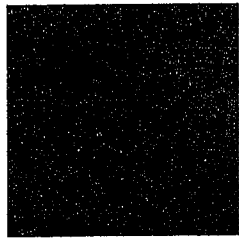


Form 71C

(June 2013)



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ENGLISH TEST

45 Minutes—75 Questions

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

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

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

PASSAGE I

Picking the Tamed Wild Grape

The farmer, my new boss, handed
me a bucket pointing down a long row.
1

"Scuppernongs are this way," he said.
2
"Muscadines start two rows over."
2

From a distance, the field had looked contained
and orderly with its grapevines in row upon tidy row,
they were all the same breadth and height and spaced
3

the same distance apart. For instance, the scene was
4

more chaos, enchanting so. Vines tangled around each
5
other, heart-shaped leaves reaching in all directions.

1. A. NO CHANGE
B. and pointed
C. by pointing
D. pointing me
2. The writer would like to introduce the topic of the essay by closely connecting the opening paragraph to the setting that is described in the rest of the essay. Given that all the choices are true, which one best accomplishes the writer's goal?
E. NO CHANGE
G. It had taken me several weeks to find a summer job.
H. Scuppernongs and muscadines are available at certain times of the year but not others.
J. "Thank you," I said, noticing that it was a big bucket.
3. A. NO CHANGE
B. all of them were
C. they're
D. all
4. E. NO CHANGE
G. Under the circumstances,
H. Up close,
J. Or else,
5. A. NO CHANGE
B. chaotic, enchantingly so.
C. so enchantingly chaotically.
D. chaos so enchantment.

1
 Clusters of grapes drooped haphazardly. The outer portions of the vines had already been picked clean.

6. Given that all the choices are true, which one continues to provide a contrast with the description in this paragraph's first sentence?

F. NO CHANGE
 G. had been neatly arranged on tables.
 H. were available for purchase.
 J. were ready to be picked.

I could see other workers nearby.

7. Given that all the choices are true, which one most effectively focuses on the act of one person picking grapes?

A. NO CHANGE
 B. I stuck my arm shoulder-deep into the mass of leaves and felt a cluster there.
 C. This farm has been part of the local landscape since before I was born.
 D. In my family, there's an annual tradition of making grape jelly from locally harvested fruit.

Scuppernongs and muscadines—the words themselves so flavorful—growing wild in the southeastern United

8. F. NO CHANGE
 G. have grown
 H. to grow
 J. DELETE the underlined portion.

States for centuries. Few farms cultivate it commercially.

9. A. NO CHANGE
 B. there own
 C. it now
 D. them

The grapes have a faintly musky flavor. They can be twice as big as the grapes more commonly sold in grocery stores.

10. Given that all the choices are true, which one provides information that is most relevant to the focus of the paragraph?

F. NO CHANGE
 G. The farm has been in the Johnson family for three generations.
 H. The day was already hot, and it wasn't even noon yet.
 J. I love all kinds of fruit, but grapes are my favorite.

Instead of being oblong or egg-shaped, they are almost perfectly spherical, something like marbles, only soft, and full of summer.

Typically, commercial grapes can be cut from the vine a cluster at a time, because all the fruit in a cluster ripens at the same time. A single cluster of scuppernongs or muscadines, however, may have two grapes ready to be picked immediately, four that will be ready the following day, and a half dozen that won't ripen until the following week. Harvesting is, therefore, labor-intensive.

1

Scuppernongs make a transition color-wise from light green to translucent yellow as they mature. But when the fruit, which grows in vineyards, is deep in the vine, so a vineyard worker can have a hard time seeing the color of the grapes. Following instructions from the farmer, I picked by feel instead, testing the skin for the rubbery texture that would indicate ripeness. After filling my bucket to the brim, I walked back to the shelter, the harvest accumulating there on long wooden tables. Resting a moment, I slipped a grape in my mouth, spat out the bitter seeds and skin, and let the sweet fruit settle on my tongue.

11. A. NO CHANGE
B. go through making a color change
C. change color
D. colorize
12. F. NO CHANGE
G. fruit, always a healthy choice,
H. fruit on the vine
J. fruit
13. A. NO CHANGE
B. whether
C. if
D. DELETE the underlined portion.
14. F. NO CHANGE
G. bucket, to the brim
H. bucket to the brim;
J. bucket to the brim:
15. A. NO CHANGE
B. would of spit
C. have spat
D. spitted

PASSAGE II

A Six-Month Stay in Space

When U.S. astronaut, Sunita Williams, left for her six-month stay at the International Space Station (ISS) in December 2006. The United States was not the only country tracking her voyage. Because her father had been born in India, many citizens of India also proudly followed Williams as she completed research about spaceflight.

16. F. NO CHANGE
G. astronaut, Sunita Williams
H. astronaut Sunita Williams,
J. astronaut Sunita Williams
17. A. NO CHANGE
B. 2006, the
C. 2006; the
D. 2006 the
18. Given that all the choices are true, which one gives the most relevant background information to explain the details presented in the remainder of the sentence?
F. NO CHANGE
G. Through articles published in local papers about Williams's accomplishments,
H. Although Williams had been born in the United States,
J. Admiring her work throughout her career,
19. Which choice most clearly suggests that Williams is not the only astronaut who has worked at the ISS?
A. NO CHANGE
B. contributed to ongoing
C. devoted herself to
D. worked on

1

[1] As a NASA flight engineer, Williams was assigned to conduct maintenance on the ISS, some of which needed to be performed outside the station. [2] Their spacewalk lasted over seven hours, during which they rerouted the temporary power system to a permanent one. [3] Before her first spacewalk in December 2006, Williams and her colleague, Bob Curbeam, spent hours preparing for the environment of space, which was to be sleeping in an airlock to help them adjust to a lack of air pressure. [4] Over the next three months, Williams conducted three more additional spacewalks to make repairs. [5] These brought her total spacewalk time to 29 hours 17 minutes, a record for women at that time. 23

Williams also conducted experiments and educational demonstrations for NASA; however, her most publicized event involved a personal goal. Having qualified for the spring 2007 Boston Marathon before her voyage; she decided to run the marathon (during the actual Boston race) on the ISS treadmill, which is used by the astronauts to fight the physical effects of microgravity. To hold the nearly weightless runner in place, a harness fastens around the runner's hips and shoulders and connect to the treadmill with bungee cords and clips. Williams completed her run in 4 hours 24 minutes, becoming the first person to participate in a marathon while in orbit.

20. F. NO CHANGE
G. of it needed
H. needed
J. need
21. A. NO CHANGE
B. that includes
C. including
D. they were
22. F. NO CHANGE
G. numerous
H. further
J. DELETE the underlined portion.
23. For the sake of the logic and coherence of this paragraph, Sentence 2 should be placed:
A. where it is now.
B. before Sentence 1.
C. after Sentence 3.
D. after Sentence 4.
24. F. NO CHANGE
G. voyage, she decided
H. voyage she decided
J. voyage, deciding
25. A. NO CHANGE
B. are connected
C. connected
D. connects

26 At the 2007 International Astronautical Congress

in Hyderabad, India, she spoke about the effects of

27

spaceflight on the human body. Due in part to one's

28

research, one day both men or women may be able to

29

journey farther out into space.

26. Given that all the following statements are true, which one, if added here, would most logically lead readers into the paragraph?

- F. One of the training procedures Williams did prior to her spaceflight was to stay in an underwater laboratory for ten days.
- G. Williams credits her teachers from her hometown of Needham, Massachusetts, with inspiring her.
- H. Williams planned to continue to train for and run in marathons after her arrival back on Earth.
- J. After returning to Earth, Williams accepted many professional invitations to share her work.

27. A. NO CHANGE

- B. affects for
- C. effects for
- D. affects of

28. F. NO CHANGE

- G. their
- H. her
- J. its

29. A. NO CHANGE

- B. and women may be
- C. and women maybe
- D. or women maybe

Question 30 asks about the preceding passage as a whole.

30. Suppose the writer's goal had been to focus on the path that Williams took to become an astronaut. Would this essay accomplish that goal?

- F. Yes, because it focuses on how parts of Williams's past led to her trip to the ISS.
- G. Yes, because it focuses on Williams's personal goals as an astronaut.
- H. No, because it focuses on long-term spaceflight and the human body.
- J. No, because it focuses on Williams's stay at the ISS.

1

PASSAGE III

Form Follows Function

Many cities are adorning their public transportation systems by implementing bike-share programs. Bikes

docked at stations throughout these cities provide commuters and tourists with another mode of transit for short, in-city trips. A person can take a bike (usually for a small fee) from one station, ride it, and then return it to another station near his or her destination. Programs vary based on cities' unique conditions, but one thing is consistent, bike-share bikes—often described as clunky or even ugly—don't look like ordinary bikes. There are, however, good reasons for that.

Bike-share bikes are designed to be durable and easy to repair. Steel, not lightweight aluminum, is the preferably material for building sturdy bike frames. To minimize mechanical problems, many programs provide single-speed or three-speed bikes: fewer gears means fewer repairs. In hilly cities, where more gears are essential, bikes are equipped with enclosed, or

internal, hub gears, they protect the gears from weather- or contact-related damage.

31. A. NO CHANGE
B. accumulating
C. augmenting
D. elaborating
32. F. NO CHANGE
G. station's throughout these cities'
H. station's throughout these cities
J. stations throughout these cities'
33. A. NO CHANGE
B. conditions but, one thing is consistent;
C. conditions, but one thing is consistent;
D. conditions: but one thing is consistent,
34. F. NO CHANGE
G. aluminum—
H. aluminum;
J. aluminum
35. A. NO CHANGE
B. preferred material
C. preferred materials
D. preferable materials
36. Which choice most strongly emphasizes the necessity of having more gears?
F. NO CHANGE
G. nice to have,
H. helpful,
J. useful,
37. A. NO CHANGE
B. gears that which
C. gears, this is to
D. gears that

1

Some bike features have been specifically chosen to prevent theft. Painting all the bikes one color, however,³⁸ makes them easily identifiable. [A] Another theft deterrent is the use of not your ordinary³⁹ bike parts. [B] Because the goal of many bike thieves is to reuse or sell individual parts; components⁴⁰ incompatible with non-bike-share bikes are relatively useless to thieves. [C] Other bike modifications make city riding practical. A front basket or rear rack accommodates bags or briefcases. [D] To keep riders' clothing clean and dry, they are⁴¹ outfitted with fenders and mud flaps to prevent riders from getting dirty.⁴² Some bikes have chain guards, encasements that prevent bike chains from rubbing grease on riders' pants. Bright lights and an upright seating position help the rider see and be seen. 43

As cities continue to experiment, bike-share programs are becoming more sophisticated, adopting "smart" technologies, such as:⁴⁴ GPS and WiFi.

45 Chances are, though, that one thing won't change: the bikes will still stand out.

38. F. NO CHANGE
G. for example,
H. therefore,
J. in fact,
39. A. NO CHANGE
B. irregular, as in not standard,
C. not the same standardized
D. nonstandard
40. F. NO CHANGE
G. parts. Components
H. parts, components
J. parts: components
41. A. NO CHANGE
B. bikes are
C. it is
D. DELETE the underlined portion.
42. F. NO CHANGE
G. to prevent riders' clothes from getting dirty.
H. to keep riders clean.
J. DELETE the underlined portion and end the sentence with a period.
43. The writer wants to divide this paragraph into two in order to separate the information about theft prevention from the information about the features that are helpful for riders. The best place to begin the new paragraph would be at Point:
A. A.
B. B.
C. C.
D. D.
44. F. NO CHANGE
G. technologies such as,
H. technologies such as
J. technologies such as:
45. At this point, the writer is considering adding the following true statement:
Additionally, some cities are adopting car-share programs.
Should the writer make this addition here?
A. Yes, because it develops the essay's discussion of bike-share programs to include other forms of transportation.
B. Yes, because it provides another example of cities' innovative efforts to expand transportation options.
C. No, because it doesn't indicate if car-share programs are also using GPS and WiFi technologies.
D. No, because it digresses from the main topic of the essay by introducing loosely related information.

1

PASSAGE IV

The following paragraphs may or may not be in the most logical order. Each paragraph is numbered in brackets, and question 60 will ask you to choose where Paragraph 4 should most logically be placed.

America the Beautiful

[1]

Katharine Lee Bates had rarely traveled out of her home state of Massachusetts before the excursion that would take her by wagon and then by mule to the top of Pikes Peak in July of 1893. As she began her motion in an upward direction of the towering landmark in ⁴⁶Colorado Springs, Bates looked up in awe at the Rocky Mountains rising majestically into the clouds.

[2]

Bates, a professor of English at Wellesley College, had traveled by train with several colleagues to Colorado College to teach a three-week session. The trip itself was an adventure. Instead, a two-day train ride ended in Chicago, where the World's Columbian Exposition, a nineteenth-century world's fair, was taking place.

West of Chicago, the train's vision shifted with the passing miles. In Colorado, because the expanse of ripening grain under ample skies gave way to the spectacle of the Rocky Mountains.

46. F. NO CHANGE
G. uprising movement
H. going up
J. ascent

47. A. NO CHANGE
B. On the other hand, a
C. Overall, a
D. A

48. F. NO CHANGE
G. happening there in Chicago.
H. on location in that place.
J. in effect.

49. A. NO CHANGE
B. train's vision from the window
C. view from the train
D. view of the train

50. F. NO CHANGE
G. where
H. seeing
J. DELETE the underlined portion.

[3]

Bates composed the first verse of her poem,
51

“America the Beautiful” while standing atop Pikes Peak.
52
From the crest, at an elevation of over

14,000 feet high up in elevation, she gazed
53
out at an America she had never seen before,
the land below as vast as the sky above.

[4]

After descending to Colorado Springs that evening,
Bates could not get the spirit of the landscape or the
staggering sight of the purples, browns, greens, and golds
of the mountain vista out of her mind. She wrote down
four stanzas of the poem in her notebook, however, she
54
was not pleased with this first attempt and set it aside.
55

[5]

Two years later, when she found her notes from
56
the Colorado trip, rewrote the poem, and submitted it
for publication. “America the Beautiful” appeared in the
July 4, 1895, issue of *The Congregationalist* magazine.
But Bates, whichever the perfectionist, continued to
57

revise the poem. In 1913, she revised “America the
58
Beautiful” for the last time, and, like some previous
versions, it was set to the tune of the old hymn “Materna.”

