

Form F07

(December 2022)



The **ACT**[®]

2022 | 2023

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

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Directions

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

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

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

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

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

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

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

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

**DO NOT OPEN THIS BOOKLET
UNTIL TOLD TO DO SO.**

1



1

ENGLISH TEST*45 Minutes—75 Questions*

DIRECTIONS: In the five passages that follow, certain words and phrases are underlined and numbered. In the right-hand column, you will find alternatives for the underlined part. In most cases, you are to choose the one that best expresses the idea, makes the statement appropriate for standard written English, or is worded most consistently with the style and tone of the passage as a whole. If you think the original version is best, choose "NO CHANGE." In some cases, you will find in the right-hand column a question about the underlined part. You are to choose the best answer to the question.

You will also find questions about a section of the passage, or about the passage as a whole. These questions do not refer to an underlined portion of the passage, but rather are identified by a number or numbers in a box.

For each question, choose the alternative you consider best and fill in the corresponding oval on your answer document. Read each passage through once before you begin to answer the questions that accompany it. For many of the questions, you must read several sentences beyond the question to determine the answer. Be sure that you have read far enough ahead each time you choose an alternative.

PASSAGE I**King Tut's Space Bug**

Among the treasures found in Pharaoh

Tutankhamen's tomb, in the 1920s one diminutive
ornament poses a mystery that spans the ages. The

"pectoral," a kind of jewelry worn on one's chest depicts
Egyptian symbols with gold and gems. Most strikingly,
at the piece's center is a beetle carved from an ethereal
yellow-green material.

[1] Originally, archaeologists identified the beetle
as chalcedony, a quartz gemstone. [2] In 1996, likewise,
mineralogist Vincenzo de Michele noticed the beetle at
the Egyptian Museum in Cairo and suspected it wasn't
chalcedony. [3] After studying the beetle, he determined
it to be 28.5-million-year-old glass. [4] De Michele
then traced the glass to the Great Sand Sea of
western Egypt, where pieces of it lay strewn
across 6,500 square kilometers. [5] Glass is
made by heating substances, such as, sand.

1. A. NO CHANGE
B. tomb; in the 1920s
C. tomb in the 1920s,
D. tomb in the 1920s
2. F. NO CHANGE
G. "pectoral"—a kind of jewelry worn on one's
chest—
H. "pectoral," a kind of jewelry worn on one's
chest—
J. "pectoral"—a kind of jewelry worn on one's chest,
3. A. NO CHANGE
B. though,
C. truly,
D. also,
4. F. NO CHANGE
G. heating, substances such as
H. heating substances such as,
J. heating substances such as

1**1**

[6] Though lava and lightning strikes can create

glass the desert glass's traces of the elements

⁵

iridium and osmium pointed to an unearthly culprit:

⁶

a meteoroid. [7] It's true that the tremendous heat and

pressure around the globe of meteorite impacts in many

⁷

places have created glass. [8] But meteorites leave craters,

⁷

and their was no crater that could account for the desert

⁸

glass. 9

In recent years, scientists John Wasson and Mark Boslough have put their research-whiz brains to work
on a new explanation for the desert glass. Intrigued by
 the 1994 collision of Comet Shoemaker-Levy 9 with
 Jupiter and a 1908 meteoroid airburst over a remote
 region of Russia that flattened 80 million trees but left
 no crater, they ran sophisticated computer simulations.
¹⁰
¹¹

5. A. NO CHANGE
 B. glass, the desert glass's,
 C. glass, the desert glass's
 D. glass the desert glass's,

6. F. NO CHANGE
 G. about
 H. with
 J. DELETE the underlined portion.

7. A. NO CHANGE
 B. in many places around the globe of meteorite
 impacts have created glass.
 C. of meteorite impacts have created glass in many
 places around the globe.
 D. have created glass of meteorite impacts in many
 places around the globe.

8. F. NO CHANGE
 G. there were
 H. their were
 J. there was

9. The writer wants to divide this paragraph into two in
 order to separate information about the discovery of
 the source of the beetle's material from the discussion
 regarding how that material was created. The best
 place to begin the new paragraph would be at the
 beginning of:

- A. Sentence 4.
 B. Sentence 5.
 C. Sentence 6.
 D. Sentence 7.

10. F. NO CHANGE
 G. postulated radiative melting as effectuating
 H. formed a compelling explanation for
 J. whipped up a fresh theory about

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

- A. an indication that the Russian meteoroid's destruc-
 tive power was greater than the event that created
 the desert glass.
 B. a detail that suggests a key similarity between the
 Russian meteoroid and the event that created the
 desert glass.
 C. a definition of "meteoroid airburst" that clarifies
 why such events are rarely studied by scientists.
 D. an explanation of a scientific theory for why mete-
 oroid airbursts occur.

1**1**

Their conclusion: a meteoroid burned up in the atmosphere, but its fireball reached Earth and scorched an expanse of sandstone to temperatures

above 1,800°C. 13

Imagination can take the story through there. Some three thousand years ago, an artisan admired a piece of

desert glass; so gorgeous that, with a little carving, it would befit a great pharaoh.

PASSAGE II
Not All It's Krakened Up to Be

On a peaceful June night in my hometown of Muscatine, Iowa, I pulled into a parking spot near the Mississippi River, eager to see my friends. Then I saw it. Protruding from the windows of the old brick building in front of me were four enormous, bright-pink tentacles (they must have been twenty-five feet long!) that waved in the slight breeze. I didn't wait around to get a full view of the creature. Instead, I put the car in reverse, driving home, figured my friends could have dinner without me.

- 12.** E. NO CHANGE
G. whether
H. which
J. that

- 13.** Which of the following true statements, if added here, would provide the best transition to the next paragraph and maintain logical chronology?
- In 2010 and 2011, scientific studies using microspectroscopy and chemical analysis bolstered Wasson and Boslough's theory.
 - In 1932, English surveyor P. A. Clayton happened upon the desert glass and helped write the first detailed account of it.
 - The resulting glass was broken, scattered, and eroded over millions of years.
 - Scientists marvel at the desert glass's purity—about 98 percent silica.

- 14.** E. NO CHANGE
G. from
H. in
J. at

- 15.** A. NO CHANGE
B. glass so gorgeous. That
C. glass so gorgeous; that
D. glass so gorgeous that,

- 16.** E. NO CHANGE
G. Iowa I pulled into a parking spot near the Mississippi River,
H. Iowa, I pulled into a parking spot near the Mississippi River
J. Iowa I pulled into a parking spot near the Mississippi River

- 17.** A. NO CHANGE
B. reverse and driving home, figuring
C. reverse and drove home, figuring
D. reverse, drove home, figuring

1



1

While I was somewhat familiar with the Norse
¹⁸

legend of the squid-like kraken, a mythological sea
¹⁹ creature that resembled an oversize squid. Supposedly,
 the kraken could wrap an entire ship in its tentacled
embrace eventually swallowing the ship whole—sailors
²⁰ and all. But the kraken of Norse legend certainly never
 frequented the homes or places of business. And
²¹

who had ever heard of a neon-pink sea monster?
²²

A month after my ordeal, my friend Rhonda called
²³ me and asked if I was feeling okay. I was just starting to
 relax and enjoy our nighttime stroll when we turned onto
 Mulberry Avenue. I must have made a noise—a yelp, or
 perhaps a blood-curdling scream because Rhonda looked
²⁴ over at me with eyebrows raised. I pointed vaguely,
 expecting her to share in my horror.

This time, the tentacles unfolded from the windows
 of a large yellow house. I covered my eyes, and Rhonda
 said, “Louise. It’s just an *art installation*.” I peered
 through my fingers as she told me that Andrew Anderson,
 a local artist ²⁵, had created the pink kraken. I had to
 admit that the kraken looked kind of friendly up close.

18. F. NO CHANGE
 G. Although
 H. Being
 J. I was

19. A. NO CHANGE
 B. ocean-dwelling creature,
 C. creature,
 D. kraken,

20. E. NO CHANGE
 G. embrace, eventually swallowing the ship whole—
 H. embrace, eventually swallowing the ship whole
 J. embrace eventually swallowing the ship whole

21. A. NO CHANGE
 B. people's
 C. those
 D. its

22. F. NO CHANGE
 G. whom had ever heard
 H. who will ever hear
 J. whomever hears

23. Which choice provides the best transition to what follows in the paragraph?

- A. NO CHANGE
 B. my friend Rhonda convinced me that it was safe to leave my house.
 C. I sat in my house while the summer slipped slowly by.
 D. I was still unsure about leaving my house.

24. F. NO CHANGE
 G. scream—because
 H. scream, because
 J. scream because,

25. At this point, the writer is considering adding the following accurate information:

- who spent five years in Istanbul, Turkey
 Should the writer make this addition here?
 A. Yes, because it explains how Anderson's experiences helped him come up with the concept of the pink kraken.
 B. Yes, because it provides information about Anderson's background as an artist.
 C. No, because it provides information that is not directly related to the description of Anderson's pink kraken.
 D. No, because it detracts from the paragraph's focus on Rhonda's knowledge of art.

1**1**

The undersides of the soft, air-filled tentacles, were

 26

white-and-pink plaid. I could hear the unceasing buzz

 27
 of the air blowers that, according to Rhonda, were
 responsible for making the inflatable sculpture
 seem alive.

As we walked away, I felt a little silly. I made

 28
 Rhonda promise not to tell our friends. And then I
 snuck one last peek at my summertime stalker and
 smiled. 29

26. F. NO CHANGE
 G. undersides, of the soft air-filled tentacles,
 H. undersides of the soft, air-filled tentacles
 J. undersides of the soft air-filled tentacles,
27. Which choice most clearly indicates that the narrator's initial opinion of the pink kraken has shifted?
 A. NO CHANGE
 B. menacing sounds
 C. soothing hum
 D. noise
28. F. NO CHANGE
 G. vacuous.
 H. humble.
 J. trivial.
29. Which of the following statements, if added here, would best conclude the essay by maintaining the characterization of the pink kraken as harmless rather than threatening?
 A. It was a sight I wouldn't soon forget.
 B. But it still looked too real to me.
 C. It waved back.
 D. But was it art?

Question 30 asks about the preceding passage as a whole.

