4.

**PASSAGE II**

### What's Shaking, Tree Frog?

Red-eyed tree frogs (*Agalychnis callidryas*) lay their eggs in clutches, gelatinous sacs of dozens of eggs, on tree leaves that dangle over ponds and swamps. Mature tadpoles hatch in six to eight days, gently dropping into the water. Though the egg clutches are safer when stuck to a leaf, than they would be drifting in a pond snakes can find and eat them. Fortunately, the clutches have a defense. As a snake attacks an *A. callidryas* egg clutch, the tadpoles that haven't been harmed hatch prematurely. As early as four days into development, the tadpoles can burst out of their eggs to swim away.

Biologist, Karen Warkentin, wanted to determine why the egg clutches react to being shaken and tugged during a snake attack they rarely react to being jostled during a rainstorm. She inserted devices called accelerometers, which measure and record the frequency of vibrations, into egg clutches at Ocelot Pond, near Gamboa, Panama. Her recordings revealed that a snake attack and a rainstorm each cause sustained low-frequency vibrations of the egg clutch. However, it also showed that a rainstorm usually produces short periods of significantly higher-frequency vibrations.

16. **F.** NO CHANGE
    **G.** leaf, than they would be drifting, in a pond,
    **H.** leaf than they would be drifting in a pond,
    **J.** leaf than they would be drifting in a pond

17. If the writer were to delete the underlined portion (adjusting the capitalization as needed), the essay would primarily lose a detail that:
    **A.** states the age at which a hatched tadpole will have the best survival rate.
    **B.** explains why the tadpoles sometimes hatch after four days.
    **C.** suggests the typical age of a tadpole when it hatches.
    **D.** indicates how early the tadpoles are able to hatch.

18. **F.** NO CHANGE
    **G.** Biologist Karen Warkentin
    **H.** Biologist Karen Warkentin,
    **J.** Biologist, Karen Warkentin

19. **A.** NO CHANGE
    **B.** attack, however, they
    **C.** attack, the clutches
    **D.** attack but

20. Given that all the choices are accurate, which one provides the most relevant information at this point in the essay?
    **F.** NO CHANGE
    **G.** devices that are increasingly used in the biological sciences,
    **H.** often designed to measure the acceleration of vehicles,
    **J.** in this case small accelerometers,

21. **A.** NO CHANGE
    **B.** it itself
    **C.** they
    **D.** that

22. **F.** NO CHANGE
    **G.** have produced
    **H.** are producing
    **J.** produce

While these interruptions are nearly absent from the
23
vibrations caused by a snake attack.

Bringing the recordings back to her lab at Boston
24

University, Warkentin's simulation of the snake-attack
25

vibrations and the rainstorm vibrations on several

four-day-old egg clutches. Most eggs in the clutches

that occupied only low-frequency vibrations hatched.
26
But few eggs in the clutches that were exposed to

low-frequency vibrations combined with periods

of high-frequency vibrations hatched.

The periods of high-frequency vibrations that occurs
27

during a rainstorm, however, seem to signal safety to
28
*A. callidryas* egg clutches. Given that premature tadpoles

risk predation by fish or shrimp, needlessly hatching early
29
is dangerous. Warkentin has shown that the egg clutches

have a complex, nearly perfectly controlled way to avoid

false alarms.
30

**23. A.** NO CHANGE
**B.** Having made clear that these
**C.** Given that these
**D.** These

**24. F.** NO CHANGE
**G.** the vibrations she had recorded from clutches she had found in Gamboa, Panama,
**H.** the data she had recorded with a device called an accelerometer
**J.** what she had, recordings,

**25. A.** NO CHANGE
**B.** Warkentin simulated
**C.** simulating
**D.** DELETE the underlined portion.

**26. F.** NO CHANGE
**G.** experienced
**H.** assimilated
**J.** theorized

**27. A.** NO CHANGE
**B.** tends to occur
**C.** often occurs
**D.** occur

**28. F.** NO CHANGE
**G.** rainstorm, nevertheless,
**H.** rainstorm, in addition,
**J.** rainstorm

**29.** If the writer were to delete the underlined portion (adjusting the punctuation as needed), the essay would primarily lose:

**A.** an indication that several creatures are more dangerous to premature tadpoles than are snakes.
**B.** an explanation of why fish and shrimp prey on premature tadpoles but not on mature tadpoles.
**C.** a detail that specifies the creatures that pose a threat to premature tadpoles in the water.
**D.** an example of a technique premature tadpoles use to escape from fish or shrimp.

**30. F.** NO CHANGE
**G.** alarms, preventing the dangerous "predator and prey" situation that was just mentioned.
**H.** alarms, which is important since premature tadpoles risk being preyed upon.
**J.** alarms; it's almost as if they can tell.

**PASSAGE III**

### Maryam Mirzakhani's Abstractions

Maryam Mirzakhani believes the beauty of mathematics only shows itself to patient followers. Few have followed math more patiently than she has. In 2014, at age thirty-seven, Iranian-born Mirzakhani became the first woman, to win the Fields Medal
<u>                                                                 </u>
**31**
math's most prestigious prize. Her research focus,

<u>highly abstract, theoretical problems relating to geometry,</u>
**32**

is so imaginative and astonishingly complex that <u>they defy</u>
**33**
explanation even to many practiced mathematicians.

Mirzakhani's thinking about her mathematical research is as imaginative as the problems she challenges herself to solve. She compares her work to that of a writer crafting a novel. To her, math research is a slow, steady process of watching characters evolve.

**31. A.** NO CHANGE
**B.** woman, to win the Fields Medal,
**C.** woman to win the Fields Medal,
**D.** woman to win the Fields Medal

**32.** If the writer were to delete the underlined portion (adjusting the punctuation as needed), the essay would primarily lose a:
**F.** short clarification that indicates that Mirzakhani prefers not to describe her most complex work to people who aren't mathematicians.
**G.** brief description that provides the reader some sense of the content of Mirzakhani's incredibly complex area of study.
**H.** detail that makes clear that the writer attended a conference during which Mirzakhani discussed the complexities of her work.
**J.** reference to a very complex area of mathematics that Mirzakhani began to study soon after she won the Fields Medal.

**33. A.** NO CHANGE
**B.** they consistently have defied
**C.** they are known to defy
**D.** it defies

7

Mirzakhani studies the geometry of curved

surfaces. Her characters are spheres, doughnut-shaped
____
34

objects, and wavering planes. Monotonous, playful
____
35
drawings of these curved forms, interspersed with

equations and mathematical notes, cover huge sheets
____
36
of white paper spread out over her office floor.

While her young daughter, Anahita, often watches on,
____
37
Mirzakhani can visualize that her first impression of a

character was wrong or that two seemingly opposing

characters are connected.

Like a writer who believes strong characters
____
38

will act with accord to their natures as a story unfolds,
____
39
Mirzakhani tries not to predict what connections her

shapes and equations will make next. This approach

has helped her find solutions so clear and elegant that
____
40

her colleagues refer to this as profound events in math.
____
41

---

**34.** Which of the following alternatives to the underlined portion would NOT be acceptable?
- **F.** surfaces; therefore, the mathematician's
- **G.** surfaces, so the mathematician's
- **H.** surfaces, her
- **J.** surfaces: her

**35.** Which choice most precisely conveys, with the least negative connotation, that the same forms appear over and over?
- **A.** NO CHANGE
- **B.** Recurring,
- **C.** Tedious,
- **D.** Stale,

**36.** Given that all the choices are accurate, which one most clearly evokes a visual image reminiscent of the curved forms that Mirzakhani studies?
- **F.** NO CHANGE
- **G.** small, handwritten
- **H.** spiraling
- **J.** intricate

**37.** Given that all the choices are accurate, which one provides the best transition from the preceding sentence to the information that follows in this sentence?
- **A.** NO CHANGE
- **B.** Remaining close friends with Roya Beheshti, a childhood classmate who became a professor of algebraic geometry,
- **C.** By constantly doodling as she tries to resolve one of her mathematical story lines,
- **D.** Even though the Fields Medal is not awarded every year,

**38.**
- **F.** NO CHANGE
- **G.** whose believing that
- **H.** who's belief is that
- **J.** whom believes

**39.**
- **A.** NO CHANGE
- **B.** in accordance with
- **C.** according to given
- **D.** accordingly to

**40.**
- **F.** NO CHANGE
- **G.** that has been helping
- **H.** which helped
- **J.** helping

**41.**
- **A.** NO CHANGE
- **B.** them
- **C.** her
- **D.** it

Over several years, she <u>felt optimistic</u> as she got to know
<sub>42</sub>

her characters better, finally seeing them clearly.

    <u>Secondly, a</u> few particularly labyrinthine plots have
<sub>43</sub>

played out before Mirzakhani for over a decade. In 2014,

researchers across the discipline <u>has been</u> wondering what
<sub>44</sub>

new mathematical tales <u>the Stanford professor</u> and Fields
<sub>45</sub>

medalist would conceptualize next. And what beautiful

solutions she would slowly find.

**42.** Given that all the choices are accurate, which one most
strongly emphasizes Mirzakhani's patient, methodical
approach to finding solutions?
   **F.** NO CHANGE
   **G.** had the opportunity to work with some of her
favorite collaborators
   **H.** noticed that her colleagues had found answers
   **J.** reformulated her ideas again and again

**43.** **A.** NO CHANGE
   **B.** To summarize, a
   **C.** Finally, a
   **D.** A

**44.** **F.** NO CHANGE
   **G.** appears to be
   **H.** were
   **J.** was

**45.** **A.** NO CHANGE
   **B.** working as a professor at Stanford
   **C.** being a Stanford professor
   **D.** as a professor at Stanford

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**PASSAGE IV**

### Starlight in the Park

    My mom and <u>I, both Michigan-born</u> have been
<sub>46</sub>

stargazing together since I was a toddler. I learned the

names of major constellations long before I could write

my own name. Every year, we spend warm August nights

lounging in our <u>yard each summer,</u> gazing skyward in
<sub>47</sub>

awe as the Perseid meteors <u>trickle across</u> the dark sky.
<sub>48</sub>

So, when the nearby Headlands area was designated an

International Dark Sky Park (a title recognizing the area's

extraordinarily clear view of the starry night skies), we

had to pay it a visit.

**46.** **F.** NO CHANGE
   **G.** I, both Michigan-born,
   **H.** I both, Michigan-born
   **J.** I both Michigan-born,

**47.** **A.** NO CHANGE
   **B.** yard, watching the Perseid meteors and
   **C.** yard to observe the night sky,
   **D.** yard,

**48.** The writer wants to emphasize the brightness and
speed of the meteors. Which choice best accomplishes
this goal?
   **F.** NO CHANGE
   **G.** streak brilliantly through
   **H.** twinkle throughout
   **J.** quickly traverse

That such a park existed just a few miles from our
——————
49
home in Petoskey was incredibly fortunate, we knew.

The designation is granted by an organization committed
—————————————
50
to protecting natural darkness from artificial light
pollution, the status of Dark Sky Park has been conferred
on only a select few places around the world. To justify the
designation, likewise, experts must measure the amount of
—————
51
light in the area and from neighboring light sources. This
inspection serves to ensure there is little to no interference
among the nighttime view of the skies from the park.
—————
52

[1] Driving into the park at sunset, we were
greeted by acres of trees silhouetted in the fading light.
[2] Eventually, we settled on a spot and snuggled into
our sleeping bags. [3] Bats flitted through the air, and
—————
53
leaves rustled in the breeze as we walked along the rocky
shoreline of Lake Michigan. [4] I told Mom I hoped we'd
sight the northern lights, despite an unlikely forecast.
[5] Eagerly, me and her waited, the two of us peering
——————————
54
into the heavens as the sky darkened and stars began

to appear. [55]


"There's Cygnus," I murmured, pointing out
the bright constellation that resembles a flying swan,
——————————————————————————————
56
its neck and wings, outstretched. Mom easily spotted
——————————————
56
Draco, the dragon, her favorite constellation,
even though it's composed of relatively dim stars.

**49. A.** NO CHANGE
 **B.** It was lucky that this
 **C.** Being that this
 **D.** Such a

**50. F.** NO CHANGE
 **G.** The park's status was granted
 **H.** This honor was granted
 **J.** Granted

**51. A.** NO CHANGE
 **B.** in other words,
 **C.** respectively,
 **D.** DELETE the underlined portion.

**52. F.** NO CHANGE
 **G.** toward
 **H.** with
 **J.** DELETE the underlined portion.

**53. A.** NO CHANGE
 **B.** air, which had breezy conditions,
 **C.** air near Lake Michigan's shore,
 **D.** air, flying around,

**54. F.** NO CHANGE
 **G.** Mom and me
 **H.** she and I
 **J.** her and I

**55.** For the sake of the logic and cohesion of this paragraph, Sentence 3 should be placed:

 **A.** where it is now.
 **B.** before Sentence 1.
 **C.** after Sentence 1.
 **D.** after Sentence 4.

**56. F.** NO CHANGE
 **G.** constellation that resembles a flying swan, its neck and wings
 **H.** constellation, that resembles a flying swan, its neck and wings
 **J.** constellation, that resembles a flying swan its neck and wings

We made a game of <u>it; each of us taking</u> turns
<sub>57</sub>

identifying stars, constellations, and planets

<u>as the night did what it does.</u> The wide, starry swath
<sub>58</sub>

of the Milky Way reflecting in the calm waters before

us, we fell asleep, <u>dreaming of sparkling skies.</u>
<sub>59</sub>

**57. A.** NO CHANGE
   **B.** it, we took
   **C.** it, taking
   **D.** it. Taking

**58. F.** NO CHANGE
   **G.** while the night just wouldn't quit.
   **H.** while the night carried forth.
   **J.** as the night wore on.