51. A. NO CHANGE
B. verse of her poem
C. verse, of her poem,
D. verse, of her poem
52. Given that all the choices are true, which one most directly reminds readers of the dramatic setting that inspired Bates?
E. NO CHANGE
G. before making the return trip to Massachusetts.
H. in a moment of inspiration.
J. in the nineteenth century.
53. A. NO CHANGE
B. feet high or more,
C. feet high up,
D. feet,
54. E. NO CHANGE
G. notebook; however,
H. notebook however,
J. notebook however
55. A. NO CHANGE
B. sat them beside.
C. set it sideways.
D. sat it aside.
56. E. NO CHANGE
G. later, having
H. later, she
J. later
57. A. NO CHANGE
B. who is
C. ever
D. if
58. If the writer wants to emphasize Bates’s determination to continue to improve her poem, which choice would be LEAST acceptable?
E. NO CHANGE
G. rethink sections of the poem.
H. reread her favorite parts.
J. generate new versions.

1

This version, still sung today, reflects Katharine Lee
Bates's own encounter with the vastness and natural
beauty of the United States of America.

59

59. Which choice concludes the essay by summarizing it?
- A. NO CHANGE
 - B. was once sung to a variety of tunes by people in many parts of the country.
 - C. is a reminder that successful poets sometimes revise their work multiple times before they are happy with it.
 - D. is the one I remember learning when I was in grade school.

Question 60 asks about the preceding passage as a whole.

60. For the sake of the logic and coherence of the essay, Paragraph 4 should be placed:
- F. where it is now.
 - G. before Paragraph 1.
 - H. after Paragraph 1.
 - J. after Paragraph 2.

PASSAGE V

The Evolution of Vocal Learning

[1]

Scientists distinguish *vocal learning*, the ability to
 remember and reproduce sounds after hearing them from
auditory learning, the ability to make associations with
 certain sounds. For example, dogs' ability to recognize
 a command such as "sit" is an example of auditory
 learning because while dogs can learn to identify
 and respond to the sound, they can't imitate the sound.
 Dogs do of course vocalize, they bark. However, dogs'
 ability to bark is a genetically innate vocalization. That
 is, a dog doesn't learn to bark but, rather, are born
 knowing how. [A]

61. A. NO CHANGE
 B. *learning* the ability to remember and reproduce sounds after hearing them,
 C. *learning*, the ability to remember and reproduce sounds after hearing them,
 D. *learning* the ability, to remember and reproduce sounds, after hearing them
62. F. NO CHANGE
 G. Dogs do, of course, vocalize:
 H. Dogs, do of course vocalize,
 J. Dogs do, of course, vocalize
63. A. NO CHANGE
 B. dogs don't
 C. one doesn't
 D. you don't

1

[2]

Only humans, bats, cetaceans (whales and dolphins),⁶⁴ seals, elephants, and three groups of birds—parrots, hummingbirds, and songbirds—are capable of vocal learning. [B] Even though these groups of animals are only distantly related, they have similarities in brain structure that accounts for the shared vocal learning ability. [C] Neurobiologist Erich Jarvis, who studies the vocal learning process in birds, has a theory about why so little species' possess this ability. 67

[3]

Jarvis suspects vocal learners share a common ancestor that existed before the avian/mammalian evolutionary split. [D] Vocal learning was once a common ability, it was, however, eliminated in most species by natural selection. Because vocal learners produce a wide range of sounds, or varied syntax, Jarvis surmises that such creatures were in more danger from predators than were innate vocalizers, whose less-varied sounds blend more easily with background noise. The

64. F. NO CHANGE
G. cetaceans (whales and dolphins.)
H. cetaceans, (whales and dolphins)
J. cetaceans, (whales) and dolphins,
65. A. NO CHANGE
B. of which accounts
C. of which account
D. that account
66. F. NO CHANGE
G. few species
H. few species'
J. little species
67. At this point, the writer is considering adding the following true statement:
In interviews, Jarvis states that his passion for studying the vocal learning process—bird songs, in particular—has been influenced by his background in classical dance.
Should the writer make this addition here?
A. Yes, because it elaborates effectively on the preceding statement about Jarvis.
B. Yes, because it explains why Jarvis chose to study vocal learning.
C. No, because it interrupts the progression of ideas in the essay.
D. No; because it introduces information that isn't relevant until later in the essay.
68. F. NO CHANGE
G. previously to
H. precedent
J. prior of
69. A. NO CHANGE
B. ability, however, it was
C. ability, but it was
D. ability; but
70. F. NO CHANGE
G. The reason being because
H. Being that the reason
J. The reason because

1

species that have retained vocal learning ability are rare exceptions. They either have few natural predators ⁷¹ or have effective escape methods (as in the case of birds).

[4]

Similarly, vocal learners may have developed the ⁷²

ability in a state of independence of one another. Jarvis ⁷³ concedes that he has yet to identify a common ancestor.

The similarities in vocal learners' brain structure's, ⁷⁴ however, make it difficult for Jarvis to dismiss the theory.

71. Which of the following parenthetical phrases, if added here, would be most consistent with the other type of information provided within the sentence?
- A. (vocal learning being different than auditory learning)
 - B. (better to be the hunter than the hunted, I always say)
 - C. (as in the case of humans, whales, and elephants)
 - D. (defined as creatures that rely on predation for survival)
72. F. NO CHANGE
G. Alternatively,
H. For instance,
J. Therefore,
73. A. NO CHANGE
B. in independency
C. independently
D. independence
74. F. NO CHANGE
G. learners' brain structures,
H. learner's brain structures'
J. learners brain structures

Question 75 asks about the preceding passage as a whole.

75. The writer is considering adding the following true statement to the essay:
- Vocal learning differs from innate vocalization in that learners must first hear the sound they later imitate.
- If the writer were to add this sentence to the essay, it would most logically be placed at Point:
- A. A in Paragraph 1.
 - B. B in Paragraph 2.
 - C. C in Paragraph 2.
 - D. D in Paragraph 3.

END OF TEST 1

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



MATHEMATICS TEST

60 Minutes—60 Questions

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

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

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

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

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

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

DO YOUR FIGURING HERE.

1. A car was purchased 4 years ago for \$26,200. The current value of the car is \$17,500. What was the car's average decrease in value per year?
 - A. \$2,175
 - B. \$2,900
 - C. \$4,350
 - D. \$4,375
 - E. \$6,550

2. For what value of x is $6x - 3 = 4x + 7$ true?
 - F. $\frac{2}{5}$
 - G. $\frac{7}{8}$
 - H. 1
 - J. 2
 - K. 5

3. Which of the following integers is NOT a factor of 132?
 - A. 6
 - B. 8
 - C. 11
 - D. 12
 - E. 33

4. A vending machine only accepts quarters (\$0.25) and nickels (\$0.05). When the machine was emptied Friday afternoon, 325 coins were counted and had a value of \$56.25. Which of the following systems of equations, when solved, gives the number of quarters, q , and the number of nickels, n ?
 - F. $q + n = 325$ and $0.25q + 0.05n = 56.25$
 - G. $q + n = 325$ and $0.25q + 0.50n = 56.25$
 - H. $q + n = 325$ and $25q + 5n = 56.25$
 - J. $q + n = 56.25$ and $0.25q + 0.05n = 325$
 - K. $q + n = 56.25$ and $25q + 5n = 325$

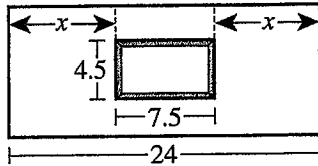
2



2

DO YOUR FIGURING HERE.

5. Carlotta is helping her grandfather center a large framed picture on his living room wall. As shown in the figure below, the rectangular wall is 24 feet long, and the rectangular framed picture is 4.5 feet high and 7.5 feet long. The left edge of the frame will be x feet from the left edge of the wall, and the right edge of the frame will be x feet from the right edge of the wall. What is the value of x ?



- A. 8.25
 B. 9.75
 C. 12
 D. 16.5
 E. 19.5
6. In $\triangle ABC$, the sum of the measures of $\angle A$ and $\angle B$ is 57° . What is the measure of $\angle C$?
- F. 33°
 G. 57°
 H. 66°
 J. 114°
 K. 123°
7. A square and a rectangle have the same area. The length of the rectangle is 32 centimeters, and the width of the rectangle is 2 centimeters. What is the length, in centimeters, of a side of the square?
- A. $2\sqrt{17}$
 B. 8
 C. 17
 D. 64
 E. 68
8. As a motivational speaker, Bree speaks at school assemblies, charging a school district for her travel costs and a fixed amount per assembly. Bree used the equation $C = 50a + 1,500$ to determine the charge of C dollars to speak at a assemblies in the Escambia City School District. Bree charged the district \$4,250 to speak at school assemblies. How many assemblies did Bree speak at in this district?
- F. 30
 G. 54
 H. 55
 J. 85
 K. 115
9. Let a and b be positive prime numbers. Which of the following numbers *must* be a factor of both a and b ?
- A. 0
 B. 1
 C. a
 D. b
 E. ab

2



10. What is the value of $80 - 5(x^2 - y) + y$ when $x = 4$ and $y = 6$?

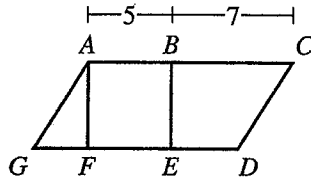
- F. 0
- G. 24
- H. 36
- J. 76
- K. 756

DO YOUR FIGURING HERE.

11. At the Winter Weather Store, the price of 1 hat is \$12 and the price of 1 scarf is \$14. Jovon spent \$128 to buy 10 items—a combination of hats and scarves. How many hats did he buy?

- A. 1
- B. 4
- C. 5
- D. 6
- E. 8

12. 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 $ACDG$?



- F. 1:12
- G. 1:24
- H. 5:12
- J. 12:1
- K. 12:5

13. Which of the following graphs shows the solution set for the inequality $6x - 5 \geq 7$?

- A.
- B.
- C.
- D.
- E.

14. The length of a rectangle is 5 inches longer than the width. The perimeter of the rectangle is 60 inches. What is the width of the rectangle, in inches?

- F. 12
- G. 12.5
- H. 24
- J. 25
- K. 27.5

2

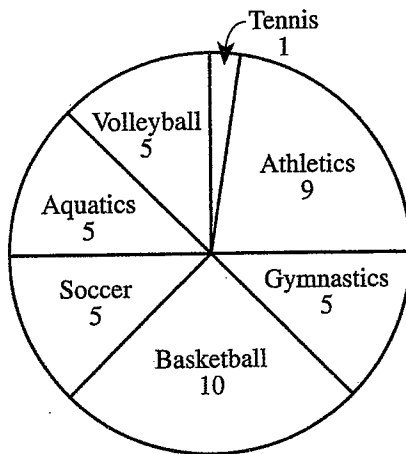


2

Use the following information to answer questions 15–17.

DO YOUR FIGURING HERE.

Miriam conducted a survey of the students in her 8th-grade class to determine which of 7 Olympic sports were the most popular. Each student who responded to the survey selected 1 Olympic sport as his or her favorite. The circle graph below shows the number of students who selected each of the 7 Olympic sports. A total of 40 students responded to the survey.



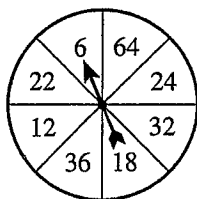
15. To the nearest 0.1%, what percent of the students who responded to the survey selected Basketball?
- A. 10.0%
 B. 12.5%
 C. 22.5%
 D. 25.0%
 E. 30.0%
16. In this survey, what is the ratio of the number of students who selected Athletics to the number of students who selected Soccer?
- F. 5:9
 G. 5:14
 H. 9:5
 J. 9:14
 K. 9:40
17. In the circle graph, what is the angle measure of the sector that represents the number of students who responded to the survey who selected Tennis?
- A. 1°
 B. $4\frac{1}{2}^\circ$
 C. 5°
 D. 9°
 E. 10°



DO YOUR FIGURING HERE.

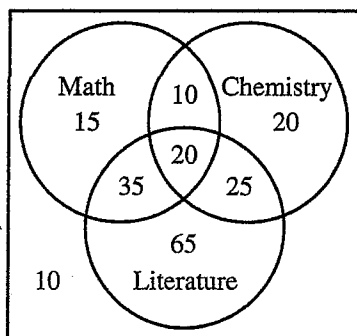
18. A spinner dial from a game is shown in the figure below. Each numbered sector of the circle has the same central angle measure. If the arrow on the spinner dial is spun randomly, what is the probability the arrow will point to a sector whose number is both a multiple of 3 and a multiple of 4?

- F. $\frac{3}{8}$
 G. $\frac{1}{2}$
 H. $\frac{5}{8}$
 J. $\frac{3}{4}$
 K. $\frac{7}{8}$



19. The counselors at Lakewood High School interviewed 200 students to determine placement in 3 different honors courses: Math, Chemistry, and Literature. The numbers of these students placed in these honors courses are shown in the Venn diagram below. Of these 200 students, 10% were placed into all 3 honors courses, and 35% were placed into exactly 2 honors courses. What percent of the students were placed into exactly 1 honors course?

Lakewood High School
Honors Course Placement



- A. 7.5%
 B. 10%
 C. 32.5%
 D. 45%
 E. 50%
20. One sign flashes every 4 seconds, and another sign flashes every 14 seconds. At a certain instant, the 2 signs flash at the same time. How many seconds elapse until the 2 signs next flash at the same time?
- F. 9
 G. 10
 H. 18
 J. 28
 K. 56
21. Which of the following transformations shifts all points graphed in the standard (x,y) coordinate plane down 5 coordinate units?
- A. $(x,y) \rightarrow (x, y - 5)$
 B. $(x,y) \rightarrow (x, y + 5)$
 C. $(x,y) \rightarrow (x, -5y)$
 D. $(x,y) \rightarrow (x - 5, y)$
 E. $(x,y) \rightarrow (x + 5, y)$

2



22. For \overleftrightarrow{AC} shown below, B is on \overline{AC} , the length of \overline{AB} is 12 cm, and the length of \overline{BC} is 20 cm. What is the distance, in centimeters, between C and the midpoint of \overline{AB} ?