30. Suppose the writer's primary purpose had been to write an essay describing the art scene in Muscatine, Iowa. Would this essay accomplish that purpose?
 F. Yes, because it describes the pink kraken art installation and its origins.
 G. Yes, because it describes how the narrator became interested in local art.
 H. No, because it instead describes how one particular piece of art became a tourist attraction.
 J. No, because it instead describes the narrator's experience with one particular piece of art.

PASSAGE III

Programmed for Success

Today's palm-sized computers descended from

 31
 the Electronic Numerical Integrator and Computer
 (ENIAC), the world's first successful electronic
 computer. It was a massive machine that took up
 1,800 square feet of floor space and weighed 30 tons.

31. A. NO CHANGE
 B. are devices that were eventually derived from the development of
 C. come from a historical lineage of technology that initially began with
 D. are descendants whose ancestor was

1**1**

ENIAC was designed during World War II with the intention of helping the US military calculate precise trajectory tables that would of allowed artillery to be adjusted quickly.

A group of men designed and built ENIAC, a group

of six women mathematicians, lead by Jean Jennings Bartik, programmed it. Bartik and her team figured out how to set ENIAC's 3,000 switches and hundreds of connection cables so that it could run each calculation correctly. Programming ENIAC required enormous patience. To change a program, the women had to rewire the machine manually by manipulating punch cards and switches in a series of wiring boards. It could take as long as two days to make even a small change.

Once Bartik's team finished a program, though,

a complex calculation such that it would have taken a human several days to complete could be done by

ENIAC in a fraction of a second. Therefore, the machine could instantly determine the cube root of 2,589 to the

16th power. In one second, ENIAC could discharge 5,000 additions, 357 multiplications, or 38 divisions.

32. F. NO CHANGE
G. would allow
H. has allowed
J. allows

33. A. NO CHANGE
B. It was a group of men who
C. Although a group of men
D. Several men

34. F. NO CHANGE
G. led among
H. lead with
J. led by

35. A. NO CHANGE
B. coincidentally,
C. moreover,
D. likewise,

36. F. NO CHANGE
G. of which
H. that
J. DELETE the underlined portion.

37. A. NO CHANGE
B. For example,
C. In addition,
D. Meanwhile,

38. F. NO CHANGE
G. administer
H. execute
J. invoke

1**1**

Such computational capacity was used not only

by the military but also in many scientific fields,

including weather prediction, atomic energy research,
³⁹
and wind-tunnel design.

[1] But all the media attention went to the machine itself and the men who designed it. [2] The introduction of ENIAC to the world in 1946 was headline news. [3] The women programmers were largely forgotten until the late 1980s, when Harvard student, Kathryn Kleiman, came

⁴⁰

across the women's names⁴¹ in a computer-history book.

⁴¹

[4] Kleiman filmed twenty hours of interviews with Bartik

⁴²

included with other surviving programmers. [5] This material finally brought attention to the ENIAC women,

they were the twentieth century's first computer

⁴³

programmers. 44

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

- A. a suggestion of the writer's skepticism regarding ENIAC's usefulness for nonmilitary purposes.
- B. a claim that indicates the vital role of palm-sized computers in modern life.
- C. an indication of the broad scope of ENIAC's impact.
- D. a list of practical ways ENIAC is commonly used today.

40. F. NO CHANGE

- G. student Kathryn Kleiman,
- H. student, Kathryn Kleiman
- J. student Kathryn Kleiman

41. A. NO CHANGE

- B. womens' names'
- C. women's names
- D. women names

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

- F. Kept, because it suggests that Kleiman interviewed the programmers with some depth and thoroughness before sharing their stories.
- G. Kept, because it makes clear Kleiman's extensive experience and talent as an interviewer.
- H. Deleted, because it suggests that Kleiman was more interested in personal glory than in uncovering the programmers' untold stories.
- J. Deleted, because it shifts the focus from the women Kleiman interviewed to her own professional achievements.

43. A. NO CHANGE

- B. along with interviewing
- C. having included the
- D. and the

44. F. NO CHANGE

- G. we now honor them as
- H. it highlighted
- J. DELETE the underlined portion.

45. For the sake of logic and cohesion, Sentence 1 should be placed:

- A. where it is now.
- B. after Sentence 2.
- C. after Sentence 3.
- D. after Sentence 4.

1**1****PASSAGE IV****Painting Outside the Lines**

[1]

Today, Yankton Sioux modernist painter, Oscar Howe,⁴⁶ is recognized as one of the most influential American Indian artists of the twentieth century. Howe received many prizes and accolades during his career. ^[47] But a pivotal moment in 1958 led to his emergence as a key

position responsible for broadening the boundaries of
⁴⁸
American Indian art.

[2]

In 1958, Howe submitted a painting, *Umine Wacipe: War and Peace Dance*, to the Philbrook Art Center for consideration in the museum's annual competition showcasing art by American Indians. Representative of Howe's style at the time, the painting featured sharp, angular shapes in rich pink, blue, and purple hues that geometrically depicted five dancers. [A] The jurors for the competition rejected Howe's submission, claiming it was "a fine painting . . . but not Indian." The then widely held
⁴⁹
jurors shared the position that American Indian art should be based on the conventions of the Studio style.

46. F. NO CHANGE

- G. modernist painter Oscar Howe
H. modernist, painter Oscar Howe,
J. modernist painter, Oscar Howe

47. At this point, the writer is considering adding the following true sentence:

While serving in the armed forces during World War II, Howe met the woman who would later become his wife, Heidi Hampel.

Should the writer make this addition here?

- A. Yes, because it establishes Hampel as an important figure in Howe's life and work.
B. Yes, because it offers details about Howe's life that are later expanded upon in the essay.
C. No, because it provides a detail about Howe's life that is only loosely related to the main subject of the essay.
D. No, because it disrupts the description of the range of prizes Howe received during his career.

48. F. NO CHANGE

- G. figure
H. taker
J. role

49. The best placement for the underlined portion would be:

- A. where it is now.
B. after the words *shared the*.
C. after the word *that*.
D. after the word *art*.

1**1**

Works in this style depict traditional ceremonies, dance, and mythology and feature strong outlines and flat fields of color. [B] Howe's deviation from the style, in particular his use of certain techniques, was perceived to be the

⁵⁰
⁵¹

result of European influences, which the jurors considered incompatible with authentic American Indian art.

[3]

Howe displayed his work in more than sixty solo art shows. In an open letter, Howe argued that adhering

⁵²
⁵³

and sticking to notions of tradition would suffocate innovation in American Indian art. Furthermore, he argued, his work did employ American Indian art conventions. The angular shapes in his painting, Howe noted, is actually derivative of the Dakota notion of *tohokmu*, the spider web.

[4]

The Philbrook's jurors conceded; they expanded the scope of the competition to internalize experimental art. [C] Although questions related to art and identity are still

on people's minds, Howe's efforts continue to inspire

⁵⁷

confidence in many artists who might otherwise feel confined by tradition. [D]

⁵⁸

50. F. NO CHANGE
G. and while it featured
H. and featuring
J. featured

51. Which choice offers the most specific description of a characteristic of Howe's painting?

- A. NO CHANGE
B. shaded, geometric shapes,
C. carefully created images,
D. some types of shapes,

52. F. NO CHANGE
G. these were considered by the jurors
H. the jurors considered these
J. they were considered

53. Given that all the choices are true, which one most effectively leads the reader from the previous paragraph into this paragraph?

- A. NO CHANGE
B. Many artists who would later become well known attended the Studio School for art instruction in Santa Fe.
C. Established by Dorothy Dunn, the Studio School was in operation for sixty years.
D. Howe responded vehemently and publicly to the rejection.

54. F. NO CHANGE
G. and sticking too tightly
H. strictly and tightly
J. too strictly

55. A. NO CHANGE
B. has been
C. were
D. was

56. F. NO CHANGE
G. envelop
H. include
J. entail

57. The writer wants to emphasize the intensity of the questions related to art and identity. Which choice best accomplishes that goal?

- A. NO CHANGE
B. talked about to some extent,
C. a matter of concern,
D. hotly debated,

58. F. NO CHANGE
G. for whom
H. for who
J. whom

1



1

Questions 59 and 60 ask about the preceding passage as a whole.

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

Eight years later, the museum awarded Howe the Waite Phillips Trophy for Outstanding Contributions to American Indian Art.

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

- A. Point A in Paragraph 2.
- B. Point B in Paragraph 2.
- C. Point C in Paragraph 4.
- D. Point D in Paragraph 4.

- 60.** Suppose the writer's primary purpose had been to discuss a significant point in an artist's career. Would this essay accomplish that purpose?

- F. Yes, because it describes Howe's interaction with the jurors of the Philbrook competition and the effect of that interaction.
- G. Yes, because it chronicles Howe's career up to Howe's involvement with the Philbrook competition.
- H. No, because it does not explain why Howe's participation in the 1958 competition at the Philbrook was important.
- J. No, because although it mentions Howe, it focuses mainly on the jurors for the Philbrook's annual competition.

PASSAGE V

In Tune

Every April, North Carolina's Louisburg College, normally only humming with students, welcomes a whistling crew for the weeklong International Whistlers Convention. A competition spawned from a folk festival, the IWC has existed for over forty years, attracting ⁶¹ whistlers from across the globe.

[1] Since most whistlers aren't professional ⁶²

(though a few do make a living from whistling ⁶³ tours and commercial spots). [2] Technique, ⁶⁴

which includes tone and pitch, represent ⁶⁴ only fifty percent of their scoring criteria.

- 61.** Which of the following alternatives to the underlined portion would NOT be acceptable?

- A. years, continuing to attract
- B. years and attracts
- C. years; attracting
- D. years. It attracts

- 62. F. NO CHANGE**

- G. Considering most
- H. While most
- J. Most

- 63.** If the writer were to delete the underlined portion (ending the sentence with a period), the essay would primarily lose information that:

- A. indicates that many professional whistlers love to compete but have other jobs on the side.
- B. hints at career options for whistlers and the talent of some of the competitors.
- C. implies that it is unusual for professional whistlers to compete at the convention.
- D. explains that competition winners go on to lucrative careers.