**59.** Which choice most effectively concludes the essay by alluding to a central idea?

   **A.** NO CHANGE
   **B.** although I had begun to worry about our cat, Orion, being left home alone all night.
   **C.** knowing tomorrow would be another day.
   **D.** despite the slightly chilly temperature.

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Question 60 asks about the preceding passage as a whole.

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**60.** Suppose the writer's primary purpose had been to discuss methods of making astronomical observations. Would this essay accomplish that purpose?

   **F.** Yes, because it describes particular astronomical phenomena appearing in the night skies.
   **G.** Yes, because it describes the narrator's background and interest in stargazing.
   **H.** No, because it instead focuses on describing the process of transforming a disused park into a popular tourist attraction.
   **J.** No, because it instead focuses on describing a particular stargazing experience the narrator had.

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**PASSAGE V**

### Replay It Again

[1]

"This is not live! Ladies and gentlemen,

Army did not score again!" declared the television

<u>announcer during the 1963</u> Army-Navy football
<sub>61</sub>

game. Army's quarterback had just carried the

ball over the goal line <u>to score</u> a one-yard touchdown.
<sub>62</sub>

Fans in the stands saw the touchdown only once.

**61. A.** NO CHANGE
   **B.** announcer, during the 1963,
   **C.** announcer during, the 1963,
   **D.** announcer during the 1963,

**62. F.** NO CHANGE
   **G.** which scored
   **H.** that scored
   **J.** scoring

Fans watching the telecast, however, were astounded as they witnessed the play twice, thanks to the first instant replay, in this case a touchdown, in a live event.
<sub>63</sub>

[2]

Responsible for this innovation Tony Verna, a
<sub>64</sub>
television sports broadcaster and director of the Army-Navy game. Often bored by the lag time in between plays, Verna had toyed with the idea of filling them with replays
<sub>65</sub>
of what had occurred on the field. He wanted to rerun footage of important, extraordinary, or controversial plays. [A] The replays could be from different vantage points or in slow motion. Above all, he wanted the replay to be broadcast immediately.

[3]

Verna authored several books about his broadcasting
<sub>66</sub>
career. Videotapes could not be cued precisely; there
<sub>66</sub>
was no way to find a particular moment in the footage.

Verna's use of a system of multiple videotape decks,
<sub>67</sub>

solved this problem. [B] At the start and stop of each play,
<sub>68</sub>
he would transmit beeps to an unused audio track on the

recording. These beeps would bookmark moments of
<sub>69</sub>
action. Verna could then rewind the tape, listen for the beeps, and restart the play at the chosen spot.

**63.** **A.** NO CHANGE
**B.** replay, while fans watched from home,
**C.** replay live on television
**D.** replay

**64.** **F.** NO CHANGE
**G.** was Tony Verna. A
**H.** was Tony Verna, a
**J.** Tony Verna a

**65.** **A.** NO CHANGE
**B.** this time
**C.** these
**D.** some

**66.** Which choice best introduces the main focus of the paragraph?
**F.** NO CHANGE
**G.** Though instant replay was first used in football, other sports soon adopted the technology.
**H.** Officials were new to the technology.
**J.** The technology, however, was limited.

**67.** **A.** NO CHANGE
**B.** Verna decided to use
**C.** Verna, using
**D.** Verna used

**68.** **F.** NO CHANGE
**G.** start, and stop, of each play
**H.** start and stop, of each play,
**J.** start and stop of each play

**69.** Which choice best indicates that the beeps served as placeholders for particular moments within the recording?
**A.** NO CHANGE
**B.** insert
**C.** yield
**D.** sort

**GO ON TO THE NEXT PAGE.**

[4]

Instant replay became a fixture in <u>football, it changed</u>
<u>                                            70</u>
the way games are officiated and watched. Fractions of

seconds can be slowed down and analyzed. [C] An

official who rules that a running back <u>took</u> the ball
<u>                                              71</u>

into the end zone might have his call reversed when

the replay shows the back was stopped just short. Fans

<u>really feel a part of the whole deal,</u> making their own
<u>                            72</u>

judgments about whether <u>the wide receivers</u> foot was
<u>                                          73</u>

in bounds after he caught a pass. Instant replay reveals

the truth that cannot always be perceived by the human

eye in real time. And, <u>it has potential,</u> the outcome of
<u>                                  74</u>

the game—or even a season—is altered. [D]

**70.** **F.** NO CHANGE
     **G.** football and it changed
     **H.** football, and changing
     **J.** football, changing

**71.** At this point, the writer wants to emphasize the force
     and action of the running back. Which choice best
     accomplishes that goal?
     **A.** NO CHANGE
     **B.** drove
     **C.** escorted
     **D.** moved

**72.** **F.** NO CHANGE
     **G.** are even more invested in the action,
     **H.** fancy themselves all official-like,
     **J.** are majorly into it,

**73.** **A.** NO CHANGE
     **B.** the wide receivers'
     **C.** a wide receivers'
     **D.** a wide receiver's

**74.** **F.** NO CHANGE
     **G.** it can potentially,
     **H.** potentially,
     **J.** its potential,

---

Question 75 asks about the preceding passage
as a whole.

---

**75.** The writer wants to add the following sentence to the
     essay:

> Calls are either upheld or refuted.

The sentence would most logically be placed at:

**A.** Point A in Paragraph 2.
**B.** Point B in Paragraph 3.
**C.** Point C in Paragraph 4.
**D.** Point D in Paragraph 4.

**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. The 1st term in the geometric sequence below is −13. If it can be determined, what is the 6th term?

$$-13, 26, -52, 104, -208, \cdots$$

   A. −416
   B. −312
   C. 312
   D. 416
   E. Cannot be determined from the given information

2. In the standard $(x,y)$ coordinate plane, point $A$ has coordinates $(-7,-5)$. Point $A$ is translated 7 units to the left and 5 units down, and that image is labeled $A'$. What are the coordinates of $A'$ ?

   F. $(-14,-10)$
   G. $(-12,-12)$
   H. $(-7,-10)$
   J. $(0, 0)$
   K. $(14, 10)$

3. Olga worked on a project for $4\frac{1}{2}$ hours on each of 6 workdays. On the 7th day of working on the project, Olga worked $\frac{1}{3}$ of the time she had worked each of the previous workdays to complete the project. How many hours did it take Olga to complete the project?
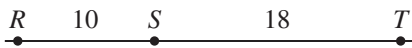
   A. $24\frac{1}{6}$

   B. $28\frac{1}{2}$

   C. 30

   D. 33

   E. $34\frac{1}{2}$

**DO YOUR FIGURING HERE.**

14

**GO ON TO THE NEXT PAGE.**

**4.** Given that 5 pounds of coffee makes exactly 210 servings, how many pounds of coffee makes exactly 70 servings?

**F.** $1\frac{2}{3}$

**G.** 2

**H.** $4\frac{2}{3}$

**J.** $5\frac{1}{3}$

**K.** 15

**5.** For $\overleftrightarrow{RT}$ shown below, point $S$ is on $\overline{RT}$, the length of $\overline{RS}$ is 10 cm, and the length of $\overline{ST}$ is 18 cm. What is the distance, in centimeters, between $T$ and the midpoint of $\overline{RS}$ ?

$R \quad 10 \quad S \quad 18 \quad T$

**A.** 14
**B.** 18
**C.** 19
**D.** 23
**E.** 28

**6.** For all real values of $p$ and $r$, which of the following expressions is equivalent to $p(2 - r) + 8(p - r)$ ?
**F.** $6p - 9r$
**G.** $6p - 8r$
**H.** $6p - 8r - pr$
**J.** $10p - 2r$
**K.** $10p - 8r - pr$

**7.** Fifty shoppers at a pet store were asked if they owned at least 1 cat or at least 1 dog. Data from their answers were recorded below.

| Ownership | Number of shoppers |
|---|---|
| Cat(s) only | 13 |
| Dog(s) only | 24 |
| Both cat(s) and dog(s) | 7 |

How many of these shoppers said that they owned NEITHER a cat NOR a dog?

**A.** 0
**B.** 6
**C.** 7
**D.** 13
**E.** 43

**DO YOUR FIGURING HERE.**

**GO ON TO THE NEXT PAGE.**

**8.** Yvette has 6 pairs of leggings, 2 pairs of shoes, and 6 T-shirts, which all go together well. How many different groupings consisting of 1 of her 6 pairs of leggings, 1 of her 2 pairs of shoes, and 1 of her 6 T-shirts are available for Yvette to wear?

    **F.**   8
    **G.**  12
    **H.**  14
    **J.**  24
    **K.**  72

**9.** According to the United States Department of Commerce, the approximate area of Rhode Island is $1.5 \times 10^3$ square miles and the approximate area of Alaska is $6.6 \times 10^5$ square miles. Using these measurements, which of the following is closest to the ratio of the area of Alaska to the area of Rhode Island?

    **A.**   22:5
    **B.**  440:1
    **C.**  484:25
    **D.**  510:1
    **E.**  810:1

**10.** Rectangle A has a length of 64 inches and a width of 48 inches. Rectangle B has a length and a width that are both $\frac{3}{4}$ times the length and the width of Rectangle A. Rectangle C has a length and a width that are both $\frac{3}{4}$ times the length and the width of Rectangle B. What is the perimeter, in inches, of Rectangle C ?

    **F.**   63
    **G.**   84
    **H.**  126
    **J.**  168
    **K.**  224

**11.** The expression $\left(x^6\right)^3$ is equivalent to:

    **A.**  $x^9$
    **B.**  $x^{18}$
    **C.**  $x^{216}$
    **D.**  $3x^3$
    **E.**  $3x^5$

**DO YOUR FIGURING HERE.**

**12.** A king-sized inflatable rectangular bed when fully inflated will have inside dimensions, in inches, of 78 by 75 by 5. An air pump can pump air into the bed at a rate of 100 cubic inches per second. At that rate, which of the following is closest to the number of seconds it will take to fully inflate the bed?

F.   58
G.   62
H.   158
J.   293
K.   1,170

**13.** Jake wants to build a scale model of his house. The house is 48 feet long and 32 feet wide, and it is 30 feet tall at the highest point. Jake wants the model to be 8 inches long. How wide, in inches, should his model be?

A.   5

B.   $5\frac{1}{3}$

C.   $7\frac{1}{2}$

D.   12

E.   $12\frac{4}{5}$

**14.** You see a circle graph in a newspaper article about student employment, but no percentages are given for the sectors. You want to use the information contained in the graph in a report for your sociology class. You measure the central angle of the sector titled "work during the week" with your protractor, and it measures 144°. According to the circle graph and your measurement, the "work during the week" sector is what percent, to the nearest percent, of the circle graph?

F.   40%
G.   30%
H.   25%
J.   14%
K.   Cannot be determined from the given information

**15.** Josiah stands on level ground 15 ft from the base of a cliff. The angle of elevation from where Josiah is standing to the top of the cliff is 50°, as shown below. Which of the following values is closest to the height, in feet, of the cliff?

(Note: sin 50° ≈ 0.8; cos 50° ≈ 0.6; tan 50° ≈ 1.2)

A.   12
B.   13
C.   18
D.   25
E.   60
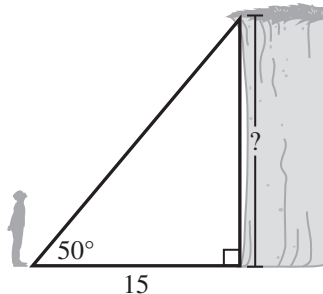


**DO YOUR FIGURING HERE.**

**16.** Consider the line $3x - 4y = 6$ in the standard $(x,y)$ coordinate plane. For the point on this line with $x$-coordinate equal to 3, what is the $y$-coordinate?
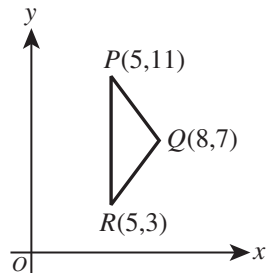
F. $-\dfrac{15}{4}$

G. $-\dfrac{3}{4}$

H. $\dfrac{3}{4}$

J. $\dfrac{6}{5}$

K. $\dfrac{15}{4}$

**DO YOUR FIGURING HERE.**

**17.** What is the solution set to the equation $x^2 - x = 12$ ?

A. $\{-4, 3\}$

B. $\{-3, 4\}$

C. $\{-2, 6\}$

D. $\{12, 13\}$

E. $\{13\}$

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

F.   6
G.   8
H.  12
J.  24
K.  28



**19.** In the standard $(x,y)$ coordinate plane, a line intersects the $y$-axis at $(0,2)$ and contains the point $(8,5)$. What is the slope of the line?