DO YOUR FIGURING HERE.

- F. 16
G. 20
H. 22
J. 26
K. 32
23. Which of the following expressions is a factored form of $x^2 - 5x + 6$?
- A. $(x - 3)(x - 2)$
B. $(x - 3)(x + 2)$
C. $(x - 5)(x - 1)$
D. $(x - 6)(x + 1)$
E. $(x + 6)(x - 1)$
24. The sum of $(-2x^2 + 2x + 8)$ and which of the following polynomials is $(5x^2 + 3)$?
- F. $3x^2 + 2x + 11$
G. $-7x^2 + 2x + 5$
H. $7x^2 - 2x - 5$
J. $-7x^2 + 5$
K. $7x^2 - 5$
25. The expression $\frac{3 + \frac{1}{9}}{1 + \frac{1}{18}}$ is equal to:
- A. $1\frac{9}{19}$
B. 2
C. $2\frac{1}{2}$
D. $2\frac{18}{19}$
E. 5
26. Ava starts with a long list of numbers, each of which she must multiply by $\frac{4}{3}$ and then divide by $\frac{1}{6}$. She could get the same results by multiplying each number on her list by which of the following numbers?
- F. $\frac{1}{4}$
G. $\frac{3}{4}$
H. 4
J. 6
K. 8

2



2

27. When $6x = 2y - 18$ is graphed in the standard (x,y) coordinate plane, what is the y -intercept?

- A. 2
- B. 3
- C. 4
- D. 6
- E. 9

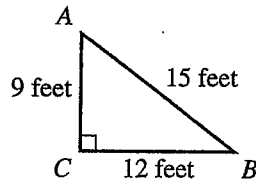
DO YOUR FIGURING HERE.

28. Given functions $f(x) = x - 5$ and $g(x) = 5 - x^2$, what is $f(g(-4))$?

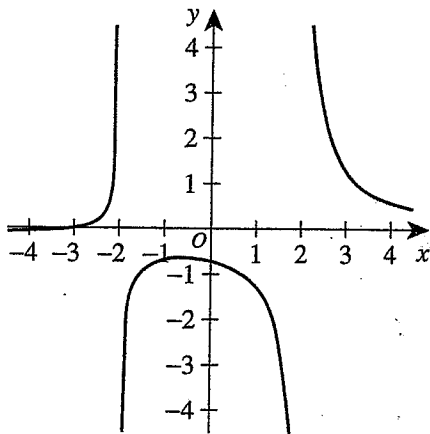
- F. -76
- G. -20
- H. -16
- J. 16
- K. 86

29. For right triangle $\triangle ABC$ shown below, which of the following expressions has a value that is equal to $\cos A$?

- A. $\sin A$
- B. $\sin B$
- C. $\cos B$
- D. $\tan A$
- E. $\tan B$



30. The equation $y = \frac{x+3}{x^2-4}$ is graphed in the standard (x,y) coordinate plane below. No point on the graph has which of the following x -coordinates?



- F. -3
- G. -2
- H. -1
- J. 0
- K. 1

31. The Wilson family sold a shipment of walnuts to a farming cooperative for \$210 at the rate of \$0.03 per pound. If their shipment averaged 12 walnuts per pound, which of the following is closest to the total number of walnuts in the shipment?

- A. 580
- B. 840
- C. 7,000
- D. 7,600
- E. 84,000

2



DO YOUR FIGURING HERE.

32. Over a 7-day period at Phil's Fitness, the average attendance of the slowest day and the busiest day was 247 members. The average of the other 5 days was also 247 members. The total attendance for the 7-day period at Phil's Fitness was how many members?

F. 247
 G. 494
 H. 1,235
 J. 1,729
 K. 2,470

33. Which of the following values is a zero of $f(x) = 2x^3 - 5x^2 - 12x$?

A. 3
 B. 2
 C. $-\frac{3}{2}$
 D. -4
 E. -6

34. The sum of a sequence of consecutive odd numbers, where the smallest term is 1, is always a perfect square. For example, $1 + 3 = 2^2$ and $1 + 3 + 5 + 7 = 4^2$. One of the sequences described above has a sum of 144. What is the largest odd number in the sequence?

F. 11
 G. 13
 H. 15
 J. 23
 K. 73

35. What is the slope of the line that passes through the points $(-2, 5)$ and $(3, -4)$ in the standard (x, y) coordinate plane?

A. 1
 B. $-\frac{1}{5}$
 C. $-\frac{5}{9}$
 D. -1
 E. $-\frac{9}{5}$

36. Among the following rational numbers, which has the greatest value?

F. 0.34
 G. $0.\overline{34}$
 H. $0.\overline{3}4$
 J. 0.343
 K. 0.3409

2

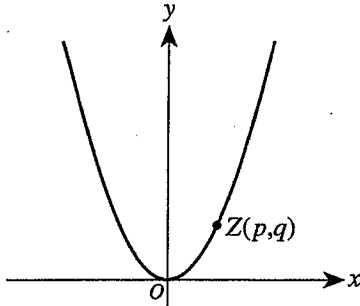


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Use the following information to answer questions 37–39.

DO YOUR FIGURING HERE.

A parabola with equation $y = ax^2$ is graphed in the standard (x,y) coordinate plane below. Point $Z(p,q)$ lies on the parabola.

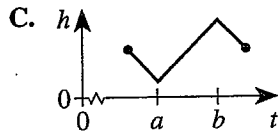
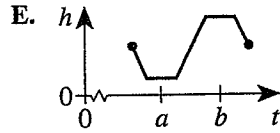
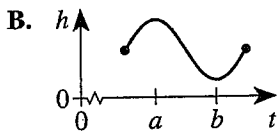
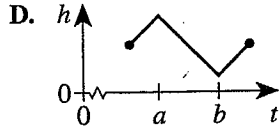
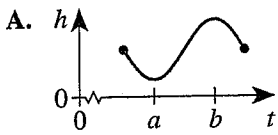


37. For any point $Z(p,q)$ on the parabola, which of the following points *must* also be on the parabola?
- $(-p, -q)$
 - $(-p, q)$
 - $(p, -q)$
 - (p^2, q^2)
 - (q, p)
38. What is the value of a if the coordinates of Z are $(5, 100)$?
- $\frac{1}{20}$
 - 2
 - 4
 - 10
 - 20
39. Suppose that the parabola is rotated clockwise (C°) by 90° about the origin. Which of the following is an equation for the parabola that results from this rotation?
- $x = -ay^2$
 - $x = ay^2$
 - $y = a\sqrt{x}$
 - $y = -ax^2$
 - $y = ax^2 + 90$
-
40. For all $k > 0$, $|x| = |y| = -k$ has how many (x,y) solutions?
- 0
 - 1
 - 2
 - 3
 - 4

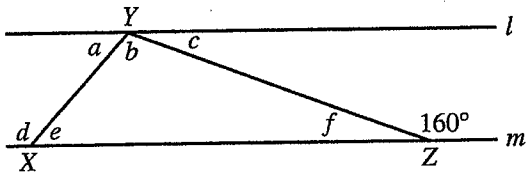


DO YOUR FIGURING HERE.

41. A Ferris wheel is turning at a constant speed during 1 of its rotations. Let t represent the time that has elapsed since the wheel started turning and let h represent the height above ground level of a certain seat on the wheel. The seat is at its minimum height at $t = a$ seconds and is at its maximum height at $t = b$ seconds. One of the following graphs represents the relationship between t and h during this rotation. Which one?

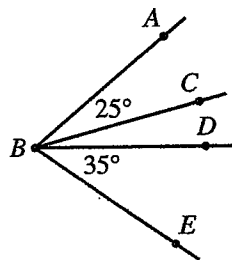


42. In the figure below, X and Z are on line m , and Y is on line l . The exterior angle to $\triangle XYZ$ at Z measures 160° . One of the following statements gives sufficient additional information to find the measure of $\angle b$. Which one?



- F. Line l is parallel to line m .
- G. The measure of $\angle d$ is 130° .
- H. The measure of $\angle c$ is equal to the measure of $\angle f$.
- J. The measure of $\angle a$ is greater than the measure of $\angle c$.
- K. The sum of the measures of $\angle b$, $\angle e$, and $\angle f$ is 180° .

43. In the figure below, C lies in the interior of the acute angle $\angle ABD$, and D lies in the interior of the acute angle $\angle CBE$. The measure of $\angle ABE$ is 75° , the measure of $\angle ABC$ is 25° , and the measure of $\angle DBE$ is 35° . What is the measure of $\angle ABD$?



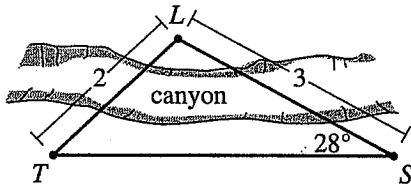
- A. 15°
- B. 30°
- C. 40°
- D. 50°
- E. 60°



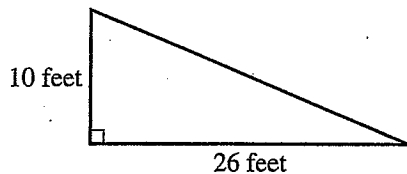
DO YOUR FIGURING HERE.

44. Li is standing at point L on the north side of the small canyon shown in the figure below. As measured by line of sight, Li is 2 miles from an observation tower at T , and she is 3 miles from a scenic overlook at S . Li, the observation tower, and the scenic overlook are all at the same elevation. The measure of $\angle S$ is 28° . Which of the following equations, when solved, gives the measure of $\angle T$?

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



- F. $\frac{\sin T}{3} = \frac{\sin 28^\circ}{2}$
- G. $\frac{\sin T}{3} = 2$
- H. $\frac{\sin T}{2} = \frac{\sin 28^\circ}{3}$
- J. $\frac{\sin 28^\circ}{T} = \frac{2}{3}$
- K. $\sin T - \sin 28^\circ = 3 - 2$
45. Mr. Green is buying mulch for his triangular-shaped garden shown below. When the mulch is uniformly spread 2 inches deep, each bag of mulch will cover 12 square feet. Mr. Green plans to uniformly spread his mulch 3 inches deep. Which of the following is closest to the number of bags of mulch Mr. Green will need for his garden?



- A. 11
- B. 17
- C. 22
- D. 24
- E. 33

2



2

DO YOUR FIGURING HERE.

46. A child's dose of medicine is often based on an adult's dose of medicine. For some medicines, Cowling's rule, $d = \frac{D(a+1)}{24}$, relates the dose of d milligrams for a child of age a years to the adult dose of D milligrams. Which of the following expressions gives a in terms of D and d ?

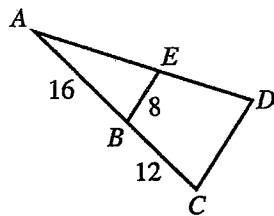
- F. $d - 1 - \frac{D}{24}$
 G. $\frac{dD}{24} + 1$
 H. $\frac{24d}{D} - 1$
 J. $\frac{24d}{D} + 1$
 K. $\frac{24d - 1}{D}$

47. For all $x > 0$, which of the following expressions is equivalent to $\log\left((2x)^{\frac{1}{2}}\right)$?

- A. $\log x$
 B. $\log 1 + \log \frac{x}{2}$
 C. $\log 2 + \frac{1}{2} \log x$
 D. $\frac{1}{2} \log 2 + \frac{1}{2} \log x$
 E. $\frac{1}{2}(\log 2)(\log x)$

48. In $\triangle ACD$ shown below, \overline{BE} is parallel to \overline{CD} , and the given lengths are in feet. Given that CD denotes the length, in feet, of \overline{CD} , which of the following proportions involving CD must be true?

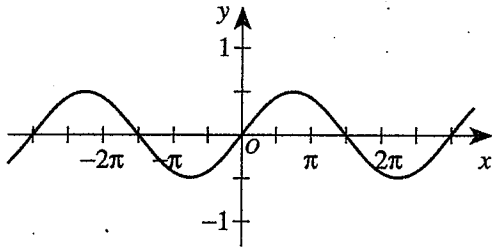
- F. $\frac{CD}{8} = \frac{16}{28}$
 G. $\frac{CD}{12} = \frac{8}{16}$
 H. $\frac{CD}{28} = \frac{8}{16}$
 J. $\frac{CD}{28} = \frac{16}{8}$
 K. $\frac{CD}{28} = \frac{8}{\sqrt{320}}$





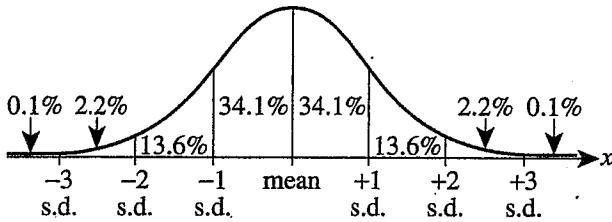
49. The graph of $y = a \sin bx$ is shown below for certain positive values of a and b . One of the following values is equal to a . Which one?

- A. $\frac{1}{2}$
- B. $\frac{2}{3}$
- C. $\frac{3}{2}$
- D. 2
- E. 3



DO YOUR FIGURING HERE.

50. The graph below illustrates the normal distribution curve. The percent of the data that falls within each standard deviation from the mean is given to the nearest 0.1%.

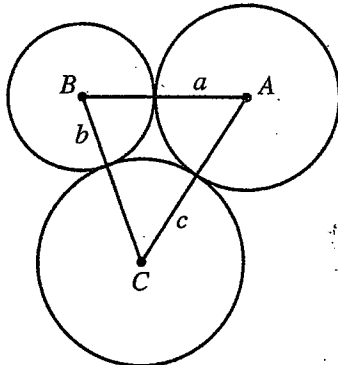


Suppose that the heights of men in a certain population are normally distributed with a mean of 69.0 inches and a standard deviation of 2.7 inches. To the nearest 0.1%, what percent of men in the population are at least 74.4 inches tall?