- 64. F. NO CHANGE**

- G. pitch, represents
- H. pitch represents
- J. pitch represent

1**1**

[3] Still, qualifying for the IWC requires rigorous training. [4] Judges look for far more than a performer's ability to carry a tune. [5] Presentation and performance make up the rest, requiring judges to scrutinize participants' facial expressions, how participants present themselves overall onstage,

⁶⁷

and use of lips. ⁶⁸

Participants can compete in both classical and popular musical categories. They might, nevertheless, whistle an entire movement from Beethoven's Fifth Symphony or a more modern selection from pop artist Beyoncé. Many returning participants ambitiously aim on top of their previous performances with even more complex pieces.

Competitors, however, are far from cutthroat. The global whistling community is a tight-knit family, and Louisburg its home. A 2012 documentary about the IWC captures these sentiments. Filmmaker, Ien Chi, a first-time whistling competitor himself, tells the story of a niche group of individuals from Japan, Korea, France, Israel, and elsewhere, whose mutual passion for whistling eclipses language barriers.

65. Which choice makes it most clear that participants have to earn a spot to compete at the IWC?

- A. NO CHANGE
- B. becoming part of
- C. preparing for
- D. enrolling in

66. E. NO CHANGE
G. rest and this requires
H. rest, this requires
J. rest; requiring

67. A. NO CHANGE
B. participants' overall stage presence,
C. presenting themselves overall,
D. overall stage presence,

68. For the sake of logic and cohesion, Sentence 2 should be placed:

- F. where it is now.
- G. after Sentence 3.
- H. after Sentence 4.
- J. after Sentence 5.

69. A. NO CHANGE
B. might, moreover,
C. might, however,
D. might

70. F. NO CHANGE
G. over top of
H. on topping
J. to top

71. A. NO CHANGE
B. Filmmaker Ien Chi,
C. Filmmaker, Ien Chi
D. Filmmaker Ien Chi

1**1**

One US participant shared with Chi that he
⁷²
had waited thirty-four years to attend the world's

premier whistling competition, and meet fellow whistlers.
⁷³
Others, acknowledging the outside perception of whistling

as simply a quirky hobby,⁷⁴ described their craft as an art
form that fosters joy. Chi concludes that the IWC attracts

people who are not just vying for medals; the convention
⁷⁵
also allows participants to communally celebrate this art
form, year after year.

72. F. NO CHANGE

- G. One participant in particular (from the United States) interviewed by Chi
H. Specifically, one individual participant who was from the United States
J. According to Chi, one US participant

73. A. NO CHANGE

- B. premier, whistling competition,
C. premier, whistling competition
D. premier whistling competition

74. Which choice makes it most clear that many outsiders perceive whistling as a lighthearted and informal activity?

- F. NO CHANGE
G. an irregular avocation,
H. an obtuse specialty,
J. a zealous interest,

75. A. NO CHANGE

- B. people, whom
C. people whom
D. people, who

END OF TEST 1**STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.**

2**2****MATHEMATICS TEST***60 Minutes—60 Questions*

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

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

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

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

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

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

DO YOUR FIGURING HERE.

1. Carnell is paid a regular hourly wage of \$13.50 per hour for working up to and including 40 hours in 1 week. For each additional hour he works in a week, Carnell is paid twice his regular hourly wage. Carnell worked 48 hours this week. What is his pay for this week?

(Note: Amounts are before taxes and benefits are deducted.)

- A. \$0.594.00
- B. \$0.648.00
- C. \$0.756.00
- D. \$0.864.00
- E. \$1,296.00

2. In the standard (x,y) coordinate plane, what is the slope of the line with the equation $y - 2 = \frac{1}{2}(x + 3)$?

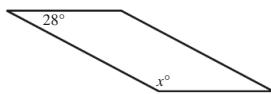
- F. $\frac{1}{2}$
- G. $\frac{3}{2}$
- H. -2
- J. 1
- K. 3

3. Sofia earned scores of 85, 86, 87, and 82 points on 4 math tests. What score must Sofia earn on the 5th math test for the average of the 5 tests to be exactly 3 points higher than the average of the first 4 tests?

- A. 070
- B. 082
- C. 085
- D. 088
- E. 100

2**2**

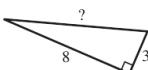
4. The parallelogram below has consecutive angles with measures x° and 28° . What is the value of x ?



- E. 112
G. 118
H. 124
J. 146
K. 152

DO YOUR FIGURING HERE.

5. Two side lengths of the right triangle shown below are given in inches. How many inches long is the hypotenuse?



- A. $\sqrt{22}$
B. $\sqrt{55}$
C. $\sqrt{73}$
D. 0011
E. 0073

6. Using *only* Step 1 followed by Step 2 below, Amir correctly solved a linear equation.

Step 1: Subtract 16 from both sides of the equation.

Step 2: Multiply both sides of the resulting equation by 5.

One of the following equations is the equation that Amir solved. Which one?

- F. $\frac{1}{5}n - 16 = 14$
G. $\frac{1}{5}n - 14 = 16$
H. $\frac{1}{5}n + 16 = 14$
J. $5n - 16 = 14$
K. $5n + 14 = 16$

2**2**

7. All the kindergarten students at Cannon Elementary School are in exactly 1 of 3 classes. The 1st class has 10 boys and 15 girls, the 2nd class has 9 boys and 17 girls, and the 3rd class has 11 boys and 12 girls. All the kindergarten students at Cannon Elementary School are gathered in the gym for an assembly where 1 kindergarten student is randomly selected to win a prize. What is the probability that the selected student will be a boy?

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

B. $\frac{15}{22}$

C. $\frac{15}{37}$

D. $\frac{22}{37}$

E. $\frac{19}{51}$

8. Jamal purchased a car that had a purchase price of \$6,400, which included all other costs and tax. He paid \$1,500 as a down payment and got a loan for the rest of the purchase price. Jamal paid off the loan by making 36 payments of \$200 each. The total of all his payments, including the down payment, was how much more than the car's purchase price?

F. \$0,800

G. \$2,300

H. \$4,900

J. \$7,200

K. \$8,700

9. What is the solution of the equation $8(x + 2) = 4x - 2(x - 3)$?

A. $-\frac{5}{3}$

B. $-\frac{5}{6}$

C. $-\frac{11}{3}$

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

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

10. The expression $(2x)^3(3x)^2$ is equivalent to:

F. $36x^5$

G. $36x^7$

H. $72x^5$

J. $72x^6$

K. $72x^7$

DO YOUR FIGURING HERE.

2**2**

11. $3a - 4(2b - 5a) + 7(3a + 2b)$ is equivalent to:

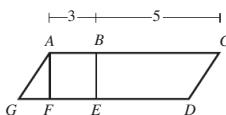
- A. $04a + 3b$
- B. $04a + 6b$
- C. $04a + 7b$
- D. $44a - 0b$
- E. $44a + 6b$

DO YOUR FIGURING HERE.

12. A square and a rectangle have the same area. The length of the rectangle is 45 centimeters, and the width of the rectangle is 5 centimeters. What is the length, in centimeters, of a side of the square?

- F. 010
- G. 015
- H. 025
- J. 100
- K. 225

13. Square $ABEF$ and parallelogram $ACDG$ are shown in the figure below. Points E and F are on \overline{DG} , B is on \overline{AC} , and the lengths given are in inches. What is the ratio of the area of $ABEF$ to the area of $ACDG$?



- A. 1:8
- B. 1:16
- C. 3:8
- D. 8:1
- E. 8:3

14. A 2-liter bottle of Fizzo contains approximately 67.6 ounces of soda. An 8-ounce serving of Fizzo has 110 calories. Which of the following is closest to the number of calories in a 2-liter bottle of Fizzo?

- F. .0220
- G. .0880
- H. .0930
- J. 1,760
- K. 7,440

2**2**

15. What is the smallest integer greater than $\sqrt{77}$?

- A. 05
- B. 08
- C. 09
- D. 11
- E. 39

DO YOUR FIGURING HERE.

16. A wheelchair ramp will be constructed for a public library. The ramp will extend 20 inches horizontally for every 1 inch of rise vertically. The rise of the ramp will be 30 inches. Which of the following values is closest to the length, in *feet*, the ramp will extend horizontally?

- F. 03
- G. 10
- H. 18
- J. 36
- K. 50

17. Padma's teacher asked her to subtract 3 from a certain number and then divide the result by 9. Instead, Padma subtracted 9 and divided the result by 3, getting an answer of 43. What would her answer have been had she worked the problem as her teacher asked?

- A. 015
- B. 034
- C. 138
- D. $\frac{40}{9}$
- E. $\frac{43}{3}$

18. On the local car dealer's lot, there are only 26 cars with a sunroof and only 18 cars with cruise control. The number of cars on the lot with both a sunroof and cruise control *must* be:

- F. exactly 44.
- G. exactly 8.
- H. at least 8.
- J. no more than 8.
- K. no more than 18.

2**2**

- 19.** On her algebra exam, Hannah had to solve the equation $x^2 + 3x - 8 = 0$ for x . Confident that the quadratic formula was the correct method to solve this equation, she started her solution with the equation below. What error, if any, did Hannah make in setting up the equation?

$$x = \frac{-3 \pm \sqrt{3^2 - 4(1)(8)}}{2(1)}$$

- A. Hannah should have used -8 instead of 8 in the term $-4(1)(8)$ under the radical.
 - B. Hannah should have used -3 instead of 3^2 under the radical.
 - C. Hannah should have used -2 instead of 2 in the denominator.
 - D. Hannah should have used 3 instead of -3 in the numerator.
 - E. Hannah did not make an error.
- 20.** Every 10 minutes, Channel 7 begins a 60-second-long commercial. Every 12 minutes, Channel 5 begins a 60-second-long commercial. Each channel began a 60-second-long commercial at the same instant. How many minutes will elapse before both channels next begin a 60-second-long commercial at the same instant?
- F. 22
 - G. 24
 - H. 30
 - J. 44
 - K. 60
- 21.** When Professor Soto began his trip to a mathematics conference, he noticed that the 2 digits of the recorded temperature, in degrees Fahrenheit, had a sum of 8. Later, he noticed that the 2 digits were reversed and that the temperature had warmed 18°F . What was the temperature, in degrees Fahrenheit, at the *beginning* of his trip?
- A. 17°F
 - B. 26°F
 - C. 35°F
 - D. 53°F
 - E. 62°F

- 22.** Given functions $f(x) = 4x + 1$ and $g(x) = x^2 - 2$, what is the value of $f(g(-3))$?