A. $\dfrac{3}{8}$

B. $\dfrac{2}{3}$

C. $\dfrac{5}{6}$

D. $\dfrac{6}{5}$

E. $\dfrac{8}{3}$

**GO ON TO THE NEXT PAGE.**

**20.** One of the following values for *a* makes the expression $\frac{2a+5}{a^2+1}$ undefined. Which one?

**F.** −3

**G.** $-\frac{5}{2}$

**H.** −1

**J.** 0

**K.** *i*

**21.** What is the least positive number that has a remainder of 3 when divided by 5 and a remainder of 7 when divided by 9 ?

**A.** 24
**B.** 35
**C.** 43
**D.** 45
**E.** 78

**22.** Two warning signs begin flashing at the same time. One sign flashes every 3 seconds, and the other sign flashes every 8 seconds. How many seconds elapse from the moment the 2 signs flash at the same time until they next flash at the same time?

**F.** 5
**G.** 5.5
**H.** 11
**J.** 12
**K.** 24

**23.** Sets *A*, *B*, and *C* are defined below.

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

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

**A.** 0

**B.** $\frac{1}{6}$

**C.** $\frac{2}{6}$

**D.** $\frac{4}{6}$

**E.** $\frac{5}{6}$

**24.** What rational number is exactly halfway between $\frac{3}{16}$ and $\frac{7}{32}$ on the real number line?

- **F.** $\frac{13}{16}$
- **G.** $\frac{13}{32}$
- **H.** $\frac{5}{48}$
- **J.** $\frac{1}{64}$
- **K.** $\frac{13}{64}$

**25.** The circle that has a center of $(-3,4)$ and is tangent to the $y$-axis is graphed in the standard $(x,y)$ coordinate plane below. What is the area, in square coordinate units, of this circle?
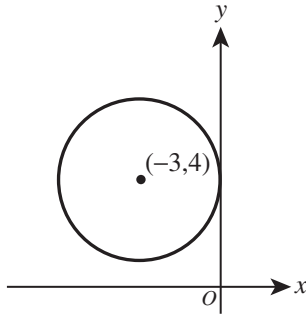


- **A.** $6\pi$
- **B.** $8\pi$
- **C.** $9\pi$
- **D.** $16\pi$
- **E.** $18\pi$

**26.** An 8-sided game piece with faces numbered from 1 to 8 is rolled twice. What is the probability that an 8 is rolled both times?

(Note: Assume that each side has an equally likely chance of being rolled.)

- **F.** $\frac{1}{64}$
- **G.** $\frac{1}{32}$
- **H.** $\frac{1}{8}$
- **J.** $\frac{1}{4}$
- **K.** $\frac{1}{2}$

**27.** When $(3x - 2)^4$ is expanded and the like terms are combined, what is the coefficient of the $x^4$ term?

- **A.** 9
- **B.** 12
- **C.** 16
- **D.** 48
- **E.** 81

**28.** Bo and Tia will balance perfectly on the seesaw shown below if $w_1 \times d_1 = w_2 \times d_2$, where $w_1$ and $d_1$ are the weight of Bo and his distance from the fulcrum, respectively, and $w_2$ and $d_2$ are similarly defined for Tia. Bo weighs 60 pounds and is sitting $3\frac{1}{2}$ feet from the fulcrum. Tia weighs $\frac{2}{3}$ Bo's weight. What distance, in feet, from the fulcrum must Tia sit in order for Bo and Tia to balance perfectly on the seesaw?

F.  $1\frac{1}{6}$

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

H.  $5\frac{1}{4}$

J.  $6\frac{5}{12}$

K.  $10\frac{1}{2}$



Bo
Tia
fulcrum
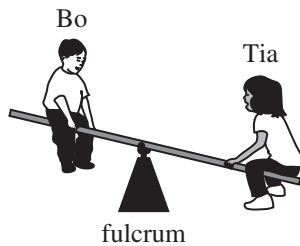
**29.** Given that $3(x - 2) = 6x - 3$, what is the value of $9x - 2$ ?

A.  −29
B.  −11
C.   −5
D.    1
E.    7

**30.** Ally is planting flowers around her square patio. The region she is planting is a 1-foot-wide strip that runs along 3 sides of her 5-foot-by-5-foot patio, as shown below. What is the area, in square feet, of the shaded region where Ally is planting flowers?
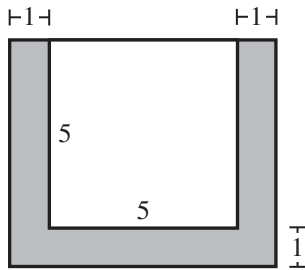
F.   5
G.  11
H.  15
J.  17
K.  19



**31.** Consider 3 circles: A, B, and C. The sum of the radii of Circle A and Circle B is 5 m. The sum of the radii of Circle A and Circle C is 8 m. The sum of the radii of Circle B and Circle C is 7 m. What is the length, in meters, of the radius of Circle C ?

A.  1
B.  2
C.  3
D.  4
E.  5

**32.** What is the complex conjugate of the number below?

$$2 + 3i$$

- **F.** $\sqrt{13}$
- **G.** $-3i$
- **H.** $3i$
- **J.** $2 - 3i$
- **K.** $2 + 3i$

**33.** The function $P(x) = x^3 - 10x^2 + 9x - 90$, where $x$ is the number of items sold, models the profit $P(x)$, in dollars, for Company A. The company *breaks even* when the profit is $0. How many items must Company A sell to break even?

- **A.** 0
- **B.** 3
- **C.** 9
- **D.** 10
- **E.** 90

**34.** Which of the following statements shows that any subtraction can be written instead as an addition?

- **F.** $a - b = |a| + |-b|$
- **G.** $a - b = |-a| + |b|$
- **H.** $a - b = a + |-b|$
- **J.** $a - b = a + (-b)$
- **K.** $a - b = (-a) + b$

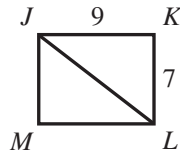**35.** What is the value of $\sqrt{\dfrac{9}{4}} - \sqrt[3]{-\dfrac{1}{8}}$ ?

- **A.** $\dfrac{1}{4}$
- **B.** $\dfrac{5}{4}$
- **C.** $\dfrac{7}{6}$
- **D.** 1
- **E.** 2

**36.** Given $f(x) = -x - 4$ and $h(x) = 2x + 3$, what is $h\bigl(f(x)\bigr)$ ?

- **F.** $-2x - 5$
- **G.** $2x - 1$
- **H.** $2x - 5$
- **J.** $-2x^2 - 11x - 12$
- **K.** $2x^2 + 11x + 12$

**DO YOUR FIGURING HERE.**
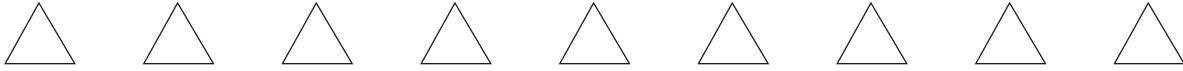
**37.** Rectangle *JKLM* is shown below. The given side lengths are in feet. What is the cosine of ∠*KJL* ?



A. $\dfrac{7}{9}$

B. $\dfrac{7}{\sqrt{130}}$

C. $\dfrac{7}{16}$

D. $\dfrac{9}{\sqrt{130}}$

E. $\dfrac{9}{16}$

**38.** The first 3 elements of a pattern are shown below. Each element is composed of small squares that are 18 inches wide and 18 inches long. Each element after the 1st element is a square that is 18 inches wider and 18 inches longer than the previous element. What is the area, in square *feet*, of the 4th element?
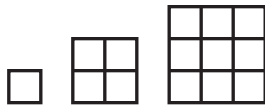


F.   6
G.   9
H.  16
J.  24
K.  36

**39.** The operation ⊗ is defined on the set of positive integers by the rule $a \otimes b = a + b^2$. What is the value of $(4 \otimes 3) \otimes 5$ ?

A.  34
B.  38
C.  44
D.  50
E.  74

**40.** The number *a* is a positive integer greater than 1. The number *b* is a negative integer. The number $a^b$ is:

F.  zero.
G.  positive.
H.  negative.
J.  irrational.
K.  an integer.

Use the following information to answer questions 41–43.

The table below is part of a delivery truck log used in Aaron's trucking business. "Mileage out" and "Mileage in" represent the truck's mileage readings when it leaves the office and when it returns to the office, respectively, giving only the last 3 digits of the cumulative mileage reading. The "Hours away" column gives the amount of time from when the truck leaves the office until it returns to the office. When moving, the truck travels at an average speed of 50 miles per hour and does not travel more than 1,000 miles in any given day. Driver Ben forgot to complete the log for June 18.

| Date | Mileage out | Mileage in | Driver | Hours away |
|------|------|------|--------|------|
| June 17 | 274 | 499 | Aaron | 5.00 |
| June 18 | | | Ben | |
| June 19 | 736 | 989 | Lenny | 5.50 |
| June 20 | 989 | 245 | Aaron | 6.00 |
| June 21 | 245 | 495 | Lenny | 5.75 |

**41.** According to the mileage reading, what distance, in miles, did the truck travel on June 20 ?

   A. 234
   B. 241
   C. 250
   D. 253
   E. 256

**42.** The figure shown below represents the route traveled on July 16. Aaron started at the office, drove 75 miles due north to the 1st stop, then 40 miles due east to the 2nd stop, and then 105 miles due south to the last stop. On his return trip, Aaron drove a straight road from the last stop to the office without stopping. Given that Aaron drove at the truck's average speed, which of the following values is closest to the time, in hours, Aaron drove on the return trip?
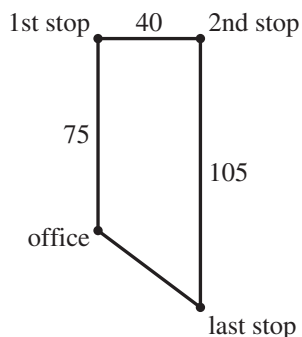
   F. $\frac{3}{5}$

   G. $\frac{5}{7}$

   H. 1
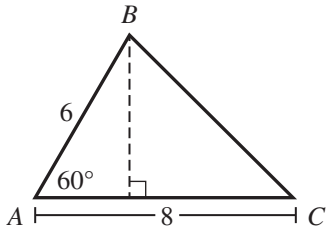
   J. $\frac{7}{5}$

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

**43.** From June 17 through June 21, the average of the "Hours away" was 5.50 hours. To the nearest 0.01, what is the value of "Hours away" when Ben was driving the truck?

 **A.** 5.25
 **B.** 5.45
 **C.** 5.50
 **D.** 5.56
 **E.** 5.75

**44.** In $\triangle ABC$ shown below, the given side lengths are in meters. What is the area, in square meters, of $\triangle ABC$ ?



 **F.** 10
 **G.** 12
 **H.** $12\sqrt{2}$
 **J.** $12\sqrt{3}$
 **K.** 24

**45.** The value of $\log(x)$, to the nearest 0.1, is given in the table below for 4 different values of $x$.

| $x$ | $\log(x)$ |
|---|---|
| 3 | 0.5 |
| 30 | 1.5 |
| 300 | 2.5 |
| 3,000 | 3.5 |

To the nearest 0.1, what is the value of $\log(3 \times 10^{5,000})$ ?

 **A.**   0.5
 **B.**   17.5
 **C.**  2,500.0
 **D.**  5,000.5
 **E.**  5,003.5

**DO YOUR FIGURING HERE.**

**46.** Susan completed 20 courses in college and her grade point average was 3.15 (A = 4.0 and B = 3.0). If all of her grades were A's or B's, and each course grade carried equal weight, what is the number of A's that Susan received?

F.  1
G.  3
H.  4
J.  9
K.  15

**47.** The right semicircular cylinder shown below has a height of 5 centimeters and a semicircular base of radius 3 centimeters. What is the volume, in cubic centimeters, of the right semicircular cylinder?
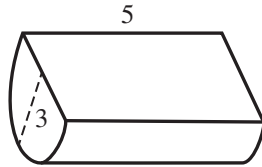


A.  $\frac{45}{4}\pi$

B.  $\frac{45}{2}\pi$

C.  $\frac{75}{2}\pi$

D.  $15\pi$

E.  $45\pi$

**48.** For positive real numbers $M$ and $N$, $\log \frac{M}{N} = ?$

F.  $\frac{\log M}{\log N}$

G.  $\log(M - N)$

H.  $\log(N - M)$

J.  $\log M - \log N$

K.  $\log N - \log M$

**49.** For what real number $b$, if any, will the equation $a - 2b + ab = 2$ be true for both $a = 1$ and $a = -1$ ?

A.  $-2$
B.  $-1$
C.  1
D.  2
E.  No such real number $b$ exists.

Use the following information to answer questions 50–52.