- F. 2.3%
- G. 2.7%
- H. 4.6%
- J. 47.7%
- K. 54.4%

51. Circles with centers A , B , and C , respectively, are mutually tangent, as shown below, and have radii of lengths a , b , and c , respectively. The lengths of \overline{AB} , \overline{BC} , and \overline{AC} are 13 inches, 15 inches, and 26 inches, respectively. What is the value of $a + b + c$?

(Note: The figure is not drawn to scale.)



- A. 18
- B. 24
- C. 27
- D. 40
- E. 54

2



DO YOUR FIGURING HERE.

52. Which of the following sets of 3 lengths, in decimeters, are the side lengths of an obtuse triangle?

(Note: An obtuse triangle has 1 angle whose measure is greater than 90° and less than 180° .)

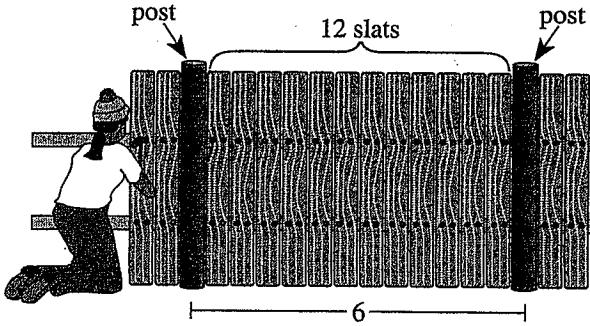
- F. {4, 4, 5}
G. {5, 12, 13}
H. {6, 8, 10}
J. {7, 10, 12}
K. {8, 11, 16}
53. Angle A measures $\frac{9}{2}\pi$ radians from its initial side to its terminal side. Angle B has the same initial side and terminal side as Angle A. Which of the following measures could be that of Angle B ?
- A. 5°
B. 14°
C. 25°
D. 90°
E. 180°
54. A polynomial in x has m nonzero terms. Another polynomial in x has n nonzero terms, where $m < n$. These polynomials are multiplied and all like terms are combined. The resulting polynomial in x has a maximum of how many nonzero terms?

- F. n
G. $\frac{m+n}{2}$
H. $m+n$
J. $\frac{mn}{2}$
K. mn



DO YOUR FIGURING HERE.

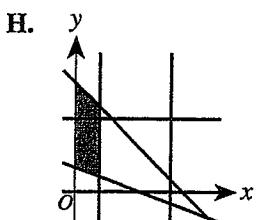
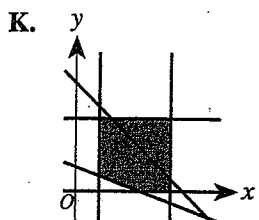
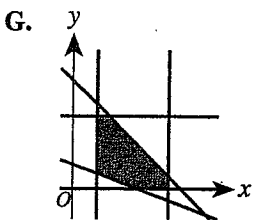
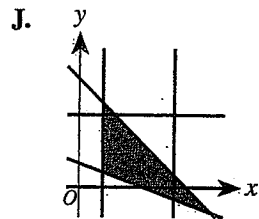
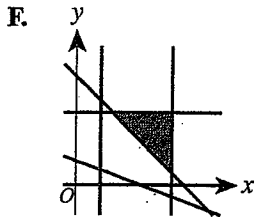
55. Hannah is building a fence along 3 sides of a rectangle, leaving 1 of the short sides unfenced. The fence has a post at each corner. The rectangle is 30 feet by 48 feet, measured from the centers of the corner posts. As shown in the figure below, adjacent posts of the fence are set every 6 feet, and there are 12 wooden slats between each pair of posts. How many wooden slats will Hannah use for the fence?



- A. 72
- B. 156
- C. 240
- D. 252
- E. 312

56. Which of the following graphs best represents the system of inequalities below?

$$\begin{aligned}
 10 &\leq x \leq 40 \\
 0 &\leq y \leq 30 \\
 y &\geq -\frac{1}{3}x + 10 \\
 y &\leq -x + 45
 \end{aligned}$$

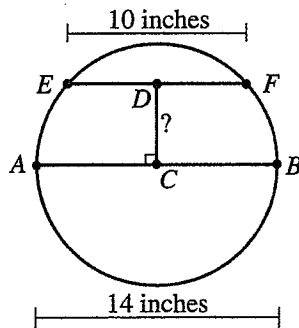


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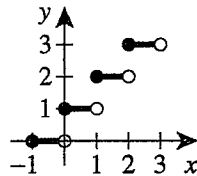
57. In the diagram below, chord \overline{EF} is parallel to diameter \overline{AB} . The length of \overline{EF} is 10 inches and the length of \overline{AB} is 14 inches. What is the distance, in inches, from C , the center of the circle, to D , the midpoint of \overline{EF} ?



- A. 4
 B. $4\frac{2}{3}$
 C. $2\sqrt{6}$
 D. 5
 E. $4\sqrt{6}$

58. The entire graph of $y = f(x)$ is shown in the standard (x, y) coordinate plane below. One of the following sets is the domain of f . Which set?

- F. $\{0, 1, 2, 3\}$
 G. $\{-1, 0, 1, 2\}$
 H. $\{-1, 0, 1, 2, 3\}$
 J. $\{x \mid 0 \leq x \leq 3\}$
 K. $\{x \mid -1 \leq x < 3\}$



59. Let the values of real numbers a , b , and c be restricted by the 2 conditions given below.

1. a is 5 less than b
2. b is at least 3 more than c

Which of the following inequalities expresses the same relationship between a and c as given by the 2 conditions?

- A. $a \geq c - 2$
 B. $a \geq c + 2$
 C. $a \geq c + 3$
 D. $a \geq c - 8$
 E. $a \geq c + 8$
60. Let m and n be nonzero real numbers such that $2^{n+1} = 2m$. Which of the following is an expression for 2^{n+3} in terms of m ?
- F. $\frac{1}{6m^3}$
 G. $\frac{1}{4m}$
 H. m^3
 J. $4m^2$
 K. $8m$

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 four 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.

Passage I

PROSE FICTION: This passage is adapted from the novel *Bel Canto* by Ann Patchett (©2001 by Ann Patchett).

Giuseppe Verdi (1813–1901) was an Italian opera composer.

He remembers another birthday, his eleventh, the birthday on which he first heard opera, Verdi's *Rigoletto*. His father had taken him to Tokyo by train and together they walked to the theater in a steady
5 downpour. It was October 22 and so it was a cold autumn rain and the streets were waxed in a paper-thin layer of wet red leaves. When they arrived at the Tokyo Metropolitan Festival Hall, their undershirts were wet beneath coats and sweaters. The tickets waiting inside
10 Katsumi Hosokawa's father's billfold were wet and discolored. They did not have especially good seats, but their view was unobstructed. In 1954, money was precious; train tickets and operas were unimaginable things. They climbed the long set of stairs to their row,
15 careful not to look down into the dizzying void beneath them. They bowed and begged to be excused by every person who stood to let them pass into their seats, and then they unfolded their seats and slipped inside. They were early. They waited, father and son, without
20 speaking, until finally the darkness fell and the first breath of music stirred from someplace far below them. Tiny people, insects, really, slipped out from behind the curtains, opened their mouths, and with their voices gilded the walls with their yearning, their grief, their
25 boundless love.

It was during that performance of *Rigoletto* that opera imprinted itself on Katsumi Hosokawa. Many years later, when everything was business, when he worked harder than anyone in a country whose values
30 are structured on hard work, he believed that life, true life, was something that was stored in music. True life was kept safe in the lines of Tchaikovsky's *Eugene Onegin* while you went out into the world and met the obligations required of you. Certainly he knew (though
35 did not completely understand) that opera wasn't for everyone, but for everyone he hoped there was something. He knew that without opera, part of himself would have vanished altogether. It was early in the second act, when *Rigoletto* and *Gilda* sang together,
40 their voices twining, leaping, that he reached out for his father's hand. He had no idea what they were saying, nor did he know that they played the parts of father and

daughter, he only knew that he needed to hold to something. The pull they had on him was so strong he could
45 feel himself falling forward out of the high and distant seats.

Such love breeds loyalty, and Mr. Hosokawa was a loyal man. He never forgot the importance of Verdi in his life. He became attached to certain singers, as
50 everyone does. He believed in the genius of Maria Callas above all others. There was never a great deal of time in his days. Custom was that after having dinner with clients and completing paperwork, he would spend thirty minutes listening to music before falling asleep.
55 It was impossibly rare, maybe five Sundays a year, that he found three consecutive hours to listen to one opera start to finish. Once, in his late forties, he ate a spoiled oyster and suffered a vicious bout of food poisoning that kept him home for three days. He remembered this
60 time as happily as any vacation because he played Handel's *Alcina* continually, even while he slept.

It was his eldest daughter, Kiyomi, who bought him his first recording of Roxane Coss for his birthday. Her father was a nearly impossible man to buy gifts for,
65 and so when she saw the disc and a name she did not recognize, she thought she would take a chance. But it wasn't the unknown name that drew her, it was the woman's face. Kiyomi found the pictures of sopranos irritating. They were always peering over the tops of
70 fans or gazing through veils of soft netting. But Roxane Coss looked at her directly, even her chin was straight, her eyes were wide open. Kiyomi gave her money to the girl at the counter.

When Mr. Hosokawa put the CD in the player and
75 sat down in his chair to listen, he did not go back to work that night. It was as if he was a boy in those high seats in Tokyo again, his father's hand large and warm around his own. It was soaring, that voice, warm and complicated, utterly fearless. How could it be at once
80 controlled and so reckless? He called Kiyomi's name and she came and stood in the doorway of his study. She started to say something—yes? or, what? or, sir?—but before she could make out the words she heard that
85 voice, the straight-ahead woman from the picture. Her father didn't even say it, he simply gestured towards one speaker with his open hand. She was enormously pleased to have done something so right. Mr. Hosokawa closed his eyes. He dreamed.

1. The point of view from which the passage is told is best described as that of:
 - A. a young boy with a passion for opera.
 - B. the daughter of an extremely busy father.
 - C. an omniscient narrator, who knows the thoughts of the characters.
 - D. an unnamed narrator who relates events from Mr. Hosokawa's perspective.
2. The passage establishes all of the following about Mr. Hosokawa EXCEPT that he:
 - F. heard his first opera on his eleventh birthday.
 - G. appreciated *Eugene Onegin*.
 - H. rarely went out into the world.
 - J. didn't understand the plot of *Rigoletto* when he saw the opera performed.
3. Which of the following statements best characterizes Kiyomi's relationship with her father, as it is presented in the passage?
 - A. She wants to please him.
 - B. She shares his fondness for opera.
 - C. She feels increasingly distant from him.
 - D. She enjoys spending time with him.
4. In the passage, lines 3–12 primarily serve to:
 - F. suggest that the opera was overshadowed by unpleasant weather and bad seats.
 - G. describe the typical, rainy October weather in Tokyo in the mid-1950s.
 - H. offer sensory details that help set the stage for the important experience to be related.
 - J. imply that for Mr. Hosokawa, the train trip was more memorable than the opera.
5. Mr. Hosokawa's reaction to the *Rigoletto* performance is most clearly reflected in the way Mr. Hosokawa:
 - A. "climbed the long set of stairs to their row" (line 14).
 - B. "bowed and begged to be excused by every person who stood to let them pass into their seats" (lines 16–17).
 - C. "waited . . . without speaking" (lines 19–20).
 - D. "reached out for his father's hand" (lines 40–41).
6. The passage indicates that Kiyomi ultimately decided on the CD by Coss because Kiyomi:
 - F. knew Coss was one of her father's favorites.
 - G. was drawn to an unknown name.
 - H. liked how Coss's face looked in a picture.
 - J. couldn't find a Callas recording.
7. The phrase *dizzying void* (line 15) is most likely included in the passage to suggest that Mr. Hosokawa and his father:
 - A. feared heights.
 - B. sat high up in the theater.
 - C. sat above a section of empty seats.
 - D. felt emotionally drained.
8. The statement in lines 34–37 most nearly means that Mr. Hosokawa:
 - F. wanted everyone to love opera as much as he did.
 - G. felt that few people could learn to appreciate opera the way he had.
 - H. wanted everyone to experience the kind of joy that opera had brought him.
 - J. refused to realize that opera wasn't for everyone.
9. The statement "Such love breeds loyalty, and Mr. Hosokawa was a loyal man" (lines 47–48) most directly refers to the fact that Mr. Hosokawa:
 - A. loved his father, and that love continued to guide his life.
 - B. retained his appreciation for his favorite opera composers and singers.
 - C. was unhesitatingly loyal to the people at his workplace.
 - D. listened exclusively to the recordings of Callas for several years.
10. According to the passage, the time Mr. Hosokawa remembered "as happily as any vacation" (line 60) was:
 - F. one of the few Sundays he was able to listen to an entire opera.
 - G. the three days he'd had the time to listen continuously to *Alcina*.
 - H. the time he saw *Rigoletto* with his father.
 - J. the sick days he took off from work when he wasn't really ill.

Passage II

SOCIAL SCIENCE: This passage is adapted from the article "A Native Spirit, Inside the Beltway" by Patricia Leigh Brown (©2004 by The New York Times Company).

Ethnobotany is the study of how plants are used in particular cultures.

When Donna House, a Navajo ethnobotanist, steps gingerly through the barbed wire fence into her backyard—a former alfalfa field along the Rio Grande now brimming with native plants framed by a distant mesa—there is a sense of homecoming, of reunion, of land returning to its origins. So it is, too, on the National Mall in Washington, D.C., where House is the guiding force behind a landscape of cornfields, meadows, forest and wetlands—complete with 3,500 specially introduced ladybugs—outside the Smithsonian Institution's National Museum of the American Indian.

In her career as an ethnobotanist, House, who grew up on a Navajo reservation in Arizona, has served as a translator of sorts between "the people" (or the Dineh) and the outside world. A traditional "old school" Indian, as she sometimes jokingly refers to herself, as well as an environmental scientist, she has worked for or consulted with the Nature Conservancy, the federal Fish and Wildlife Service, the National Park Service, the Navajo Nation and others, helping to protect rare and endangered plants that have cultural, as well as ecological, significance. "Recognizing the diversity of plants is no different than recognizing the diversity of people," she said.