- F. -123
- G. $0-43$
- H. $0-31$
- J. $0-29$
- K. 119

2**2**

23. In the standard (x,y) coordinate plane, A is located at $(4,9)$. What is the location of the image of A that results from reflecting A over the y -axis?

- A. $(-9, 4)$
- B. $(-4,-9)$
- C. $(-4, 9)$
- D. $(4,-9)$
- E. $(9,-4)$

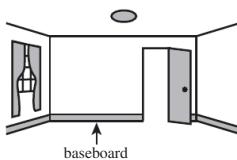
24. For every odd integer x , the expression $x^2 + x$ results in:

- F. an even integer.
- G. an odd integer.
- H. a positive integer.
- J. a negative integer.
- K. a prime number.

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

- A. 20
- B. 27
- C. 33
- D. 35
- E. 50

26. Naomi is going to install baseboard around the perimeter of her room's rectangular floor, shown below. The floor has dimensions 15 feet by 20 feet. The 2 doorways in her room are each 3 feet wide and do not require baseboard. Assuming an average cost of \$0.30 per linear foot requiring baseboard, how much will it cost Naomi to purchase baseboard for her room?



- F. \$10.50
- G. \$19.20
- H. \$21.00
- J. \$88.20
- K. \$90.00

27. Chou flies directly from New York City to San Francisco. New York City's time is 3 hours later than San Francisco's time. Chou left New York City at 7:30 a.m. local time and landed in San Francisco at 11:12 a.m. local time. How long was the trip?

- A. 3 hours 42 minutes
- B. 4 hours 18 minutes
- C. 6 hours 18 minutes
- D. 6 hours 42 minutes
- E. 7 hours 18 minutes

DO YOUR FIGURING HERE.

2**2**

Use the following information to answer
questions 28–30.

DO YOUR FIGURING HERE.

Petsnacks produces and markets food treats and toys for pets. It currently produces 3 different flavored treats for cats and 4 different flavored treats for dogs. One of its cat toys is a spherical catnip ball with an outside diameter of 4 inches. Catnip is an herb that causes a reaction in 80% of all domestic cats. Petsnacks makes a profit of \$7.50 on each catnip ball it sells.

28. Petsnacks is going to test its catnip ball on 200 domestic cats. Which of the following values is equal to the expected number of cats that will NOT have a reaction to the catnip in the toy?

- F. 020
- G. 040
- H. 080
- J. 120
- K. 160

29. Petsnacks sold 1,500 catnip balls in its 7th month of operation and 1,550 catnip balls in its 8th month. Given that its sales of these toys have followed an arithmetic sequence since the operation began, how much profit, in dollars, did Petsnacks make on the catnip balls in its 3rd month of operation?

- A. \$09,375
- B. \$09,750
- C. \$10,125
- D. \$11,250
- E. \$11,625

30. Next month at a pet-food trade show, Petsnacks will exhibit 1 box of each flavor of its entire line of pet treats in a row on a shelf. By that time, the company will have added 3 different flavors of gerbil treats to its line of pet treats. Which of the following computations gives the number of *additional* orders in which Petsnacks will be able to arrange its treats on the shelf with the new line of gerbil treats than without the gerbil treats?

- F. $\frac{10!}{3!}$
 - G. $\frac{10!}{3!7!}$
 - H. $(10 - 3)!$
 - J. $10! - 7!$
 - K. $\frac{10!}{4!3!3!} - \frac{7!}{3!4!}$
-

2**2**

31. A tree farmer has exactly 3 kinds of trees on his farm:

apple, cherry, and evergreen. Of these trees, $\frac{1}{2}$ are apple, $\frac{1}{3}$ are cherry, and 120 trees are evergreen. The farmer has how many trees on his farm?

- A. 203
- B. 210
- C. 220
- D. 400
- E. 720

32. What is the median of the list of 10 numbers below?

87, 85, 78, 94, 67, 97, 55, 81, 87, 99

- F. 82
- G. 83
- H. 85
- J. 86
- K. 87

33. A board $1\frac{5}{8}$ inches by $3\frac{5}{8}$ inches is $6\frac{1}{2}$ feet long. You want to cut as many pieces as possible from the board so that each piece is $1\frac{5}{8}$ inches by $3\frac{5}{8}$ inches and 6 inches long. Each saw cut wastes $\frac{1}{8}$ inch of the board. How many 6-inch-long pieces will you be able to cut?

- A. 13
- B. 12
- C. 11
- D. 10
- E. 9

34. The probability that Event A will occur is $\frac{1}{8}$. The probability that Event B will occur is $\frac{1}{4}$. Given that Events A and B are mutually exclusive, what is the probability that Event A or Event B will occur?

- F. $\frac{1}{32}$
- G. $\frac{1}{12}$
- H. $\frac{1}{8}$
- J. $\frac{3}{8}$
- K. $\frac{1}{2}$

DO YOUR FIGURING HERE.

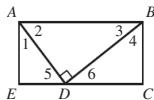
2**2**

35. What is the measure, in degrees, of an angle with a measure of $\frac{7\pi}{9}$ radians?

- A. 063°
- B. 070°
- C. 090°
- D. 140°
- E. 280°

DO YOUR FIGURING HERE.

36. As shown below, D is on side \overline{CE} of rectangle $ABCE$ such that the measure of $\angle ADB$ is 90° . Which of the following angles *must* be congruent to $\angle 1$?



- F. $\angle 2$ only
- G. $\angle 4$ only
- H. $\angle 5$ only
- J. $\angle 2$ and $\angle 4$
- K. $\angle 3$ and $\angle 6$

37. The area of a circle is 64π square inches. What is the circumference, in inches, of the circle?

- A. 08π
- B. 16π
- C. 24π
- D. 32π
- E. 64π

38. In the standard (x,y) coordinate plane, points $A(2,3)$, $B(4,0)$, and $C(7,b)$ lie on the same line. What is b ?

- F. $-\frac{21}{2}$
- G. $-\frac{9}{2}$
- H. $-\frac{1}{3}$
- J. 6
- K. $\frac{19}{3}$

2**2**

39. When $a \neq 0$, which of the following is equivalent to

$$\frac{1}{a} + \frac{2}{3}$$

- A. $\frac{2}{3a}$
- B. $\frac{3}{3a}$
- C. $\frac{3}{a+3}$
- D. $\frac{3+2a}{3a}$
- E. $\frac{3+2a}{3+a}$

DO YOUR FIGURING HERE.

40. A jar contains 2 green mints and 3 white mints. If Renée randomly takes 2 mints out of the jar to eat, what is the probability that *both* of these mints are green?

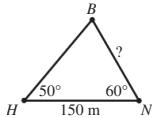
- F. $\frac{1}{10}$
- G. $\frac{3}{10}$
- H. $\frac{1}{20}$
- J. $\frac{9}{20}$
- K. $\frac{3}{5}$

41. The number of decibels, d , produced by an audio source can be modeled by the equation $d = 10 \log\left(\frac{I}{10^{-12}}\right)$, where I is the sound intensity, in watts per square meter, of the audio source. What is the sound intensity, in watts per square meter, for an audio source that produces 100 decibels?

- A. 0.10^{-2}
- B. 0.10^{22}
- C. 0.10^{78}
- D. 0.14
- E. 140

2**2**

42. The diagram below shows the location of Manuel's boat, which is on a lake and anchored to a stationary buoy at point B . On the shore, Manuel's house is at point H and his nearest neighbor's house is at point N , which is 150 meters from H . The measures of 2 angles are given. Which of the following expressions represents the straight-line distance, in meters, from B to N ?



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

- F. $\frac{150 \sin 50^\circ}{\sin 60^\circ}$
 G. $\frac{150 \sin 50^\circ}{\sin 70^\circ}$
 H. $\frac{150 \sin 60^\circ}{\sin 50^\circ}$
 J. $\frac{150 \sin 60^\circ}{\sin 70^\circ}$
 K. $\frac{150 \sin 70^\circ}{\sin 50^\circ}$
43. Packmore Box Company manufactures a standard rectangular box a feet by b feet by c feet. A customer ordered a new box with double the volume of the standard box. Which of the following expressions represents the volume, in cubic feet, of the new box?

- A. $8abc$
 B. $a^2b^2c^2$
 C. $2a + b + c$
 D. $2a + 2b + 2c$
 E. $2abc$

44. For her mathematics class, Ms. Wilkerson is preparing a probability experiment using only dried kidney beans, dried pinto beans, and an empty jar. First, she puts 4 kidney beans into the empty jar. How many pinto beans must be added to the jar in order to make the probability of drawing a kidney bean exactly $\frac{1}{5}$ when randomly drawing 1 bean from the jar?

- F. 20
 G. 16
 H. 05
 J. 04
 K. 01

DO YOUR FIGURING HERE.

2**2**

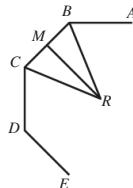
- 45.** A car rental agency has 20 cars. Of those cars, 4 are luxury sedans and all the other cars are midsize sedans. Each luxury sedan rents at a daily rate 50% greater than the daily rate for the midsize sedans. If the luxury sedans rent for \$45 per day, what is the average daily rental fee, to the nearest dollar, of all 20 cars at this agency?

- A. \$27
B. \$33
C. \$38
D. \$42
E. \$56

DO YOUR FIGURING HERE.

- 46.** A portion of a regular polygon (all sides of equal length and all interior angles of equal measure) with n sides is shown below. The midpoint of BC is M . The distance, in centimeters, from the polygon's center, R , to the midpoint of a side is the same for all sides. Which of the following is an expression for the area, in square centimeters, of the polygon?

- F. $\frac{n}{2}(BC)(MR)$
G. $\frac{n}{2}(CM)(MR)$
H. $n(BC)$
J. $n(BC + BR + CR)$
K. $\sqrt{(CM)^2 + (MR)^2}$



- 47.** Let a , b , and c be the respective side lengths, in feet, of a triangle. Given that a is 5 and b is 7, which of the following inequalities gives all and only the possible values of c ?