Terri is a dress designer and owns a retail store. She designs, produces, and sells 5 dress styles. These styles and the production cost of 1 dress of each style are shown in the table below.

| Style | Production cost of 1 dress |
|-------|----------------------------|
| A | $15.00 |
| B | $25.00 |
| C | $45.00 |
| D | $60.00 |
| E | $65.00 |

**50.** Terri will hang 1 dress of each style along a rod in the window of her store. How many total possible orders (permutations) of these dresses are there for Terri to consider?

F.  1
G.  5
H.  25
J.  120
K.  3,125

**51.** Terri will offer a coupon in the local newspaper for 20% off the regular price of a dress. What is the regular price Terri must set for a Style B dress so that the sale price using the coupon is exactly $15.00 more than the cost of producing 1 Style B dress?

A. $32.00
B. $45.00
C. $48.00
D. $50.00
E. $55.00

**52.** The labor cost of each dress is 40% of the production cost. What is the *average* labor cost per dress for 1 dress of each of the 5 styles?

F. $ 16.80
G. $ 25.20
H. $ 42.00
J. $ 84.00
K. $126.00

**53.** It took 0.5 second for an object to travel 60.5 feet. To the nearest 0.01 *mile* per hour, what was the speed of the object?

(Note: 1 mile = 5,280 feet)

A.  30.25
B.  61.00
C.  82.50
D.  87.30
E.  121.00

**54.** Representatives of vectors **u**, **v**, **p**, **q**, and **r** are shown in the standard $(x,y)$ coordinate plane below.
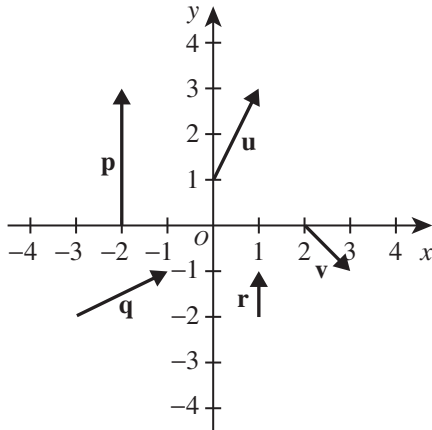
One of the following vectors is equal to the vector **u** + **v**. Which one?

F.  −**r**
G.  −**q**
H.  −**p**
J.  **p**
K.  **q**

**55.** In the standard $(x,y)$ coordinate plane below, a shaded square is shown with vertices at $(2,3)$, $(2,4)$, $(3,3)$, and $(3,4)$. Two lines, $y = rx$ and $y = sx$, each intersect the shaded square at exactly 1 point. Given that $r \neq s$, what is the positive difference of $r$ and $s$ ?

A.  $\frac{1}{6}$

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

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

D.  $\frac{2}{3}$

E.  1
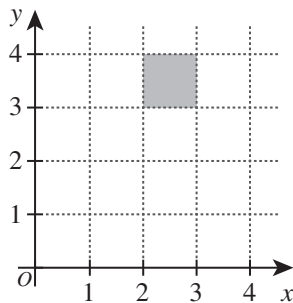


**56.** A random number generator that generates an integer 1 through 6 will be used 15,000 times. Each time an integer is generated, the number will be recorded. Which of the following descriptors will most likely characterize the distribution of the 15,000 recorded numbers?

F.  Bimodal
G.  Normal
H.  Skewed left
J.  Skewed right
K.  Uniform

**57.** In the standard $(x,y)$ coordinate plane, define the *h−v distance* between 2 points to be the length, in coordinate units, of the shortest path between the 2 points using only horizontal and vertical segments. The expression $|5 - 2| + |3 - (-4)|$ gives the *h−v distance* between which of the following pairs of points?

**A.** $(3, 5)$ and $(-4, 2)$
**B.** $(3, 5)$ and $(-2, -4)$
**C.** $(5, -4)$ and $(-2, 3)$
**D.** $(5, -2)$ and $(3, 4)$
**E.** $(5, 2)$ and $(3, -4)$

**58.** Let $m$ and $s$ be the mean and standard deviation, respectively, of the ages of children in a certain daycare center. Which of the following gives the mean and standard deviation of the ages of the same children 5 years later?

| | Mean | Standard deviation |
|---|---|---|
| **F.** | $m$ | $s$ |
| **G.** | $m$ | $s + 5$ |
| **H.** | $m + 5$ | $s$ |
| **J.** | $m + 5$ | $s + 5$ |
| **K.** | $m + 5$ | $5s$ |

**59.** The ellipse in the standard $(x,y)$ coordinate plane below is the graph of $\dfrac{(x - 5)^2}{25} + \dfrac{(y - 3)^2}{9} = 1$. Which of the following points are the foci of the ellipse?
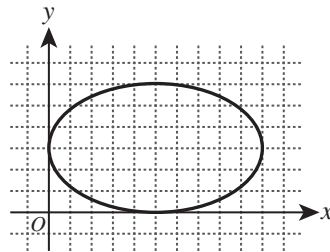
**A.** $(0,3)$ and $(5,3)$
**B.** $(0,3)$ and $(10,3)$
**C.** $(1,3)$ and $(5,0)$
**D.** $(1,3)$ and $(9,3)$
**E.** $(5,0)$ and $(5,6)$

**60.** Lucinda ran a 3-mile cross-country course in 24.0 minutes while Frannie ran the same course in 21.0 minutes. Which of the following values, in miles per *hour*, is closest to the difference between Frannie's average speed and Lucinda's average speed?

**F.** 0.1
**G.** 1.0
**H.** 1.1
**J.** 1.5
**K.** 3.0

**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

**LITERARY NARRATIVE:** This passage is from the short story "Long Distance" by Alejandro Zambra.

Portillo was a good boss, a generous guy; I rarely saw him, sometimes only on the twenty-ninth, when I waited, with some stupendous circles under my eyes, to pick up my paycheck. What I remember most about him
5　is his voice, so high-pitched, like a teenager's—a common enough tone among Chileans but, for me, a disconcerting one to hear from a Spaniard. He would call me very early, at six or seven in the morning, so I could give him a report on what had happened the pre-
10　vious night, which was pretty much pointless, because nothing ever happened, or almost nothing: maybe some call or other from Rome or Paris, simple cases from people who weren't really sick but who wanted to make the most of the medical insurance they had bought in
15　Santiago. My job was to listen to them, take down their information, make sure the policy was valid, and connect them to my counterparts in Europe.

Portillo let me read or write, or even doze off, on the condition that I always answer the phone in good
20　time. That's why he called at six or seven—although, when he was out partying, he might call earlier. "The phone should never ring more than three times," he would tell me if I took too long picking up. But he didn't usually scold me; on the contrary, he was quite
25　friendly. Sometimes he asked me what I was reading. I would say Paul Celan, or Emily Dickinson, or Emmanuel Bove, or Humberto Díaz Casanueva, and he always burst out laughing, as if he had just heard a very good and very unexpected joke.

30　One night, around four in the morning, I received a call from someone whose voice sounded mock-serious, or disguised, and I thought it was my boss pretending to be someone else. "I'm calling from Paris," said the voice. The man was calling direct, which increased my
35　feeling that it was a prank of Portillo's, because clients usually reversed the charges when they called. Portillo and I had a certain level of trust between us, so I told him not to mess with me, that I was very busy reading. "I don't understand, I'm calling from Paris," the man
40　responded. "Is this the number of the travel insurance?"

I apologized and asked him for his number so I could call him back. When we talked again I'd become the nicest phone operator on the planet, which wasn't really necessary, because I've never been impolite, and
45　because the man with the unrealistic voice was also unrealistically nice, which was not usual in that job: it was more common for clients to show their bad manners, their high-handedness, their habit of treating phone operators badly, and surely also laborers, cooks,
50　salespeople, or any other of the many groups made up of their supposed inferiors.

Juan Emilio's voice, on the other hand, suggested the possibility of a reasonable conversation, although I don't know if *reasonable* is the word, because as I was
55　taking down his information (fifty-five years old, home address in Lo Curro, no preexisting conditions) and checking his policy (his insurance had the best coverage available on the market), something in his voice made me think that, more than a doctor, he just needed
60　someone to talk to, someone who would listen.

He told me he'd been in Europe for five months, most of that time in Paris, where his daughter—whom he called la Moño—was working on her doctorate and living with her husband—el Mati—and the kids. None
65　of this was in response to my questions, but he was talking so enthusiastically that it was impossible for me to break in. He told me how the kids spoke French with charmingly correct accents, and he also threw in a few commonplace observations about Paris. By the time he
70　started talking to me about the difficulties la Moño had been having lately meeting her academic obligations, about the complexity of the doctoral programs, and about what kind of sense parenthood made in a world like this one ("a world that sometimes seems so strange
75　nowadays, so different," he told me), I realized we'd been talking for almost forty minutes. I had to interrupt him and respectfully ask him to tell me why he was calling. He told me he was a little under the weather, and he'd had a fever. I typed up the fax and sent it to the
80　office in Paris so they could coordinate the case, and then I started the long process of saying good-bye to Juan Emilio, who fell all over himself in apologies and politeness before finally accepting that the conversation had ended.

85　Back then I'd picked up a few evening hours teaching at the technical training institute. The schedule fit perfectly.

1. The point of view from which the passage is told is best described as that of a first person narrator who:

   A. used to work with Portillo and Juan Emilio.
   B. heard about Portillo from Juan Emilio, who was his close friend.
   C. worked with Portillo and interacted with Juan Emilio over the phone.
   D. became acquainted with Portillo and Juan Emilio through his teaching job.

2. Based on the passage, which of the following statements lists the events of the narrator's typical work schedule in chronological order?

   F. He worked at the insurance company overnight, talked to Portillo the following morning, and taught just afterward.
   G. He talked to Portillo in the evening, worked at the insurance company overnight, and taught the following morning.
   H. He taught in the afternoon, worked at the insurance company in the evening, and talked to Portillo in the middle of the night.
   J. He taught in the evening, worked at the insurance company overnight, and talked to Portillo the following morning.

3. Based on the passage, Portillo can best be described as a boss who was mostly:

   A. kind and caring, unless he caught the narrator sleeping.
   B. abrasive and distant, though he asked little of the narrator.
   C. friendly and generous, requiring that the narrator meet simple standards.
   D. boisterous and fun, though he had exacting standards.

4. Based on the passage, where and for what purpose did the clients who called the narrator purchase their insurance?

   F. In Santiago to prepare for travelling to Europe
   G. In Santiago to prepare for travelling in South America
   H. In either Europe or Santiago in order to travel internationally
   J. In Paris to prepare for an extended stay in Santiago

5. According to the passage, the narrator regarded his conversations with Portillo as pointless because:

   A. Portillo did not understand the narrator's job.
   B. nothing notable happened during the narrator's work shift.
   C. Portillo did not pay attention to the narrator's report.
   D. the narrator had too many calls to summarize.

6. The main idea of the fifth paragraph (lines 52–60) is that:

   F. the narrator generally tried to have reasonable conversations with his clients.
   G. Juan Emilio lived overseas with his daughter, son-in-law, and grandchildren.
   H. the narrator could tell from Juan Emilio's voice that he needed someone to talk to.
   J. Juan Emilio sounded tired and slightly ill, though he was usually in good health.

7. In the fifth paragraph (lines 52–60), the details in parentheses primarily serve to:

   A. provide a sense of the information the narrator gathered while talking with Juan Emilio.
   B. relate facts pertaining to the specific illness Juan Emilio was experiencing.
   C. imply that Juan Emilio's health was better than he believed it to be.
   D. emphasize the narrator's sense that Juan Emilio was different from most clients.

8. According to Juan Emilio, la Moño was struggling with:

   F. finding time to spend with her father because of her academic obligations.
   G. meeting the academic obligations of her doctoral program.
   H. finding a job in Paris that related to her academic expertise.
   J. learning enough French to succeed in her academic program.

9. Based on the passage, Juan Emilio says that the world "sometimes seems so strange nowadays, so different" (lines 74–75) while thinking about:

   A. contemporary Paris.
   B. modern-day parenthood.
   C. changes in health care.
   D. doctoral programs.

10. The passage indicates that what the narrator remembers most about Portillo is Portillo's:

    F. pompous nature.
    G. managerial style.
    H. distinctive clothes.
    J. high-pitched voice.

## Passage II

**SOCIAL SCIENCE:** This passage is from the book *On the Map: A Mind-Expanding Exploration of the Way the World Looks* by Simon Garfield.

We are now sure—because we have seen it on maps—that California is firmly attached to Oregon, Arizona and Nevada. Even south of San Diego, when it eventually becomes the Mexican state of Baja Califor-
5 nia, it is firmly hitched to the mainland. But in 1622, something untoward happened. After eighty-one years officially attached to a huge landmass, California drifted free. It wasn't a radical act of political will, nor a single mistake (a slip of an engraver, perhaps), but a
10 sustained act of cartographic misjudgment. Stranger still, the error continued to appear on maps long after navigators had tried to sail entirely around it and—with what must have been a sense of utter bafflement— failed.