Along the way, she often bridges the gap between the native world view—in which human beings and nature are interrelated, and all plants, animals and mountains and other landforms are sacred—and the more scientific one, pollinating a deeper understanding between them. Her home ground, or habitat—a word she prefers to landscape—stretches far into the horizon, to the cottonwoods along the river presided over by the steep, rocky mesa. "A landscape is not dynamic," she said. "A habitat is a place where beings come to life."

These fields were farmland until House, much to the consternation of some of her neighbors, dispensed with the alfalfa and roses, "allowing the memory of the land to return." The globe mallow, prized by the Navajo for its medicinal applications, came back. So did the sunflowers, used for millennia by the Navajo to treat prenatal infections. The Navajo have also fashioned the hollow stalks of sunflowers into bird snares and flutes and boiled the seed hulls for a dark-red dye. The seeds themselves are used for soup.

To the Mall's polite formality—its "tulips all in a line," in House's words—has come a contrasting presence: a wetland visible from the Capitol sprouting cattails, wild rice and about 1,440 waterlilies. Visitors meander past a meadow of buttercups, panic grass and other Potomac Valley plants and a somewhat surreal field of corn, tobacco, squash and other crops. Massive

boulders, shipped from as far away as the Northwest Territories, echo the curvaceous form of the museum building, its rough-hewn limestone surface meant to recall a cliff face sculptured by the wind.

To acquaint herself with the Middle Atlantic region, House consulted fellow botanists, but also set out on the Potomac River in a canoe. In a sense, she has served both as a botanist and the conscience of the landscape, guiding the planting to reflect both the museum's collection—which includes artifacts like a 2,000-year-old Paiute duck decoy made of bulrushes—and Indian beliefs and values.

House frequently receives calls at odd hours from tribes worried about endangered plants. During her eight years advising the Nature Conservancy about conservation on Indian lands, House worked with the Tohono O'odham (the Papago) in southern Arizona, on whose lands grows Kearney's blue star, a wildflower that in the late 1980's federal botanists declared the rarest plant in Arizona, believing that it was down to its last eight specimens. A few years later, House showed a picture of the plant to Jefford Francisco, now the tribe's natural resources technician, and he thought he recognized it from the days when his father took him deer hunting. House traveled with him to the shady canyon of his childhood memories, where they found scores of blue stars. "They knew more about their ecosystem than I did, no matter how much I read," she said of the tribe. "Elders know the birds, the paths the animals take, the plants. A lot of knowledge you can't find in a library."

She was overjoyed recently to discover that a great blue heron had arrived on the Mall and was perched on a dead cypress trunk in the museum wetland. Ducks were feasting on the wild rice, somewhat to her chagrin, and the dragonflies were soaring four stories high. It is a habitat—"one little quark," she said, "in the huge galaxy of the native world"—coming to life.

11. The main purpose of the passage is to:
- discuss House, with emphasis on her ideas about and work on behalf of the environment.
 - recount in chronological order several key events in House's career.
 - describe the National Museum of the American Indian and House's work for it.
 - list and describe the duties of a typical ethnobotanist, using House as an example.
12. The passage indicates that House intentionally added all of the following to the grounds outside the National Museum of the American Indian EXCEPT:
- herons.
 - ladybugs.
 - corn.
 - squash.

13. The phrase in quotation marks in lines 37–38 most nearly means that the fields:
- A. had been well tended by the farmers who had owned them.
 - B. are an important resource for the Navajo who use them.
 - C. were permitted by House to revert to their natural condition.
 - D. live on in House’s memory long after she sold them.
14. The sixth paragraph (lines 56–63) primarily does which of the following regarding House’s work on the grounds of the National Museum of the American Indian?
- F. Reveals flaws in her work
 - G. Lists influences on her work
 - H. Describes the Paiute reaction to her work
 - J. Portrays museumgoers’ reaction to her work
15. The main purpose of the seventh paragraph (lines 64–81) is to:
- A. depict House’s work with the Nature Conservancy.
 - B. describe the habitat and features of the Kearney’s blue star.
 - C. illustrate the knowledge of ecosystems that tribal elders possess.
 - D. discuss the role of federal botanists on Tohono O’odham lands.
16. Based on the passage, the federal botanists’ claim in the late 1980s about the Kearney’s blue star is best described as:
- F. correct; only recent efforts by House and Francisco have saved the plant from extinction.
 - G. correct; experts estimate that as few as eight specimens of the plant exist today.
 - H. incorrect; for centuries, the Tohono O’odham have raised the plant.
 - J. incorrect; numerous specimens of the plant still grow wild, as House and Francisco discovered.
17. In the passage, House says that recognizing the diversity of plants and of people is:
- A. the same kind of thing.
 - B. occasionally possible.
 - C. rarely desirable.
 - D. a continual challenge.
18. The neighbors mentioned in the passage are said to have reacted to House’s decisions about what should grow in her backyard with:
- F. praise.
 - G. curiosity.
 - H. indifference.
 - J. disapproval.
19. The arrangement of which of the following plants is used in the passage to symbolize the general orderliness of the National Mall?
- A. Water lilies
 - B. Tulips
 - C. Cattails
 - D. Buttercups
20. The passage implies that the design of the National Museum of the American Indian building was intended to:
- F. suggest that the building was a natural form affected by the elements.
 - G. minimize the damage to the cliff from which the building was carved.
 - H. use a wide variety of materials imported from the Northwest Territories.
 - J. match the style and form of other buildings on the National Mall.

Passage III

HUMANITIES: This passage is adapted from the essay "Southern Women" by Shirley Abbott (©1993 by Franklin Square Press).

The South where I was born and raised was Arkansas, in a peaceable little resort town called Hot Springs.

My mother and the other women I knew as a child, just before World War II began, were farm women, one or two generations removed from the real pioneer days, gentled and domesticated by the time I came among them. But the marks were there. Their skin was leathery from working outdoors. Some of these women were serene and some hot-tempered, and in either case they brooked no transgressions of their notions of morality, and woe to anyone who spoke to these women with disrespect. They were not innocent or submissive or delicately constituted, not afraid of balky cows or chicken hawks. It took them approximately two hours to transform a live rooster into Sunday dinner. They could reason with a mule and shoot a gun. But they also knew just how to take hold of a baby and what to say to a weeping two-year-old.

Urban spirit that I was, I had no more aptitude as a farmer's daughter than my father had as a farmer. I hated digging potatoes, and I hated gathering eggs. I hated the smell of chicken houses—vinegary, sweet, rotten—despised the chickens, shrank from the finger-skinning work that went on seven days a week, indoors and out. I comforted myself with the thought that I had, after all, not been born for such indignities.

Sometime in the late 1960s feminists brought forth the notion of sisterhood—of women "bonded" to women. Sisterhood was going to be "powerful." But sisterhood was nothing new to me. It has been a zealously guarded secret among Southern women for years. Next to motherhood, sisterhood is what they value most, taking an endless pleasure in the daily, commonplace society of one another.

The most vivid memories of my childhood are long afternoons when my Aunt Vera would come to our house with her daughter June. Sometimes the four of us would dress and get in the car and drive around Hot Springs, buying thread and snaps at the dry-goods store, "rattling up and down," as my aunt called it, on Central Avenue. Hearing what they said on these afternoons, I gradually realized that my mother and her sister were not awed by men in the least, that they preferred each other's company.

I also realized that these two women had unmantronly desires, usually involving beautiful dresses and travel, that otherwise went unmentioned—merely the circumspsect fantasies of a pair of young housewives caught in the coils of the commonplace. And yet the sharing of these fantasies made them laugh, gave them a secret life as they bent their dark heads over the

sewing machine. I knew that the part of their lives they liked most was here, with each other. Not at the supper table or at work. My father used to be jealous of these tête-à-têtes, and he had cause.

I was in love with my mother too. I hated her doing housework, could not bear the sight of her in an old dress and a pair of unlaced oxfords, feeding soapy bedsheets into the wringer, scraping carrots and parsnips at the sink. But one thing she had acquired in town was the ability to be glamorous, to divorce herself, by means of paints and polishes, from that other world. I loved her glamorous aspect.

On those rare afternoons when she did abandon her housework and go out, having brought her face to its state of daytime perfection, she would take up her car keys and shut the door on her immaculate house. She and I would set out for town together. We'd go find a parking place and go into Woolworth's for a spool of thread and a nickel's worth of candy. Sometimes, to my despair, she'd bump into one of her thousands of cousins on the street and talk for half an hour. The exoticism of the afternoon would vanish sooner than the bag of candy.

Many years later, I stopped to wonder why a woman of her thoroughly practical inclinations would spend upward of an hour prettying up to go to the dime store. She certainly was not trying to attract a man. She was not doing it for Daddy, for by the time he got home from work she'd be in a housedress again, perspiring over the kitchen range. Nor was she competing with other women. She was doing it for fun, and for a mark of her separateness, and for a way of showing herself—and me—that even so responsible a person as herself could do something that had no purpose to it. It was her one real break with her past. Maybe she wanted to let me know, in the most subtle way, that femininity was not merely the massive, serious, strenuous thing she usually made it seem to be, but occasionally a matter of pleasing yourself.

21. The passage can best be described as the author seeking a balance between:
- her dislike for farmwork, a respect for the women who performed it, and an awareness of how they influenced her notions of what femininity is.
 - her attraction to urban life, her awareness of how it broke her ties to her mother's generation, and her belief that time heals all wounds.
 - her childhood as she remembers it, as her mother remembers it, and as it must in fact have been.
 - the life she envisioned for herself, the one her mother envisioned for her, and the one she is living.

22. The author would most likely agree with which of the following descriptions of her mother?
- F. She grew to like farmwork, after years of feeling confined by it.
 - G. She was gradually worn down, both physically and psychologically, by grueling farmwork.
 - H. She was more than capable of managing the many demands that a life of farmwork placed on her.
 - J. She wanted a better life for her daughter than the isolated life she lived as a farm woman.
23. It is most reasonable to infer that the description in lines 13–19 would apply to:
- A. Aunt Vera.
 - B. June.
 - C. the author's father.
 - D. the author.
24. How does the author characterize the outings that she and her mother would take in Hot Springs?
- F. Boring obligations, dutifully performed
 - G. Cherished escapes, rich in significance
 - H. Strained visits, mercifully brief
 - J. Quiet drives, soothing to their spirits
25. In the passage, how does the author relate Southern women to the feminists of the late 1960s?
- A. The sisterhood honored publicly by feminists of the late 1960s had long been practiced and valued among Southern women.
 - B. Southern women valued motherhood while feminists of the late 1960s valued sisterhood, creating tension between the two groups.
 - C. The Southern women's notion of sisterhood was directly challenged by the feminists of the late 1960s.
 - D. The feminism of the late 1960s was embraced among Southern women primarily because of its emphasis on sisterhood.
26. The author concludes that her mother's occasional efforts at "prettying up to go to the dime store" (lines 78–79) were intended in part to:
- F. uphold an honored practice from the past.
 - G. attract the attention of men.
 - H. compete for the fun of it with the glamorous women in town.
 - J. demonstrate the worth of doing something with no apparent purpose.
27. The author strongly implies that for her mother, breaking from the past was something:
- A. to experience rarely and be enriched and inspired by.
 - B. to be avoided, as the past is what defines the present.
 - C. she longed for but achieved only at the end of her life.
 - D. she wanted for her daughter but not for herself.
28. As it is used in the passage, which word conveys something with unpleasant associations for the author?
- F. Spirit (line 20)
 - G. Sweet (line 23)
 - H. Secret (line 32)
 - J. Society (line 35)
29. According to the passage, when the author was young, the sight of her mother wearing an old dress and scraping carrots and parsnips at the sink had what effect on the author?
- A. It comforted her in that it was a familiar part of everyday life.
 - B. It inspired her to see the connection between her mother and the person she imagined she herself would become.
 - C. It upset her because it suggested that her mother was caught in a restricted life of endless drudgery.
 - D. It prompted her to drop what she was doing and help her mother, even though she hated the work.
30. According to the passage, what effect did running into her mother's cousins on the shopping trips she took with her mother have on the author?
- F. It excited her to see people outside the world of farming.
 - G. It showed her how little interest her mother had in superficial socializing.
 - H. It renewed a connection she felt to people who had once lived on the farm.
 - J. It drained the appeal out of moments the author was otherwise enjoying.

Passage IV

NATURAL SCIENCE: This passage is adapted from the article "Infrasonic Symphony" by Kate Ramsayer (©2004 by Science Service).

"Let me start off with a riddle," says NASA scientist Allan J. Zuckerwar. In his office in Hampton, Va., he rattles off items as dissimilar as rhinoceroses, supersonic aircraft, and hurricanes. "Now, what do they have in common?" The answer, Zuckerwar explains, is that each one generates silent infrasound—long sound waves at a frequency below 20 hertz. People can't hear anything below that frequency, probably for good reason. Otherwise, they'd be bombarded by the constant din of wind, the intermittent groaning of Earth, and the occasional distant explosion. But scientists are eavesdropping on volcanoes, avalanches, earthquakes, and meteorites to discern these phenomena's infrasound signatures and see what new information infrasound might reveal.

Just as seismic waves travel through Earth, infrasonic waves travel through the air. And the lower the frequency of the waves, the farther they can travel without losing strength. Scientists first detected infrasound in 1883, when the eruption of the Krakatoa volcano in Indonesia sent inaudible sound waves careening around the world, affecting barometric readings.

Infrasonic research gained significant attention and funding in the 1950s, when the United States and the Soviet Union used infrasound to detect each other's atmospheric nuclear testing. Interest declined when aboveground bomb testing was banned in 1963 as part of the Limited Test Ban Treaty.

But lately, scientists have turned back to infrasound.

Infrasound interpretation is a young science. Acousticians and geophysicists are still learning what phenomena generate infrasound signatures and how to match signatures with phenomena.