- A. $c > 12$
B. $c < 12$
C. $0 < c < 12$
D. $2 < c < 12$
E. $5 < c < 17$

- 48.** For the complex number i , which of the following expressions is equivalent to $(x+i)(x-i)$?

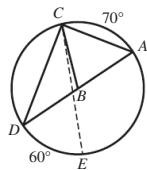
- F. $x^2 + 1$
G. $x^2 - 1$
H. $x^2 + 2ix + 1$
J. $x^2 - 2ix + 1$
K. $x^2 - 2ix - 1$

2**2**

Use the following information to answer
questions 49–51.

DO YOUR FIGURING HERE.

The center of the circle shown below is at B , and the length of diameter \overline{AD} is 12 cm. The measure of $\angle DE$ is 60° , and the measure of $\angle AC$ is 70° .



49. What is the measure of major arc \widehat{ACE} ?
- 130°
 - 230°
 - 240°
 - 250°
 - 260°
50. Triangle $\triangle ACD$ is a right triangle. Which of the following expressions represents the length, in centimeters, of \overline{AC} ?
- $(6 \sin 35^\circ)$
 - $(6 \sin 55^\circ)$
 - $(6 \sin 70^\circ)$
 - $12 \sin 35^\circ$
 - $12 \sin 70^\circ$
51. If all points on the circle remain fixed in their current positions except E , which moves along the circle counterclockwise (\curvearrowleft) until it reaches A , the length of \overline{CE} during this movement will:
- remain unchanged.
 - decrease, then increase.
 - decrease only.
 - increase only.
 - increase, then decrease.

2**2****DO YOUR FIGURING HERE.**

- 52.** The function $f(x) = x^3$ is defined for all real numbers x .
Which of the following expressions represents $f^{-1}(x)$?

F. $\sqrt[3]{x}$

G. $\frac{1}{\sqrt[3]{x}}$

H. $\frac{1}{x^3}$

J. $-\frac{1}{3}x$

K. $-\frac{1}{3}x$

- 53.** Given positive integers a and b such that $b < a < 14$, what is the largest value of $a + b$ that has a factor of 3?

A. 15

B. 18

C. 21

D. 24

E. 27

- 54.** At an end-of-school-year party for juniors and seniors only, there are 20 more juniors than seniors. Of the 52 students at the party, 25% have summer jobs. Which of the following is closest to the maximum possible percent of the seniors at the party who have summer jobs?

F. 25%

G. 36%

H. 44%

J. 81%

K. 97%

- 55.** What is the minimum value of $2x - 3y$ given that x and y satisfy the system of inequalities below?

$$\begin{aligned} x &\geq -2 \\ y &\leq 3 \\ x - y &\leq 5 \end{aligned}$$

A. -25

B. -13

C. 07

D. 17

E. 25

- 56.** The ratio of a to b is 5 to 1, and the ratio of b to c is 9 to 1. What is the value of $\frac{2a+3b}{4b+3c}$?

F. 3

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

H. $\frac{13}{31}$

J. $\frac{37}{39}$

K. $\frac{37}{7}$

2**2**

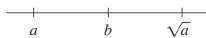
57. If t is any real number, which of the following statements must be true?

- A. $-t < 0$
- B. $-t < t$
- C. $-t = t$
- D. $-t \leq |-t|$
- E. $(-t)^2 = -t^2$

58. Let a and b be positive real numbers such that $\log(a) = 3$ and $\log(b) = 2$. What is the value of $\log(a^2b)$?

- F. 7
- G. 8
- H. 11
- J. 12
- K. 18

59. For real numbers a and b on the number line below, where $a < b$, which of the following values is a possible value for b ?



- A. -2
- B. 0
- C. 3/7
- D. 1
- E. 9/4

60. For all positive values of x , which of the following expressions is equivalent to $2\sqrt[3]{2x} \cdot \sqrt[3]{x}$?

- F. $\sqrt[3]{12x}$
- G. $\sqrt[3]{24x}$
- H. $\sqrt[3]{4x^2}$
- J. $\sqrt[3]{8x^2}$
- K. $\sqrt[3]{16x^2}$

DO YOUR FIGURING HERE.

END OF TEST 2
STOP! DO NOT TURN THE PAGE UNTIL TOLD TO DO SO.
DO NOT RETURN TO THE PREVIOUS TEST.

READING TEST

35 Minutes—40 Questions

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

Passage I

LITERARY NARRATIVE: This passage is adapted from the memoir *City Kid* by Nelson George (©2009 by Nelson George).

I am in the living room of apartment 6C in the Samuel J. Tilden housing projects in Brownsville, Brooklyn. It is 1960. I am four. I stand on my tiptoes in my stocking feet. My small brown fingers clutch the edge of Motorola high-fidelity stereo, which is made of shiny lacquered wood and has a lemony smell, from the polish my mother applies every Saturday afternoon.

I feel the bass speakers in my stomach. I smell the polish. I feel the music. Looking over the edge, down into the bowels of the hi-fi, I watch the turntable needle roll across the grooves of a seven-inch record with a blue-and-white label at 45 revolutions per minute. The song is "Please Mr. Postman" by the Marvelettes.

As much as I enjoy "Please Mr. Postman," I'm anxious to hear the next record. Not just because it's Roy Orbison's "Oh, Pretty Woman" (which is the first record I ever asked my mother to buy for me), but because above "Mr. Postman" on the turntable are a slew of seven-inch singles suspended around a fat brown cylinder. Once "Please Mr. Postman" finishes, the needle arm moves away, a single vinyl 45 plops down on the turntable, and the needle returns, catching the groove and sending the rhythm of "Oh, Pretty Woman" vibrating through my body.

This Motorola stereo was the centerpiece of my family's living room, and our social life. Ma didn't allow my little sister, Andrea, or me in our living room too often, because she didn't want us sitting on her plastic-covered sofa or fingering the dice-shaped lighter 30 on her glass-and-wood living-room table. But if we were playing records in the early evenings or on weekends, it was okay.

All through my childhood, from my first consciousness of music into the early seventies, that 35 Motorola was my passport, not simply to records, but to the vast nation outside New York that the music came from. While the black-and-red labels of Atlantic 45s carried a Broadway address, most of the records in her collection came from Memphis (the Stax Records label 40 was pale blue, with a finger-snapping logo) or Detroit

(Motown's black-and-white label had a red star for the Motor City, while Tamla's colors were yellow and brown). As I read the labels of the records Ma brought home, I slowly became familiar with the cities of soul—Philadelphia, Los Angeles, Chicago, and Cincinnati. By the time I was an adolescent, I could identify certain names that recurred in the credits. Way before I understood what these credits meant, or who these people were, I was already collecting info for the books 50 and articles I had no idea I would eventually write.

My interest in these records stemmed from a desire to better understand my mother's life. My mother was a soul girl: petite and cute, with a bright, girlish smile. Arizona Bacchus George, aka Doll, aka Ma, was 55 full of life, and loved to laugh. Though burdened with raising two kids alone in a Brooklyn housing project, she didn't allow herself to become a stranger to fun. Not only was her ever-growing stack of 45s a testament to her love of music and dance, but she regularly held 60 parties in that sacrosanct living room for her girlfriends and their male admirers.

I remember the time we took a pilgrimage to the Apollo Theater for a matinee show. It was a chilly, overcast day, and my mother and I joined a long line of 65 black folk, as far as I could see, huddled on 125th Street, awaiting entry. Once inside, we sat in the orchestra near the back. I remember the elements of the James Brown Revue quite distinctly: Pigmeat Markham did his famous "Here Comes the Judge" routine; the 70 Fabulous Flames danced like demons and harmonized like choir boys; the J.B.s, behind the antic introduction of MC Danny Ray, banged out a medley of the great man's hits.

Then Brown himself appeared, a short, dark man 75 with shiny, processed hair who whirled and shuddered and shouted. On the way back to Brooklyn on the A train, I babbled to my mother about the sweaty man who kept tossing the cape off his back and running back to the mike to wail, "Please! Please! Please!"

It was special for me, not only because I'd seen James Brown, but because I was too young for so many of the shows my mother attended. Unlike today, when the separation between adult and kid entertainment has been blurred to the detriment of both, soul music was 85 fundamentally music by, about, and for adults. When

my ma put on her auburn wig to see Otis Redding, or her blue eyeliner to watch the Supremes, it was to experience things so raw and so smooth, they weren't right for a child to see.

- The tone of the passage could best be described as:
 - remorseful; the narrator imagines the life his mother could have had without the burden of raising a family in a Brooklyn housing project.
 - jubilant; the narrator expresses his delight that the musicians he revered in childhood eventually became such big stars.
 - inspirational; the narrator explains how he managed to overcome the obstacles he faced during childhood and pursue an education in music.
 - nostalgic; the narrator fondly describes his childhood experiences with music and his relationship with his mother.
- In the fourth paragraph (lines 25–32), the perspective of the narrator shifts from being that of a child describing an enjoyable experience to being that of:
 - an adult reflecting on the role music played during his childhood.
 - an adult reminiscing about his relationship with his sister.
 - a child daydreaming about what his life will be like when he grows up.
 - a child describing what his mother likes to do for fun.
- The passage states that as a child the narrator associated the colors and designs on the labels of his mother's records with:
 - favorite musicians.
 - various genres of music.
 - different American cities.
 - important events that occurred in his childhood.
- It can reasonably be inferred that the phrase “the great man's hits” (lines 72–73) refers to the music of:
 - James Brown.
 - Otis Redding.
 - MC Danny Ray.
 - Pigmeat Markham.