15 The name California first appeared on a map in 1541. It was drawn as part of Mexico by Domingo del Castillo—a pilot on an expedition by Hernando de Álarcón—and it is shown as a peninsula and labeled. Its first appearance on a printed map occurred in 1562,
20 when the Spanish pilot and instrument maker Diego Gutierrez again wrote its name at the tip of a peninsula, a very minor detail on a busy and very beautiful engraving of the New World. The map, the largest then made of the region at 107 x 104 cm, may have been engraved
25 after Gutierrez's death by Hieronymus Cock, an artist who clearly took great delight in imaginative trappings: huge ships and legends populate its seas, with Poseidon driving horses on a seaworthy chariot, and a huge gorilla-type creature breaking the waves while it dines
30 on a fish.

California subsequently appeared attached to the mainland for sixty years. And then off it floated into the Pacific, where it remained a cartographic island for more than two centuries.

35 Its first known insular appearance occurred in 1622, on an inset on a title page of a Spanish volume entitled *Historia General*. Two years later it was drift- ing free, bounded by the Mar Vermeio and Mar Del Zur on a Dutch map by Abraham Goos. But it received its
40 most prominent currency on a London map of 1625 entitled "The North Part of America." This accompa- nied an article about the search for the Northwest Passage by the mathematician Henry Briggs. He sup- plemented the great untracked northerly spaces toward
45 the Arctic with text describing the wonders of his map, "Conteyning Newfoundland, new Eng/land, Virginia, Florida, New Spaine . . . and upon ye West the large and goodly lland/ of California." On the eastern seaboard both Plymouth and Cape Cod are placed in
50 Massachusetts, but not yet Boston.

The misconception persisted for decades. It was the seventeenth century's forerunner to a mistake on Wikipedia—doomed to be repeated in a thousand school essays until a bright spark noticed it and dared

55 to make amends. Compiling a paper for the California Map Society in 1995, Glen McLaughlin and Nancy H. Mayo catalogued 249 separate maps (not including world maps) which cast the Golden State adrift. Their names carry bold assertions, with no wiggle room: "A
60 New and Most Exact map of America" claimed one, while another promised "America drawn from the latest and best Observations." Between 1650 and 1657, the French historian Nicolas Sanson published several maps that showed California as an island, and their
65 translations into Dutch and German ensured that they superseded Briggs as the most influential mythmakers for half a century. But they also promoted newer, truer discoveries, including the first cartographic depiction of all five Great Lakes.

70 Even when new maps were published showing California attached to the mainland, the island kept on appearing. In the end, though, it was killed off by a royal decree issued by Ferdinand VII of Spain in 1747, which denied the possibility of this Northwest Passage
75 with the reasonably clear statement: "California is not an Island." Yet news traveled slowly. California appeared as an island on a map made in Japan as late as 1865.

And how did it all begin? The cartographical point
80 zero has been tracked to a Carmelite friar named Antonio de la Acensión who sailed with Sebastian Vizcaino along the West Coast in 1602–3 and kept a journal. Two decades later he is believed to have mapped his trip on paper, which featured California as
85 an island nation. The map was sent to Spain, but the ship on which it traveled was captured by the Dutch, and it ended its journey in Amsterdam. In 1622, Henry Briggs wrote of seeing this map of California in London. And shortly afterward, the map drawn from
90 the one "taken by Hollanders" was set in copper and began its journey through the world.

**11.** The main purpose of the passage is to:

**A.** outline how explorers' maps of California came to be published in Europe.

**B.** provide a partial cartographic history of Califor- nia, focusing on when it was drawn as an island.

**C.** compare the unreliable maps showing California as an island with the accurate early maps of North America.

**D.** recount the discovery of California and explorers' trouble mapping the difficult terrain of that region.

**12.** Which of the following quotations is the clearest example of the author using a lighthearted tone?

- **F.** "It was drawn as part of Mexico" (line 16).
- **G.** "And then off it floated into the Pacific" (lines 32–33).
- **H.** "California appeared as an island on a map made in Japan as late as 1865" (lines 76–78).
- **J.** "Two decades later he is believed to have mapped his trip on paper" (lines 83–84).

**13.** Which of the following events mentioned in the passage occurred first chronologically?

- **A.** De la Acensión and Vizcaino sailed along the west coast of North America.
- **B.** Ferdinand VII decreed that California wasn't an island.
- **C.** Sanson published several maps that showed California as an island.
- **D.** Briggs published a map entitled "The North Part of America."

**14.** The author's central claim is that the depiction of California as an island was an error that mapmakers:

- **F.** knew about and ignored.
- **G.** should have caught.
- **H.** spread for centuries.
- **J.** hoped would inspire exploration of North America.

**15.** The passage indicates that Sanson's maps were partly beneficial in that they:

- **A.** served as the basis for the first Japanese maps of the Western world.
- **B.** encouraged explorers to sail around California in search of a Northwest Passage.
- **C.** forced Ferdinand VII to issue a royal decree about the existence of the Northwest Passage.
- **D.** included truer discoveries, such as the first cartographic depiction of all five Great Lakes.

**16.** The main idea of the sixth paragraph (lines 70–78) is that:

- **F.** explorers stopped searching for a Northwest Passage once Ferdinand VII issued a decree.
- **G.** maps commissioned by Ferdinand VII finally attached California to the mainland.
- **H.** California was depicted as an island even after accurate maps appeared and Ferdinand VII declared it was not an island.
- **J.** Ferdinand VII was adamant that a Northwest Passage existed around California even after sailors explored the area.

**17.** As it is used in line 40, the word *currency* most nearly means:

- **A.** legal tender.
- **B.** property.
- **C.** monetary value.
- **D.** attention.

**18.** In the context of the passage, the map titles presented in lines 59–62 primarily serve to:

- **F.** illustrate that cartographers were very confident in the accuracy of their maps.
- **G.** help the reader visualize the first maps drawn of Virginia and Massachusetts.
- **H.** support the claim that Briggs believed his maps were superior to others.
- **J.** distinguish the maps created by Goos from the maps created by Briggs.

**19.** Based on the passage, the phrase "influential mythmakers" (line 66) refers to maps:

- **A.** drawn by Goos.
- **B.** published by Sanson.
- **C.** that Briggs and Sanson published together.
- **D.** by cartographers whom Briggs and Sanson copied.

**20.** Based on the passage, before it reached London, de la Acensión's map was sent to:

- **F.** Amsterdam, but the British seized it and brought it to Spain.
- **G.** Spain, but the Dutch intercepted it and brought it to California.
- **H.** Spain, but the Dutch seized it and brought it to Amsterdam.
- **J.** Amsterdam, but the Spanish intercepted it and brought it to Spain.

**Passage III**

**HUMANITIES:** This passage is from the book *Apollo's Angels: A History of Ballet* by Jennifer Homans.

    I never thought of ballet as anything but contemporary, a here-and-now art. Even the oldest of ballets are of necessity performed by young people and take on the look of their generation. Besides, unlike theater or
5  music, ballet has no texts and no standardized notation, no scripts or scores, and only the most scattered written records; it is unconstrained by tradition and the past. Choreographer George Balanchine encouraged this idea. In countless interviews he explained that ballets
10 are here and gone, like flowers or butterflies, and that dance is an ephemeral art of the present; *carpe diem*. The point, he seemed to be saying, was not to bring back old musty dances such as *Swan Lake*: it was to "make it new." For the dancers, however, this was a
15 paradoxical injunction: history was all around us—in our teachers and the dances, but also in Balanchine's own ballets, many of which were suffused with memories and a Romantic ethos. But we nonetheless made a cult of never looking back, of setting our sights res-
20 olutely on the present.

    And yet it is because ballet has no fixed texts, because it is an oral and physical tradition, a storytelling art passed on, like Homer's epics, from person to person, that it is more and not less rooted in the past.
25 For it does have texts, even if these are not written down: dancers are required to master steps and variations, rituals and practices. These may change or shift over time, but the process of learning, performing, and passing them on remains deeply conservative. When an
30 older dancer shows a step or a variation to a younger dancer, the ethics of the profession mandate strict obedience and respect: both parties rightly believe that a form of superior knowledge is passing between them. I never for a moment, for example, questioned the steps
35 or style Alexandra Danilova conveyed when she taught us variations from *The Sleeping Beauty*: we clung to her every movement. The teachings of the master are revered for their beauty and logic, but also because they are the *only* connection the younger dancer has to the
40 past—and she knows it. It is these relationships, the bonds between master and student, that bridge the centuries and give ballet its foothold in the past.

    Ballet, then, is an art of memory, not history. No wonder dancers obsessively memorize everything:
45 steps, gestures, combinations, variations, whole ballets. It is difficult to overstate this. Memory is central to the art, and dancers are trained, as the ballerina Natalia Makarova once put it, to "eat" dances—to ingest them and make them part of who they are. These are physical
50 memories; when dancers know a dance, they know it in their muscles and bones. Recall is sensual and brings back not just the steps but also the gestures and feel of the movement, the "perfume," as Danilova said, of the dance—and the older dancer. Thus ballet repertory is
55 not recorded in books or libraries: it is held instead in the bodies of dancers. Most ballet companies even

appoint special "memorizers"—dancers whose prodigious recall sets them apart from their peers—to store its works: they are ballet's scribes (and pedants) and
60 they keep whole oeuvres in their limbs, synchronized (usually) to music that triggers the muscles and helps to bring back the dance. But even dancers with superlative memories are mortal, and with each passing generation, ballet loses a piece of its past.

65    As a result, the ballet repertory is notoriously thin. The "classics" are few and the canon is small. We have only a handful of past ballets, most of which originated in nineteenth-century France or late Imperial Russia. The rest are relatively new: twentieth- and twenty-first-
70 century works. There is some record of seventeenth-century court dances, but the notation system recording these dances died out in the eighteenth century and has never been fully replaced. These court dances are thus an isolated snapshot; the before and after are missing.
75 The rest is spotty and full of holes. One might suppose that French ballet would be well preserved: the fundamental precepts of classical ballet were codified in seventeenth-century France and the art form has enjoyed an unbroken tradition there to the present day.
80 But we have almost nothing. *La Sylphide* premiered in Paris in 1832, but that version was soon forgotten: the version we know today originated in Denmark in 1836. *Coppélia*, from 1870, is in fact the only nineteenth-century French ballet still widely performed in its
85 (more or less) original form.

**21.** The passage most closely conveys the perspective of an experienced dancer who is primarily:

   **A.** recalling ballet lessons she had with particularly challenging teachers.
   **B.** reflecting on the nature of ballet as an art form.
   **C.** discussing how ballet as an art has changed in recent years.
   **D.** documenting her quest to preserve ballet's remaining written records.

**22.** Based on the passage, Balanchine compared ballets to flowers and butterflies primarily to highlight the idea that:

   **F.** every ballet is unique and fleeting.
   **G.** ballets must be danced lightly and delicately.
   **H.** ballets are natural and beautiful.
   **J.** every ballet requires investments of energy and time before "growing" into its final form.

**23.** Based on the passage, which of the following statements best summarizes the "paradoxical injunction" mentioned in the first paragraph?

**A.** Ballet is known for its rigid constraints, yet dancers are told to improvise steps when performing.
**B.** Dancers are not taught ballet's history, yet they are expected to perform traditional ballets.
**C.** Ballet is marked by its connection to history, yet dancers are told to focus on the present.
**D.** Dancers are encouraged to choreograph new ballets, yet only traditional ballets are produced onstage.

**24.** The author includes the detail about Danilova teaching variations from *The Sleeping Beauty* (lines 33–37) primarily to:

**F.** indicate why Danilova is a well-respected ballet master.
**G.** support the idea that younger dancers believe older dancers possess a superior knowledge.
**H.** illustrate the types of exercises that make up a typical ballet class.
**J.** articulate Danilova's unique process of imparting knowledge to younger dancers.

**25.** The passage states that the scribes of the ballet world are those dancers who:

**A.** record contemporary ballet in books and libraries.
**B.** are exceedingly gifted teachers and scholars.
**C.** interview older dancers and compile their wisdom.
**D.** commit a ballet company's works to memory.

**26.** The passage states that one way ballet differs from theater and music is that ballet:

**F.** cannot be truly understood by young people.
**G.** requires physical discipline.
**H.** has no standardized notation.
**J.** is characterized by a conservative learning process.

**27.** As it is used in line 21, the word *fixed* most nearly means:

**A.** altered.
**B.** conjoined.
**C.** repaired.
**D.** established.

**28.** The passage states that ballet as a profession demands which of the following traits from younger dancers?

**F.** Obedience and respect
**G.** Passion and emotiveness
**H.** Innovation and creativity
**J.** Encouragement and amiableness

**29.** As it is presented in the passage, the "perfume" of a dance refers mainly to the:

**A.** gestures and feel of the dance's movement.
**B.** expressions and scents used by the older dancer.
**C.** guidance and correction from the older dancer.
**D.** actual steps in the dance's choreography.