For example, John V. Olson of the University of Alaska in Fairbanks recalls one morning last April when a colleague rushed into his office and asked whether he had heard an explosion the night before. The two scientists found a large pulse on the infrasound record from the nuclear-test monitoring station that the university operates and traced it to a nearby firing range. The next day, the local paper reported that a citizen had found a bundle of dynamite, which police exploded at the range.

"So, we take [the signal] out of the 'little green men' file and say, 'This is what dynamite looks like from 5 miles away,'" says Olson. "Slowly, daily, we sift and sort through these signals."

Ocean storms and waves are two of the big generators of infrasound, says Milton A. Garcés of the Uni-

versity of Hawaii at Manoa. The routine up-and-down movements of the waves act as a giant loudspeaker, pushing the air at infrasonic frequencies.

Low-frequency sounds are also generated by one of the most colorful displays in the sky, the northern lights, which are caused by charged particles in the air. This electricity heats atmospheric gases, and the warmed gas molecules spread out and increase air pressure.

"It pushes the neutral air forward, almost like the bow wave off a ship," says Olson. This air movement creates an infrasonic signal. The readings are visible during the beginnings of these magnetic storms, as the bright, greenish lights sweep across the sky like a fluttering curtain.

While specialized microphones can pick up infrasonic signals generated high in the atmosphere, they detect more earthly rumbles, as well. For instance, Jeffrey B. Johnson of the University of Hawaii at Manoa has placed microphones within a kilometer of a vent of the active Erebus volcano in Antarctica. The sensors have recorded low-frequency signals so powerful that, were they audible, they'd have a volume in excess of 130 decibels—"somewhere between a jet airplane and the threshold of pain," says Johnson. Erebus does produce some audible sound, but it's not very loud, he says.

The infrasound radiating from the volcano's lava lake is generated by the rupture of 10-meter-wide, gas-filled bubbles, which pushes huge infrasound waves into the atmosphere. Johnson can use infrasound readings to estimate the size of the lava bubbles within Erebus and the amount of gas they contain.

"Infrasound is a powerful tool to understand more about explosions and eruption sources," says Johnson. "It allows us to directly quantify what's going on at a volcanic vent."

Whether infrasound is used for commercial purposes, to learn more about natural phenomena, or simply to listen for something that nobody wants to hear, it is entering what those in the field call a renaissance. Geophysicists and acousticians are sorting through, categorizing, and studying a wide range of inaudible noise.

31. The main idea of the passage is that:
- understanding the infrasonic frequency of the northern lights can help scientists track magnetic storms in space.
 - scientists expect that recently developed methods of measuring infrasound will be useful primarily for commercial purposes.
 - identifying new sources of infrasound has led scientists to conclude that earlier definitions of infrasound were inaccurate.
 - scientists have recently begun focusing more attention and resources on expanding on earlier infrasound research.
32. The passage's mention of scientists' attempts to "discern these phenomena's infrasound signatures" (lines 13–14) most nearly refers to their attempts to:
- understand the effects of making infrasound audible to humans.
 - categorize different types of infrasound detection devices.
 - determine identifying characteristics of the infrasound various phenomena produce.
 - label infrasound phenomena with the names of the scientists who discovered them.
33. Which of the following is NOT mentioned in the passage as something that has indicated to scientists the presence of infrasound activity?
- Barometers
 - Specialized microphones
 - Nuclear-test monitoring equipment in Alaska
 - Loudspeakers used by scientists at the University of Hawaii at Manoa
34. Allan J. Zuckerwar's riddle (lines 1–5) is based mainly on the unstated assumption that most people:
- won't immediately see what rhinoceroses, supersonic aircraft, and hurricanes have in common.
 - will find it humorous that a rhinoceros could generate more infrasound than a supersonic aircraft.
 - already know that supersonic aircraft and hurricanes are sources of infrasound.
 - won't realize that sounds below 20 hertz are inaudible to humans.
35. Within the passage, the sixth and seventh paragraphs (lines 35–48) primarily serve to:
- provide an example of how scientists correlate infrasonic data with particular phenomena.
 - indicate that one practical application of infrasonic identification is preventing explosions.
 - illustrate how infrasound can be used in nuclear-test monitoring.
 - explain the disagreements among scientists in interpreting infrasonic data.
36. The passage indicates that all of the following contribute to creating the northern lights' infrasonic sounds EXCEPT:
- warmed gas molecules spreading out.
 - air pressure increasing.
 - electricity heating atmospheric gases.
 - greenish lights fading to yellow.
37. According to the passage, how does infrasound help scientists understand volcanoes?
- Infrasonic activity originating from tremors at the base of a volcano provides an indication of lava activity within.
 - Infrasound readings help scientists estimate the size of lava bubbles within a volcano and collect data about volcanic vent activity.
 - Knowing the frequency of infrasonic waves helps scientists determine the history of a volcano's eruption patterns.
 - Details gathered about infrasound can help scientists better understand the composition of volcanic matter.
38. According to the passage, the fact that infrasound is inaudible to the human ear is:
- fortunate; the intermittent groaning of Earth would interfere with radio frequencies.
 - fortunate; the additional noise of infrasound activity would be overwhelming to humans.
 - unfortunate; hearing infrasound would be useful to humans in their daily lives.
 - unfortunate; the constant din of infrasound would prevent people from eavesdropping.
39. The passage indicates that the distance infrasonic waves can travel without losing strength is in inverse proportion to the:
- size of the waves' source.
 - depth of water over which the waves travel.
 - frequency of the waves.
 - electricity in the atmospheric gases.
40. According to the passage, which of the following was the source of the earliest detected infrasonic waves?
- A hurricane
 - The northern lights
 - A nuclear test
 - A volcano

END OF TEST 3

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

SCIENCE TEST

35 Minutes—40 Questions

DIRECTIONS: There are seven 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

Deicers (mixtures of salt and water that are used on roads to melt ice) can over time cause concrete pavement to deteriorate.

Two studies examined how 4 different deicers affected the length, mass, and compressive strength (CS) of identical cylinders made of hardened concrete. (CS is the maximum lengthwise pressure that can be applied to the ends of a cylinder without crushing it.) Each deicer was 15% by mass of Ca(OH)_2 , NaCl , MgCl_2 , or CaCl_2 kept at 4°C .

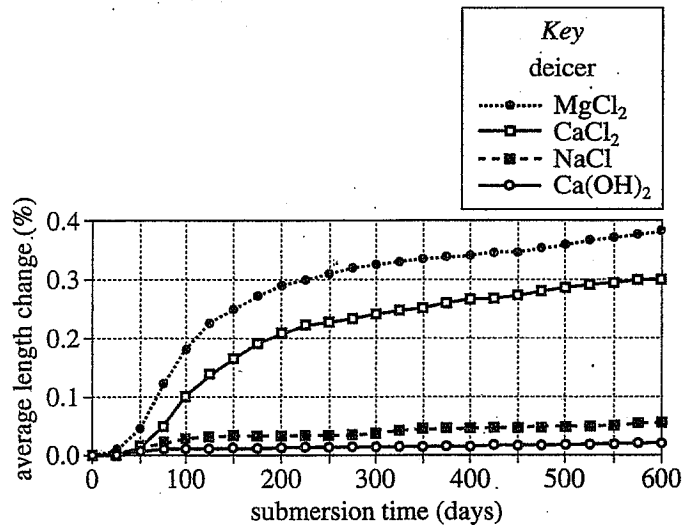


Figure 1

Study 1

Five of the cylinders were submerged in 4 L of the Ca(OH)_2 deicer. Every 25 days over the next 600 days, the following was done:

1. The 5 cylinders were removed from the deicer and wiped dry.
2. Each cylinder's length and mass were measured.
3. Two average values were calculated for the 5 cylinders: the average percent change in length relative to the original length and the average percent change in mass relative to the original mass.
4. The cylinders were resubmerged.

All of the above procedures were repeated for the other deicers (see Figures 1 and 2).

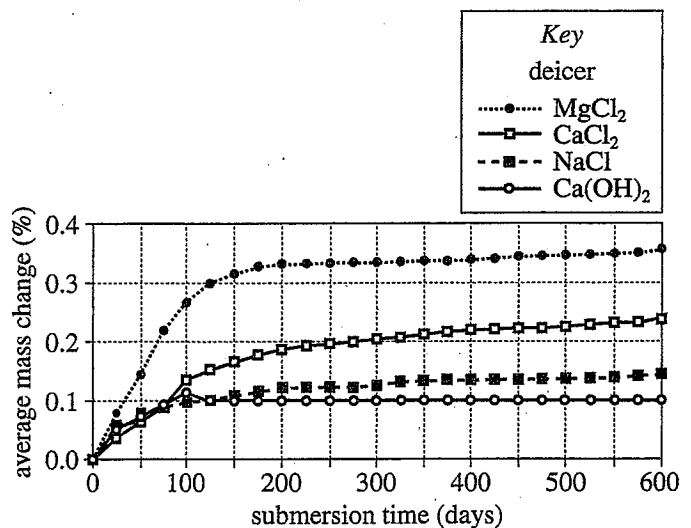


Figure 2

4



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Study 2

Sixty more of the cylinders were submerged in 20 L of the $\text{Ca}(\text{OH})_2$ deicer. Every 50 days over the next 600 days, the following was done:

- Five cylinders were removed from the deicer and wiped dry.
- Each cylinder's CS, in megapascals (MPa), was determined.
- The average CS was calculated for the 5 cylinders.

All of the above procedures were repeated for the other deicers. Finally, the CS of 5 more of the cylinders—cylinders that had not been submerged in any deicer—was determined, and their average CS was calculated (see Figure 3).

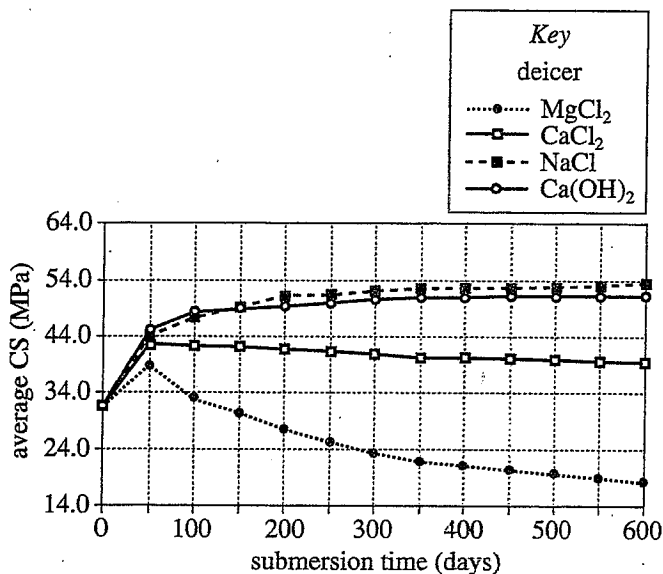


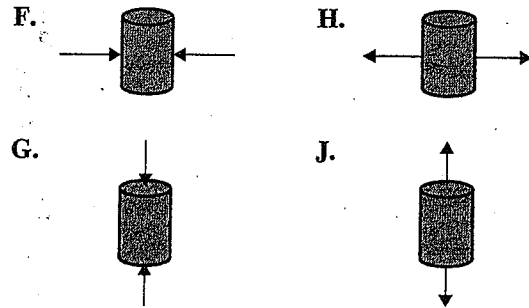
Figure 3

Figures adapted from Lawrence Sutter et al., "The Deleterious Chemical Effects of Concentrated Deicing Solutions on Portland Cement Concrete," South Dakota Department of Transportation Study SD2002-01. 2008.

- According to Figure 1, for any submersion time after 0 days, what is the order of the 4 deicers, from the deicer that produced the greatest average percent change in cylinder length to the deicer that produced the least average percent change in cylinder length?

- MgCl_2 , CaCl_2 , NaCl , $\text{Ca}(\text{OH})_2$
- MgCl_2 , NaCl , CaCl_2 , $\text{Ca}(\text{OH})_2$
- $\text{Ca}(\text{OH})_2$, NaCl , CaCl_2 , MgCl_2
- $\text{Ca}(\text{OH})_2$, NaCl , MgCl_2 , CaCl_2

- Which of the following diagrams best shows how pressure was applied to a cylinder to determine its CS?



- The change in the mass of the cylinders was caused by the absorption of the deicer into the concrete. Based on Figure 2, the cylinders submerged in which deicer had absorbed, on average, the greatest mass of deicer at 250 days?
 - MgCl_2
 - CaCl_2
 - NaCl
 - $\text{Ca}(\text{OH})_2$

- Based on the information provided, how many grams of solid NaCl would have had to be dissolved in water to prepare 1,000 grams of the NaCl deicer?

- 15 g
- 30 g
- 150 g
- 300 g

- In the studies, it is most likely that the cylinders were submerged in deicers at 4°C because that temperature is:

- the freezing point of all 4 deicers.
- the freezing point of water.
- a typical summer temperature in areas where deicers are used.
- a typical winter temperature in areas where deicers are used.

- For pavement made of the same concrete as the cylinders, the minimum CS that is required to maintain a smooth, uncracked road surface is 25 MPa. Based on the results of Study 2, which deicer(s) could most likely be kept in contact with this concrete continuously for 600 days without lowering the average CS of the concrete below 25 MPa?

- NaCl only
- MgCl_2 and CaCl_2 only
- MgCl_2 , NaCl , and $\text{Ca}(\text{OH})_2$ only
- CaCl_2 , NaCl , and $\text{Ca}(\text{OH})_2$ only

Passage II

When the nucleus of an atom of a radioactive isotope undergoes certain types of decay, the atom transforms into an atom of a different isotope. An isotope's *half-life* is the time it takes for half of any given number of its nuclei to decay. An isotope's *decay constant*, λ , depends on the isotope's rate of decay. Table 1 gives the value of λ (in yr^{-1}) for 8 isotopes of different elements.

Element	Isotope	λ (yr^{-1})
Nickel	Ni-63	0.0069
Titanium	Ti-44	0.010
Strontium	Sr-90	0.024
Hydrogen	H-3	0.056
Sulfur	S-35	2.9
Iron	Fe-59	5.7
Phosphorus	P-32	18
Iodine	I-131	32

Figures 1 and 2 show, for each of 6 of the isotopes listed in Table 1, the change over time in the number of the nuclei remaining, N_t , in a sample initially containing 1,000 of the nuclei.