- In the narrator's description of his mother's stereo, which detail most clearly points to the care she gave it?
 - “Motorola high-fidelity” (line 5)
 - “Lacquered wood” (line 6)
 - “Lemony smell” (line 6)
 - “Fat brown cylinder” (lines 19–20)
- The passage indicates that the first record the narrator asked his mother to buy for him was by:
 - the Marvelettes.
 - Roy Orbison.
 - Otis Redding.
 - James Brown.
- The passage suggests that the narrator was initially drawn to his mother's records because he wanted to:
 - learn about places outside of New York City.
 - sing and dance in the style of the great soul musicians.
 - impress his friends with his knowledge of soul music.
 - gain insight into his mother's life.
- The narrator describes the performances of which of the following Apollo Theater performers in terms of the contrast between singing style and dancing style?
 - Pigmeat Markham
 - MC Danny Ray
 - The J.B.s
 - The Fabulous Flames
- The narrator suggests that going to the concert at the Apollo Theater was special because:
 - Otis Redding and the Supremes joined James Brown onstage.
 - soul music wasn't considered appropriate for children.
 - James Brown was his favorite musician.
 - it was the first time he had ridden a train.
- Another writer made the following statement about soul music:

Musically, I believe, soul remains the story of how a universal sound emerged from the black church.

How does this statement relate to the ideas expressed in the passage?

 - It echoes the narrator's view of soul as he recalls the living room, where he listened to music.
 - It's consistent with the narrator's opinion that soul was originally meant to be music for listeners of all races.
 - It contradicts the narrator's claim that soul was secular music, not religious music.
 - It addresses a topic, the origin of soul, which the narrator doesn't address in the passage.

Passage II

SOCIAL SCIENCE: Passage A is adapted from the article “Talk to the Hands” by Jen Doll (©2013 by The Atlantic Monthly Group). Passage B is adapted from the article “Gestures Offer Insight” by Ipke Wachsmuth (©2006 by Scientific American).

Passage A by Jen Doll

Leaving a group of friends the other night, I turned to wave. “Text me!” one of them said, wagging her thumbs in the air. I didn’t need the words to understand.

Today, we may be more likely to move our fingers across a tablet than turn the pages of a book; to swipe a card, press a button, or enter numbers onto a keypad than turn a key. We type on keyboards more often than we put pens to paper, and we roll down the windows of our cars by pressing a button instead of cranking a 10 handle. Yet when it comes to gesturing, certain outdated motions endure.

Gestures can generally be sorted into two categories, according to Spencer Kelly, an associate professor of psychology at Colgate University. “Co-speech gestures” are the idiosyncratic, often unconscious ways we move our hands as we talk. Researchers believe these gestures help us think and speak and even learn. “Emblematic gestures” are the culturally codified motions that we use to supplement or substitute 15 speech—the peace sign, the thumbs-up. Some of these gestures are symbolic, and some, as in the case of thumb-texting, are imitative.

As with words, we tend to pick up our hand movements from the groups with whom we communicate 20 most frequently—especially our peers. If your friends are thumb-texting at you, you will thumb-text back at them. Soon enough, Kelly says, “the movement of your thumbs can be done without speech, and people know what it is. That’s the definition of an emblem.”

Some emblems are recycled, their meanings changing as cultures evolve. Anthony Corbeill at the 25 University of Kansas suspects that the current American connotation of the thumbs-up gesture developed during the 20th century, when GIs used the thumbs-up 30 to signify that a plane was cleared for takeoff. Other emblems are coined afresh, the result of ubiquitous new technology or the quirks of a public figure. The fist bump, which went viral after Barack and Michelle Obama were photographed in action in 2008, can be 35 traced to the germophobic mid-20th-century baseball player Stan Musial, who is said to have preferred it to the high five.

Passage B by Ipke Wachsmuth

The interpretations of sounds and movements are closely related. For years, the link could be demonstrated only indirectly by asking test subjects what information they gleaned from others who were speaking and gesticulating. Recent brain research has provided much better insight. For example, neuroscientist

Spencer D. Kelly of Colgate University has studied gestures with the help of event-related potentials—characteristic brain waves consisting of a sequence of peaks and valleys—that occur in certain patterns when one person observes another communicating. The patterns reveal neuronal-processing steps in particular brain 55 regions. One of the negative peaks (a valley), referred to as N400, is especially significant. It occurs when we stumble over an inappropriate and unexpected word, for example, when we hear a sentence like “He spread his toast, with socks.”

Kelly hooked test subjects to an electroencephalograph and charted their event-related potentials while they watched a video. In it, an actor spoke while using gestures to indicate characteristics of an object. A hand movement might fit a word semantically, such as when 60 the word “tall” was illustrated by gesturing at a long-stem glass on a table. A gesture might also be used to convey additional information, such as when “tall” was accompanied by finger movements that indicated the thinness of the elongated stem of the glass. Viewers 65 saw contradictory scenes, too, in which an actor combined the word “tall” with a gesture that referred to a short object on the table. And sometimes an actor made no gesture at all; in this control situation, the test subjects heard only the spoken word.

Subjects exhibited substantially different brain-wave patterns depending on the situation. The researchers found strong negative peaks—a so-called 70 N400 effect—whenever speech and gesture contradicted one another. They interpreted this phenomenon 75 to mean that gestures and words are in fact processed together: observers factor the meaning of a gesture into their interpretation of a word.

This conclusion was supported by the finding that the event-related potentials exhibited no comparable 80 negativity in the control situation. Even during early processing, the curves differ depending on whether the hand movement fits the word, complements it or contradicts it. “The semantic content” of hand gestures, Kelly 85 says, “contributes to the processing of word meaning in the brain.”

Questions 11 and 12 ask about Passage A.

11. Passage A primarily focuses on which of the following types of gestures?

- A. Co-speech gestures
- B. Repurposed gestures
- C. Emblematic gestures
- D. Illogical gestures

12. The main point of the second paragraph of Passage A (lines 4–11) is that:
- although technology is changing how we interact with the world, many gestures remain the same.
 - we have more ways to communicate than ever, so gestures are increasingly important.
 - as a result of new technologies, new gestures are being created at a fast rate.
 - because technology has become so complicated, gestures are symbolic of simpler times.

Questions 13–17 ask about Passage B.

13. Which of the following quotations from Passage B best represents the passage’s central claim?
- “Kelly hooked test subjects to an electroencephalograph and charted their event-related potentials” (lines 60–61).
 - “Subjects exhibited substantially different brain-wave patterns depending on the situation” (lines 75–76).
 - “Observers factor the meaning of a gesture into their interpretation of a word” (lines 81–82).
 - “The curves differ depending on whether the hand movement fits the word, complements it or contradicts it” (lines 86–88).
14. Details in Passage B most strongly suggest that recent research into the relationship between speech and gestures is more fruitful than previous research because scientists can now:
- simultaneously test reactions to both logical and illogical speech and gestures.
 - objectively measure the brain’s responses to speech and gestures.
 - question test subjects about their reactions to gestures.
 - use video recording to document how gestures change over time.
15. The main purpose of the second paragraph of Passage B (lines 60–74) is to:
- describe the experiment that Kelly conducted.
 - explain that speech and gestures are processed separately.
 - illustrate how test subjects reconciled differences between speech and gestures.
 - clarify why speech and gestures relate to each other.

16. Based on Passage B, which of the following sentences would be most likely to evoke an N400 negative peak in brain activity?
- As the batteries die, the radio’s volume fades.
 - The baker decorates the cake with frosting.
 - A car squeezes through the alleyway.
 - At the top of the tree sits a library.
17. According to Passage B, while their brain activity was being monitored, test subjects in Kelly’s experiment watched:
- two actors gesturing to each other.
 - past test subjects gesturing to each other.
 - a video of an actor speaking and gesturing.
 - Kelly speaking and gesturing.

Questions 18–20 ask about both passages.

18. How do the writing styles of the two passages compare?
- Passage A is more argumentative and persistent than Passage B.
 - Passage A is more personal and conversational than Passage B.
 - Passage B is more humorous and anecdotal than Passage A.
 - Passage B is more opinion-based and loosely organized than Passage A.
19. Which of the following statements best captures the main difference in the purposes of the two passages?
- Passage A explains how hand gestures enhance speech, while Passage B explains how hand gestures overrule speech.
 - Passage A argues that technology is decreasing our use of hand gestures, while Passage B examines how speech and hand gestures evolved together.
 - Passage A considers the types and origins of hand gestures, while Passage B considers how hand gestures are processed by the brain.
 - Passage A speculates that gestures existed before speech, while Passage B contrasts logical hand gestures with illogical hand gestures.
20. The gesture referred to in lines 2–3 of Passage A is similar to the gestures referred to in Kelly’s experiment in Passage B in that these gestures all are:
- used by the authors’ friends.
 - associated with cell phones.
 - describing recent trends.
 - referring to physical objects.

Passage III

HUMANITIES: This passage is adapted from the book *The Lost Painting* by Jonathan Harr (©2005 by Jonathan Harr).

The *St. John* is a painting by seventeenth-century Italian painter Michelangelo Merisi da Caravaggio. At the time of the examinations, the Doria *St. John* version belonged to the Doria Pamphilj Gallery in Rome, and the Capitoline *St. John* version belonged to the Capitoline Museum in Rome.

Close up, Francesca Cappelletti could see the damage caused to the Doria *St. John* by time. Over its entire surface the picture had lost many tiny particles of paint, mere pinpricks—puntinature, Paola Sannucci, the 5 restorer, called them—not discernible from a normal viewing distance. These particles had fallen at nearly regular intervals, at the intersections where the threads of the canvas, the warp and the weft, crossed each other and formed small nodules. The canvas had been cheap, 10 made of poor-quality hemp and carelessly woven. Still, Caravaggio might have used just such a canvas. He had once painted a picture on a bedsheet. Another time, after he'd left the Mattei palazzo and was living alone in a small house off the Via della Scrofa, he had spread 15 a half-finished canvas on a kitchen table and dined off the back of it.

The earlier examination of the Capitoline *St. John* had revealed it to be in much better shape than the Doria, in large part because the Capitoline canvas was 20 of higher quality, more tightly woven with linen threads of uniform diameter.

The technical examination lasted the entire day, and for long periods Francesca had nothing to do but observe. The portable X-ray machine could capture 25 only a small portion of the painting, and the technicians had to keep repositioning the machine, sixteen times in all, to get a composite of the entire picture. Francesca wandered in and out of the room and tried to dream up an excuse for leaving early.