**30.** In the passage, the author indicates that one reason a person could reasonably assume that French ballet would be well preserved is that ballet:

**F.** has been studied meticulously by French historians.
**G.** has been practiced continuously in France for centuries.
**H.** is performed more widely in France than in most countries.
**J.** is considered by most French citizens to be part of their national identity.

**Passage IV**

NATURAL SCIENCE: Passage A is from the article "Just Add Water" by Jan Zalasiewicz and Mark Williams. Passage B is from the article "Plate Tectonics Spotted on Europa" by Thomas Sumner.

## Passage A by Jan Zalasiewicz and Mark Williams

A look at our neighbours Mars and Venus shows how lucky Earth has been. They too had surface water in the early days, perhaps even large oceans. On frozen Mars today we see ancient shorelines more than 3 bil-
5  lion years old, and detect clays formed in water. Soon, though, Mars lost most of its atmosphere and protective magnetic field, and its water vapour leaked away. Venus is an inferno surrounded by suffocating clouds of sul-phuric acid now, but probe measurements show it too
10 once had abundant liquid water, until rising levels of water vapour and carbon dioxide led to a runaway greenhouse effect that boiled it off.

What made Earth different? The key is probably plate tectonics. The movement of segments of Earth's
15 uppermost layer is unique, we think, among the rocky planets of the solar system. They crash against each other, buckling, rising or driving down into the planet's hot mantle. There is some evidence such tectonics tried to start up on Mars, but if so it didn't last long. On
20 Earth, it has created natural depressions: ocean basins, underlain by dense newly forming crust, that hold deeper waters; and shallow seas on the lighter, more ancient crust of the continents. The bottom of these containers is cracked at the subduction zones where
25 water-soaked plates slide down into the mantle. That water is mostly wrung back out to emerge as volcanic steam in mountain ranges.

This constant cycling of water, and the unlikely coexistence of wet and dry surfaces is, it turns out, cru-
30 cial. Water evaporating from the oceans condenses as rain and chemically attacks the land, modulating atmo-spheric composition and global temperature. The atmosphere thus formed has a lid—a "cold trap" made by the chill of the stratosphere—that freezes water
35 vapour out and stops it escaping into space. Below this lid, almost uncannily, all three phases of water—solid, liquid and gas—coexist almost all of the time: the only planetary surface known where this has been sustained for any long period.

40    To complete this remarkable planetary machine, plate tectonics itself needs water to function: water lubricates descending tectonic plates and softens mantle minerals so they melt more easily. Geochemist Francis Albarède of the Ecole Normale Supérieure in Lyon,
45 France, thinks that water's arrival from outer space kick-started the plate-tectonic motor 3 billion years ago.

## Passage B by Thomas Sumner

Plate tectonics churns the icy exterior of Jupiter's moon Europa, researchers reported in 2014. The finding
50 marks the first evidence of plate tectonics beyond Earth.

"Earth is not unique—we've found another body in the solar system with plate tectonics," says planetary scientist Simon Kattenhorn of the University of Idaho
55 in Moscow. "This tells us that this process can happen on more than just rocky planets like Earth."

Previous observations have seen surface reshaping, such as volcanic activity, on other planetary bodies including Saturn's moon Titan. However, Kattenhorn
60 says, Europa is the first found with a patchwork of drifting tectonic plates.

The rising and sinking ice slabs on Europa's sur-face may provide a mechanism for nutrients to move from the moon's surface to its subsurface ocean,
65 Kattenhorn argues. Such transport would bolster the likelihood that this ocean hosts life. Astrobiologist Britney Schmidt of Georgia Tech in Atlanta says the mechanism is "very exciting for Europa's chances for supporting life."

70    Though the moon formed over 4 billion years ago, at the same time as the rest of the solar system, Europa's icy surface is surprisingly young. Based on the moon's small number of impact craters, scientists estimate Europa's surface to be just 40 million to
75 90 million years old. Dark bands crisscross the moon where warm, fresh ice wells up to the frigid surface, but a mystery remained: Where is the old material?

Two years ago, Kattenhorn and coauthor Louise Prockter of Johns Hopkins University spotted some-
80 thing odd as they scoured a Louisiana-sized portion of Europa mapped by NASA's Galileo spacecraft in 1998. In the moon's northern hemisphere, a 20,000-square-kilometer hunk of landscape was missing. Like a torn photograph placed so that the pieces overlap, Europa's
85 crisscrossing surface fractures didn't properly line up.

The researchers propose that this discrepancy marks where two massive ice slabs smashed together, with one sinking under the other and blending into the moon's warmer interior ice. The action resembles a
90 subduction zone on Earth, where one slab of crust—or tectonic plate—slides beneath another.

**31.** Which statement best summarizes the discussion of water in the last paragraph of Passage A (lines 40–47)?

  **A.** Water is what makes Earth remarkable among all the planets.
  **B.** After water created natural depressions on Earth, plates could more easily interact with one another.
  **C.** Notable geochemists confirm that water caused tectonic plates, and it melts the plates as they descend.
  **D.** Water may have been the impetus for the tectonic process, and it helps the plates move more easily.

**32.** In Passage A, the authors mention which of the following as evidence that Mars once had surface water?

  **F.** Oceans
  **G.** Clay
  **H.** Water vapor in the atmosphere
  **J.** Mars's magnetic field

**33.** According to Passage A, Venus lost its liquid water due to:

  **A.** loss of its magnetic field.
  **B.** unchecked infernos on its surface.
  **C.** clouds of sulphuric acid in its atmosphere.
  **D.** rising levels of water vapor and carbon dioxide.

**34.** According to Passage A, one main function of a "cold trap" (line 33) is to:

  **F.** keep water vapor within Earth's atmosphere.
  **G.** chill the stratosphere by freezing water vapor into ice.
  **H.** construct a lid that chemically attacks the land.
  **J.** stop water vapor in space from entering Earth's atmosphere.

**35.** In Passage B, the author mentions a torn photograph most likely to:

  **A.** help illustrate Europa's jagged landscape before plate tectonics emerged there.
  **B.** clarify that Kattenhorn and Prockter needed to tear the images they were studying in order to replicate Europa's surface fractures.
  **C.** help portray the fractures on Europa's surface that intrigued Kattenhorn and Prockter.
  **D.** reveal that the images NASA's *Galileo* took of Europa's surface fractures were somewhat flawed.

**36.** According to Passage B, scientists base their belief that Europa's surface is relatively young on its:

  **F.** subsurface ocean.
  **G.** small number of impact craters.
  **H.** patchwork of drifting tectonic plates.
  **J.** dark crisscrossing bands and icy surface.

**37.** As it is used in line 80, the word *scoured* most nearly means:

  **A.** dredged up.
  **B.** rummaged in.
  **C.** carefully cleaned.
  **D.** thoroughly examined.

**38.** Based on the passages, Earth can be considered unique because it is the only known body in the solar system:

  **F.** with tectonic plates that drift across its uppermost layer.
  **G.** where tectonic plates can transport nutrients below its surface.
  **H.** where water, ice, and water vapor share a sustained coexistence.
  **J.** that had surface water three billion years ago.

**39.** The functions of the first paragraph of Passage A and the third paragraph of Passage B (lines 57–61) are similar in that both paragraphs:

  **A.** use other planetary bodies to highlight the uniqueness of Earth or Europa.
  **B.** introduce the discovery of plate tectonics on Earth or Europa.
  **C.** contrast previous discoveries of volcanic activity with newer discoveries of tectonic plates.
  **D.** explain how various planetary bodies lost their surface water.

**40.** It can reasonably be inferred from both passages that tectonic plates most greatly influence a planetary body's ability to support life:

  **F.** when tectonic plates buckle during impact with volcanic plates.
  **G.** if the tectonic plates consist of ice rather than rock.
  **H.** when one tectonic plate slides beneath another one.
  **J.** if the tectonic plates are less than ninety million years old.

**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**

*Solar time* is determined by the position of the Sun relative to a *meridian* (an imaginary line that passes through the northernmost and southernmost points of the horizon, dividing the visible sky into 2 equal halves). At *solar noon*, the Sun appears to cross the meridian. A *solar day* is the period between one solar noon and the next. Because the Sun's apparent motion is not uniform, a solar day is generally not the same length as a *mean day*, which is exactly 24 hrs (1,440 min). See Figure 1.
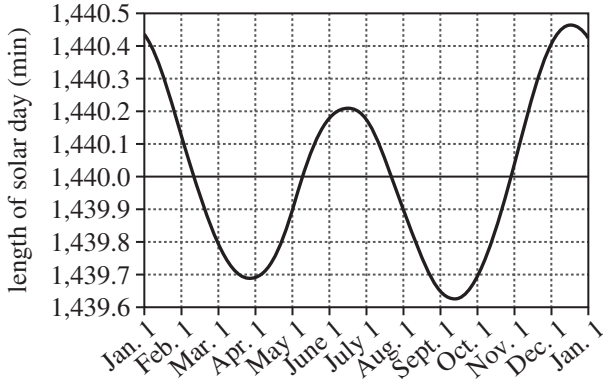


Figure 1

Figure 2 shows how the difference between solar time and *mean time* (time as indicated by a clock) varies throughout the year.
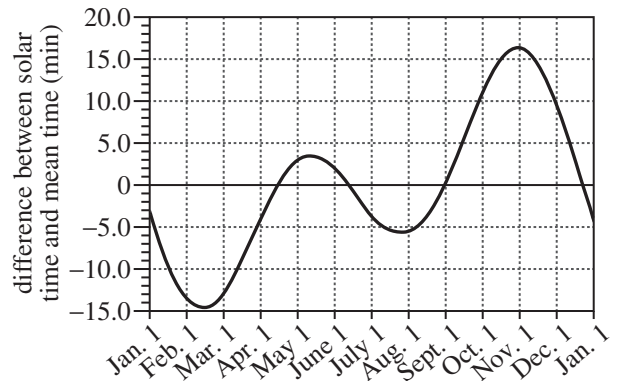


Note: If the difference between solar time and mean time is positive, solar time is ahead of mean time; if the difference is negative, solar time is behind mean time.

Figure 2

**1.** Based on Figure 2, on how many dates each year is solar time exactly 8 minutes behind mean time?

A. 2
B. 4
C. 6
D. 8

**2.** According to Figure 2, on which of the following dates does solar time have the same value as mean time?

F. February 10
G. March 15
H. April 15
J. July 1

**GO ON TO THE NEXT PAGE.**

**3.** During the first 6 months of the year, is solar time more often ahead of mean time or behind mean time?

   **A.** Ahead; the difference between solar time and mean time is more often positive during the first 6 months of the year.

   **B.** Ahead; the difference between solar time and mean time is more often negative during the first 6 months of the year.

   **C.** Behind; the difference between solar time and mean time is more often positive during the first 6 months of the year.

   **D.** Behind; the difference between solar time and mean time is more often negative during the first 6 months of the year.

**4.** According to Figure 1, on which of the following dates is the solar day longer than the mean day?

   **F.** February 15
   **G.** March 15
   **H.** June 15
   **J.** August 15

**5.** According to Figure 2, in a given year, solar time is ahead of mean time for approximately how many months in total?

   **A.** 3.5
   **B.** 5.5
   **C.** 7.5
   **D.** 9.5

**6.** Based on Figure 1, the longest solar day of the year is approximately how much longer than the shortest solar day of the year?

   **F.** 0.4 min
   **G.** 0.8 min
   **H.** 1.2 min
   **J.** 1.6 min

## Passage II

An experiment was conducted to determine how sea-water temperature and salinity affect food consumption and growth in *Scophthalmus maximus* (a species of fish). The table shows, for each of 8 trials, average total food consumption, $C_T$, and average gain in body mass for *S. maximus* kept at various temperature and salinity combinations. Each trial involved the same number of fish and lasted the same number of months.

| Trial | Temperature (°C) | Salinity (ppt*) | Average $C_T{}^\dagger$ (g) | Average gain in body mass (g) |
|---|---|---|---|---|
| 1 | 22 | 15 | 53.3 | 91.6 |
| 2 | 22 | 25 | 52.1 | 87.1 |
| 3 | 22 | 30 | 46.4 | 81.0 |
| 4 | 22 | 35 | 42.6 | 74.5 |
| 5 | 10 | 15 | 15.6 | 24.3 |
| 6 | 14 | 15 | 27.9 | 50.7 |
| 7 | 18 | 15 | 44.6 | 79.5 |
| 8 | 22 | 15 | 53.6 | 92.6 |

*parts per thousand
$^\dagger C_T$ = (food supplied to each fish) − (food uneaten)

Table adapted from Albert K. Imsland et al., "The Interaction of Temperature and Salinity on Growth and Food Conversion in Juvenile Turbot (*Scophthalmus maximus*)." ©2001 by Elsevier Science B. V.

7. Based on the table, for which 2 trials was the average $C_T$ value less than 50 g and the average gain in body mass greater than 75 g ?