(Note: In Figure 1, the unit of time is *years*; in Figure 2, the unit of time is *days*.)

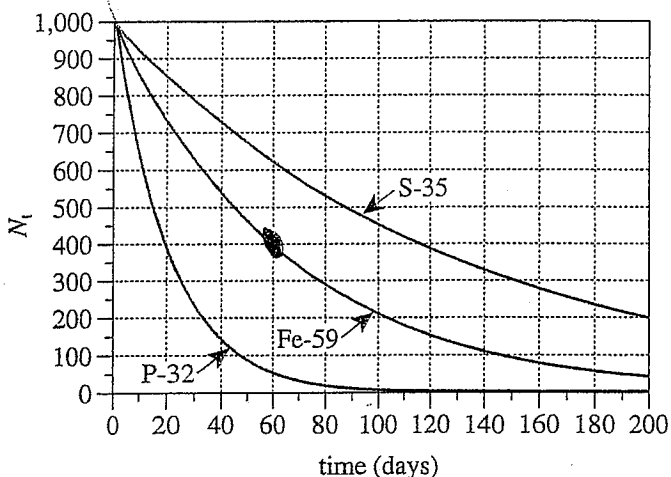


Figure 2

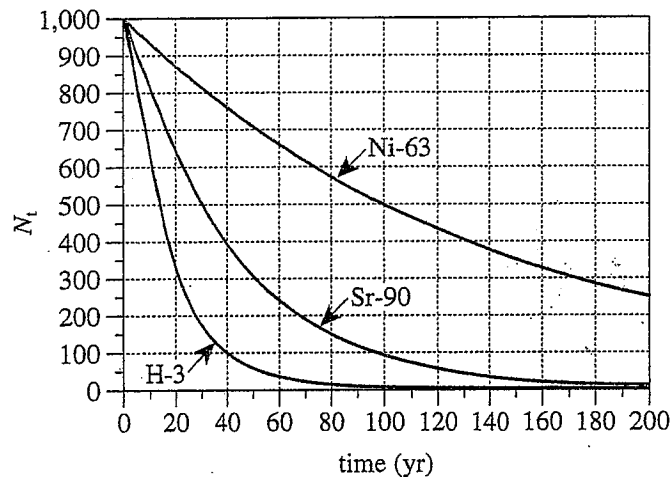
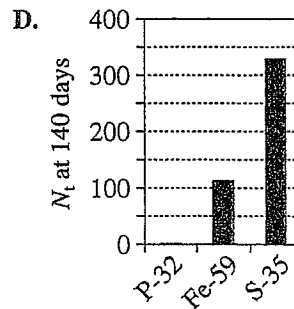
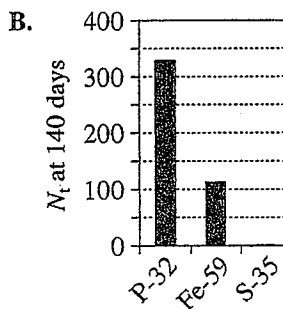
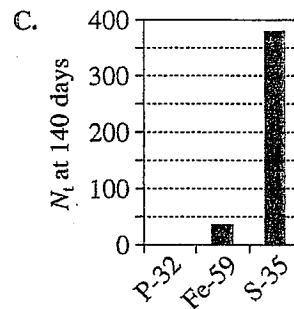
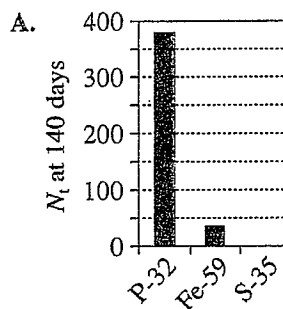


Figure 1

7. The data in Figure 2 for time = 140 days are best shown by which of the following graphs?



4



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8. According to Figure 2, for which isotope, S-35 or P-32, will the average rate of decay be greater over the first 200 days?
- F. S-35, because at any given time after zero, S-35 will have the lower N_t .
 - G. S-35, because at any given time after zero, S-35 will have the higher N_t .
 - H. P-32, because at any given time after zero, P-32 will have the lower N_t .
 - J. P-32, because at any given time after zero, P-32 will have the higher N_t .
9. Based on Table 1 and Figure 1, if a sample initially contains 1,000 Ti-44 atoms, the number of Ti-44 atoms in the sample 20 yr later will most likely be:
- A. less than 300.
 - B. between 300 and 600.
 - C. between 600 and 900.
 - D. greater than 900.
10. According to Figure 1, the half-life of Sr-90 is approximately:
- F. 30 yr.
 - G. 90 yr.
 - H. 160 yr.
 - J. 200 yr.
11. Based on Figure 2, if a sample contained *2000 atoms* of Fe-59 at time = 0, at approximately what time will the N_t of the sample be 400?
- A. 40 days
 - B. 60 days
 - C. 80 days
 - D. 100 days

Passage III

Transferrin is a blood protein. When in the presence of iron ions (Fe^{3+}), each transferrin molecule will bind with 2 Fe^{3+} . *Iron chelators* are used to remove excess iron in the blood because they can bind with and thereby remove Fe^{3+} from transferrin.

Transferrin bound to Fe^{3+} strongly absorbs light at a wavelength of 466 nanometers (nm), but unbound transferrin and unbound Fe^{3+} do not. Three experiments were done using a *colorimeter* (a device that measures a solution's absorbance of light) to study the removal of Fe^{3+} from transferrin by iron chelators.

Experiment 1

Seven solutions (Solutions 1–7) were made, all with an initial unbound transferrin concentration of 100.0 micromoles per liter (μM), but each with a different initial unbound Fe^{3+} concentration. The solutions were incubated at 37°C for 30 min. A test tube containing a sample of Solution 1 was placed in the colorimeter. The colorimeter was adjusted such that the absorbance reading measured at 466 nm for Solution 1 at 37°C was 0.00. The absorbance at 466 nm of each of Solutions 2–7 at 37°C was then measured (see Table 1).

Solution	Initial unbound Fe^{3+} concentration (μM)	Absorbance
1	0.0	0.00
2	50.0	0.35
3	100.0	0.64
4	150.0	0.76
5	200.0	0.80
6	250.0	0.80
7	300.0	0.80

Experiment 2

For each of 4 trials, 0.0010 mL of solution that contained 10 millimoles of 1 of 4 iron chelators was added to 3 mL of Solution 5. The absorbance at 466 nm was then monitored at 37°C over the next 4,000 sec (see Figure 1).

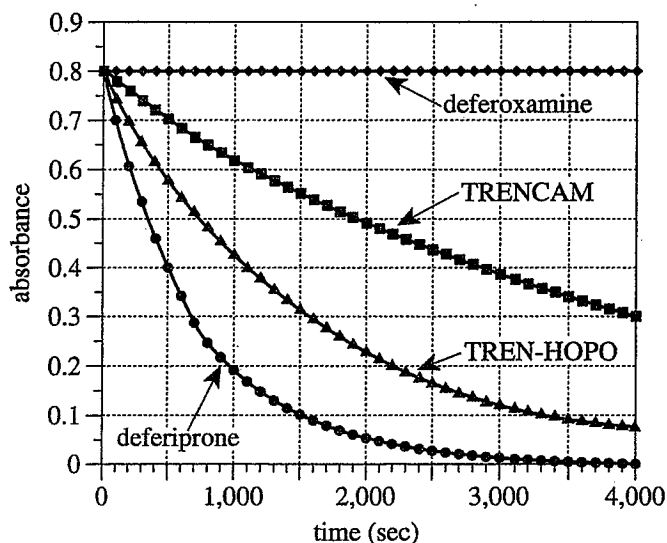


Figure 1

Figure 1 adapted from Isabelle Turcot et al., "Fast Biological Iron Chelators: Kinetics of Iron Removal from Human Diferric Transferrin by Multidentate Hydroxypyridonates." ©2000 by Society of Biological Inorganic Chemistry.

Experiment 3

The deferiprone trial in Experiment 2 was repeated twice, except that one trial was carried out at 25°C and the other trial was carried out at 32°C (see Figure 2).

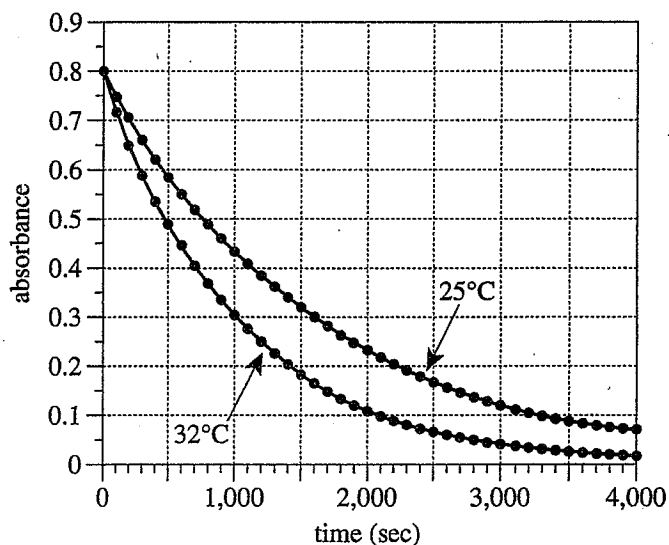


Figure 2

Figure 2 adapted from Erin E. Battin et al., "Using Proteins in a Bioinorganic Laboratory Experiment: Iron Loading and Removal from Transferrin." ©2009 by Division of Chemical Education, Inc., American Chemical Society.

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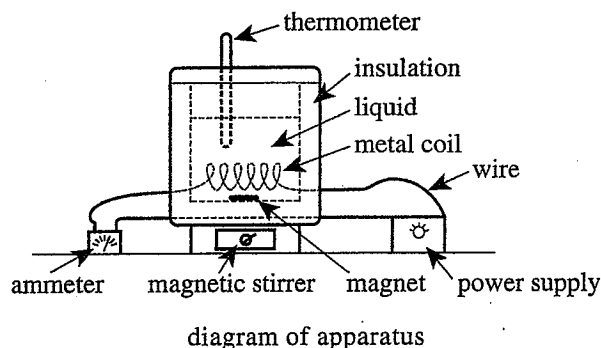
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12. When a colorimeter is used, a solution called a *blank* is first placed in the colorimeter to establish a baseline value against which other solutions will be measured. Which of the solutions served as the blank?
- F. Solution 1
 - G. Solution 3
 - H. Solution 5
 - J. Solution 7
13. In each trial of Experiments 2 and 3, how often was an absorbance measurement recorded?
- A. Every 10 sec
 - B. Every 50 sec
 - C. Every 100 sec
 - D. Every 500 sec
14. Based on the experiments, as the concentration of Fe^{3+} bound to transferrin in a solution *decreases*, the absorbance:
- F. increases only.
 - G. decreases only.
 - H. varies, but with no general trend.
 - J. remains constant.
15. Based on the results of Experiments 2 and 3, the average rate of change in the absorbance during the TREN-HOPO trial was closest to that observed during the trial with what other iron chelator and at what temperature?
- A. TRENCAM at 25°C
 - B. TRENCAM at 37°C
 - C. Deferiprone at 25°C
 - D. Deferiprone at 32°C
16. Suppose that in Experiment 1, 10 mL of Solution 2 had been mixed with 10 mL of Solution 4 after the solutions were incubated. If the absorbance of a sample of the resulting solution had been measured at 37°C, it would most likely have been closest to which of the following?
- E. 0.35
 - G. 0.64
 - H. 0.76
 - J. 0.80
17. Based on the description of Experiment 1 and of a colorimeter, the material making up the test tube that was placed in the colorimeter most likely:
- A. absorbed little or no light at 466 nm.
 - B. strongly absorbed light at 466 nm.
 - C. reflected all light that was less than 466 nm.
 - D. reflected all light that was greater than 466 nm.

Passage IV

In 2 studies, students recorded the temperature changes that occurred in different liquids when the liquids were heated for 10 min each by various metal coils through which selected amounts of electrical current, I , flowed.

For each trial in the studies, the students carried out the following procedure: First, they poured 400 mL of a liquid into an insulated container fitted with a thermometer and a metal coil and sealed the container (see diagram).



With the liquid, the container, and the coil at room temperature, 25°C , the students began to stir the liquid with a magnetic stirrer. Next, they adjusted the voltage across the ends of the coil until I reached the desired value, in amps (A). For the next 10 min, they continued to stir the liquid. After 10 min of heating, they recorded T , the liquid's temperature, in $^{\circ}\text{C}$, and computed ΔT , the difference between T and the liquid's initial temperature of 25°C .

Study 1

The students computed water's ΔT after 10 min of heating at each of several selected values of I , first with a copper coil, then with an aluminum coil, and finally with a tungsten coil. Plots of water's ΔT versus I for each metal coil are shown in Figure 1.

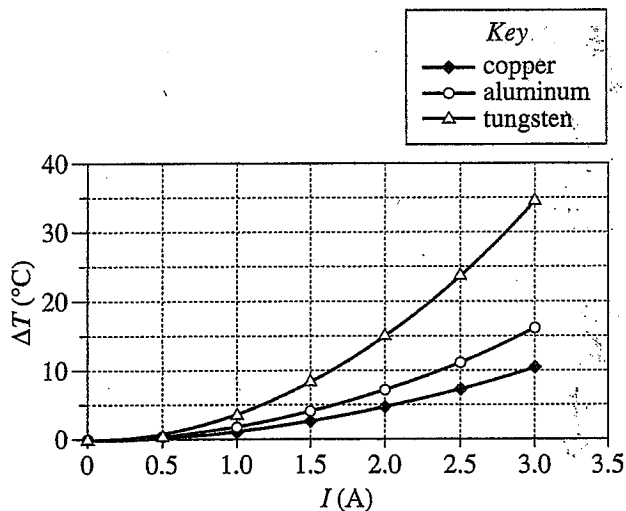


Figure 1

Study 2

With the aluminum coil, the students heated ethylene glycol for 10 min at each of the values of I selected in Study 1. For each value of I , they computed ΔT . They did likewise with vegetable oil, substituting it for the ethylene glycol. Plots of ΔT versus I for water (from Figure 1), the ethylene glycol, and the vegetable oil are shown in Figure 2.