30 Giampaolo Correale had a particular interest—an obsession, one could call it—with finding incised lines in Caravaggio's paintings. Few other Baroque painters had made these types of lines, scored with the butt end of a brush into the wet undercoat, and no one had made 35 them in quite the same way as Caravaggio. He painted from life, from models sitting before him, and most art historians believed that he didn't make preliminary drawings. In this, he had departed from a long-established tradition by which painters made detailed 40 studies before applying brush to canvas. The scored lines, it was surmised, had served as a guide for positioning his models. In the finished paintings, the lines were sometimes visible to the naked eye, usually at a certain angle, in a raking light. Not every one of his 45 paintings revealed signs of these marks. But to Caravaggio experts, their presence was almost as good as the artist's signature.

Two weeks earlier, during the examination of the Capitoline *St. John*, Correale had hoped to find incised

- 50 lines, and thus add to the proof that it was Caravaggio's original. He and Paola Sannucci and the technicians had scrutinized every inch of the painting, but in the end they had not found a scoring mark. True, there were a few faint ridges on the borders of the boy's figure, and 55 for a while Correale maintained that these could be scoring marks, but everyone else interpreted them merely as brushstrokes in wet paint, places where Caravaggio had defined the boy's flesh against the dark background.

- 60 But evidence of a different kind had emerged from beneath the surface of the Capitoline version, and it seemed to confirm the painting's authenticity. The X rays and the infrared images had revealed a ghostly image—a pentimento—at the precise point where the boy's arm and the curved horn of the ram intersected. The artist had painted the arm first, and then had painted the ram's horn over the finished arm. This constituted a clear sign that the painting was the authentic one. A copyist, following the outlines of an original 70 painting, would not have bothered to paint the arm and then paint the horn over it. The infrared images also revealed other pentimenti, in the folds and drapery of the red and white cloths, and in the foliage in the dark background. These were false starts and adjustments 75 that no copyist would have needed to make.

So Correale had come to accept the Capitoline as the original even before the technical examination of the Doria version. All the same, the paintings were so strikingly similar—the outline of one placed atop the 80 other matched in almost every contour—that it seemed necessary to examine the Doria picture as fully as the Capitoline. But how, Correale wondered, could anyone make such a near perfect copy?

This question interested Francesca, too. She 85 thought of all the copies art historian Roberto Longhi had found of Caravaggio's lost *Taking of Christ*. None of them had been good enough for Longhi to mistake for the original. Yet the Doria *St. John* had fooled him completely.

21. Which of the following statements comparing the Doria *St. John* and the Capitoline *St. John* is best supported by the passage?
A. The Doria *St. John* was painted on cheaper canvas than was the Capitoline *St. John*.
B. The Doria *St. John* canvas had smaller nodules than that of the Capitoline *St. John*.
C. The Capitoline *St. John* showed evidence of more puntinature than did the Doria *St. John*.
D. The Capitoline *St. John* contained more incised lines than did the Doria *St. John*.

22. It can most reasonably be inferred from the passage that Francesca wanted to leave the examination early mainly because she:
- F. had already witnessed an examination of the Doria *St. John*.
 - G. disliked working alongside Correale.
 - H. was uninterested in Caravaggio's paintings.
 - J. disliked being a mere observer.
23. According to the passage, who at first maintained that the Capitoline *St. John* might show evidence of incised lines?
- A. Sannucci
 - B. Correale
 - C. Francesca
 - D. The technicians
24. The main purpose of the sixth paragraph (lines 60–75) is to:
- F. describe the discovery that helped prove the authenticity of the Capitoline *St. John*.
 - G. provide a more specific description of the scene depicted in the *St. John* painting.
 - H. describe the steps a copyist must take when re-creating a painting.
 - J. provide a definition of the term "pentimento."
25. In the last paragraph, the comparison between Longhi's appraisal of the *Taking of Christ* copies and Longhi's appraisal of the Doria *St. John* mainly serves to:
- A. demonstrate that *Taking of Christ* was one of Caravaggio's more popular paintings.
 - B. suggest that Longhi studied the *Taking of Christ* copies more thoroughly than he did the Doria *St. John*.
 - C. emphasize that the Doria *St. John* was painted with unusual skill.
 - D. prove that the copyist who painted the Doria *St. John* was another well-known Baroque artist.
26. Which of the following details from the passage best exemplifies the idea that Caravaggio sometimes used unconventional canvases for his paintings?
- F. He once dined off the back of a half-finished painting.
 - G. He used colorful cloths as the backdrop for some of his paintings.
 - H. He painted the *St. John* on woven linen.
 - J. He once painted a picture on a bedsheet.
27. As it is used in line 24, the word *capture* most nearly means:
- A. seize.
 - B. divert.
 - C. document.
 - D. control.
28. According to the passage, Caravaggio used incised lines in his paintings most likely to:
- F. guide the positioning of his models.
 - G. reflect light off the surface of his paintings.
 - H. indicate the authenticity of the painting.
 - J. separate his style from that of other Baroque painters.
29. The passage states that most experts who study Caravaggio agree that:
- A. the practice of using incised lines in painting was pioneered by Caravaggio.
 - B. the presence of Caravaggio's style of incised lines is strong evidence that a painting is an authentic Caravaggio.
 - C. even an experienced copyist could not have painted the Doria *St. John*.
 - D. an authentic Caravaggio probably would not contain as many false starts and adjustments as the Capitoline *St. John* had.
30. In the context of the passage, which of the following is evidence of a pentimento in the Capitoline *St. John*?
- F. The brushstrokes that define the boy's flesh against the dark background
 - G. The contrast of the red and white cloths against the dark background
 - H. The faint ridges on the border of the boy's figure
 - J. The ram's horn painted over the boy's finished arm

Passage IV

NATURAL SCIENCE: This passage is adapted from the essay "Archives of Life: Science and Collections" by Richard Fortey
(©2010 by Richard Fortey).

Safely stored behind the scenes at the Natural History Museum in London is a slightly twisted vertebrate skeleton preserved on a slab of creamy white limestone. This particular specimen was discovered in quarries 5 near Solnhofen in southern Germany in 1861. The fine limestones of Solnhofen are ideally suited to making lithographic stones, and in the nineteenth century lithographs provided one of the most important means of book illustration—indeed lithographic stones of this 10 quality are still in demand by artists today. Vast quantities of this lithographic limestone of Jurassic age—about 150 million years old—have been taken out of opencast workings, where the rocks can be split into convenient slabs a centimetre or two thick. On many of 15 these flat-surfaced pieces of rock, fossils are laid out like gifts on a salver.

Some Solnhofen fossils are rather common, such as those of delicate little sea lilies. Others are both rare and more spectacular. There are a great variety of fish 20 species known nowhere else, for example. The fossil horseshoe crab *Mesolimulus* provides evidence that its living relatives breeding each year along the Atlantic coast of America have changed little over tens of millions of years. Delicate flying reptiles—half a dozen 25 species or so of pterodactyl—testify by contrast to creatures that have vanished from the Earth forever. A few species of dinosaur are known, of the most delicate sort (*Compsognathus*), and quite unlike the monsters of popular imagination. Insects include dragonflies 30 (*Aeschnogomphus*) whose every wing-vein is visible as delicate tracery. All these creatures are preserved in rocks which originated as tacky muds flooring a lagoon that lay offshore from a richly biodiverse habitat. Such 35 special circumstances sampled and preserved a much wider variety of organisms than the usual fossil locality, and the wide range of fossils provides a rare window into an entire habitat from a very different world. Yet if the remains were not kept carefully in museums all this evidence of past life would perish, and new generations 40 of children and scholars could not interrogate the past. Local museums at Eichstätt and Solnhofen fulfil that function for those who would come to Bavaria and marvel at its geological treasures. But some of the specimens from the Solnhofen limestone have a relevance 45 that extends far beyond the reconstruction of the late Jurassic scene, and these specimens are treasures in the collections of museums around the world. None more so than that specimen—a mere 35 cm at its longest—safely curated in the Natural History Museum in 50 London.

For this is the first example ever discovered of the early bird *Archaeopteryx*. It remains one of the most important specimens in the British national collections. The next complete fossil bird of the same species—the 55 so-called Berlin specimen—was found sixteen years

later. It would be difficult to overstate the importance of this London specimen of *Archaeopteryx* in the history of biology.

First, the date of its discovery is only two years 60 after the publication of *The Origin of Species*. Charles Darwin famously described what he called 'difficulties on theory' in that work, where he anticipated a number of criticisms that he expected his great idea to encounter. Prime among these was 'the rarity or 65 absence of intermediate forms' in the fossil record. Second, the detailed scientific description of *Archaeopteryx* was an accomplishment of Richard Owen in 1863; he was later to become first director of the Natural History Museum. Owen was no Darwinian, 70 but he was an able anatomist. It must have proved anathema to him when *Archaeopteryx* was recruited as probably the best example of an 'intermediate form' and one that had turned up with the impeccable timing usually associated with a good piece of theatre. Its 75 amalgam of reptilian and bird features (feathers and wishbone among them) was a striking vindication of the notion of descent with modification, and a rebuttal to those who might wonder how it was possible for animals to make the transition from earth to the skies.

80 In this sense *Archaeopteryx* became a kind of talisman for evolution. Owen was enough of a 'Museum man' to ensure that this fossil was safely curated, and part of any museum's function is just that—to protect material regardless of the current explanations of its 85 importance. The old bird has now been joined by half a dozen or so subsequent examples worldwide, but its importance has not diminished over the years.

31. In terms of its overall structure, the passage can best be described as:
 - A. a description of the types of specimens found at the Natural History Museum in London, followed by a discussion of the importance of the museum.
 - B. an overview of the geological discoveries made in Solnhofen, followed by a discussion of one particular discovery.
 - C. a list of the types of fossils Darwin used to research his theory, followed by a description of a particular fossil he discovered.
 - D. a general explanation of the process of making lithographic stones, followed by an example of how the stones are used.
32. The passage most strongly suggests that in the history of biology, the discovery of the *Archaeopteryx* fossil was significant mainly because it:
 - F. made the Natural History Museum of London the most visited museum in the world.
 - G. was the first bird fossil ever discovered.
 - H. helped scientists accurately reconstruct the late Jurassic scene.
 - J. helped fill a critical gap in Darwin's evolutionary theory.