   A. Trial 1 and Trial 2
   B. Trial 1 and Trial 8
   C. Trial 3 and Trial 4
   D. Trial 3 and Trial 7

8. Consider Trials 1−4. Based on the table, as salinity increased, did average $C_T$ increase or decrease, and did average gain in body mass increase or decrease?

   |  | average $C_T$ | average gain in body mass |
   |---|---|---|
   | F. | increase | decrease |
   | G. | increase | increase |
   | H. | decrease | decrease |
   | J. | decrease | increase |

9. Consider the 4 trials for which the average $C_T$ values were less than 45 g. What is the order of these trials from the trial with the least average $C_T$ value to the trial with the greatest average $C_T$ value?

   A. Trial 5, Trial 6, Trial 4, Trial 7
   B. Trial 5, Trial 6, Trial 7, Trial 8
   C. Trial 7, Trial 8, Trial 5, Trial 6
   D. Trial 7, Trial 4, Trial 6, Trial 5

10. Based on the table, average gain in body mass was approximately how many times as great for the *S. maximus* in Trial 6 as for the *S. maximus* in Trial 5 ?

   F. $\frac{1}{5}$
   G. $\frac{1}{2}$
   H. $2$
   J. $5$

○ ○ ○ ○ ○ ○ ○ ○ ○

**11.** Suppose Trial 1 lasted 3 months. How many months did Trial 8 last?

   **A.** 3 months
   **B.** 8 months
   **C.** 24 months
   **D.** Cannot be determined from the given information

**12.** What was the average $C_T$, in *kilograms* (kg), for fish kept at a temperature of 22°C and a salinity of 25 ppt ?

   **F.** 0.0521 kg
   **G.** 0.521 kg
   **H.** 52.1 kg
   **J.** 52,100.0 kg

**GO ON TO THE NEXT PAGE.**

**Passage III**

Three studies examined the effects of *compost* (organic matter) on 3 physical properties of soil.

Five soil mixtures (Mixtures 1–5) were prepared (see Table 1).

| Table 1 | | |
|---|---|---|
| | Percent by volume of: | |
| Mixture | compost | soil |
| 1 | 5 | 95 |
| 2 | 25 | 75 |
| 3 | 50 | 50 |
| 4 | 75 | 25 |
| 5 | 95 | 5 |

*Study 1*

A 1.5 L pot was prepared by placing 500 g of Mixture 1 into the pot, after which the pot was stored at 30°C for 72 hr. The pot and its contents were then baked in a 105°C oven for 24 hr. After cooling, the mixture's *bulk density* (the dry mass of the mixture per unit volume) was determined.

These procedures were repeated for each of Mixtures 2–5 (see Table 2).

| Table 2 | |
|---|---|
| Mixture | Bulk density (mg/mL) |
| 1 | 104 |
| 2 | 159 |
| 3 | 213 |
| 4 | 255 |
| 5 | 302 |

*Study 2*

Another 1.5 L pot of Mixture 1 was prepared, stored, and baked as in Study 1.

The dried mixture was ground into powder and passed through a screen with 2 mm diameter openings. Five grams of the screened powder were then mixed with 5 mL of $H_2O$, and the pH of the powder-$H_2O$ suspension was determined.

These procedures were repeated for each of Mixtures 2–5 (see Table 3).

| Table 3 | |
|---|---|
| Suspension of $H_2O$ and Mixture: | pH |
| 1 | 6.5 |
| 2 | 6.2 |
| 3 | 6.7 |
| 4 | 7.0 |
| 5 | 7.2 |

*Study 3*

Another 1.5 L pot of Mixture 1 was prepared, stored, and baked as in Study 1. The dried mixture was then ground and screened as in Study 2.

Fifty grams of the screened powder were mixed with 5 mL of $H_2O$ to form a soil paste, and the paste was placed on a filter. Suction was then applied to the filter, and the *extract* (the clear, colorless liquid that passed through the filter) was collected. The electrical conductivity of the extract was determined.

These procedures were repeated for each of Mixtures 2–5 (see Table 4).

| Table 4 | |
|---|---|
| Extract from Mixture: | Electrical conductivity (dS/m*) |
| 1 | 2.40 |
| 2 | 2.56 |
| 3 | 3.45 |
| 4 | 2.15 |
| 5 | 1.86 |
| *decisiemens per meter | |

**13.** Which of the following is the most likely reason that a given mixture was exposed to a temperature of 105°C in Study 1 ?

**A.** To allow the mixture to be passed through a screen
**B.** To prevent the mixture from being passed through a screen
**C.** To add moisture to the mixture
**D.** To remove moisture from the mixture

**14.** In Study 3, once the suction was applied, the filters most likely allowed the passage of:

**F.** soil but not liquid.
**G.** liquid but not soil.
**H.** both soil and liquid.
**J.** neither soil nor liquid.

**15.** Based on the results of Study 1, if a mixture with 60% by volume of compost had been tested in Study 1, the bulk density of this mixture would most likely have been:

**A.** less than 159 mg/mL.
**B.** between 159 mg/mL and 213 mg/mL.
**C.** between 213 mg/mL and 255 mg/mL.
**D.** greater than 255 mg/mL.

**16.** Study 2 differed from Study 3 in which of the following ways?

**F.** A greater mass of the screened powder was mixed with $H_2O$ in Study 2 than in Study 3.
**G.** A greater mass of the screened powder was mixed with $H_2O$ in Study 3 than in Study 2.
**H.** A longer storage time was used in Study 2 than in Study 3.
**J.** A longer storage time was used in Study 3 than in Study 2.

**17.** Consider the mixture that resulted in the suspension with the *lowest* pH in Study 2. According to the results of Study 1, was the bulk density of this mixture greater than, less than, or equal to 150 mg/mL ?

**A.** Greater than
**B.** Less than
**C.** Equal to
**D.** Cannot be determined from the given information

**18.** In Study 2, was the suspension for Mixture 1 acidic or basic?

**F.** Basic, because the pH was greater than 7.0.
**G.** Basic, because the pH was less than 7.0.
**H.** Acidic, because the pH was greater than 7.0.
**J.** Acidic, because the pH was less than 7.0.

**19.** Consider the statement "The percent by volume of compost in the mixture that had the greatest bulk density was the same as the percent by volume of compost in the mixture that had the extract with the *lowest* electrical conductivity." Do the results of Studies 1 and 3 support this statement?

**A.** Yes; 50% by volume of compost resulted in the greatest bulk density and the lowest electrical conductivity.
**B.** Yes; 95% by volume of compost resulted in the greatest bulk density and the lowest electrical conductivity.
**C.** No; 50% by volume of compost resulted in the greatest bulk density, but 95% by volume of compost resulted in the lowest electrical conductivity.
**D.** No; 95% by volume of compost resulted in the greatest bulk density, but 50% by volume of compost resulted in the lowest electrical conductivity.

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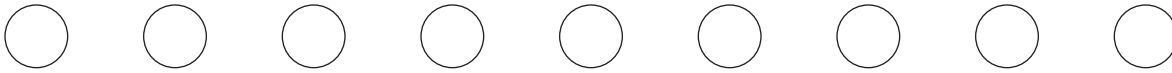
## Passage IV

When a sand-covered drumhead vibrates at certain frequencies, the sand collects at *nodes* (areas of least vibration). Two types of nodes can form on a vibrating drumhead: *radial nodes*, which look like rings, and *linear nodes*, which look like straight lines. As sand collects at nodes, patterns called *nodal patterns* (NPs) form. Figure 1 shows two NPs that can form on a sand-covered drumhead: NP 1 (a radial node only) and NP 2 (a radial node and a linear node).

radial nodes      linear node



NP 1            NP 2
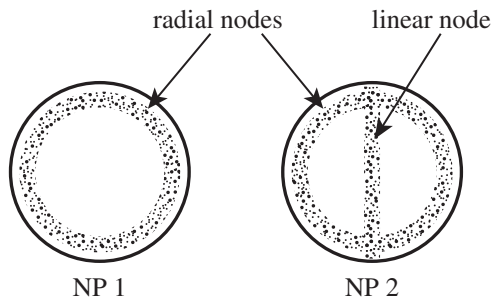
Figure 1

Students performed 2 experiments to study the formation of NP 1 and NP 2 on various drumheads.

*Experiment 1*

The students obtained 5 drumheads, each having a different diameter and each set to a tension of 2,000 newtons per meter (N/m). They performed a trial with each drumhead, using the following procedure: First, they placed the drumhead directly above a speaker emitting sound waves having a frequency of 90 hertz (Hz). Then, they gradually increased the frequency until they observed NP 1. Finally, they continued to increase the frequency until they observed NP 2. Throughout each trial, the *amplitude* (loudness) of the sound waves was held constant. Table 1 shows the frequency at which the students observed NP 1 and NP 2 for each trial.

| Table 1 | | |
|---|---|---|
| Diameter (cm) | Frequency (Hz) at which the students observed: | |
| | NP 1 | NP 2 |
| 20 | 330 | 530 |
| 30 | 224 | 356 |
| 40 | 168 | 267 |
| 50 | 134 | 213 |
| 60 | 112 | 178 |

*Experiment 2*

The students performed 7 more trials with the 50 cm diameter drumhead. In each trial, first the tension was adjusted to a certain value, and then the procedures of the Experiment 1 trials were repeated. Figure 2 shows the results for each trial, as well as a line of best fit for each NP.
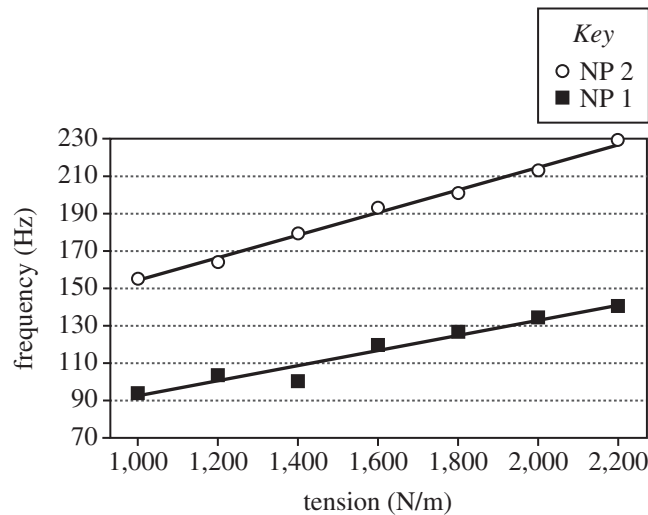


Figure 2

**20.** Based on the results of Experiment 1, for how many of the diameters tested was the frequency for NP 1 *less* than that for NP 2 ?

F. 1
G. 3
H. 4
J. 5

**21.** Which of the following questions about either drumhead diameter or drumhead tension can be answered by the results of Experiment 2 ? What effect did the:

A. diameter of the drumhead have on the frequency at which the NPs were observed?
B. diameter of the drumhead have on the time at which the NPs were observed?
C. tension of the drumhead have on the frequency at which the NPs were observed?
D. tension of the drumhead have on the time at which the NPs were observed?

**22.** Suppose that in Experiment 2 a trial had been performed in which NP 1 was observed at a frequency of 130 Hz. Based on Figure 2, the tension of the drumhead would most likely have been closest to which of the following?

F.   1,700 N/m
G.   1,900 N/m
H.   2,100 N/m
J.   2,300 N/m

**23.** Experiments 1 and 2 differed in which of the following ways? In Experiment 1:

A. loudness was held constant and frequency was varied, whereas in Experiment 2, loudness was varied and frequency was held constant.
B. loudness was varied and frequency was held constant, whereas in Experiment 2, loudness was held constant and frequency was varied.
C. 5 drumheads were used, whereas in Experiment 2, 1 drumhead was used.
D. 5 drumheads were used, whereas in Experiment 2, 7 drumheads were used.

**24.** Based on the results of Experiment 1, for the 60 cm diameter drumhead, what was the difference between the frequency at which NP 1 was observed and the frequency at which the speaker was initially set during the procedure?

F.    22 Hz
G.    88 Hz
H.   112 Hz
J.   178 Hz

**25.** For a given diameter and tension, the *fundamental frequency* is the frequency at which NP 1 is observed. Suppose that, for a 20 cm diameter drumhead set at a tension of 2,000 N/m, a certain NP is known to form at a frequency that is 2.3 times the fundamental frequency. Based on the results of Experiment 1, this NP would most likely form at approximately what frequency?

A.   330 Hz
B.   530 Hz
C.   759 Hz
D.   1,219 Hz

**26.** A student claimed that the greater the drumhead diameter, the longer the *wavelength* of sound needed to observe a given NP. Is this claim supported by the results for NP 2 from Experiment 1 ?

F. Yes; as the diameter was increased, the frequency at which NP 2 was observed increased.
G. Yes; as the diameter was increased, the frequency at which NP 2 was observed decreased.
H. No; as the diameter was increased, the frequency at which NP 2 was observed increased.
J. No; as the diameter was increased, the frequency at which NP 2 was observed decreased.

**Passage V**

Three students observed that Trait R is present in some people but not in others. The presence or absence of Trait R in a person is determined entirely by alleles of Gene R. Gene R has 2 alleles: *R*, which is dominant, and *r*, which is recessive.