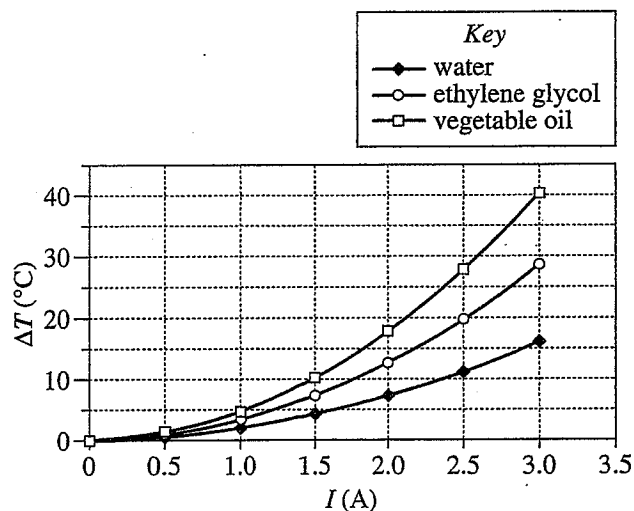


Figure 2

18. According to the results of the studies, for a given coil and a given liquid, as the current that passed through the coil was increased, ΔT :

- F. increased only.
 G. decreased only.
 H. varied, but with no general trend.
 J. remained the same.

19. Based on the results of the studies, to obtain the *lowest* ΔT after 10 min of heating at a given I using the apparatus diagrammed in the passage, the students should select which liquid and which metal coil?

- | | liquid | metal coil |
|----|-----------------|------------|
| A. | water | copper |
| B. | water | aluminum |
| C. | ethylene glycol | tungsten |
| D. | vegetable oil | aluminum |

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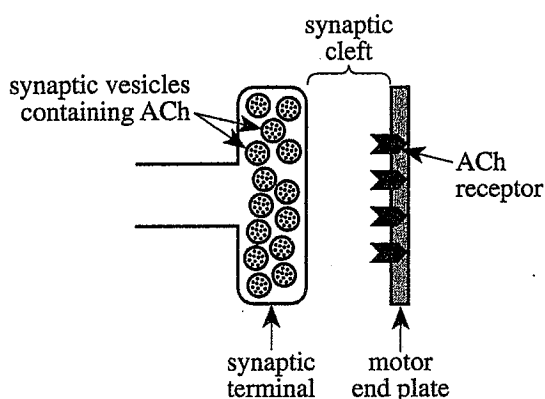
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20. The students stirred each liquid for which of the following reasons?
- F. To provide additional heat to the liquid
 - G. To ensure that the temperature was uniform throughout the liquid
 - H. To prevent the liquid from settling to the bottom of the container
 - J. To prevent the liquid from contacting the metal coil
21. Suppose that, in Study 1, the students had also tested a coil made of a fourth metal, Metal X, at $I = 1.5$ A, and determined that after 10 min of heating, ΔT was 6°C . Based on Figure 1, if the students had next tested the Metal X coil at $I = 2.0$ A, ΔT after 10 min of heating would most likely have been:
- A. less than 5°C .
 - B. between 5°C and 7°C .
 - C. between 7°C and 15°C .
 - D. greater than 15°C .
22. Based on the results of Study 2, when vegetable oil was heated with $I = 1.5$ A, T at the end of 10 min was closest to which of the following?
- F. 30°C
 - G. 35°C
 - H. 40°C
 - J. 45°C
23. Suppose that, in a new study, the tungsten coil with $I = 2.0$ A is used to heat 200 mL of water. After the water is heated for 10 min, ΔT will most likely be:
- A. less than 5°C .
 - B. between 5°C and 10°C .
 - C. between 10°C and 15°C .
 - D. greater than 15°C .

Passage V

Introduction

A skeletal *neuromuscular junction* (NMJ; see the figure) is composed of a *synaptic terminal* (a tip of an axon of a neuron), a *motor end plate* (a depression in the plasma membrane of a muscle fiber), and a *synaptic cleft* (the region between these 2 structures). The synaptic terminal contains *synaptic vesicles*: structures that contain the neurotransmitter *acetylcholine* (ACh). When the neuron fires, synaptic vesicles fuse with the neuron's plasma membrane and release ACh into the synaptic cleft. ACh then diffuses across the synaptic cleft and binds to *ACh receptors* (membrane proteins produced by the muscle fiber) in the motor end plate. If this binding does not occur, the muscle fiber cannot contract.



If a person ingests *botulin* (a toxin), it enters the bloodstream, diffuses into NMJ synaptic clefts, and disrupts the contraction of the muscle fibers associated with these NMJs. Four hypotheses propose mechanisms for the disruption of function at an NMJ.

Hypothesis 1

Botulin is absorbed from the synaptic cleft by the synaptic terminal. Botulin then binds to and breaks down the neuron's *docking proteins* (proteins required for the fusion of synaptic vesicles with the neuron's plasma membrane). Because the vesicles cannot fuse with the plasma membrane, they cannot release ACh into the synaptic cleft. Thus, ACh does not bind to the ACh receptors. Therefore, the muscle fiber cannot contract.

Hypothesis 2

Botulin remains in the synaptic cleft, where it binds to and breaks down ACh before the ACh can diffuse across the synaptic cleft and bind to the ACh receptors. Therefore, the muscle fiber cannot contract.

Hypothesis 3

Botulin remains in the synaptic cleft, where it binds to and irreversibly blocks the ACh receptors. As a result, ACh cannot bind to the ACh receptors. Therefore, the muscle fiber cannot contract.

Hypothesis 4

Botulin is absorbed from the synaptic cleft by the muscle fiber. Botulin then binds to and breaks down *myosin*, a protein that is an essential component of the contractile apparatus of a muscle fiber. As a result of this breakdown, the muscle fiber cannot contract.

24. Both Hypothesis 1 and Hypothesis 4 indicate that, in the human body, botulin is:
- F. absorbed by a human cell.
 - G. synthesized by a human cell.
 - H. destroyed before it leaves the bloodstream.
 - J. excreted before it enters the digestive tract.
25. Which of the following statements best characterizes ACh as it is described in the introduction?
- A. It is a hormone because it carries information from a muscle fiber to a synaptic terminal.
 - B. It is a hormone because it carries information from a synaptic terminal to a muscle fiber.
 - C. It is a neurotransmitter because it carries information from a muscle fiber to a synaptic terminal.
 - D. It is a neurotransmitter because it carries information from a synaptic terminal to a muscle fiber.
26. An *acetylcholinesterase* is a molecule that binds to and breaks down ACh. Which hypothesis indicates that botulin functions like an acetylcholinesterase?
- F. Hypothesis 1
 - G. Hypothesis 2
 - H. Hypothesis 3
 - J. Hypothesis 4
27. In which of the following ways do Hypotheses 3 and 4 differ with regard to how botulin disrupts muscle contraction? Hypothesis 3 asserts that botulin:
- A. breaks down a protein that partially composes the plasma membrane of a neuron; Hypothesis 4 asserts that botulin blocks ACh binding sites.
 - B. breaks down a protein that partially composes the contractile apparatus of a muscle fiber; Hypothesis 4 asserts that botulin blocks ACh binding sites.
 - C. blocks ACh binding sites; Hypothesis 4 asserts that botulin breaks down a protein that partially composes the plasma membrane of a neuron.
 - D. blocks ACh binding sites; Hypothesis 4 asserts that botulin breaks down a protein that partially composes the contractile apparatus of a muscle fiber.

4



4

28. In which of the following ways does Hypothesis 1 differ from the other 3 hypotheses with regard to the location in the body where botulin is likely to be found after it is consumed? Only Hypothesis 1 asserts that botulin enters:
- F. NMJs.
 - G. neurons.
 - H. the bloodstream.
 - J. muscle fibers.
29. According to Hypotheses 3 and 4, which of the following statements best describes a step in the mechanism that results in the disruption of function at an NMJ by botulin?
- A. Botulin binds to a protein that is part of a muscle fiber.
 - B. Botulin binds to a protein that is part of a neuron.
 - C. Botulin synthesizes a type of protein that is also synthesized by a muscle fiber.
 - D. Botulin synthesizes a type of protein that is also synthesized by a neuron.
30. Which hypothesis would be best supported by the finding that botulin has a high affinity for the ACh receptors in a motor end plate?
- F. Hypothesis 1
 - G. Hypothesis 2
 - H. Hypothesis 3
 - J. Hypothesis 4

Passage VI

Tasters are people who can taste Chemical P. *Non-tasters* are people who cannot taste Chemical P. The ability to taste Chemical P is determined by Gene T, which has 2 alleles: T and t . In a population that is not evolving—a population in *Hardy-Weinberg equilibrium* (HWE)—the frequency of allele T is p and the frequency of allele t is q . Table 1 shows the Gene T genotype(s) of tasters and of nontasters and the expression that predicts the frequency of each genotype in a population in HWE. Table 2 shows p , q , and the frequency of each Gene T genotype for 4 populations in HWE.

Phenotype	Genotype	Frequency
Taster	TT	p^2
Taster	Tt	$2pq$
Nontaster	tt	q^2

Population	p	q	Frequency of:		
			TT	Tt	tt
1	0.5	0.5	0.25	0.50	0.25
2	0.4	0.6	N.P.	0.48	0.36
3	0.8	N.P.	0.64	0.32	0.04
4	N.P.	N.P.	0.09	0.42	0.49

Note: N.P. indicates that the value has not been provided.

31. Based on Table 2, in which population would the number of people with the genotype TT and the number of people with the genotype tt be closest to the same?
- A. Population 1
B. Population 2
C. Population 3
D. Population 4
32. The frequency of nontasters is greatest in which population?
- F. Population 1
G. Population 2
H. Population 3
J. Population 4
33. A student concluded that for Population 3, p is greater than q . Is this conclusion consistent with Table 2?
- A. Yes; $p = 0.8$ and $q = 0.64$.
B. Yes; $p = 0.8$ and $q = 0.2$.
C. No; $p = 0.8$ and $q = 0.8$.
D. No; $p = 0.8$ and $q = 0.9$.
34. For Population 2, what is the frequency of the genotype TT ?
- F. 0.16
G. 0.4
H. 0.6
J. 1
35. People that are heterozygous for Gene T are most common in the population for which p is:
- A. greater than q .
B. less than q .
C. equal to q .
D. not provided.

Passage VII

When an object floats in a liquid, a fraction of the object extends above the surface of the liquid.

Seven objects with different densities were placed in containers of 4 different liquids. Table 1 lists the objects and their densities, in grams per cubic centimeter (g/cm^3), at 15°C .

Object	Density (g/cm^3)
1	0.100
2	0.200
3	0.300
4	0.400
5	0.500
6	0.600
7	0.700

Table 2 lists the 4 liquids and their densities, in g/cm^3 , at 15°C .

Liquid	Density (g/cm^3)
Crude oil	0.87
Gasoline	0.74
Mercury	13.6
Water	0.99

Figure 1 shows, for each liquid, a graph of the fraction of each object extending above the liquid's surface versus the object's density, in g/cm^3 .

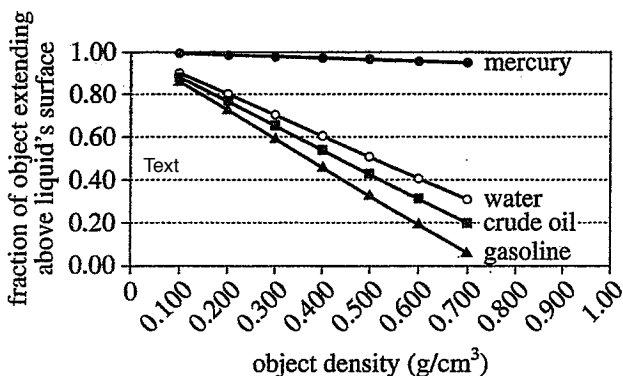


Figure 1

36. Based on Figure 1, for each liquid, as object density increased, the fraction of the object extending above the liquid's surface:
- increased only.
 - decreased only.
 - varied, but with no general trend.
 - remained the same.

37. Based on Table 1 and Figure 1, the fraction of Object 6 extending above the surface of the crude oil was closest to which of the following values?

- 0.10
- 0.20
- 0.30
- 0.40

38. A material composing a cube has a density of $0.200 \text{ g}/\text{cm}^3$ at 15°C . Each side of the cube is 10 cm long. The cube floats in a container of water. Based on Figure 1, what *volume* of the cube, in cm^3 , will extend above the surface of the water?

- 200 cm^3
- 600 cm^3
- 800 cm^3
- $1,000 \text{ cm}^3$

39. Suppose an object with a density of $0.99 \text{ g}/\text{cm}^3$ floats in a container of water, and both the object and the water are at 15°C . If the temperatures of both the object and the water are raised to 90°C , and if the object neither expands nor contracts with the change in temperature, will the object more likely sink or remain afloat?

- Sink, because the water will become more dense than the object.
- Sink, because the water will become less dense than the object.
- Remain afloat, because the water will become more dense than the object.
- Remain afloat, because the water will become less dense than the object.

40. What is the meaning of the value for the density of mercury that is given in Table 2?

- One g of mercury has a volume of 13.6 cm^3 .
- One g of mercury has a mass of 13.6 cm^3 .
- One cm^3 of mercury has a volume of 13.6 g.
- One cm^3 of mercury has a mass of 13.6 g.

END OF TEST 4

STOP! DO NOT RETURN TO ANY OTHER TEST.

Form 18L
ACT Writing Test Prompt
(June 2013)

Educators debate whether high school students should have an active role in classroom instruction, such as selecting some course materials and leading some class discussions. Some educators support giving students an active role in classroom instruction because they think doing so would increase students' interest in their classes. Other educators do not support giving students an active role in classroom instruction because they think students would not learn as much from their peers as they would from a teacher. In your opinion, should high school students have an active role in classroom instruction?

In your essay, take a position on this question. You may write about either one of the two points of view given, or you may present a different point of view on this question. Use specific reasons and examples to support your position.

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