33. The passage author's characterization of Owen as a "Museum man" (lines 81–82) can best be described as:
- A. a compliment; the author respects Owen as both a Darwinian and an anatomist.
 - B. a compliment; the author appreciates Owen's understanding of the importance of safely curating a fossil.
 - C. an insult; the author resents Owen's lack of interest in the *Archaeopteryx* fossil.
 - D. an insult; the author believes the *Archaeopteryx* fossil should have been curated by a more capable anatomist than Owen.
34. In the passage, the main point the author makes about museums is that they primarily:
- F. exist to educate tourists about the areas they are visiting.
 - G. function to protect and preserve specimens for future study.
 - H. preserve only the specimens excavated from nearby sites.
 - J. display only the specimens that are currently considered to be important.
35. The detail about the *Archaeopteryx* fossil being "a mere 35 cm at its longest" (line 48) helps establish a contrast between the fossil's small size and the:
- A. considerable time it took to curate the fossil.
 - B. substantial impact the fossil had on the scientific community.
 - C. overall complexity of *Archaeopteryx*'s bone structure.
 - D. ferocity associated with the *Archaeopteryx* species.
36. Which of the following events mentioned in the passage occurred first chronologically?
- F. An *Archaeopteryx* fossil was discovered in Solnhofen.
 - G. The *Archaeopteryx* fossil known as the Berlin specimen was discovered.
 - H. Darwin's book *The Origin of Species* was published.
 - J. Owen became the first director of the Natural History Museum.
37. The passage author characterizes the timing of the *Archaeopteryx* fossil discovery as ideal. Which of the following people mentioned in the passage would be most likely to support this characterization?
- A. Darwin
 - B. Owen
 - C. Critics of Darwin's theory
 - D. Visitors of the Eichstätt and Solnhofen museums
38. It can reasonably be inferred that one reason the *Archaeopteryx* fossil qualifies as an example of an "intermediate form" is that:
- F. its mixture of reptilian and bird features demonstrates the notion of descent with modification.
 - G. its significance was not fully realized until long after it had been curated.
 - H. it was discovered in the time between the excavations of the *Mesolimulus* and *Compsognathus* fossils.
 - J. it convinced critics that animals were not yet capable of transitioning from earth to the skies.
39. Based on the passage, compared to the "delicate little" sea lily fossils found at Solnhofen, the fossils of certain species of fish found at Solnhofen are more:
- A. well-preserved.
 - B. indistinct.
 - C. rare.
 - D. fragile.
40. As it is used in line 40, the word *interrogate* most nearly means:
- F. request.
 - G. demand.
 - H. signal.
 - J. examine.

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

4**4****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

Two experiments examined how pH and temperature affect the activity of *Amoeba limax* (a single-celled eukaryote).

Experiment 1

Twenty identical glass slides were equally divided into 5 groups (Groups 1–5). Each slide was then prepared as follows: First, a drop of water containing a single 1-day-old *A. limax* was placed on the slide. Next, the water (but not the *A. limax*) was removed and replaced with a drop of an aqueous solution having a pH of 8.2. Then, a glass cover slip was placed over the drop, and *paraffin* (a type of wax) was used to seal the edges of the cover slip.

Each of the Group 1 slides was incubated at a temperature of 0°C. During incubation, the movement of the *A. limax* on each slide was observed for 30 min, and the total distance traveled (TDT) by the *A. limax* over the 30 min was recorded. The average TDT for Group 1 was then determined.

The procedure for Group 1 was repeated for each of Groups 2–5, except that each group was kept at a different incubation temperature.

The results are shown in Table 1.

Table 1		
Group	Incubation temperature (°C)	Average TDT (mm)
1	00	0.4
2	05	2.0
3	10	3.9
4	15	5.6
5	20	6.1

Table 1 adapted from C. F. A. Pantin, "On the Physiology of Amoeboïd Movement II.—The Effect of Temperature." ©1924 by The Company of Biologists Ltd.

Experiment 2

Twenty more of the slides were equally divided into 5 groups (Groups 6–10). Each slide was prepared as in Experiment 1, except that for each group, the aqueous solution had a different pH (see Table 2).

Each of the Group 6 slides was incubated at a temperature of 10°C. During incubation, the movement of the *A. limax* on each slide was observed for 30 min, and the TDT by the *A. limax* over the 30 min was recorded. The average TDT for Group 6 was then determined.

The procedure for Group 6 was repeated for each of Groups 7–10.

The results are shown in Table 2.

Table 2		
Group	pH	Average TDT (mm)
06	6.6	3.9
07	7.0	6.2
08	7.5	7.0
09	8.7	5.0
10	9.3	3.1

Table 2 adapted from C. F. A. Pantin, "On the Physiology of Amoeboïd Movement III.—The Action of Calcium." ©1926 by The Company of Biologists Ltd.

- According to the results of Experiment 1, as the incubation temperature increased, the average TDT:
 - increased only.
 - decreased only.
 - increased, then decreased.
 - decreased, then increased.

4**4**

2. Consider the claim “On average, the activity of *A. limax* always increases with increasing pH.” Are the results of Experiment 2 from pH 6.6 through pH 9.3 consistent with this claim?
- F. Yes; as the pH increased from 6.6 through 9.3, the average TDT increased only.
G. Yes; as the pH increased from 6.6 through 9.3, the average TDT decreased only.
H. No; as the pH increased from 6.6 through 9.3, the average TDT initially increased and then decreased.
J. No; as the pH increased from 6.6 through 9.3, the average TDT initially decreased and then increased.
3. In Experiments 1 and 2 combined, the incubation temperature was either at or below the freezing point of water for how many of the groups tested, if any?
- A. 0
B. 1
C. 2
D. 4
4. Which, if either, of the paraffin and the cover slip likely functioned to slow the rate of evaporation from each slide?
- F. The paraffin only
G. The cover slip only
H. Both the paraffin and the cover slip
J. Neither the paraffin nor the cover slip
5. Assume that for *A. limax*, the greater the activity level, the greater the frequency of cell division. Under the conditions of Experiment 1, an *A. limax* would most likely undergo the *fewest* cell divisions at which of the incubation temperatures tested?
- A. 0°C
B. 05°C
C. 15°C
D. 20°C
6. In Experiments 1 and 2 combined, for how many of Groups 1–10 was the average TDT *less* than 1 centimeter?
- F. 00
G. 02
H. 05
J. 10
7. Was the solution placed on the Group 10 slides acidic or basic?
- A. Acidic, because its pH was less than 7.
B. Acidic, because its pH was greater than 7.
C. Basic, because its pH was less than 7.
D. Basic, because its pH was greater than 7.

4**4****Passage II**

The amino acid molecules necessary for life are thought to have been produced on Earth before organisms were present. Amino acids can be produced through chemical reactions among ammonia (NH_3), methane (CH_4), hydrogen (H_2), and water (H_2O). Four hypotheses have been proposed to describe the conditions that were responsible for the production of amino acids on Earth.

Hypothesis 1

Amino acids were introduced to Earth by meteors containing NH_3 , CH_4 , H_2 , and H_2O . If the reactions among these 4 substances are provided enough energy, amino acids can be produced. As meteors containing these substances entered Earth's atmosphere, the substances were rapidly heated by friction, and this heat resulted in immediate amino acid production on the surface of the meteors.

Hypothesis 2

Hypothesis 1 is correct that meteors brought NH_3 , CH_4 , H_2 , and H_2O to Earth; however, amino acid production did not occur on the meteors. Once a meteor containing these substances entered Earth's atmosphere, the substances were released into the atmosphere. Meteors continued to enter the atmosphere over hundreds of millions of years. The concentration of these substances in the atmosphere eventually became high enough for the reactions that produce amino acids to occur. The energy provided to these reactions was UV light energy from the sun.

Hypothesis 3

Meteors had nothing to do with the production of amino acids. *Thermal vents* (cracks in the floors of Earth's oceans) allowed magma from Earth's crust to seep into the ocean. The magma caused some of the ocean water to boil. Since ocean water contains dissolved NH_3 , CH_4 , and H_2 , these substances were released into the atmosphere (along with H_2O) upon boiling. Then, UV light from the sun provided the energy for these substances to react to produce amino acids.

Hypothesis 4

Magma from thermal vents did not provide enough energy to cause ocean water to boil; however, the magma did provide enough energy to cause the NH_3 , CH_4 , and H_2 dissolved in ocean water to react with the ocean water, producing amino acids. These reactions occurred near the thermal vents.

8. Suppose that a scientist determined that UV light does not provide enough energy to cause any chemical reactions to occur. This finding would *weaken* which hypotheses?

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

9. Hypothesis 3 and Hypothesis 4 agree on which of the aspects of amino acid production listed below?

- I. The source of the substances needed for amino acid production
 - II. The location of amino acid production
 - III. The source of the energy needed for amino acid production
- A. I only
 - B. II only
 - C. II and III only
 - D. I, II, and III

10. Which of Hypotheses 1 and 2, if either, state(s) or suggest(s) that amino acid production occurred on the surface of a meteor?

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

11. Which hypothesis suggests that the reactions among the 4 substances that form amino acids occurred in an aqueous solution?

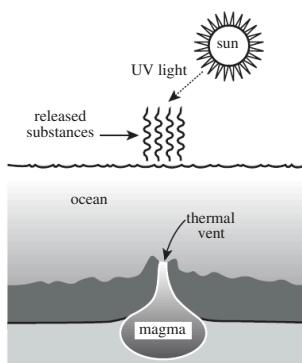
- A. Hypothesis 1
- B. Hypothesis 2
- C. Hypothesis 3
- D. Hypothesis 4

12. The chemical formula for the amino acid *glycine* is $\text{C}_2\text{H}_5\text{O}_2\text{N}$. Based on the information in the passage, how many molecules of methane would be needed to provide the correct number of carbon atoms in 1 molecule of glycine?

- F. 1
- G. 2
- H. 3
- J. 4

4**4**

13. The diagram below best illustrates which hypothesis?



- A. Hypothesis 1
- B. Hypothesis 2
- C. Hypothesis 3
- D. Hypothesis 4

14. Which hypotheses, if any, claim that amino acid production occurred within thermal vents?

- F. Hypotheses 1 and 2 only
- G. Hypotheses 2 and 3 only
- H. Hypotheses 3 and 4 only
- J. None of the hypotheses