A teacher gave the students a pedigree showing the inheritance of Trait R in a particular family (see Figure 1). Each individual represented in the pedigree was assigned a number (shown below the symbol for the individual) for reference. Based on the pedigree, each student proposed a hypothesis explaining the pattern of inheritance for Trait R in this family.
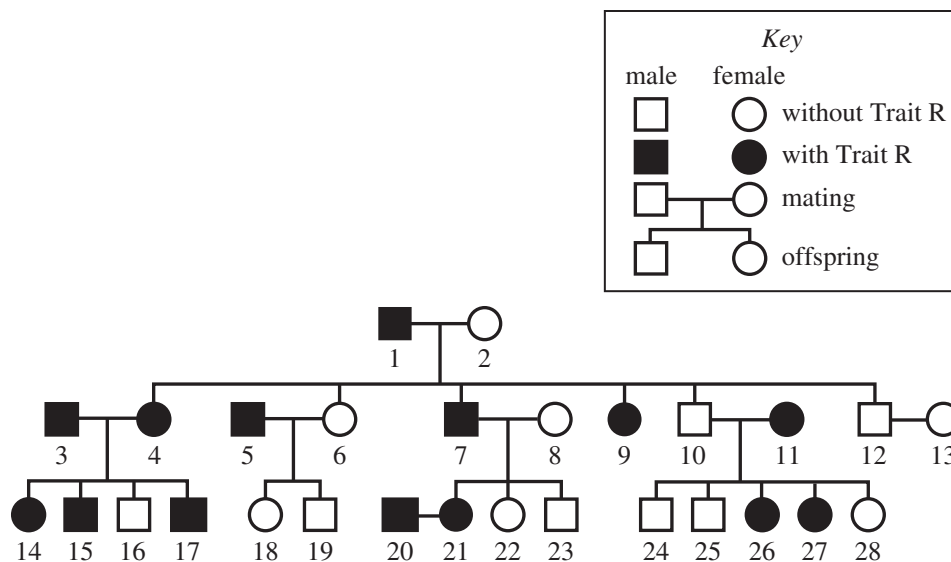


Figure 1

*Student 1*

Gene R is located on the X chromosome, so females (who inherit two X chromosomes) inherit 2 copies of Gene R, whereas males (who inherit one X chromosome) inherit only 1 copy of Gene R. All females with Trait R inherited 2 copies of the *r* allele, and all males with Trait R inherited 1 copy of the *r* allele. Table 1 shows the possible Gene R genotypes for females and for males and indicates whether the genotypes result in Trait R.

| Table 1 | | |
|---|---|---|
| Gender | Gene R genotype | Trait R present? |
| Female | *RR* *Rr* *rr* | no no yes |
| Male | *R\** *r\** | no yes |

\*Because males inherit only one X chromosome, their Gene R genotype has only 1 copy of Gene R.

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*Student 2*

Gene R is not located on the X chromosome or the Y chromosome. All individuals with Trait R inherited 2 copies of the *r* allele.

*Student 3*

Gene R is not located on the X chromosome or the Y chromosome. All individuals with Trait R inherited either 1 or 2 copies of the *R* allele.

**27.** Which student, if any, would be likely to predict that the Gene R genotype of Individual 5 is *rr* ?

**A.** Student 1
**B.** Student 2
**C.** Student 3
**D.** None of the students

**28.** Which of the following tables is most consistent with the hypothesis of Student 3 ?

**F.**

| Gene R genotype | Trait R present? |
|---|---|
| *RR* | yes |
| *Rr* | yes |
| *rr* | yes |

**G.**

| Gene R genotype | Trait R present? |
|---|---|
| *RR* | yes |
| *Rr* | yes |
| *rr* | no |

**H.**

| Gene R genotype | Trait R present? |
|---|---|
| *RR* | yes |
| *Rr* | no |
| *rr* | no |

**J.**

| Gene R genotype | Trait R present? |
|---|---|
| *RR* | no |
| *Rr* | no |
| *rr* | yes |

**29.** Which of Student 2 or Student 3 implied that Trait R is a recessive trait?

**A.** Student 2, because Student 2 predicted that individuals with 2 copies of the recessive allele of Gene R will have Trait R.
**B.** Student 2, because Student 2 predicted that individuals with only 1 copy of the recessive allele of Gene R will have Trait R.
**C.** Student 3, because Student 3 predicted that individuals with 2 copies of the recessive allele of Gene R will have Trait R.
**D.** Student 3, because Student 3 predicted that individuals with only 1 copy of the recessive allele of Gene R will have Trait R.

**30.** Suppose that Individual 20 and Individual 21 have a biological child. Based on Student 2's hypothesis, what is the probability that the child will have Trait R ?

**F.** 0%
**G.** 25%
**H.** 50%
**J.** 100%

**31.** Based on Student 1's hypothesis, is an individual with the Gene R genotype *RR* female or male, and does the individual have Trait R ?

**A.** Female; yes
**B.** Female; no
**C.** Male; yes
**D.** Male; no

**32.** Which of the students proposed a pattern of inheritance that would most likely result in Trait R being rarer in females than in males?

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

**33.** Consider Individuals 3 and 4 and their offspring. Is this portion of the pedigree more consistent with the hypothesis of Student 1 or the hypothesis of Student 3 ?

**A.** Student 1; this portion of the pedigree suggests that Trait R is a dominant trait.
**B.** Student 1; this portion of the pedigree suggests that Trait R is a recessive trait.
**C.** Student 3; this portion of the pedigree suggests that Trait R is a dominant trait.
**D.** Student 3; this portion of the pedigree suggests that Trait R is a recessive trait.

**GO ON TO THE NEXT PAGE.**

**Passage VI**

The hot, spicy flavor of chili peppers is directly proportional to the concentration of *capsaicinoids* (a class of chemical compounds). Scientists studied the effects of fertilizer application and pepper color on the capsaicinoid concentration of 3 varieties of chili peppers (V1–V3).

*Study*

Two hundred V1 plants that were 82 days old were divided into 4 equal groups, and each group was planted in a different plot (Plot L, M, N, or O) in a particular field. This procedure was repeated with V2 and V3 plants in separate, but adjacent, fields. Fertilizer was then applied to the type L plots and the type M plots. Each plot was irrigated equally once every 20 days until harvest. All the peppers in the type L plots and the type N plots were harvested 77 days after planting, while the peppers were still green. All the peppers in the type M plots and the type O plots were harvested 87 days after planting, after the peppers had turned red. Table 1 summarizes, for each plot type, whether fertilizer was applied to the plot and the color of the peppers in the plot at the time of harvest.

| Table 1 | | |
|---|---|---|
| Plot type | Fertilizer applied? | Pepper color at harvest |
| L | yes | green |
| M | yes | red |
| N | no | green |
| O | no | red |

Immediately after being harvested, all the peppers were dried at 65°C for 24 hr. Then, for each field, all the dried peppers grown in a given plot were ground up and combined. The total capsaicinoid concentration, in milligrams of capsaicinoids per gram of dry pepper (mg/g), was then determined for the peppers from each plot of each field. The results are shown in Table 2.

| Table 2 | | |
|---|---|---|
| Pepper variety | Plot | Total capsaicinoid concentration (mg/g) |
| V1 | L | 78 |
| | M | 60 |
| | N | 70 |
| | O | 55 |
| V2 | L | 105 |
| | M | 87 |
| | N | 92 |
| | O | 72 |
| V3 | L | 87 |
| | M | 49 |
| | N | 71 |
| | O | 30 |

Tables adapted from Alberto González-Zamora et al., "Measurement of Capsaicinoids in Chiltepin Hot Pepper: A Comparison Study between Spectrophotometric Method and High Performance Liquid Chromatography Analysis." ©2015 by Alberto González-Zamora et al.

**34.** The hottest peppers in the study were most likely those of which variety grown in which plot?

**F.** The V2 peppers grown in Plot L, because they had the highest total capsaicinoid content.
**G.** The V2 peppers grown in Plot L, because they had the lowest total capsaicinoid content.
**H.** The V3 peppers grown in Plot O, because they had the highest total capsaicinoid content.
**J.** The V3 peppers grown in Plot O, because they had the lowest total capsaicinoid content.

**35.** The spiciness of a pepper is often reported in *Scoville heat units* (SHU). In general, the higher the total capsaicinoid concentration, the higher the SHU value. Based on the results of the study for V1 in the plots that had fertilizer applied, would the SHU rating likely have been higher for green peppers or for red peppers?

**A.** Green; the total capsaicinoid concentration of the Plot L peppers was higher than that of the Plot M peppers.
**B.** Green; the total capsaicinoid concentration of the Plot N peppers was higher than that of the Plot O peppers.
**C.** Red; the total capsaicinoid concentration of the Plot L peppers was higher than that of the Plot M peppers.
**D.** Red; the total capsaicinoid concentration of the Plot N peppers was higher than that of the Plot O peppers.

**36.** Consider the statement "For a given variety of pepper grown *without* applied fertilizer, the total capsaicinoid concentration of red peppers is generally higher than that of green peppers." Are the results of the study for V3 consistent with this statement?

**F.** No, because the total capsaicinoid concentration of the Plot L peppers was higher than that of the Plot M peppers.
**G.** No, because the total capsaicinoid concentration of the Plot N peppers was higher than that of the Plot O peppers.
**H.** Yes, because the total capsaicinoid concentration of the Plot L peppers was higher than that of the Plot M peppers.
**J.** Yes, because the total capsaicinoid concentration of the Plot N peppers was higher than that of the Plot O peppers.

**37.** Assume that 50 kg of fertilizer was applied to each plot that was fertilized in the study. Suppose an additional plot type in which 100 kg of fertilizer was applied to each plot had also been included in the study. The peppers grown in these plots were harvested 77 days after planting in the fields. The results are shown in the following table.

| Pepper variety | Total capsaicinoid concentration (mg/g) |
|---|---|
| V1 | 91 |
| V2 | 110 |
| V3 | 97 |

Based on the available information, how did the total capsaicinoid concentration of the peppers change as the amount of fertilizer applied changed from 0 kg to 50 kg to 100 kg ? For each pepper variety, the total capsaicinoid concentration:

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

**38.** For each of the 3 pepper varieties, which plot was most likely intended to serve as the control for the effect of applied fertilizer on peppers that were harvested when they were red?

**F.** Plot L
**G.** Plot M
**H.** Plot N
**J.** Plot O

**39.** Based on the description of the study, how many pepper plants were planted in each plot?

**A.** 50
**B.** 200
**C.** 600
**D.** Cannot be determined from the given information

**40.** Assume that the average mass of a dried V1 pepper was 20 g. On average, the total mass, in milligrams, of capsaicinoids found in a V1 pepper from Plot M was closest to which of the following?

**F.** 3 mg
**G.** 60 mg
**H.** 600 mg
**J.** 1,200 mg

**END OF TEST 4**

**STOP! DO NOT RETURN TO ANY OTHER TEST.**

## Scoring Keys for Form D05

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

### Test 1: English—Scoring Key

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

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

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

| **Number Correct (Raw Score) for:** | |
|---|---|
| Production of Writing (POW) | _____ (24) |
| Knowledge of Language (KLA) | _____ (11) |
| Conventions of Standard English (CSE) | _____ (40) |
| Total Number Correct for English Test (POW + KLA + CSE) | _____ (75) |

# Test 2: Mathematics—Scoring Key

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

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

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

**\*Reporting Categories**
**PHM** = Preparing for Higher Math
   N  = Number & Quantity
   A  = Algebra
   F  = Functions
   G  = Geometry
   S  = Statistics & Probability
**IES**  = Integrating Essential Skills
**MDL** = Modeling

| Number Correct (Raw Score) for: | |
|---|---|
| Preparing for Higher Math (PHM) | _____ |
|    (N + A + F + G + S) | (35) |
| Integrating Essential Skills (IES) | _____ |
| | (25) |
| Total Number Correct for Mathematics Test | _____ |
|    (PHM + IES) | (60) |
| | |
| Modeling (MDL) | _____ |
|    (Not included in total number correct for | (21) |
|    mathematics test raw score) | |

# Test 3: Reading—Scoring Key

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

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

**Reporting Category\***

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

**Number Correct (Raw Score) for:**

Key Ideas & Details (KID) _____ (24)

Craft & Structure (CS) _____ (11)

Integration of Knowledge & Ideas (IKI) _____ (5)

Total Number Correct for Reading Test _____
(KID + CS + IKI) (40)

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# Test 4: Science—Scoring Key

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

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

**Reporting Category\***

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

**Number Correct (Raw Score) for:**

Interpretation of Data (IOD) _____ (20)

Scientific Investigation (SIN) _____ (10)

Evaluation of Models, Inferences & Experimental Results (EMI) _____ (10)

Total Number Correct for Science Test _____
(IOD + SIN + EMI) (40)

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

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

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

**ACT Test D05**          **Your Scale Score**

English           _____

Mathematics          _____

Reading           _____

Science            _____

**Sum of scores**          _____

**Composite score (sum ÷ 4)**      _____

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

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

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